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Sumário

Special Issue: Regulation and Economic Integration

Article

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Regulation and Economic Integration: Introduction

Regulação e Integração Económica: Introdução

Luís Aguiar Santos
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In any society and in any historical age, economic activities have been conditioned by the legal framework and by constraints of various kinds, first and foremost cultural ones. In a broad sense, some form of regulation of economic activities has always existed; thus, different conceptions and regulatory practices have followed each other in time or have been contemporaries in different societies with their own political-legal orders.

In a narrow sense, the regulation of economic activities is a recent framework (in historical terms) oriented towards a modern market economy integrated in multinational spaces and in need of rules. The previous endemic disorder in some economic spaces and discretionary forms of political interventionism in others have supposedly been replaced by a new paradigm of freedom regulated by specialized agencies in harmony with a limited, but vigilant, political power.

From both perspectives (the broad and the narrow) one can analyze the impact of the European Union's single market and the World Trade Organization on the economies and regulatory practices of various states after a quarter of a century framing several different states in these two integrated economic spaces, one on a European scale and the other on a world scale.

Indeed, economic integration and regulation are two inseparable concepts and the European Union (EU) may be considered as the most advanced model to this regard. As it gathers 28 Member States and more than 510 million inhabitants in a single internal market, in which the free movement of goods, services, capital and persons is assured, and in which citizens are free to live, work, study and do business, the number of regulations is massive. As an example, only in 2019 (January to October), counting Regulations, Directives and Decisions, approved by the top three institutions (European Parliament, Commission and Council), a total of 298 legislative acts were adopted, plus 71 amended.[1]

The current *Notas Económicas*'s thematic issue is an output of the Research Seminar "Governance, Regulation and Economic Integration" held at ISEG – Lisbon School of Economics and Management (University of Lisbon) on May 8, 2019, and gathers a selected number of papers that were delivered at the seminar, which will contribute to the study on regulation and economic governance in increasingly integrated geographical areas.

[1] Source: https://eur-lex.europa.eu/statistics/legislative-acts-statistics.html last consulted 05/11/2019.

The purpose of that event was to gather, on an interdisciplinary basis, the results of ongoing research on economic regulation in the context of its integration into multinational spaces. Of these spaces, the EU and the World Trade Organization were the most obvious: the former, because it is one of the most relevant and structured bloc worldwide; the latter, because it is the organization that sets the normative framework for global trade, of which the EU is one of the main players.

The diversity of topics and approaches, which was also one of the aims of the seminar, as well as the complexity of regulation itself, are represented in this thematic issue. The articles prove the advantage of the multidisciplinary approach, in a topic that is simultaneously economic and normative, but that also intersects with politics and culture, unfolding in different scales of analysis – from global, regional to national/local.

The institutional impact of economic integration from the perspective of corruption is analysed by Pedro Bação, Inês Gaspar and Marta Simões in the article "Corruption and economic growth: the case of Portugal". The authors conclude the modest progress that has been achieved in reducing corruption in Portugal between 1980 and 2018, despite the country's EEC/EU membership since 1986. Regardless of the effects of corruption on economic growth, this particular issue allows us to question the nonlinear relationship between economic integration, institutional convergence and governance between different Member States. Based on the Corruption Perceptions Index data for Portugal from Transparency International, and using VAR and SVAR models, the authors concluded that corruption can have a marginal effect on the output; however, such result would indicate that the limits of the Portuguese standard of living's convergence with the EU average would have to be due to factors other than corruption. Therefore, we face an understanding of regulation in which the complexity of normative, institutional and even cultural factors is called for a broad understanding of the economic phenomenon in an integrated world.

From a seemingly different perspective, focused on aspects that we could situate within the scope of the "material civilization" (infrastructures, technology), Mattia Frapporti's article focus on "The European logistics space: on Jean Monnet and the integration of Europe". The author argues that the establishment of the European Coal and Steel Community in 1951 is an event in the "structural continuity" of a logistical integration that preceded the major political landmarks of the European integration process. In fact, he identifies a long process of standardization of the main infrastructure networks in the European space (apparent on the railway), which took place during the two great wars of the twentieth century, and in which Jean Monnet had already played a pivotal role. Such an approach connects regulation to transport, communications and distribution networks that support the movement of people, goods and services.

Finally, the globalization of trade flows has led to a need for integration of the major trading blocs themselves such as the EU, ASEAN, NAFTA or MERCOSUR. The relationship between these complex political and/or economic organizations requires a closer look of the economic regulation focused on the political management of economic interests, public expectations and distinct normative traditions. Annette Bongardt and Francisco Torres, in their article "EU trade and regulation in today's world trading system", deal precisely with this from the EU's recent experience in negotiating treaties with other trading blocs, and where all those factors interfere. The authors argue that recent experience with EU treaty

negotiation shows the need to safeguard the "European values"; and that such a need, reflected in the principles of environmental protection or consumer rights, is fundamental to the coherence and stability of the European project itself.

In fact, as the level of economic integration increases, so does complexity, which not only involves a set of numerous regulations, enforcement and arbitration mechanisms, but also political and civilizational issues, such as the abovementioned, which are at the core of the European integration project. To this regard, it will be interesting to follow the future results of both the Digital Single Market, already under implementation, and the upcoming European Commission's "Green Deal" project and the impact that they will have on regulation.

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Corruption and Economic Growth: The Case of Portugal

Corrupção e Crescimento Económico: O Caso Português

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ABSTRACT
In this paper we investigate the impact of corruption on economic growth in Portugal over the period 1980-2018. The empirical approach makes use of a VAR model inspired by the standard Cobb-Douglas aggregate production function. The VAR model includes the capital stock, hours worked, total factor productivity and the corruption perceptions index (CPI) of Transparency International. The CPI combines several sources of information on the level of corruption in each country. The scale of this index goes from 0, the highest level of corruption, to 10, the lowest level. The magnitude of the estimated effect of corruption on economic growth in the unrestricted VAR model is large (and positive), but statistically not significantly different from zero. However, the results from the estimation of a structural VAR model with economically plausible long-run restrictions indicate modest gains from reducing corruption.
Keywords: Corruption; economic growth; Portugal; VAR model; SVAR.

JEL Classification: D73: O11; O40; O52

RESUMO
Neste texto estudamos o impacto da corrupção sobre o crescimento económico em Portugal no período 1980-2018. A abordagem empírica emprega um modelo VAR inspirado pela função de produção Cobb-Douglas tradicional. O modelo VAR inclui o stock de capital, as horas de trabalho, a produtividade total dos factores e o índice de percepções da corrupção (CPI) da Transparency International. O CPI combina informação sobre o nível de corrupção de diferentes fontes para cada país. A escala do índice vai de 0, o nível mais alto de corrupção, a 10, o nível mais baixo. A magnitude do efeito estimado da corrupção sobre o crescimento económico no modelo VAR sem restrições é grande (e positiva), mas do ponto de vista estatístico não é significativamente diferente de zero. Contudo, os resultados da estimação de um modelo VAR estrutural com restrições de longo prazo plausíveis do

ponto de vista económico indicam que a redução da corrupção trará ganhos, ainda que relativamente modestos.
Palavras-chave: Corrupção; crescimento económico; Portugal; modelo VAR; SVAR.

1. Introduction

By joining the European Economic Community – now the European Union (EU) – in 1986, after the political revolution of 1974 and the first steps as a democracy (following 48 years of dictatorship), Portugal became officially committed to the European integration process, viewed as important in supporting the transition to a developed democracy and in achieving higher standards of living. European integration resulted in more policies and regulations moving from the national to the European level. It also led to the adoption of new models of governance, requiring more transparency and accountability, which were considered instrumental in reducing corruption. Nevertheless, in the 2017 Special Eurobarometer on Corruption, 92% of Portuguese respondents stated that corruption is a widespread problem in their country (EU average: 68%) and 42% said that they are personally affected by corruption in their daily life (EU average: 25%). Additionally, 54% of Portuguese respondents believed corruption had become worse over the past three years (EU average: 43%). As for businesses' attitudes towards corruption in the EU, 59% of businesses in Portugal stated that favouring friends and family members in public institutions is among the most widespread practices and 70% agreed that the only way to succeed in business is to have political connections. In its 2018 report released in January 2019, Transparency International (TI), a leading non-governmental organization in the anticorruption effort, places Portugal below the European average in its Corruption Perceptions Index (CPI), down one place in the world ranking from the 29th to the 30th position. At the economic level, despite some years of fast and above average economic growth (following EU accession), since the beginning of the 21st century economic growth has been dismal, resulting in divergence from the average per capita income in the EU. A natural question that arises is thus whether the high relative levels of corruption can be partly responsible for the slowing down of output growth in Portugal.

But is good governance, and the consequent control of corruption, really important for promoting growth? The literature predicts two opposite effects of corruption on economic growth (Aidt, 2009; Ugur, 2014; Saha et al., 2017). According to Aidt (2009), Leff (1964) was one of the first authors to regard corruption as a driver of economic growth (the greasing the wheel hypothesis). The argument is that corruption allows economic agents to correct and avoid existing government failures (such as cumbersome and time-consuming regulations), and thus facilitates beneficial deals that would not take place in the absence of corruption, which contributes to faster growth. On the other hand, authors such as Buchanan and Tullock (1962) argue that corruption creates inefficiencies rather than corrects them, which in turn hampers growth (the sanding the wheel hypothesis).

The sign of the relationship between corruption and economic growth is thus an empirical issue. Here we address this issue for the case of Portugal over the period 1980-2018. We report estimates obtained using different approaches. Our preferred approach relies on a VAR model based on the Solow growth model, i.e., a VAR model that includes total factor productivity, capital and labour, besides a measure of corruption. Our main contribution is that we report estimates of the impact of corruption on economic growth in Portugal imposing the constraint that temporary shocks to corruption do not have long-run impacts on the level of the other variables in the VAR model and, consequently, on output. In other

words, our focus is on estimating the long-run effect of corruption on the level of output, in a framework that rules out implausible dynamics in that relation.

Previous literature highlights the fact that no "one-size-fits-all" implications can be derived in the case of this relationship. By focusing on a single country we overcome to some extent data comparability and parameter heterogeneity issues and are able to apply time series methodologies that allow us to identify the existence (or not) of a causal impact between corruption and the behaviour of output. Also, generalizing the results from panel data studies for each and every country in the sample may lead to the implementation of inadequate policies since if the link between corruption and growth is heterogeneous across countries, panel results may lead to misleading inference when, for instance, a large negative effect that applies to only one country offsets many small positive or non-existent effects that took place in other countries. Historical time series analyses of output dynamics are thus more likely to lead to appropriate conclusions with the aim of deriving policy implications for specific countries.

The paper is organized as follows. Section 2 gives a concise presentation of the theoretical predictions on the sign of the relationship between corruption and growth, as well as a review of some recent empirical evidence. Section 3 introduces the data and describes the empirical strategy. Section 4 presents and discusses the results. Concluding remarks are given in section 5.

2. Theoretical Background and Recent Findings

The literature that studies the relationship between corruption and economic growth from the theoretical point of view revolves around two main axes, the one that sees corruption as a threat to economic growth, known as the 'sanding the wheels' hypothesis, and the other which poses that the nexus is positive, the 'greasing the wheels' hypothesis – see e.g. Aidt (2009), OECD (2013), Ugur (2014) and Campos et al. (2016). The negative impact of corruption on growth results from the inefficient resource allocations and distortions in economic policies associated with corruption. The former appear because corruption influences the ability of private investors to evaluate the relative merits of different investment projects, and also because corruption influences decisions on how public funds are invested. For instance, Cieslik and Goczek (2018) develop an AK endogenous growth model with international capital mobility that predicts that corruption negatively affects the stock of international investment in the host country. Theoretical predictions favouring a positive impact of corruption on growth pose that corruption can help to develop businesses faster, bypassing inefficient regulations, increasing efficiency and growth in more bureaucratic and inefficient countries. Corruption is viewed as a "second best" solution, given the distortions caused by the malfunctioning of public institutions, with bureaucracy hampering investment. Thus corruption can help only in situations where some aspects of good governance are absent and economic policy is inefficient (Aidt, 2009). For instance, Dzumashev (2014) develops a model that draws on the endogenous growth model of Barro (1990) where the public sector interacts with the private sector through taxation and public goods provision. The model predicts that the interaction between corruption and governance shapes the

efficiency of public spending, which in turn determines the growth effects of corruption. Specifically, corruption improves economic efficiency only when the actual government size is above the optimal level, implying that a growth-maximising level of corruption is possible. The model additionally predicts that the incidence of corruption declines with economic development. Reverse causation from economic growth to corruption is thus also possible as documented by the literature that investigates the determinants of corruption (Treisman, 2000, 2007; Pellegrini and Gerlagh, 2008). In a recent survey on the causes and effects of corruption, Dimant and Tosato (2018) find support for the argument that growth reduces corruption in the presence of strong institutions; however, it has no effect when institutions are weak. The OECD (2013) claims that only rich countries can afford high quality institutions and thus have low incidence of corruption. Tresiman (2000) had already argued that corruption will be lower in more developed countries, where citizens are more educated and the wages in public office higher.

The sign of the relationship between corruption and economic growth is thus an empirical issue. This nexus has attracted a lot of attention in empirical research, an interest patent in two recent studies that use meta-analysis as a tool for synthesizing evidence on this topic. Ugur (2014) identifies 327 estimates of corruption's direct effect on per-capita GDP growth from 29 studies. Ugur concludes that the results indicate that corruption has a negative effect on per capita GDP growth, but the magnitude of the effect is small and more adverse in low income countries. Campos et al. (2016) apply meta-regression analysis to a sample of 41 empirical studies encompassing 460 comparable estimates of the effect of corruption on growth. About 32 percent of those estimates support a significant and negative impact of corruption on growth, 62 percent suggest a statistically insignificant relationship, while approximately only 6 percent support a positive and significant relation. The authors find evidence of a true effect of corruption on growth, stronger in academic studies, with the large degree of heterogeneity in the results driven by authors' affiliation (academics systematically report smaller and less negative effects), whether the estimation methodology controls for endogeneity and uses fixed-effects (increases the negative effect) and the inclusion in the model of trade and institutions (both tend to decrease the negative effect).

Recent empirical studies that investigate the corruption-growth nexus include Paul (2010), Farooq et al. (2013), Huang (2016), Chapsa, Tsanana and Katrakilidis (2015), D'Agostino, Dunne and Pieroni (2016), Saha, Malik and Vortelinos (2017) and Cieslik and Gozcek (2018).

Similar to the present study, Paul (2010) and Farooq et al. (2013) explore time series data for specific countries. Paul (2010) conducts a survey to build a corruption perceptions index for Bangladesh from 1972 to 2009 which is then used to investigate the direction of Granger causality between corruption and growth. The main conclusion is that corruption influences growth (from 1977 onwards), but the opposite does not apply, and that the sign of the relationship is positive, a result that the author interprets as an indication that the transition to a market economy initiated in Bangladesh in the late 70s was not accompanied by sufficient reforms at the public administration and legislative levels, making corruption a necessary means to promote private sector investment and in this way growth. Farooq et al. (2013) examine the nexus for Pakistan with data for the period 1987–2009. The results found using cointegration and VECM approaches indicate that there is a long run

relationship between the variables, with corruption, proxied by the CPI from Transparency International, hampering growth.

The remaining studies apply panel data methodologies taking advantage of both the cross section and time series dimension of the data. Applying time series methodologies adapted to a panel data context to determine the direction of causality, Huang (2016) investigates the corruption-growth nexus in thirteen Asia-Pacific countries over the period 1997–2013. The results show that the impact of corruption on growth is only significant for South Korea (and positive), while causality on the opposite direction was only found for China. Saha et al. (2017) use fixed effects and generalized method of moments (GMM) estimators to examine the non-linear effect of corruption on growth in a wide sample that includes 110 countries over the period 1984-2009. The authors find that the relationship is best described by an inverted U curve indicating that corruption is beneficial for growth at low levels of corruption but after a threshold (around 6, on a scale from 0, least corrupt, to 10, most corrupt, resulting from a rescaling of the ICRG corruption index) the effect is growth retarding. For a more restricted sample that includes only the fourteen older EU member states (ignoring Luxembourg) over the period 1995-2013, Chapsa et al. (2015) estimate a convergence regression that includes also a measure of corruption as an explanatory variable. The results obtained support the idea that for Greece, Ireland, Portugal and Spain, less corruption promotes growth.

D'Agostino et al. (2016) and Cieslik and Gozcek (2018) explore evidence on different transmission channels from corruption to growth. D'Agostino et al. (2016) estimate a growth regression for a panel of 106 countries and the results confirm the prediction that government investment spending enhances growth, while large military burdens, current government spending and high levels of corruption have negative effects. Additionally, the interactions between corruption and public investment and between corruption and military spending have strong negative impacts on growth: allowing for corruption makes the negative effect of military burden on growth stronger. Cieslik and Gozcek (2018) estimate a model where corruption hampers growth in an open economy by diverting international investment using data for 142 countries over the period 1994-2014. Less corruption was found both to have a positive and statistically significant impact on the growth rate of real per capita GDP and to increase investment.

To the best of our knowledge, the only previous study that attempts to quantify the impact of corruption on growth for Portugal is that of Tavares (2004). The author first estimates a growth regression in a cross section context for the period 1960-1995 and between 48 and 80 countries to assess how much different institutions matter for growth. The results obtained indicate that lower corruption fosters growth and the author next uses the estimated coefficient to evaluate the growth benefits of institutional reforms resulting in lower corruption in Portugal. For this purpose, Tavares computes an index that measures the yearly increase in per capita growth – estimated for the period 1960–1995 – that would result from an institutional reform elevating Portugal to the EU level in terms of (lower) corruption. Reducing corruption to the levels of the EU would enable growth to increase by 0.61% a year making this one of the reforms with the highest growth impact in the Portuguese economy. More recently, Júlio et al. (2013) carry out a similar analysis but focusing on the gains in terms of FDI attraction from implementing institutional reforms. They first estimate a

gravity model to assess the impact on inward FDI stocks of economic and institutional factors using data for 28 European host countries over the period 2005–2007. Institutional factors are measured with data from the Index of Economic Freedom computed by the Heritage Foundation, the Political Risk Rating from the International Country Risk Guide and the World Bank's Doing Business database. The first two indicators include measures of corruption and the authors estimate the respective impact in terms of FDI attraction concluding that less corruption is one of the main institutional drivers of inward FDI. These estimates are next used to assess how institutional reform in Portugal, corresponding to reaching the EU-15 and EU-17 average levels in terms of different institutional indicators, may impact the country's ability to attract FDI. The main conclusion is that investment freedom is the institutional reform with the highest impact in Portugal, but lowering corruption and improving the quality of bureaucracy are also at the top of the list. Although the literature has not reached a consensus on the sign of the overall impact of FDI inflows on economic growth in the host economy (Carbonell and Werner 2018), if the relationship is positive for Portugal then according to the results of Júlio et al. (2013) lowering corruption could result in quantitatively important growth benefits.

Whether corruption is a threat or an opportunity to economic growth thus remains an open empirical question and no one-size-fits-all policy response can be derived from the existing theoretical literature and empirical evidence. In what follows we focus on the experience of a particular country, Portugal. Due to the heterogeneous relationship between corruption and and economic growth patent in the reviewed literature, single-country studies are needed to gain a better understanding of the nexus in specific economies.

3. ECONOMETRIC ISSUES AND DATA

The empirical studies on the relation between corruption and growth usually employ an equation such as the following (see Ugur, 2014, for a more detailed discussion):

$$g_t = \beta_0 + \beta_1 C_t + \sum \gamma_j Z_{j,t} + \epsilon_t. \quad (1)$$

The dependent variable in equation (1) is the growth rate of real GDP per capita, C is the measure of corruption and Z represents the control variables. The interpretation of the estimation results depends on what control variables are included, for example, on whether Z contains lags or differences of C and g. If we can ignore the contents of Z, then equation (1) implies that a transitory (permanent) variation in corruption will have a temporary (permanent) effect on the growth rate. The transitory effect on the growth rate will translate into a permanent effect (a shift) on the level of GDP. A permanent effect on the growth rate will cause the new path of GDP to diverge from the path that would have been observed in the absence of the shock. From an economic point of view, the two outcomes are very different and therefore it is important to be clear on what the model that is to be estimated implies for the path of GDP. If the researcher's framework indicates that a permanent shift in corruption should cause only a permanent shift in the level of GDP, then the first difference of C should replace C in equation (1).

Furthermore, there is still the question of which variables to include as control variables (Z). These should be the variables that determine GDP growth, or at least those determinants that may be correlated with corruption, otherwise their absence would lead to an endogeneity problem. The difficulty lies in identifying those factors and in obtaining the corresponding data. A large number of factors have been suggested as fundamental growth determinants, leading to a problem of model uncertainty and making the results for a specific explanatory variable dependent on the regressors that each researcher finds relevant to include.

In this paper, we propose to address this issue in the following way. The standard approach to the study of growth makes use of a Cobb-Douglas aggregate production function in which output (Y) depends on total factor productivity (A), the capital stock (K) and the labour input (L)[1]:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}. \tag{2}$$

Taking logs and first-differencing we get

$$g_t^Y = g_t^A + \alpha g_t^K + (1-\alpha) g_t^L, \tag{3}$$

where the g's are the log-growth rates of the variables in superscript. From this point of view, what matters for GDP growth is the growth of productivity and of factor inputs – these are the proximate sources of growth. Our approach is based on the analysis of the relation between corruption and these variables. In other words, does corruption influence any of the proximate sources of GDP growth? To answer this question, we resort to a VAR model where we include the growth rates of total factor productivity, capital stock and hours worked, alongside a variable related to corruption. The growth rate of total factor productivity must be estimated; we do so by setting α, the capital share, to one third, as is customary. The variable related to corruption may be either a corruption index or its first difference. As discussed above, if the variable is the level of the corruption index, then a permanent variation in corruption will have cumulative effects on the path of GDP; if the variable is the first difference of the corruption index, then the model will imply that a permanent variation in corruption will have temporary effects on the growth rate of GDP and will only shift (permanently) the level of GDP.

[1] We consider a production function with two inputs, capital and labour, and do not extend it to include human capital due to measurement issues associated with the latter, namely because of very limited data availability for the quality of human capital. Additionally, considering only a measure of the quantity of human capital, such as average years of schooling is problematic for the specific case of Portugal since the time series is basically a straight line with a break at the beginning of the 21st century. In fact, Gouveia and Coelho (2018), p. 38 report that "(…) when only a quantity measure of human capital (mean years of schooling) is allowed for, the estimates of TFP are implausible as several countries, such as Spain, Italy and Portugal have very short periods of TFP growth (or none in the case of Spain), and prolonged reductions in recent years. If human capital is captured in the residual instead, relative levels and trends of TFP estimates become more plausible (…)"

The general VAR model of order p to analyse the relationship between corruption and real GDP growth in Portugal over the period 1980-2017 can thus be defined as follows:

$$X_t = \alpha+\beta_1 X_{t-1}+\beta_2 X_{t-2}+...+\beta_p X_{t-p}+\epsilon_t, \quad (4)$$

where the vector X contains the variables under analysis and the variable for corruption is considered either in levels (logs) or the first difference of the log (g^{CPI}).

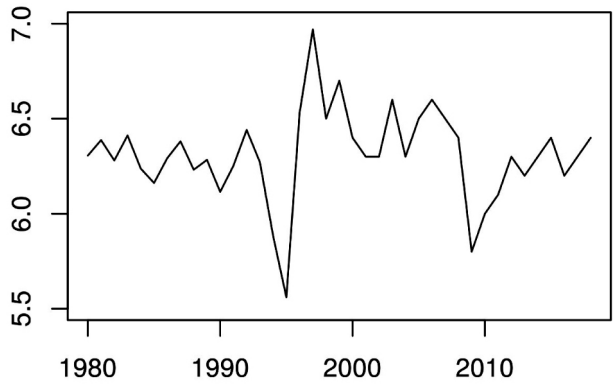
Transparency International defines corruption as: "(…) behaviour on the part of officials in the public sector, whether politicians or civil servants, in which they improperly and unlawfully enrich themselves, or those close to them, by the misuse of the public power entrusted to them". We measure corruption with the Corruption Perceptions Index (CPI) published by Transparency International. This index is available from 1995 until 2018. We also employ the series provided in the CANA dataset (Castellacci and Natera, 2011), which extends the CPI series back to the 1980-1994 period. The CPI combines several sources of information on the level of corruption in each country.[2] The scale of this index goes from 0, the highest level of corruption, to 10, the lowest level. Since this index is based on the perceptions of corruption, it is only a proxy for actual corruption, but the very nature (illegal) of corruption makes better alternatives difficult to come by.[3] This data has been used in several previous empirical studies, such as Aidt (2009), Farooq et al. (2013), Haque and Kneller (2015), Huang (2016), Saha et al. (2017) and Cieslik and Goczek (2018), among others.[4]

[2] See https://www.transparency.org/.

[3] Hamilton and Hammer (2018) classify measures of corruption in two categories: subjective indicators that measure the perceptions and/or experience of corruption by different groups (e.g. country analysts, business people) using survey data; and objective indicators which calculate the magnitude of waste and abuse in public works and/or services using, for instance, data from the criminal justice system on unlawfull acts such as briberies and embezzlement or audits of specific projects. The authors argue that the aggregate survey-based indicators are strongly correlated with the objective measures.

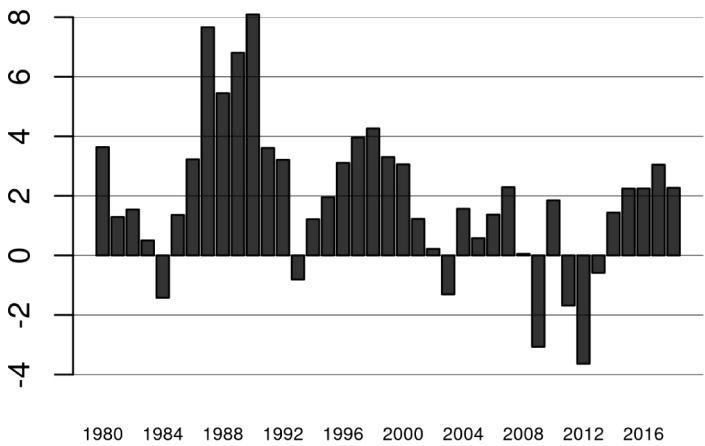
[4] Alternative indexes of corruption include the ICRG. However, ICRG is not freely available for researchers. Moreover, the CPI is viewed as the most suitable measure for corruption in the public sector since the ICRG main aim is to measure the risk for investors associated with corruption and is thus not as encompassing a measure of corruption as the CPI. In particular, it reflects mainly political instability, which may be only partially caused by corruption. Another alternative could be the Worldwide Governance Indicators, in particular the dimension Control of Corruption, but this has been criticized for several methodological issues such as definitions problems or the use of the unobserved components model (Langbein and Knack 2010; Thomas 2010; Qu et al. 2019).

Figure 1: Corruption perceptions index for Portugal, 1980-2018



Source: Castellacci and Natera (2011) and Transparency International.

Figure 2: Growth rate of real per capita GDP in Portugal (%), 1980-2018



Source: AMECO and authors' computations.

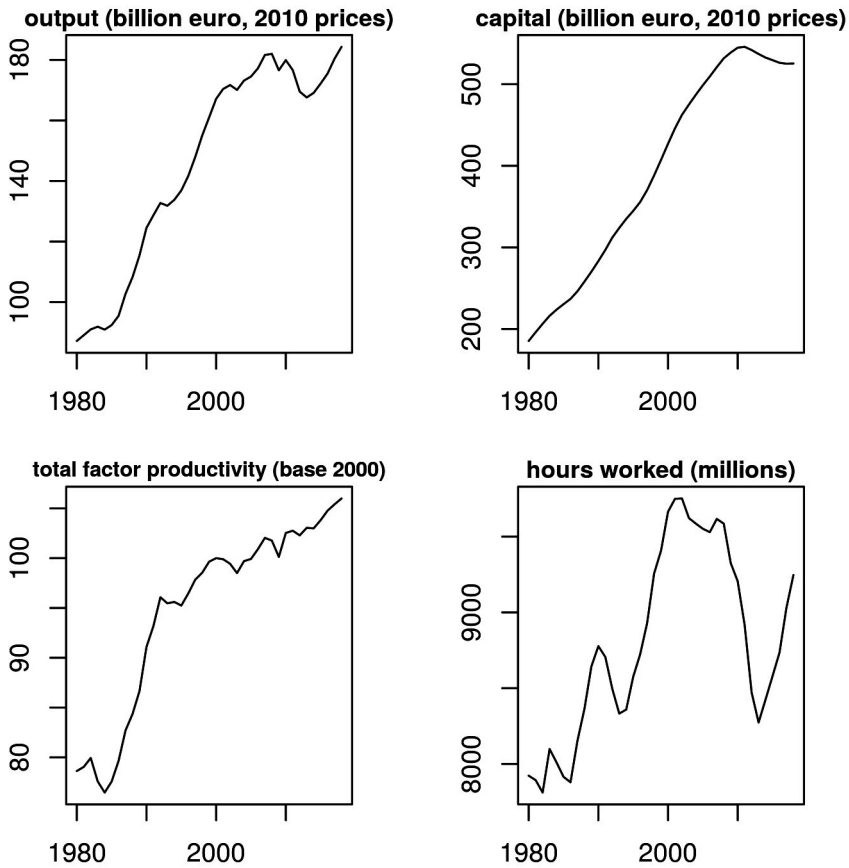
Figure 1 shows the CPI series and Figure 2 shows the evolution of the growth rate of real GDP per capita for Portugal over the period 1980-2018. At first sight, it is difficult to see a clear relation between the corruption index (which is basically constant, although punctuated by a few spikes) and the growth rate of real GDP per capita (which appears to be declining in recent decades). We started by regressing the growth rate of real GDP

per capita on the CPI[5] using all the data points and also omitting the point for 2009. Both regressions yield statistically insignificant coefficients for corruption. The regression that omits the point for 2009 illustrates the difficulties of estimating the effect of corruption on GDP growth with our (relatively small) sample. Omitting the point for 2009 (the year in which the international financial crisis had the largest impact on economic activity) reduces the estimate by more than half, from 1.9 to 0.9. Still, the estimates of the coefficient of corruption are clearly positive in both cases, and, if either of the estimates corresponded to the true effect, they would assign to reducing corruption in Portugal a very significant effect on GDP growth. If corruption had been lower in Portugal in a way that made the Corruption Perceptions Index increase by 1.7 points, so as to match the average value of the index for Germany, then the average growth rate of Portuguese GDP would have been 1.5 (if we take the 0.9 estimate) or more than 3 percentage points (if we use the 1.9 estimate) higher. This evidence is only illustrative in terms of gauging the impact of corruption on GDP growth in the Portuguese case and should thus be taken with care. Univariate regressions are not informative about causality (which could run either or both ways); the regression postulates a contemporaneous effect of corruption on GDP growth and ignores all the other factors that influence GDP growth.

The econometric approach described before allows us to deal with these issues. That approach requires data for output, the capital stock and hours worked. We obtained measures of these variables from the AMECO database (8 November 2018 release). For output we use the series "Gross domestic product at 2010 reference levels", for the capital stock we use "Net capital stock at 2010 prices: total economy", and for hours worked we use "Total annual hours worked: total economy". With these series, we estimated total factor productivity using equation (2) and setting $\alpha=1/3$. The original AMECO series and our estimate of total factor productivity are plotted in Figure 3. The first differences of the logarithm of the capital stock, hours worked and total factor productivity are plotted in Figure 4 – these transformed series will be used in the VAR model. Figures 3 and 4 reveal behaviours that may have a detrimental impact on the performance of our VAR model. In fact, the swings in the levels of the series, especially since the onset of the sovereign debt crisis, may be challenging for a simple VAR model. The most obvious case is that of the capital stock, which in recent years displays an inversion of the trend.

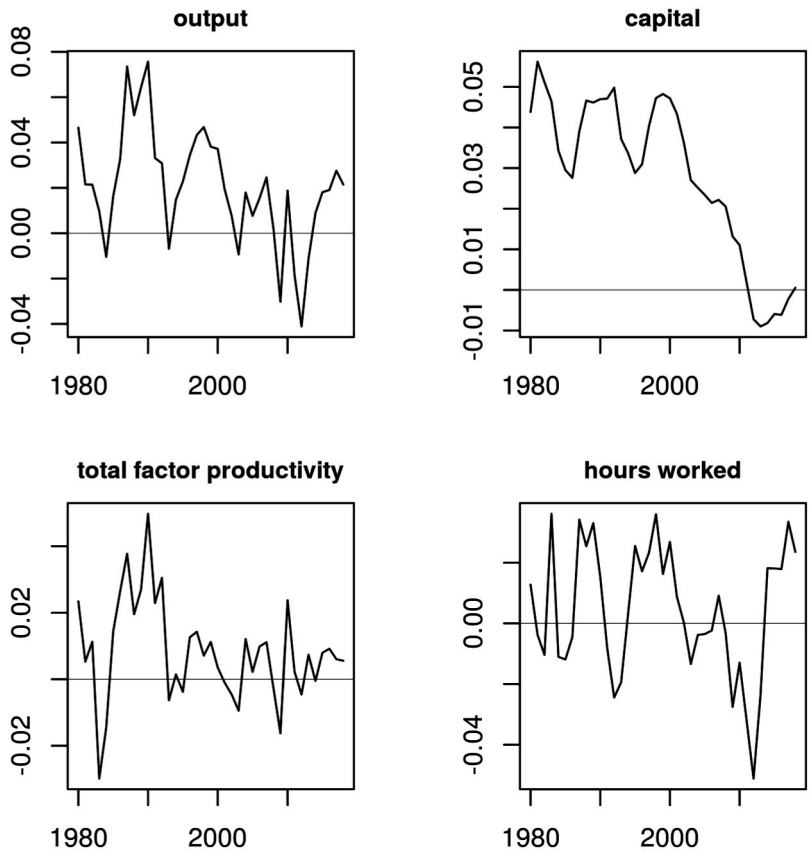
[5] All estimations were performed with the econometrics software Gretl.

Figure 3: The AMECO series and our estimate of total factor productivity



Source: AMECO and authors' computations.

Figure 4: Transformed series (first differences, logs) for inclusion in the VAR model



Source: AMECO and authors' computations.

4. Results

We estimated two VAR models, one with the corruption indicator in levels (implying that permanent changes in corruption have cumulative effects on GDP), the other with the first difference of the corruption index (implying that permanent changes in corruption shift the level of GDP).[6]

[6] We tested, using the ADF test, for the existence of unit roots in the logs of output, capital, productivity, hours worked and (untransformed) corruption. The results suggest that corruption is stationary, while the other series have

The order of the VAR model was selected by setting a maximum order of two; this choice comes from dividing the result of the formula suggested by Schwert (1989) for univariate AR models by the number of variables included in our model (four). The formula is thus:

$$l_{\max} = \text{int}\left(\frac{12 * (T/100)^{0.25}}{4}\right), \quad (6)$$

where int(.) is the integer part of the argument and T is the number of observations. The rationale for adjusting Schwert's formula in this way is that the same number of lags of each variable will be present in each equation of the VAR model; therefore, the four variables will be consuming degrees of freedom in every equation of the VAR model – the division by four takes this into account. For both versions of the VAR model, the information criteria and the likelihood ratio test point to one lag (see Table 1).

Table 1: Selection of the optimal number of lags in the VAR models

Model with the level of corruption					
Lags	Loglik	p(LR)	AIC	BIC	HQC
1	366.77988		-19.265549*	-18.385816*	-18.958498*
2	373.40622	0.65420	-18.744790	-17.161271	-18.192100
Model with the first difference of corruption					
Lags	Loglik	p(LR)	AIC	BIC	HQC
1	357.55743		-18.753191*	-17.873458*	-18.446140*
2	367.00382	0.27426	-18.389101	-16.805582	-17.836411

Notes: p(LR) is the p-value for the test of one lag (the null hypothesis) against two. Estimated over the period 1983-2018.

The results of the estimation of the selected VAR models show that the model with corruption in levels appears to fit the data better than the model with the first difference of corruption: the log-likelihood is 366.77988 for the model with the level and 357.55743 for the model with the first difference. Since the number of parameters is the same in both models, the difference in the log-likelihood gives rise to similar differences in the value of the information criteria (Akaike, Bayesian and Hannan-Quinn). Therefore, the results suggest that a permanent change in the level of corruption may have cumulative effects on GDP; in other words, it may have a powerful impact on living standards. Nevertheless, we

a unit root. The ADF test applied to the first differences rejects the null hypothesis of a unit root for all series except the capital stock. Nevertheless, we decided to treat the first difference of capital as stationary, based on two arguments. First, given that output is a linear combination of the other three series, the results of the ADF test for capital are inconsistent with the results of the tests for output, productivity and hours worked. Second, the estimated VAR models (which include the first difference of capital) are stationary, i.e. the eigenvalues of the companion matrix are outside of the unit circle.

still need to know whether the impact on GDP (via either the capital stock, hours worked or productivity) is positive or negative, and whether it is statistically significant.

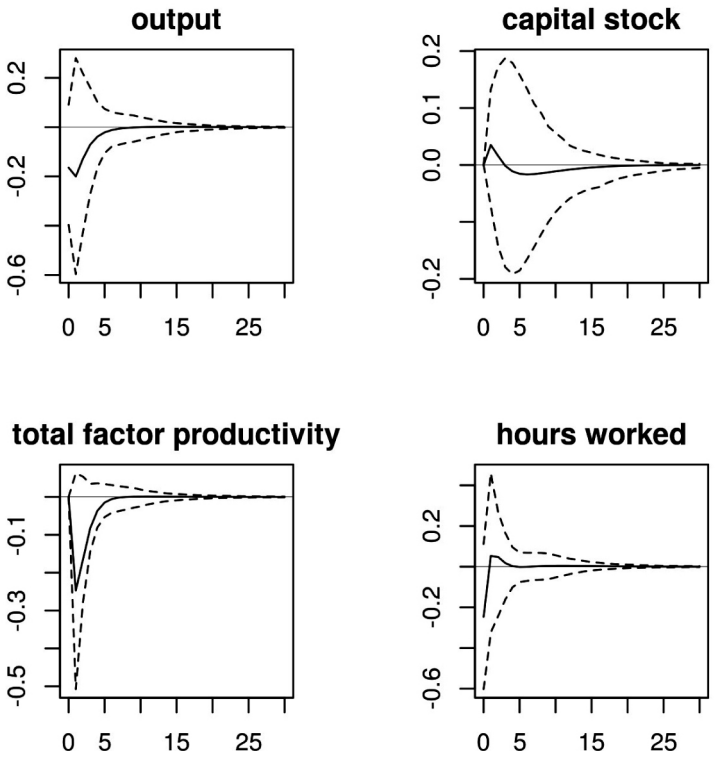
Table 2 shows the estimated coefficients for lagged corruption in the equations for the other variables in the model. None of the estimates is statistically significant. However, the magnitude of the estimates is large and could again assign to corruption a very important role in the evolution of, in particular, productivity and hours worked.

Table 2: Coefficient of lagged corruption in the other equations of the VAR model

Equation	coefficient	std. error	t-ratio	p-value
Capital	0.00296367	0.00332219	0.8921	0.3792
TFP	-0.0105714	0.0102260	−1.034	0.3092
Hours	0.00864046	0.0129871	0.6653	0.5108

In a VAR model the correct way to assess the importance of corruption is by analyzing the impulse-response functions. The difficulty is that this requires an assumption about the structure of the relationship between the variables in the model. Here we employ the standard Cholesky decomposition, which imposes a recursive structure on the shocks that move the variables. We believe that hours worked is the variable that can more rapidly adjust to shocks. Therefore, we will assume that hours worked will react contemporaneously to all the structural shocks in the model. On the opposite extreme we consider the capital stock; accordingly, it will only react contemporaneously to the structural shock associated with the capital stock equation. Similar to the capital stock, total factor productivity should also display some inertia. We thus assume it only reacts contemporaneously to its specific structural shock and to capital stock shock. As a result, corruption will be in between hours worked and total factor productivity, and may react contemporaneously to its own shocks and to shocks to the capital stock and to total factor productivity. The estimated impulse-response functions and the 90% confidence intervals (dashed lines) are shown in Figure 5. Note that the impulse response function for output can be obtained by substituting output for hours worked in the VAR model.

Figure 5: Impulse-response functions of log-diffs (percent) to a temporary change in corruption



The impulse-response functions are also not significantly different from zero (the confidence interval never excludes zero). Nevertheless, the prevailing effect across the three components of the production function seems to be negative: an increase in the corruption index (a decline in perceived corruption) would appear to decrease hours worked and productivity. Consequently, the estimated impact of a temporary increase in the corruption index (a decrease in perceived corruption) would shift down the level of output, as shown in Figure 6. The shift corresponding to a one-standard-deviation temporary shock in the CPI would amount to about -0.6 percentage points of GDP. If the shock is permanent, then the effect would be a decrease of 0.6 percentage points every period (see Figure 7). This would be a very large impact, if it were real; we cannot forget that the coefficients of lagged corruption are not statistically significant.

Figure 6: Impulse-response function of levels (percent) to a temporary change in corruption

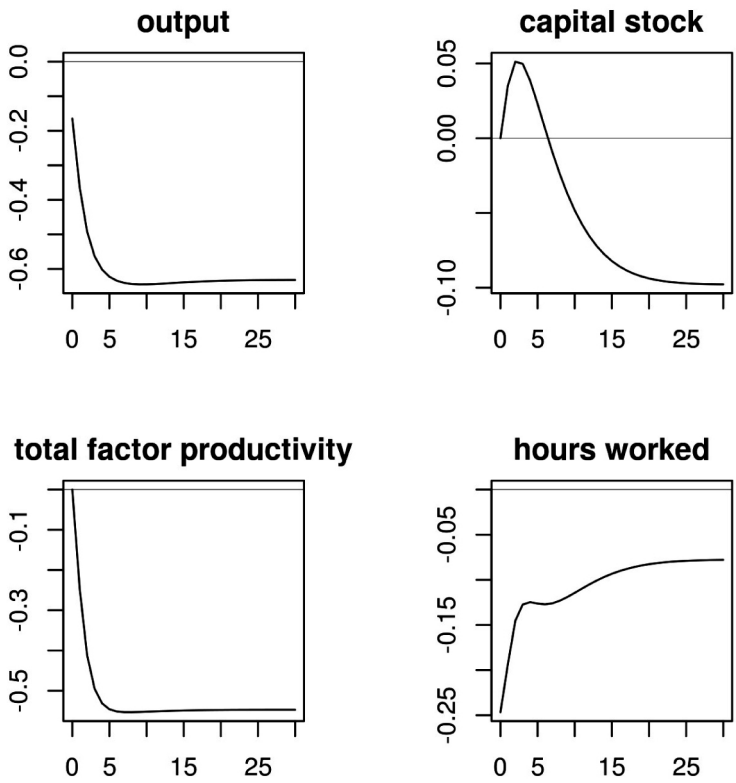
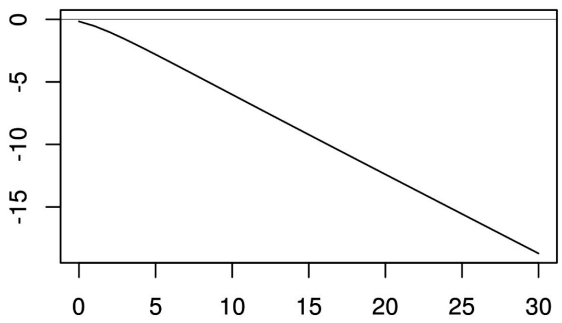


Figure 7: Impulse-response function of the level of output (percent) to a permanent change in corruption



The fact that the previous VAR model, based on the Cholesky decomposition, implies a large negative and cumulative response of the level output to a permanent change in the level of corruption is unpalatable. It is a reflection of the fact that the model allows temporary changes in corruption to have permanent effects on the levels of the other variables. However, this possibility can be ruled out by imposing – as suggested by Blanchard and Quah (1989) – long-run restrictions on the VAR model, and thus moving to a more complex structural VAR (SVAR) model. We therefore impose the restrictions that temporary shocks to corruption have zero long-run impacts on the levels of the other variables. From the restrictions included in the Cholesky-based version of the model, we must drop those that impose a zero contemporaneous response to a shock to corruption. The new impulse response functions are presented in Figures 8 to 10. The impact of a shock to corruption is still not statistically significant (Figure 8). However, in the SVAR model temporary shocks to corruption have a positive effect on the levels of output and productivity (Figure 9). As required by the long-run restrictions imposed in the SVAR model, the impact tends to zero over time (all variables are approximately back to the pre-shock position 30 periods after the shock). As a result, a permanent shock to corruption in the SVAR model shifts the level of output up. The impact of this is relatively small: in the long run, a one standard deviation shock to corruption raises output by about 0.2 percentage points. Given that the standard deviation of the corruption shock is also around 0.2, if the index of corruption were to improve 1.7 units in Portugal (to reach German levels), output in Portugal would shift up 1.7 percentage points. This estimate is far from those obtained with the Cholesky VAR model, and with the simple univariate regressions, which implied a permanent impact on the average growth rate.

Figure 8: Impulse-response functions of log-diffs (percent) to a temporary change in corruption in the SVAR model

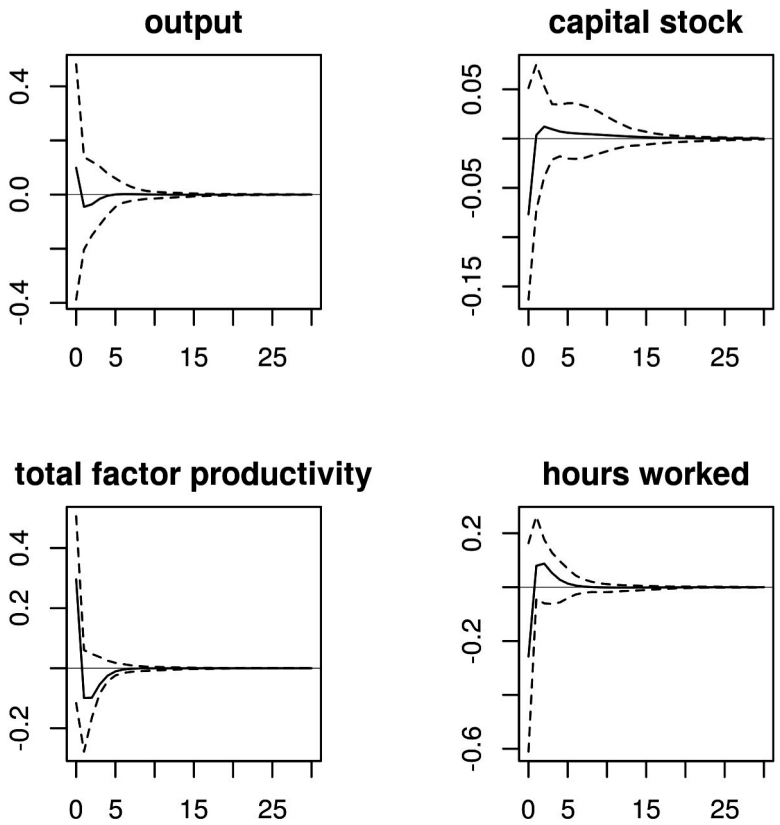


Figure 9: Impulse-response function of levels (percent) to a temporary change in corruption in the SVAR model

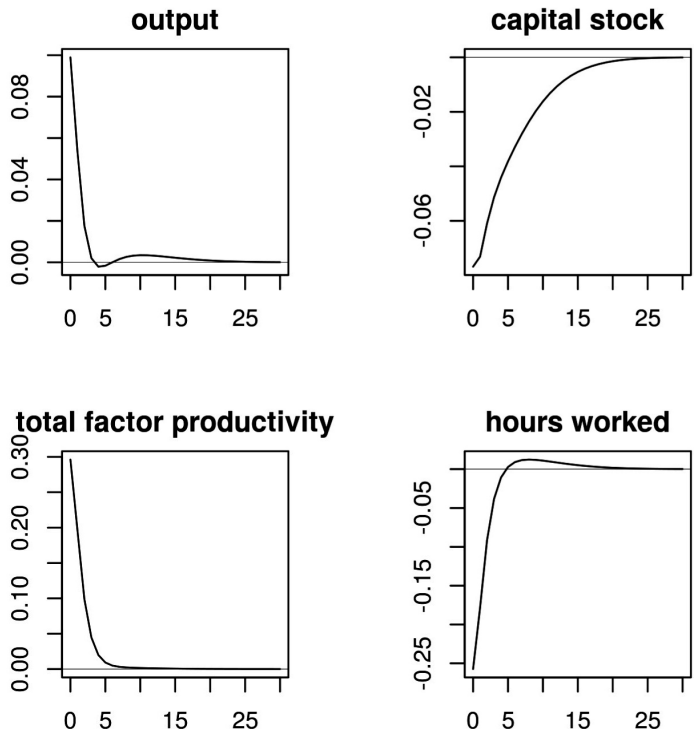
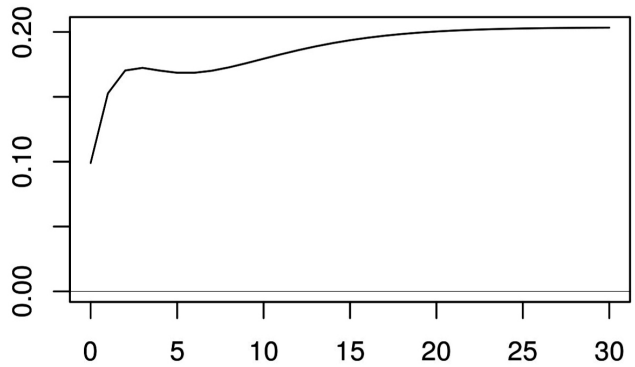


Figure 10: Impulse-response function of the level of output (percent) to a permanent change in corruption in the SVAR model



5. Conclusion

In this paper we analyze the relationship between corruption and economic growth in Portugal in recent decades (1980-2018). We employed a VAR model comprising the Corruption Perceptions Index produced by Transparency International, as well as the factors determining output suggested by the standard Cobb-Douglas aggregate production function: the capital stock, total factor productivity and hours worked. The results indicate that the model with the level of the CPI fits the data better than the model with the first difference of the CPI. However, the corruption index was not statistically significant in the equations of the other variables in the VAR model. A somewhat puzzling finding is that, despite the lack of statistical significance, the magnitude of the coefficients on the corruption index is sizeable, leaving open the possibility that the impact of corruption on the other variables may be large (and positive). In fact, taking the estimated coefficients as correct implies that a temporary one-standard-deviation shock to the corruption index (equivalent to a decrease in perceived corruption) would lead output to shift down 0.6 percentage points. Consequently, a permanent shock to the corruption index (less corruption) would cause output to decline by that amount every period. These estimates are very large and consequently sound implausible.

We therefore moved to a SVAR model with long-run restrictions that eliminate any impact of temporary shocks to corruption on the long-run level of output. The results from the SVAR model indicate that if the level of corruption in Portugal reached the level of corruption in Germany, the long-term benefit would be an increase of 1.7 percentage points in the level of output. This sounds like a modest gain, but it is much more plausible than the estimates provided by the VAR model. Overall, this result implies that the failure of the Portuguese standards of living to converge to those of the richest countries in the EU is probably not due (for the most part) to corruption in the Portuguese economy. Further research, with alternative methods, namely based on panel data, may help shed light on this issue.

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The European Logistics Space: On Jean Monnet and the Integration of Europe

O Espaço Logístico Europeu: Jean Monnet e a Integração Europeia

Mattia Frapporti

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ABSTRACT
This article aims to investigate a different genealogical line of European integration. Through a partial use of the biography of Jean Monnet, I aim to expand the temporal borders of the path often outlined by European integration history, taking advantage of an analytical tool that is rarely used in this context: logistics. On the one hand, I propose to make the Schuman Declaration resonant with a broader "European past". On the other hand, my aim is to show that some categories of the global present also pervade the process of continental integration. All in all, this path reveals that the latter process was originally developed to build what I call the "European Logistics Space".
Keywords: Jean Monnet; logistics; European integration; logistics rationale.

JEL Classification: N40; N43; N47

RESUMO
Este artigo tem como objetivo investigar uma linha genealógica diferente do processo de integração europeia. Recorrendo à biografia de Jean Monnet, pretende-se expandir as fronteiras temporais muitas vezes delineadas pela história da integração europeia, utilizando uma ferramenta analítica raramente usada neste contexto: a logística. Por um lado, propõe-se que a Declaração de Schuman faça eco de um "passado europeu" mais amplo. Por outro lado, mostra-se que algumas das categorias globais conhecidas já estão presentes no processo de integração continental. A abordagem proposta revela afinal que o último processo foi desenvolvido originalmente para construir o que se pode designar de "Espaço Logístico Europeu".
Palavras-chave: Jean Monnet; logística; integração europeia

L'Europe n'a jamais existé.
Jean Monnet

1. **Introduction**

Through what we might identify as a "logistics gaze", it is possible to understand better some of the most disruptive economic, geopolitical, and social upheavals of the global present. The so-called critical logistics studies far exceed the field in which the subject was traditionally enclosed. Indeed, until 20 years ago, logistics studies were the prerogative of technical, engineering, or managing fields; however, in the last few years, it has become – along with finance, extraction, and governance – a new analytical category that is being applied to a range of disciplines, because in contemporary «supply chain capitalism» (Tsing, 2009) we know that «logistics do politics» (Neilson, 2012; Mezzadra and Nielson, 2013, 2019).

Nevertheless, the widespread usefulness of logistics today has given rise to an approach that is excessively focused on present time. Starting from this assumption, one of the aims of this article is to assess the boundaries of logistics as a field, and test its usefulness in historical analysis, something that has been underestimated even in critical logistics studies. Specifically, I will apply "the lens of logistics" to interpret the birth of the European Coal and Steel Community (ECSC), designed by Jean Monnet, and to show how a "logistics rationality" informed Monnet's thoughts and led to the rise of the European integration process.

Today's geopolitical panorama is constantly under stress. New forms of space continuously arise outside of the traditional form of sovereignty (Brenner, 2004; Sassen, 2013), thoroughly reshaping the "geometry of globalization" (Galli, 2001). New types of borders (Mezzadra and Neilson, 2013), spaces of exception (Ong, 2006; Collier, 2011; Easterling, 2014a, 2014b), transnational corridors (Grappi, 2016), and new kinds of supranational or intranational regions are only some examples of this tendency. In this article I aim to show how the European integration process could be seen in the same perspective, dismantling the thesis that categorically reads the rise of the process leading to today's European Union as a direct and linear consequence of the Schuman Plan.

The story of European integration usually takes 9 May 1950 as a breaking point, a "new beginning" in the history of Europe: «Schuman's proposal – as it says on the EU's website – is considered to be the beginning of what is now the European Union.»[1] The so-called «founding fathers» are deeply iconized in European history,[2] and among them Monnet holds an important position. But is all of this correct? In this article I will reconsider the idea that 9 May represented the beginning of European integration, and I will underline the role Monnet played even before that date. Examining more carefully his exact method and rationale, we can assert that «he transformed Europe» (Walters and Haahr, 2005: 23), which will become clear when considering his work not just from 1950 onwards, but his previous career as well.

[1] https://europa.eu/european-union/about-eu/symbols/archived-europe-day_en.

[2] For example Alcide De Gasperi, Konrad Adenauer, Paul-Henri Spaak, and Schuman and Monnet themselves. See https://europa.eu/european-union/about-eu/history_en.

In addition to Monnet's life, the history of European integration should also be examined more carefully, to avoid the limits of existing scholarship.[3] In doing so, two purposes will lead this article. First, I will retrace one of the multiple origins of the EU, building a *longue durée* history where the birth of the ECSC better represents the end of a long project or, at best, only an important passage of the "long twentieth century".[4] Second, I will demonstrate that we may find some of the aforementioned categories that emerge in the global present in the process of continental integration too. In sum, this path will allow us, first, to decode the rationale that drove European integration; second, it will prove the crucial role played by Monnet; and last but not least, it will reveal that the process was originally developed so as to build what I call the "European Logistics Space".

2. Monnet's Early Life Between Finance and Logistics

To get a fuller picture of Monnet's thought we must start from the very beginning. Born on 9 November 1888, he spent the first part of his life in Cognac. Known worldwide, almost the entire village was involved in the production or trading of its homonymous beverage, and Monnet's family was no exception. As happened with other firms, the cognac of Monnet's father was sold mostly abroad, something that – according to Jean Monnet himself – led the people of Cognac towards a "natural" anti-nationalistic feeling. As Monnet said:

> *Donc les gens de Cognac s'intéressent aux conditions qui existent dans ces différents pays. Je dirais même qu'ils s'y intéressent plus qu'aux conditions qui existent en France, parce que le commerce est plus sensible à ce qui se passe à Winnipeg, au Canada, qu'à Bordeaux ou en France. Donc le gens sont tout naturellement tournés vers l'extérieur. C'est naturel.*[5]

According to Frederic J. Fransen, the citizens of Cognac could be defined as «cosmopolitan peasants» (Fransen, 2001: 6) due to their deep knowledge of world affairs. In Monnet's own writings this characteristic is outstandingly underlined; we frequently read, in his Memoirs, of an early "global gaze" that was somehow innate in him.

Responding to the needs of the family firm, at the age of 16 Monnet left school to travel. Firstly, he went to London, where he lived for two years. In London, Monnet first experienced the "global dimension" of trade as well as of politics:

> *From the days of my childhood, while French society stagnated in its own parochialism, I was taught to realize that we lived in a world of vast distances, and it was natural for me to expect to meet people who spoke other languages and had different customs. To observe and take account of these customs was our daily necessity (Monnet, 1978: 43).*

[3] For a broad perspective on the historiography on this topic, see Kaiser and Varsori, 2010.

[4] I am referring to "the long twentieth century" both for the history of capitalism (see Arrighi, 2010) and for the history of technology, where "a new era began, an era from 1850 to 2000, that we refer to as The Long Twentieth Century" (Schot and Scranton, 2014).

[5] Interview by Alan Watson with Jean and Silvia Monnet, conducted on 15–16 November and 2–3 December 1971, in Rieben et al., 2004: 250.

In 1905 and 1906, the Empire's capital was at its apogee. In the words of Giovanni Arrighi, we can affirm that London "finance" was triumphing worldwide and, at the same time, the City of London was affirming its position as the global logistical pole from 1870 to 1913 (Arrighi, 2010), the exact period in which Monnet was living in England. It was there where he understood how important the "flows" of commodities, and "logistics" more generally, would become in the new century.

After his London experience, in July 1907 Monnet moved to Canada, where he spent the greater part of his life prior to the First World War. The Canada trip was formative, particularly for the idea of European integration he developed later on; according to the political theorist Trygve Ugland, «the journey, from the beginning to end, served as inspiration for his theory of European supranational unity» (Ugland, 2011: 20). We can trace two of his most important ideas back to this early period. First, in Canada Monnet discovered the political power of infrastructure. The historian George Glazebrook argues that, «without such a communication political union would be absurd» (Glazebrook, 1966: 201). James Careless claims that the so-called Pacific Railway represented a «solid groundwork for union» (Careless, 1963: 213), and even Harold Innis underlines the fact that, among the «varied effects», railways brought «the prosperity, the expansion and the integration» (Innis, 1923: 292-293). Railways allowed the linkage of different territories and different populations to a new, unified political body, after two centuries of Anglophones and Francophones contesting territorial leadership. When Monnet visited Canada this feeling was still very strong and easily sensed by the young French visitor, who perceived the territory as a proper "logistics space", ready to answer the necessity of the upcoming global twentieth century, in which «the basis of power had changed» (Monnet, 1978: 48). In other words, Canada became a "political model" for Monnet, as US democracy was for his fellow countryman Alexis de Tocqueville:

> *Just as Tocqueville's journey to America in 1831 convinced him that he had witnessed the future, it appears that Monnet's trip to Canada in 1907 formed the quintessential core of the inspiration for his lifelong fixation on European supernational unity. (Ugland, 2011: 10)*

The second reason for which this journey was so crucial to Monnet's life is even more directly connected to logistics. In Canada, Monnet encountered the management of the Hudson Bay Company (HBC), the primary worldwide logistics society at the time. In 1911, Monnet signed a commercial agreement with HBC, where his family's brand became «the sole supplier of brandy to HBC's vast Canadian market» (Wells, 2011: 9). As of that moment, Monnet essentially became a collaborator of HBC, which was an extremely important career move.

Eventually, the London and Canada trips led Monnet to develop a global logistics way of thinking. In England he witnessed systematized global trade; in Canada he perceived how much importance should be given to infrastructures such as railways, which could build a "logistics space" on which to base a subsequent "political space". Since «biography, unlike method, is unique and untransferable» (Wolin, 2001: 87), I have dedicated this first section to a discussion of Monnet's early life. It is only through a proper understanding of the latter that we can interpret his later contributions, while taking advantage of the analytical categories of the contemporary world.

3. The Materialization of the European Space

Infrastructures are «the nervous system» (Opitz and Tellmann, 2015) of economy and society. The role they played in the formation of the modern nation-state has been widely analysed. Books such as that of Eugen Weber, on the modernization of France in the second half of the nineteenth century (Weber, 1976), or Joe Guldi's essay on the definition of England as an «infrastructural state» (Guldi, 2012), are good examples of this line of research. Furthermore, many authors grant infrastructures a central role in modern biopolitical history: a clear example of these is the Canadian Pacific Railway mentioned above, a key mechanism «through which the health, welfare, and conditions of existence of the population have been constituted as objects of governmental management» (Collier, 2011: 205). Thus we see that infrastructures have an intrinsic political capacity, and that they anticipate political unity, building «collectivity through connectivity across a defined space» (Opitz and Tellmann, 2015: 175). Quoting a famous article of Langdon Winner «infrastructures have politics» (Winner, 1980); they first act on a state level, helping the creation of national «imagined communities» (Anderson, 2016). Next, they act, on a different scale, to «deboarder» (Sassen, 2013) the political space of modern European states, building a new idea of Europe as emancipated from historical, cultural, religious, ethnic, or moral linkages, and grounded on an infrastructural base. The creation of an "Infrastructure Europe" – from the 1850s onwards, when the so-called "hidden integration" began (Misa and Schot, 2005: 1) – prepared the way for the birth of the ECSC. Railways were the principal agent of this integration.

In the first half of the nineteenth century, the European territory was characterized by a great technical and structural diversity of railways (Schot et al., 2011). Railroad construction and management were both in the hands of private companies, with little or no intention of collaborating (Heinrich-Franke, 2009: 15). However, thanks to the birth of what we would nowadays call "railway governance agencies" (notably the Verein Deutscher Eisenbahn-Verwaltungen), the variegated railways of the European panorama gradually became more and more compatible. International conventions, such as the ones held in Bern in 1878, 1881 and 1886, were increasingly defining a number of basic international standards for the building of new railways and for the mobility of commodities. «Railway Europe» (Tissot, 1998) was slowly arising.

By the beginning of the First World War, European space already benefited from an efficient railway interoperability; infrastructurally speaking, many European states – such as Italy, France, Germany, the Netherlands, the Austro–Hungarian Empire, and a few other Eastern European Countries – were already integrated. This trend accelerated after the First World War, thanks to the League of Nations (LoN) and the Union International des Chemins de fer (UDC), which substituted Verein as the principal railways governance agency on European soil. It is in this context that we meet Monnet once again.

Thanks to the role he played during the First World War, Monnet became vice-secretary of the LoN, with a mandate for technical decisions (Roussel, 1996: 84). In technical matters, the LoN operated well during the interwar period, providing a major impulse for the construction of «Iron Europe» (Anastasiadou, 2008): «[T]he League's failure in international politics contrasted with its relative success as a technical organization» (Schipper et al., 2010: 114). In those years, «infrastructures were discovered as symbols for the unification

of Europe» (Heinrich-Franke, 2009: 28), and the railway itself as «an instrument that would bring a constellation of European nation-states closer economically, politically and ideologically» (Anastasiadou, 2008: 93). Throughout this process, Monnet occupied a pivotal position, acting through the LoN for the creation of a European space where trains could travel smoothly, avoiding natural or technical bottlenecks.

To conclude, we may affirm that the «materialization of Europe» (Badenoch and Fickers, 2010) could be seen as a longue durée history. European integration, in a broader sense, is a project that is anything but new, and takes root in the middle of the nineteenth century. Put differently, we could state that, «using the lens of technology, we situate European integration (typically viewed as a political process) as an emergent outcome of a process of linking and delinking of infrastructures» (Misa and Schot, 2005: 1). In such a process, Monnet played a central role as the vice-president of the LoN, favouring the building of a European monotopia: «an organized, ordered and totalized space of zero-friction and seamless logistic flows» (Jensen and Richardson, 2014: 3). Long before 1950, Monnet was already working towards continental integration, through the "logistics rationale" that led to the idea of the ECSC.

4. **Logistics Governance**

What exactly do we mean by a "logistics rationale"? Giorgio Grappi recently defined logistics as the implementation of «processes that are made up both of technological innovations and of new organizational processes. It is in this sense that we can speak about a 'logistics rationale'» (Grappi, 2016: 38, my translation). "Technological innovations" and "new organizational processes": both these elements, described by Grappi with a focus on the global present, can also be observed if we develop an analysis of European integration history and of Monnet's actions. In the previous section, we have seen how technological innovations across railway sectors acted towards the material linkage of certain European states. Without this kind of "integration", no political or economic integration would have started in 1950. This was something Monnet knew well, and which incentivized European railway interoperability when he was the vice-president of the LoN. Moreover, during the two World Wars, a number of European states were already testing "new organizational processes" grounded precisely on logistics and led by Monnet.

Nowadays the political and geographical scale is constantly redefined by the needs of logistics. Most of these "new areas" are redrawing the political geometry of our global present in ways that are not just theoretical, but deeply tangible. As I have mentioned, we are seeing more and more "Special Economic Zones", trade corridors, macro-regions, supranational and intranational formations characterized by functional needs. New geographical entities are spreading as a consequence of capital's capacity to produce new spatial entities, creating what Sandro Mezzadra and Brett Neilson have called the new «borders of Capital» (Mezzadra and Neilson, 2013).

To put it more clearly, the "logistics rationale" is producing "logistics spaces" for the rapid circulation of commodities. Such an area «contrasts powerfully with the territoriality of the national state» (Cowen, 2014: 8), but nonetheless presents a general infrastructure

homologation and a partial, common legislation. The latter does not refer to a complete coincidence of constitutional codes, but merely to a form of «graduated sovereignty» (Ong, 2006: 75) whereby states no longer retain total control of their territory. All of this, which inevitably recalls the operation of the ECSC, happened in Europe even before 1950, in the most critical period of the World Wars.

During the First World War, one of the most critical times for the Allies was when Germany initiated, in 1917, the so-called "unrestricted submarine warfare", attacking all cargo ships, including from neutral states such as the US.[6] According to Arthur Salter, «more tonnage was lost in the first ten months of 1917 than in the previous thirty months of the war» (Salter, 1921: 144). To face this dramatic situation, the Allies welcomed a plan implemented by Monnet, at that time a member of the Advisory Board of the French Trade Minister Etienne Clémentel (Piétri, 1999: 25). Formally organized by the latter, but conceived by Monnet himself,[7] the Paris Conference – held between 29 November and 1 December 1917 – created the Allied Maritime Transport Council (AMTC). According to Salter, the AMTC represented «the most advanced experiment yet made in international cooperation» (Salter, 1921: XIII). Thanks to the ships of the Hudson Bay Company, through the AMTC the UK, France, and Italy were jointly governing the «complex logistics of war supply» (Kaiser and Schot, 2014: 63), guaranteed by a common organism with executive power: the first, properly European, logistics Community.

Similar to the AMTC was the Anglo–French Coordinating Committee (AFCOC), established at the beginning of the Second World War. Organized and directed once again by Monnet, the AFCOC acted as a proper suprastate entity, as the AMTC had done. On 1 October 1939, Monnet wrote to the British Secretary of War, Edward Bridges:

> *In the main, the ideas and organization I have discussed with you and the various British Ministries to whom you were good enough to introduce me, are nothing other than the very ideas and organization that, after three years of conflict, the Allies have finally had to recognize as essential, and were successfully tested* [in the First World War].[8]

The British and French governments basically agreed to grant a portion of their sovereign power to another entity, over which they had only indirect control. It is worth quoting a letter written to Monnet by Edouard Daladier, the French Prime Minister:

> *Le Président du Comité de Coordination sera un fonctionnaire allié et que tout en n'étant en aucun sens un arbitre vous devrez employer tous vos efforts pour aplanir les divergences de vue et provoquer des décisions communes en vous plaçant à un point de vue allié et non à un point de vue national.*[9]

[6] The US entered the First World War only on 6 April 1917.

[7] In two letters stored in the Departmental Archive of Puy-de-Dôme dated 20 and 24 November 1917, Monnet gives Clementèl details for the creation of the new European Common Logistics Unit, suggesting that it should be called the Allied Maritime Transport Council. Archive file: 5 J 35.

[8] Letter by Monnet to Edward Bridges, 1 October 1939. Archive of the Fondation Jean Monnet pour l'Europe (FJME). File number: AME 2/2/5.

[9] Letter by Edouard Daladier to Monnet, 2 December 1939, FJME. File number: AME 2/8/15.

Significantly, in his Memoires Monnet commented on this letter as follows: "For 'Allied' read 'Community', and there is no better definition for the role to be played later on by the President of the European Coal and Steel Community's High Authority – which is doubtless no coincidence" (Monnet, 1978: 128).

During both the First and Second World Wars, Monnet was profoundly involved in the logistical organization of the Allies, by promoting initiatives that had an important common feature: an element of "graduated sovereignty" for European states. Despite the «state of exception» (Agamben, 2005) of both wars, the AMTC and the AFCOC were true governance agents with a clear "executive power", whereby a small portion of European territory became what we could call – using contemporary analytical categories – a "logistics space": a super-state area interconnected with uniformed infrastructures and partially governed by an extra-state power.[10] Monnet wanted to continue this common supply (logistics) management even after the end of each war. In a telegram written to Raymond Fillioux (the French representative for supply affairs in London) at the end of the First World War, Monnet wrote:

> *Au moment où la guerre finit le maintien des arrangements interalliés devient vital pour la France. Il est évident que la consolidation des mécaniques existantes s'impose et que nous devons éviter toutes modifications des attributions essentielles des organisations existantes.*[11]

Although his hope apparently vanished in 1918, after the Second World War Monnet finally achieved his longtime goal: a truly supranational European Logistics Space.

5. The European Logistics Space

«The methods of the French Planning Commissariat were readily adaptable both to European problems and to the Europeans involved» (Monnet 1978: 329).[12] These words by Monnet explain the importance of the years between 1945 and 1950 for the development of his action plan after the birth of the ESCS. It is not possible here to examine in depth this period of Monnet's life, nor can we delve into the contingent circumstances that led to the Schuman Declaration. Many factors contributed to the birth of the ESCS: a) the US-initiated European Recovery Program pushing Western European states towards political and economic integration; b) the birth of the Bundesrepublik Deutschland on 24 May 1949 (and the threat of a recomposed German Army); c) the necessity of a common management of steel production as it emerged in a report by Tony Rollman (Director of the Steel Committee of the United Nations Economic Commission for Europe), who «predicted overproduction of up to eight million tons of steel in Europe by 1953» (Kaiser and Schot, 2014: 225). All this and more contributed to the signature of the Schuman Plan. The last section of this article will highlight how the first European Community, too, comprised what I have called the European Logistics Space.

[10] For a general overview of what "logistics space" means, see Waldheim and Berger, 2008; Cowen, 2014: 4-11; Easterling 2014a; Grappi, 2016: 1-10; Into the Black Box, Matteucci (2019).

[11] Telegram by Monnet to Raymond Fillioux, 25 November 1918, FJME. File number: AMB 1/1/97.

[12] For a proper analysis of Monnet's role in the French Modernization Plan, see Walters and Haahr (2005: 1-54).

Since antiquity, "Europe" has been a nebulous concept. However, since the birth of the ECSC, in everyday parlance "Europe" has often overlapped with the European Community. This in spite of the fact that neither of these have ever had a predetermined border:

> *Six pays ont commencé: la France, l'Allemagne, les pays de Benelux et l'Italie. Mais la réalisation des États-Unis d'Europe est ouverte à la participation de tous les pays qui voudront s'y joindre en acceptant l'autorité de leurs institutions et de leurs règles communes.*[13]

Far from being linked only by a geographical or territorial perspective, Monnet's Europe was a dynamic concept. More broadly speaking, Monnet's idea was linked, on the one hand, to its "representation", and on the other, to its "function".

Making reference to Henry Lefebvre, Ole Jensen and Tim Richardson underline the fact that «analysis of space requires analysis of discourse if we are to understand how spaces come to be as they are» (Jensen and Richardson, 2014: 43). Although the ESCS (and subsequently, the European Economic Community) merely reflected the territories of six states, from that moment onwards it was identified as "Europe" in public discourse. After all, as Monnet wrote to Georges Bidault in a letter, only a few days before 9 May 1950, «L'Europe n'a jamais existé […]. Il faut véritablement créer l'Europe, qu'elle se manifesta à elle-même et à l'opinion américaine, et qu'elle ait confiance en son propre avenir».[14] After the birth of Europe, which occurred through the creation of the ECSC, the next step was the birth of the European citizen:

> *I want to underline this fundamental point – Monnet said in the 1950s – henceforth, no Frenchman, no German or Italian or Belgian or Dutchman or Luxembourger welcomed here in Washington will come simply as a representative of his own country. Each will become more and more what he has hitherto been only in a cultural sense – a European. (Monnet, 1978: 428)*

In addition to the representation of a territory, there are functional aspects of what "Europe" might mean. To quote Jensen and Richardson once more, globalization means

> *a dialectical struggle between two incompatible "spatial logic" or rationalities […]. The essence of this conceptualization is a dialectical tension between the historically rooted local spatial organization of human experience (the space of places) versus the global flow of goods, signs, people and electronic impulses (the space of flows).* (Jensen and Richardson, 2014: 217)

As is well known, by "space of places" Manuel Castells means «a place as the local whose form, function, and meaning are self-contained within the boundaries of territorial contiguity» (Castells, 1999: 296). The other side of the coin is the "space of flows", which implies «that the material arrangements allow for simultaneity of social practices without territorial contiguity» (Castells, 1999: 295). In light of these considerations, it seems that the real contribution of Monnet and the ECSC could be described as placing on the historical "space of place" of the European nation-states a European "space of flows".

[13] J. Monnet. "Note". FJME. File number: AMK 2/2/12.

[14] Letter from Monnet to Georges Bidault, 3 May 1950. FJME. File number: AMG 1/1/5.

Does this mean that the ECSC was nothing more than a free-trade zone? Not at all; within the Space of the Community, close attention must be paid to the "non-tariff barriers", among which «technical standards […] but also health and safety regulations or detailed rules for the individuals to work in a particular profession» (Kaiser and Schot, 2014: 276). In other words, we may consider "non-tariff barriers" as the "bottlenecks" that a logistics space has to overcome so as to gain the seamless space for its purposes. This is one of the primary achievements of the ECSC.

All in all, we could claim that in a period when globalization was about to enter its most advanced phase, where «flows of capital and people challenge the sovereignty of bounded nation-states and call for new forms of politics and regulation» (Walters and Haahr, 2005: 2), Europe – and Monnet – replicated through the ECSC project, which was the first step of what Martin Hajer calls the present-day «Europe of flows» (Hajer, 2000: 138). Thanks to the ECSC, the six states that adhered to the project were ready for a "new global world" that was knocking on their doors. However, they were also accepting a new governance entity on European soil, which fully realized a European Logistics Space without unmaking the continental history built on a territory divided into a multitude of sovereign states.

6. Conclusion

The main aim of this article has been to consider the European integration process as a sort of paradoxical narrative, inasmuch as the birth of the ECSC has been considered not as the starting point of that path, but rather as the final step of a longstanding process, in which Jean Monnet played a pivotal role. Indeed, as I have tried to explain throughout the article, both the building and standardization procedures of infrastructures, such as the railways on European soil, and the logistics cooperation experiences that took place during the two World Wars, have to be considered crucial steps towards the first European Community. Highlighting these decisive moments allows us to develop a discourse on the European integration process out of its immanency. In other words, through what I have called a "logistics gaze" – which starts from the assumption that sees «logistics as a power» (Neilson, 2012) – we can interpret the ECSC experience not as a radical "new beginning" of European history, but as an important step in a longer process, and on a broader path.

«Since 9 May 1950, we have been grappling with history» (Monnet, 1978: 336), Monnet wrote in his Memoirs. In this article I have partially sought to argue the converse. Indeed, considering the Schuman Plan as part of the "long twentieth century" allows us to emphasize a sort of structural continuity in a long European history. To do this, I have placed side by side two types of literature. On the one hand, I have paid considerable attention to the many works concerning Monnet's life and European integration historiography. On the other, I have considered other sources of interpretation, such as those pertaining to critical logistics studies. In sum, I have aimed to build neither a teleological history of European integration, nor one of Jean Monnet's political thought. Rather, I have tried to offer a novel contribution to the spectrum of interpretations of this important event by underlining its main essence: the building of the European Logistics Space.

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EU Trade and Regulation: Economic and Political Dynamics

Política Comercial e Regulação na UE: Dinâmicas Económicas e Políticas

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ABSTRACT
The EU's new generation of deep and comprehensive free trade agreements not only promote EU trade but also have a bearing on the shape of the European model and in consequence on the sustainability of the integration project. They reach much further than conventional free trade agreements. Their benefits hinge on the abolition of non-tariff and regulatory barriers and enter into areas that are member state competences. Much depends on the agreements in question and similarity of preferences between trading partners. It is up to the EU, ultimately for the sake of the sustainability of its political integration project, to explicitly contemplate not only trade impacts but impacts on the Union's economic model instead of letting rather than being pushed further down the road by unfolding trade dynamics.
Keywords: Comprehensive free trade agreements; EU regulation and preferences; subsidiarity.

JEL classification: F13; F68; P16

RESUMO
A nova geração de acordos globais de comércio bilateral não promove apenas o comércio externo da UE mas tem igualmente um impacto no seu modelo de desenvolvimento e, em consequência, na sustentabilidade do projeto de integração europeia. A nova geração de acordos vai para além dos convencionais acordos de comércio livre. Os seus benefícios dependem da abolição de barreiras não tarifárias e barreiras regulatórias, o que entra na esfera de competências dos Estados Membros. Muito depende dos acordos em questão e da similitude de preferências entre os parceiros. Em última análise, cabe à UE tomar em consideração não apenas os impactos comerciais desses acordos mas também o impacto no seu modelo económico, evitando assim ser condicionada pelas dinâmicas económica e política deles resultante.

Palavras-chave: Acordos globais de comércio bilateral; regulação e preferências na UE; subsidiariedade

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1. Introduction

This article discusses European Union (EU) trade and regulation in the context of today's world trading system. Its purpose is to spell out the challenges facing the Union as a by-product of its trade dynamics, which have been pushing it towards deepening globalization further through an ever-increasing number of deep and comprehensive 'new generation' trade agreements with a growing geographical reach. While EU trade policy pays tribute to European values, it is not clear to what extent the European model – central to the EU's identity - is thereby being upheld, not least in light of the complexity of issues involved that would need to be contemplated in trade talks. The experience with the EU-Canada Comprehensive Economic and Trade Agreement (CETA), the EU's showcase new generation free trade agreement, has underscored both the complexity of issue areas and also the difficulties associated with ratification.

Adopting a trade focus tends to overlook that the EU's new generation deep and comprehensive free trade agreements not only promote EU trade but also have a bearing on the shape of the European model and, we argue, in consequence on the sustainability of the political integration project.[1] Comprehensive and deep free trade agreements are unlike conventional free trade agreements in that they reach much further. Whereas the latter do away with tariff-barriers to trade and are an exclusive competence of the Union, the benefits of comprehensive and deep free trade agreements hinge on the abolition of non-tariff, regulatory barriers and enter into areas that are member state competences.[2] If qualifying as a mixed agreement, the ratification of a trade agreement requires not only consent at the EU level but in addition of all member states (and some regions).[3]

The CETA treaty exemplifies the far-reaching rules that govern issues as diverse and broad as access to goods and services markets, investments and public procurement; intellectual property rights; sanitary and phyto-sanitary measures; sustainable development, regulatory co-operation; mutual recognition; trade facilitation; co-operation on primary materials; and the resolution of disputes and of technical barriers to trade. Fears voiced by member states or civil society that deep and comprehensive free trade agreements might not correspond to the preferences or values of society cannot be dismissed out of hand.[4] For instance, this could be the case if there was a race to the bottom of standards through regulatory competition and/or regulation being hollowed out by regulatory cooperation and

[1] For a discussion of the meaning of the European model, see Bongardt and Torres (2009). In an environmental context sustainability denotes the capacity of a system to reproduce itself over time. It is here used also in a wider context with regard to the resilience of the EU political system (see Begg et al. 2015).

[2] The Court of Justice of the European Union (CJEU) clarified the distribution of competences between member states and the EU in its verdict on the Singapore agreement. A comprehensive trade agreement that qualifies as a mixed agreement (like CETA) hinges not only on ratification at the EU level but also at the EU member state, and in some cases regional, level.

[3] For a discussion see Bongardt and Torres (2017). Applied provisionally since the second half of 2017, CETA is still awaiting ratification by all member states. The EU- Japan agreement, the EU's largest trade agreement so far, was signed in July 2018 and entered into force on 1 February 2019. It still lacks an investment component.

[4] See de Ville and Siles-Brügge (2017) on the case of the EU-US Transatlantic Trade and Investment Partnership (TTIP).

being beyond democratic reach, or when investor state arbitration came to limit the policy space for future more stringent consumer and environmental protection.

This article puts forward that much depends on the agreements in question and similarity of preferences between trading partners. It is up to the EU, ultimately for the sake of the sustainability of its political integration project, to explicitly contemplate not only trade impacts but impacts on the Union's economic order instead of letting itself being pushed further down the road by unfolding trade dynamics. Doing so may imply more 'dialogue' among various levels of policymaking, according to the subsidiarity principle, more 'transparency' rather than negotiations behind closed doors, and more legitimate 'regulation', rather than investor-state dispute settlements. It would also imply to internalize societal concerns, such as longer-term environmental concerns that have for long and consistently been among European citizens' priorities.

The remainder of this article is organized as follows. The ensuing section takes stock of the essential features of today's trading system and the challenges facing the EU in a weakened multilateral trade order. Section 3 takes a closer look at the EU's new generation deep free trade agreements and why they imply a qualitative change in EU trade. Section 4 discusses the interaction between external trade and EU regulation and the impact on the European model. Section 5 argues that the fundamental challenge for the EU to address is a rules and value-based international trade order on a sustainable footing. The concluding section places EU trade and the European model in the context the European integration project.

2. Today's Rules-Based Multilateral Trade Order: Weakened and Contested

These are testing times for the rules-based international trading order, which Europeans (among many others) got accustomed to and used to count on as a source of growing prosperity for much of the post WWII period, and for today's globalisation-fuelled international trade. Old certainties, where multilateralism seemed a given and the progression of globalisation unstoppable, with world trade feeding on its dynamics, are at best being severely shaken.

First and foremost, the world trading system faces contestation of an unprecedented level. Far from being any longer the domain of no-global movements, which have voiced their concerns with globalisation for quite some time, the world's traditional anchor of free trade and fundamental pillar of the multilateral trade order, the United States (US), changed its trade policy course and joined in. The different actors' motivations for contestation might admittedly differ significantly, featuring social and environmental effects on the one side and bilateral trade disequilibria on the other. Yet, what cuts across is a notion of unfairness that goes together with certain side effects of trade perceived as negative. In consequence, the progression of globalisation can no longer be taken for granted and globalisation, and with it world trade, might even come to experience some downscaling or unwinding. The EU, which has been a staunch supporter of multilateralism in international trade, finds itself in a context in which trade disputes risk spiralling out of control into trade wars and the very multilateral rules-based trade order is cast in doubt.

Global trade and growth have undoubtedly greatly benefited from the multilateral framework drawn up under the auspices of the General Agreement on Tariffs and Trade (GATT)

and its successor, the World Trade Organisation (WTO). It however started to encounter sizable problems that await resolution, as the increasingly difficult conclusion of multilateral trade rounds, which culminated in the demise of the Doha round in 2005, and growing frustration with some trade partners' practices viewed as unfair (most notably China's[5]) indicate. In response the world has witnessed a proliferation of bilateral and regional trade deals through which countries aim to further their trade interests more directly.

In more recent times, multilateralism and the idea of international trade as a win-win situation received a further, severe blow when the current US administration shifted to an 'America first' stance with a bilateral, zero-sum perspective on and approach to extracting benefits from trade.[6] In the course of trying to address its concerns and push for its interests with selected trading partners and by recourse to its clout, the US declared the EU, a long-standing close ally not only in international trade forums, a foe and singled out countries like Germany, Japan and China, among others. It suspended the negotiated EU-US Transatlantic Trade and Investment partnership (TTIP), did not sign the Trans Pacific Partnership agreement (TPP – subsequently signed by the remaining TPP11 partners under the designation of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, CPTPP), in whose coming into existence it had taken a leading role, and took to renegotiating an existing plurilateral trade agreement with one partner at a time (the case of the trilateral North American free trade agreement (NAFTA), starting with a bilateral agreement with Mexico), which gave rise to the United States-Mexico-Canada Agreement (USMCA), the trade deal replacing NAFTA. In addition, the US has threatened trade partners with and embarked on imposing import trade tariffs. Those unilateral measures have met with retaliation, among others by the EU (which imposed countermeasures in the form of import duties on a range of US products in response to US tariffs on EU steel and aluminium, and China), and raised the possibility of tit-for-tat trade wars (also with the EU, but most acute in the case of China). As for the EU, recent developments (above all, Brexit and the US's stance) have reinforced its external liberalization agenda and it has come to present itself as a champion of free trade in an era of global populism (de Ville and Siles-Brügge, 2019).

Alleging, among others, discontentment with a WTO overstepping its competences, US actions (blocking the nomination of judges to arbitration panels) jeopardize the WTO's functioning, most notably its dispute settlement mechanism, which is central to the multilateral rules-based trade order. The WTO has warned that this, together with the US entering into trade conflicts with the rest of the world, risks damaging the WTO as a guarantor of the international system and imperils world trade.[7] While the task of reforming an international organization of 164 members, which have different interests but take decisions by unanimity, is a steep and cumbersome one that is only possible by building the necessary cross-country consensus, it is in the EU's interest to ensure a workable trade order. In our view, the EU's approach to global trade should not stop there.

[5] While the WTO would have been well placed to obtain concessions from China at the time it was to join, China has since become a major global trading force.

[6] See also Pelkmans (2018) on the implications for EU trade policy.

[7] Declarations by Roberto Azevedo, Director-General of the WTO: "Warum wir die Welthandelsorganisation WTO brauchen", *Handelsblatt*, 9 August 2018.

At this junction for world trade, the role of the Union, which is a major player in the world trade arena given its market size and openness to trade, becomes pivotal, but a mere defence of the current system will not do. Rather, the EU faces a two-fold challenge, which not only consists of seeking to uphold a rules-based international order, but also, less obviously but we would argue crucially so, of shaping the future world trade order. The latter requires that the EU project its values - enshrined in the European model that aims at making compatible growth and social and environmental protection - onto the global stage through its trade policy. The challenge is especially acute with respect to the de facto still largely ignored link between trade and the environment.

3. New Generation Free Trade Agreements: A Qualitative Change in EU Trade

With multilateralism increasingly in crisis, the EU has resorted, at first reluctantly, to striking bilateral trade deals. The Union developed trade dynamics that have led it towards deepening globalization. In light of the already rather low tariff barriers among WTO members the EU came to embark on a new generation of international agreements. It means that in most cases, and in the absence of any one-size-fits-all trade agreement, the Union negotiates deep and comprehensive free trade agreements with third countries.[8] Recent examples of those deep free trade agreements include the EU-Canada Comprehensive and Economic Trade Agreement (CETA), the EU-Japan Free Trade Agreement, the EU-Singapore, the EU-South Korea, the EU-Vietnam and the EU-Mercosul deep free trade agreements, and in the foreseeable future potentially also the United Kingdom, once it becomes a third party to the EU.[9]Yet, abandoning multilateralism tends to distort global trade and harm third countries, and there are disadvantages for the EU, too, not least because pursuing (new generation) free trade agreements such as the TTIP or CETA rather than trying to revive the multilateral Doha round locks the Union into a less dynamic geographical area and also has the effect of excluding other countries and regions, most notably China (Winters, 2014). The welfare benefits of deep FTAs are not clear-cut and may even be uncertain. None the less, with tariffs already low in international trade, it seemed a logical step for the EU to embark on an ever-increasing number and geographical spread of deep free trade agreements that seek to also abolish non-tariff barriers to trade.[10]

Deep and comprehensive free trade agreements establish bilateral rules to govern the trade relation. Those do not only influence global norms and standards but also come to feed back into and interact with the EU's economic order in a way that traditional trade agreements have not. New generation free trade agreements thereby trigger a qualitative change in EU trade: they could reinforce the European model or, in the case where they

[8] There are currently 44 trade agreements in force. Updates of the state of play of EU free trade agreements are available at: http://ec.europa.eu/trade/policy/countries-and-regions/negotiations-and-agreements/.

[9] A discussion of EU international trade and Brexit can be found Bongardt and Torres (2018a). The impact of Brexit on EU trade policy is discussed in de Ville and Gheyle (2019).

[10] A review of studies on the economic effects of TTIP can be found in Felbermayer (2016). A tariffs-only agreement would have only small effects on trade flows with very low welfare gains. For a comprehensive TTIP, the increase in bilateral trade flows would be sizeable, but studies differ substantially with respect to welfare effects.

weaken it, risk eroding the trust of European citizens and economic agents in the Union (Bongardt and Torres, 2009). The matter is economically and politically sensitive at a time when the European model, as a result of the limited progress to date with respect to the EU's economic and institutional modernization agenda and on the belated implementation of the social pillar, is still not consolidated.

Deep trade agreements will promote market-making but may well come to constrain market correction. Rather predictably, this creates friction within the EU, not least because in many policy areas now included in those agreements it is EU member states that have retained competences for market correction. To further complicate matters, new generation trade agreements imply higher co-ordination needs and raise issues of preferences and sovereignty when invading the competences of EU member states. They are likely to affect the European model since they address non-tariff barriers to trade and other issues such as investment protection, which interfere with political preferences regarding the role of the state in the economy. Regulation is intrinsically political, too, as it is based on values and beliefs. As de Ville and Gheyle (2019) point out, the EU had been insufficiently aware of the different nature of its first deep free trade agreement, TTIP, with regard to its scope (and also partner) as compared to other trade negotiations. [11] One result was the politization of TTIP (de Ville and Siles-Brügge 2016 and 2017) and, in its wake, of CETA (Hübner et al. 2017). TTIP and CETA in particular brought to the fore popular concern with the effects of globalization on European society and the environment in the context of EU trade policy.[12] Public contestation of the EU's new generation of comprehensive trade agreements sits uneasily with EU trade dynamics.

A trade focus may easily lead the EU to overlook the complex and potentially broad consequences for society of (deep) economic and trade agreements, as the Belgian region of Wallonia reminded the EU in the case of the CETA agreement. It was due to contestation by civil society and especially the refusal by the region of Wallonia to sign the original agreement, which resulted in some amendments before CETA could be signed at the EU-Canada summit in late October 2016. Wallonia obtained a number of assurances, *inter alia*, on investor–state dispute settlement (which was initially not even to be replaced by the investment court system); regulatory co-operation (requiring common agreement by member states); safeguards with respect to genetically modified organisms; and a guarantee of the precautionary principle. The European Commission (2015) subsequently modified the principles that guide its trade talks, emphasizing that EU trade policy is to become more effective with respect to delivering economic results, more transparent and also to not only to protect EU interests but to protect and further European values in external trade.

[11] De Ville and Gheyle (2019) argue that even not having gone ahead, TTIP triggered major unintended consequences for the EU, such as demands from third countries to upgrade their trade relationship and unprecedented politicization, which affected CETA and brought about reform of EU trade governance and amendments to EU trade policy positions. In their view, EU trade policy has since adapted to the new politics of trade, thereby making unintended consequences less likely.

[12] According to de Ville and Siles-Brügge (2016), TTIP contained a neoliberal agenda bound to bring into the trade domain and de-politicize many political areas. The contestation of TTIP is regarded as an opportunity to bring the issues into the open and re-politicize EU trade policy.

With US commitment to the international trading order increasingly in doubt, the EU has a unique opportunity not only to be the anchor of the international rules-based system but to condition it in line with its objectives and values. That would mean to push, notably, for labour and environmental standards in trade agreements, something that the European Commission has not yet fully embraced. However, treating trade issues without due regard to the EU's wider objectives risks becoming a credibility issue for the EU. In the EU-Japan trade agreement, the EU made a first step in this direction by making observance of the Paris climate agreement a prerequisite, albeit belatedly and without much detail.[13]

Generally speaking, bilateral new generation free trade agreements in principle offer the EU an easier and speedier way to advance European goals and project its values onto the global stage in comparison with multilateral forums. The EU could aim to be a global rule maker. [14] Yet, there is little evidence that it has even aimed at doing so. Young (2015) finds that the EU has not used regulatory coordination to try to export its rules and that it has generally settled for granting equivalence. Unsurprisingly, critiques persist and centre on fears that those trade agreements could undermine environmental and labour standards and give multinational firms the power to challenge national laws and limit the EU's and member states' regulatory space.

Even more preoccupying from an EU point of view, the backlash against the effects of globalization became directed against the Union, which was perceived as prioritizing economic (commercial) interests over making sure that its economic goals were compatible with societal (social and environmental) concerns. The incompleteness of the European model has fuelled fears of the potential impact of comprehensive agreements on policy domains beside narrow trade in goods, many of which have remained in the EU member state sphere. They regard the fleshing out of a European model in line with European citizens' present or evolving preferences. The politization motivated the European Commission (2015) to update its trade policy.

4. Interaction Between External Trade and EU Regulation and Impact on the European Model

The EU's new generation of deep trade agreements magnifies the issue of regulation, which is already complex in internal EU trade, in an international trade context (Bongardt and Torres, 2018b). In addition, external trade and regulation interact and impact on the European model, a fact that any discussion on what should be the EU's approach to global trade needs to take into account.

The issue of market making versus market correcting – or negative versus positive integration, in the terminology of Tinbergen (1954) – gives a foretaste of the issues (of a much larger scale) at stake in new generation free trade agreements. The CETA case illustrated that rules on regulation in deep and comprehensive trade agreements, such as through

[13] With a view to obtain the CETA trade agreement, the European Commission had facilitated trade in highly polluting Canadian tar sands.

[14] The issue of the EU as a rule-maker or rule-maker under TTIP is analysed by Hamilton and Pelkmans (2015).

regulatory co-operation, mutual recognition or investment court arbitration, may come to limit the European and national policy space.

As Pelkmans (2013) lays out, most EU-level rules currently refer to risk regulation, which pursues safety, health, environmental and consumer protection objectives. This risk regulation concerns mostly goods and services markets – for example financial market regulation and supervision, and network industry aspects – and only sporadically labour and capital markets. On a more horizontal level, it includes environmental regulation and consumer protection and rights. The precautionary principle, enshrined in the treaties, is an important EU principle in this context.

What made regulation-based integration possible in the EU, economically and politically speaking, was sufficient similarity of preferences. Heterogeneity of preferences is accommodated by the single market's mutual recognition principle, which implies competition between regulatory systems, and requires its societal acceptability. The rejection of the original (Bolkestein) services directive, based on the home country principle, illustrates well the political difficulties with co-existing different national regulation even within the EU.

Mutual recognition is a basic principle for single market functioning in European varieties of capitalism. It exists only in the single market framework, providing a fall-back solution to accommodate different preferences that do not allow for establishing common, European standards. Crucially, it presupposes a degree of trust that rules will be similar in their effect as well as supervision and enforcement capacity. Note that as a principle it has at times proven problematic even in a European context, once it allows for regulatory arbitrage (competition between regulatory systems) in an EU that has become ever more heterogeneous after successive enlargements.[15]

The economic case for EU deep and comprehensive trade agreements rests on realizing largely untapped benefits from abolishing non-tariff barriers to trade. Still, trade and welfare effects are complex and may even be ambiguous.[16] Those free trade agreements tend to have broader implications for society and influence its model of development (Rodrik, 2016). Those are conditioned by the scope of the agreements in question (e.g., covering areas like public or regulated services, intellectual property rights, investment protection).

Akin to issues raised by regulation in the single market, non-tariff barriers to trade and the inclusion of other issues such as investment protection interfere with political preferences on the role of the state in the economy and also highlight the role of regulation, which is also intrinsically political as it is based on values and beliefs. Acceptance is not a given and ratification more complex and uncertain once they encroach on member state competences. The market making versus market correcting issue, which features prominently in the internal market context, is an even larger issue in deep free trade agreements.

The contestation of CETA and TTIP in the EU showed that trust might be limited even with regard to a fellow G7 country. Still, there is no mutual recognition in EU international trade. The principle only exists in the single market framework and not with regard to third

[15] The issue of harmonized standards for financial services is a case in point.

[16] With respect to TTIP, Connell et al. (2018) argue the costs of non-TTIP are even larger if one takes into account complex global value chains. They conclude that while those potential benefits are substantial, they derive less from the abolition of tariff barriers than from non-tariff measures. Still, a comprehensive TTIP could harm third countries (Felbermayr, 2016).

countries. Instead, the EU may grant equivalence to third country regulation (which, unlike mutual recognition, is not automatic and can be revoked at relatively short notice). Young (2015) points out that the EU makes little use of regulatory coordination, that it customarily grants equivalence and that it does not try to export its standards.

The CETA case illustrated that rules on regulation in comprehensive trade agreements, such as through regulatory cooperation, mutual recognition or investment court arbitration, may come to limit the European and national policy space. Those were also key elements in the contestation of TTIP. The EU had been prepared to go further under TTIP with the US than the US had been under TPP, with deeper agreement on regulatory issues, covering three broad areas, namely market access, regulatory issues and non-tariff barriers, and rules.

To the extent that comprehensive agreements come to constrain market correction – for instance by pre-empting higher standards via regulatory coordination, putting downward pressure on existing ones via equivalence or limiting future regulation through investment protection - they can reinforce negative integration tendencies in the EU by putting downward pressure on standards through trade. To hope otherwise would require a notion of similarity with regard to third countries that is already stretched even within the Union.

It is worth noting that through the bilateral rules established in the context of a comprehensive trade agreement the EU may not only influence global norms and standards but that those also come to feed back into and interact with the EU's economic order in a way that traditional trade agreements have not. They can thus reinforce the European model or in case of weakening it, risk eroding trust of European citizens and economic agents in the Union.[17] The matter is economically and politically sensitive at a time when the European model, as a result of the limited progress to date with respect to the EU's economic and institutional modernization agenda and on the belated implementation of the social pillar, is still not consolidated.

5. The Fundamental Challenge for the EU to Address: A Rules and Value-Based International Trade Order on a Sustainable Footing

First and foremost, the EU is seeking to uphold the multilateral trade order, de-escalate trade conflicts and defuse looming trade wars. Doing so it is treading a fine line in its trade policy. For a global player like the EU it becomes a matter of credibility to adequately respond to US unilateral actions and not give in to threats, whereas it is not in its interest to let trade conflicts escalate and be drawn into trade wars. Those are costly in real terms once they pose a serious risk to activity in the short to medium term and to the outlook for global trade (ECB, 2018). The EU opted to engage with the US and to find some common ground; after all, there are some shared interests and concerns, such as WTO reform or issues with market access discrimination and intellectual property right protection in China. Bilateral trade remains important, regardless of the fact that the EU-US TTIP, the EU's first comprehensive trade agreement, intended to create a common transatlantic marketplace

[17] Europeans' attachment to high sanitary, food and environmental standards (including upholding the precautionary principle) is illustrated by recent European citizens' initiatives to ban genetically modified organisms (GMO) or glyphosate.

with low barriers to trade and investment and with aspirations to shape the world trade order, ended up as the EU's only one that did not advance. Formally on ice by decision of the current US administration, the EU-US trade deal was very much contested in the EU where it proved unsellable in light of the reach of third country regulatory autonomy on EU territory. Still, as de Ville and Gheyle (2019) point out, TTIP had lasting if unintended effects on the evolution of EU trade policy.

The EU has pursued two parallel strands of action. To start with, it attempts to achieve a negotiated settlement with the US on the WTO. The EU regards the WTO, in particular its role in global trade disputes, as vital for upholding a rules-based international trading order. Since no clarity exists as to whether the US administration intends to reform the WTO or do away with it, the EU drew up reform proposals that take up the kind of complaints that the US has raised, in a move meant to test the US's willingness to work constructively on its critiques (and consequently lift its opposition to the judges on dispute settlement panels) or otherwise call its bluff with regard to its stated commitment to engage with the EU on WTO reform.

At the same time, the Union has, rather successfully, sought to augment and strengthen its trade ties and to strategically close ranks with like-minded trading partners.[18] The shared concern - the new US stance did not only raise the EU's resolve to sustain free trade but also the importance of securing free trade for many other countries - has predictably promoted and accelerated new EU trade deals with existing and prospective trading partners.[19]

Apart from EU trade dynamism, US protectionism opened up a strategic space in which the Union could seek to also condition global trade in line with its preferences for growth with high environmental and social standards. The crucial question remains to what extent the EU is willing to put this capacity to good use.

The meeting between Commission president Juncker and US president Trump on 25 July 2018 in Washington, realized at the initiative of the EU, resulted in an agreement to suspend a war on trade tariffs and work toward an accord (European Commission, 2018). It also gives clues on the EU's priorities in trade and on the kind of compromises that the EU looks prepared to make in the name of external trade.

The EU managed to achieve a (even if temporary) truce (no additional US import tariffs on cars from the EU) as long as a perspective EU-US trade agreement is negotiated, without apparently making substantial concessions to the US. The US is to reassess (rather than lift, however) its punitive tariffs. The EU commits to raising imports from the US in certain sectors (more soybeans, which would make up for reductions of US exports to China, in face of Chinese retaliations to US policy, and more American liquefied natural gas (LNG), hereby competing with Russian gas and diversifying EU energy supplies). The parties also

[18] For an explanation of this new policy stance, see Bongardt and Torres (2017). More recently, the EU has teamed up with Canada (a possible blueprint for agreements with other trading partners) to ensure that (bilateral) arbitration panels will be operational to deal with trade conflicts once the WTO's do not function any more for lack of judges.

[19] For instance, CPTPP countries turned to the EU to make (or accelerate or deepen) free trade and investment deals. There has also been a fresh impetus for a number of free trade negotiations that were previously slow-moving or had stalled (among others with Japan, South Korea, and Mercosul) to upgrading existing ones (such as with Mexico).

commit to negotiating a comprehensive tariff reduction for industrial goods and a reform of the WTO (as referred above).

For the time being the truce holds but it is fragile. The scope of the agreement has turned out to be ambiguous apart from contentious within the EU (Is agriculture in or out? Is the idea to reactivate the wide TTIP or a reduced version of it?).[20] And to cement the truce, the EU has already made further offers (higher quotas for non-hormone US beef exports, to lift all car tariffs if the US reciprocates), however already qualified as insufficient by the US.[21]

If we accept the argument that what matters is that the agreement ended the escalation of tit-for-tat tariffs and averted a trade war (Gros, 2018), then the question at what price, if any, becomes relevant. After all, any potential benefits of reviving TTIP depend heavily on doing away with regulatory barriers. However, the TTIP was heavily contested because of the concern that any such deal might come at the expense of EU (present or future) standards (notably high sanitary, food and environment standards).

The EU Commission, often accused in the past of privileging trade liberalization over societal (labour, environmental) concerns, has hence committed to internalizing those concerns in trade and to protect the EU's high standards (European Commission, 2015). Judging by this measure, the EU-US agreement risks sending the wrong signals. The EU abandoned its customary defence of the Paris Climate Agreement and of environmental standards for the sake of achieving a suspension of US trade sanctions. And although any concessions may appear symbolic since higher imports of US soybeans and LNG rest on market decisions, those are two areas that happen to be rather sensitive on environmental grounds (genetically modified agricultural products and gas produced through fracking). The objective to internalize environmental externalities on efficiency and environmental grounds and to work towards the European model through external trade appears to have been sidelined in the name of trade. In fact, Young (2019) finds that the EU's updated trade policy in response to the politization of trade policy (TTIP, CETA) and anti-globalization movements reflects continuity with past practices.

6. Concluding Remarks on EU Trade and the European Model

Pragmatism that privileges trade over European values does not bode well for the defence and even less promotion of the European model through EU external trade policy. In the face of vocal criticism of the negative side effects of international trade, combined with the

[20] The Juncker deal risked disrupting European unity. Favoured by Germany (with an automotive industry strongly exposed to US sanctions), France rejects a wide TTIP-style agreement and the inclusion of agriculture. It is also opposed to the EU negotiating while sanctions are active. In any case, renewed trade negotiations would require a mandate for the Commission and the European Parliament would also have a word to say (limiting the role of expert groups).

[21] Perhaps more importantly in practice, the US is already experiencing that in today's globalised world (with features like complex supply chains), trade policy can be a double-edged sword, so that tariffs hurt not only foreign but also domestic economic agents through more expensive inputs, and that trade partners retaliate against punitive tariffs, and prefers to focus more on China for the time being.

rise of populism[22], the EU needs to face up to the challenge to condition globalization in order to make the European model work for and deliver results for its citizens, in line with European values and objectives.[23] Even though some progress has been made, the European Commission still needs to fully internalize those values also in its trade policy and actively push for them in order not to risk a backlash against international trade and the Union. With the US's commitment to the international trading order increasingly in doubt, the EU has a unique opportunity to be an anchor of an international rules and value-based system and to use its clout to push notably for high labour, environmental and climate standards in trade agreements, something that the European Commission has embraced in theory but seemingly not yet in practice.

In theory bilateral trade agreements offer the EU an easier and speedier way to advance European goals and project its values onto the global stage than multilateral forums. On the downside, they could also come to lower environmental and labour standards and give multinational firms the power to challenge national laws and limit the EU's and member states' regulatory space. A trade focus easily may – and we would argue did – lead the EU to overlook the complex and potentially broad consequences for society of the new generation economic and trade agreements. Suffice it to recall here that the EU only belatedly integrated the environment and the Paris Climate Agreement in recent trade deals (with Japan and South Korea) that it abandoned the climate issue to achieve a trade truce with the US, and that in the newest trade deal (the EU-Mercosul agreement), the potential environmental impact (of agricultural trade on the deforestation of the Amazon forest) might still derail the ratification of the mixed agreement.[24]

In the authors' view, it is not only EU external trade that is at stake if a trade focus trumps the European model. It could damage trust in European institutions if EU wider objectives were to be alienated in the name of trade, to deliver growth in the short run, regardless of its quality and impact on society. The approach that the EU takes to global trade will define its credibility as a global actor but, perhaps more importantly, impact on the sustainability of the European integration project. The issue is whether the Union actively works towards a rules and value based international order, which delivers on EU preferences for quality growth and fairness and which prioritizes the overdue link between

[22] The success of anti-EU populist parties in continental Europe, especially in France, derives partly from opposition to a (Anglo-Saxon-type) deregulated economic model and a neglect of the European model. It stresses the importance of fairness for the success of the European economy and of the European project. The social chapter is an expression of the EU seeking to complete its model in the social sphere. See Bongardt and Torres (2019).

[23] For Young (2019), the Commission's assessment of the politicization of trade policy is exaggerated. In his view its wrong assumptions have however produced the right policy, that is, a less politically fraught EU trade policy. That assessment does not take into account the importance of the European model for the future of the European integration project, which we want to stress.

[24] It is also not yet clear whether Brazil will stay in the Paris Climate Agreement, which would seem a precondition for the deal. Former French Environment Minister Hulot qualified the EU-Mercosul trade deal as completely contradictory to the bloc's climate goals (https://www.climatechangenews.com/2019/07/01/eu-mercosur-trade-deal-will-drive-amazon-deforestation-warns-ex-minister/, consulted on 14 July 2019). Often characterised as cows for cars, the trade deal has been criticized due to cattle being the biggest driver of deforestation of the Amazon (followed by soy beans and timber) and the violation of indigenous peoples' rights (https://www.greenpeace.org/eu-unit/issues/democracy-europe/2122/eu-mercosur-environmental-destruction/, consulted on 14 July 2019).

environmental sustainability and trade. EU's self-declared leadership role in combating climate change provides a test case for its resolve. After all, economic growth cannot be sustained over time if the limits of the planet are not accounted for nor is trade sustainable if negative externalities are not priced in.

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Are CO_2 emissions converging in the European Union? Policy implications

As Emissões de CO_2 Estão a Convergir na União Europeia?

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ABSTRACT
This paper focuses on the process of convergence in per capita CO_2 emissions that would occur if the measures taken by the European Union to meet the Kyoto Protocol commitments had been effective. We apply a time series and cross-sectional analysis to test for the existence of convergence among countries and for different economic sectors. The sample covers data for the 28 member countries from 1960 to 2012. The results show weak absolute convergence across countries but clear evidence of conditional convergence, with GDP, the weight of industrial sector and the use of renewable energies being the main drivers of divergence. Concerning sectors, there is an increase of emissions in the agricultural sector, but a reduction in the industrial and energy sectors. Different patterns arise in the energy subsectors where manufacturing and electricity notably reduced their emissions while the transport sector increased them in all countries.
Keywords: Convergence; CO_2 emissions; European Union.

JEL Codes: Q43; Q48; Q53

RESUMO
Este documento enfoca o processo de convergência das emissões de CO2 per capita que ocorreria se as medidas adotadas pela União Europeia para cumprir os compromissos do Protocolo de Kyoto tivessem sido efetivas. Aplicamos uma série temporal e uma análise transversal para testar a existência de convergência entre países e para diferentes setores econômicos. A amostra cobre dados para os 28 países membros de 1960 a 2012. Os resultados mostram uma convergência absoluta fraca entre os países, mas evidências claras de convergência condicional, sendo o PIB, o peso do setor industrial e o uso de energias renováveis os principais fatores de divergência. No que diz respeito aos setores, há um aumento das emissões no setor agrícola, mas uma redução nos setores industrial e de energia. Diferentes

padrões surgem nos subsetores de energia, onde a produção e a eletricidade reduziram notavelmente suas emissões, enquanto o setor de transporte aumentou em todos os países.
Palavras-chave: Convergência; emissões de CO_2; União Europeia.

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1. Introduction

Since the Kyoto Protocol was signed in 1997, the European Union has played a leading role in the fight against climate change, pledging to reduce its emissions of greenhouse gases (GHG). The EU committed to reduce them by 8 % in 2008-2012 related to 1990 levels, by means of a bubble system, whereby a global target was set for the EU but with different specific goals and emission allowances for individual member states according to its specific characteristics. Following the entry into force of the Paris Agreement, the EU have now to complete the process of internally defining targets and implementation tasks. Following the Europe 2020 strategy for smart, sustainable and inclusive growth, a Climate and Energy Package was set in 2008 to ensure that the EU meets its climate and energy targets for the year 2020: 20% cut in greenhouse gas emissions (from 1990 levels), 20% of EU energy from renewables and 20% improvement in energy efficiency. More ambitious targets have even been set to be reached in 2030 and beyond, with a roadmap for moving to a competitive low carbon economy in 2050 (COM/2011/0112 final): 30% by 2020, 40% by 2030 and 80% by 2050, relative to 1990 levels. The European Commission (2016) aims a smooth transition to a low carbon economy taking into account that EU countries are different concerning their energy mix and their production structures. Therefore, the EU has continued with the bubble system to reduce GHG emissions and has set several goals with different time horizons. The targets range from a 20% reduction in GHG emissions for Denmark, Ireland and Luxembourg to an increase of 20% for Bulgaria. Basically, these goals imply a process of convergence in emissions among the member countries: the heavier polluters must reduce them while the countries with lower emissions are allowed to increase them.

Our paper addresses this timely and important matter. We test whether convergence in CO_2 emissions has occurred across countries and economic sectors within the EU using suitable econometric methodologies. We study convergence in specific sectors, namely agriculture, industry, and energy. We have chosen the industrial and energy sectors because their economic relevance and because they are sectors regulated by the IPPC Directive[1] and included later in the European carbon market. We also focus on the agricultural sector since it is the main producer of methane, a greenhouse gas included in the Kyoto Protocol with a warming power around twenty times that of carbon dioxide. In addition, we disaggregate the energy sector into four subsectors: heat and power generation, manufactures and construction, transport and other minor fuel combustion subsectors. We present in the next section the empirical models applied to test for convergence. Sections 3 shows the results obtained and section 4 concludes.

2. Data and Methods

The sample covers data for the 28 member countries from 1960 to 2012. The data set comes from the World Resources Institute (CAIT Climate Data Explorer) and the World

[1] Council Directive 96/61/EC of 24 September 1996 concerning Integrated Pollution Prevention and Control (IPPC).

Bank (World Development Indicators). We present below the empirical models we use tot test for convergence:

2.1. Absolute convergence

We rely on the model of Barro and Sala-i-Martin (1992). We estimate a model that relates emissions at time T with respect to time t. The growth rate is defined as:

$$Y_{i,t,t+T} \equiv \frac{\log\left(\frac{y_{i,t+T}}{y_{i,t}}\right)}{T}, \tag{1}$$

where $\gamma_{i,t,t+T}$ is the annual growth rate of the economy i between t and $t + T$; log is the natural logarithm; $Y_{i,t+T}$ is the value of the variable under study in country i at time T; $Y_{i,t}$ is the value of the variable at time t. The econometric formulation of the Sala-i-Martin (1996) model is:

$$\frac{1}{T} Y_{i,t,t+T} = \alpha - \beta \log\left(y_{i,t}\right) + \varepsilon_{i,t}. \tag{2}$$

If $\beta > 0$, there is absolute convergence across economies. The rate of convergence can be estimated as follows:

$$V = -\log\left(1+T\beta\right)/T. \tag{3}$$

2.2. Conditional convergence

Conditional convergence implies that countries converge to different steady states. To reflect this heterogeneity across countries, some explanatory variables are added to the model. Sala-i-Martin (1996) presents the following formulation:

$$Y_{i,t,t+T} = \alpha - b \log\left(y_{i,t}\right) + \Psi X_{i,t} + \epsilon_{i,t} + T, \tag{4}$$

where $X_{i,t}$ is a vector of variables which keeps the steady state constant. There is absolute convergence (meaning that countries tend to converge to the same value) if none of the exogenous variables is statistically significant and b is significant and negative. There is conditional convergence (meaning that countries converge to different levels of emissions) if some coefficients of the exogenous variables are significant and b is less than 0 and significant.

2.3. Sigma convergence

Sigma convergence analyzes the dispersion of the variable under study. Based on the standard deviation:

$$\sigma_t = \sqrt{\frac{1}{N}\Sigma_{i=1}^{N}(\log y_{i,t} - \mu_t)^2}, \tag{5}$$

where μ_t is the sample mean of $log(y_{i,t})$, σ-convergence occurs if the standard deviation of all countries decreases over time, indicating that the values are concentrated around the average value.

2.4. Stochastic convergence

We rely on the model defined by Carlino and Mills (1993) based on the order of integration of the difference between the values of the variable and the mean, expressed in logarithms. They test whether relative per capita earnings are converging toward unity with the national average, plus or minus a compensating differential which may differ from region to region according to each one's unique characteristics. Under this assumption, the log of relative per capita income in region i at time t (RI_{it}) consists of two parts, the time-invariant equilibrium differential, RI^e_t, and the deviation from this equilibrium, $u_{i,t}$.

$$RI_{i,t} = RI_t^e + u_{i,t}. \tag{6}$$

The formulation of the models is based on the decomposition of $u_{i,t}$ into a deterministic linear trend and a stochastic process:

$$u_{i,t} = v_i^0 + \beta_i t + v_{i,t}, \tag{7}$$

where ν^0_i is the initial deviation from the equilibrium and β_i is the rate of deterministic convergence. In our case, income per capita is replaced by emissions per capita and the ν_{it} term is modeled as an ARMA(2,O) process, represented by

$$(1 - \rho L)(1 - \phi L) v_t = \varepsilon_t, \tag{8}$$

where L is the lag operator, p and ø are the two roots, $|ø|<1$, and ε_t is the serially uncorrelated shock to ν_t. Shocks will be temporary if $|ø|<1$. If $|ø|=1$, ν_t is said to have a unit root and shocks are permanent.

Another set of solutions have been proposed which apply unit root tests in a context of an undetermined number of breaks, such Carrion *et al.* (2005) and Carrion *et al.* (2009).

3. **Results**

3.1. Descriptive analysis of data

We have analyzed the historical evolution of CO_2 emissions in the 28 EU countries from 1960 to 2012 and we detect three groups of countries showing different patterns:

1. Group 1: countries that record an overall increase in CO_2 emissions, despite a decrease in recent years: Austria, Croatia, Cyprus, Finland, Ireland, Italy, Malta, the Netherlands, Portugal, Slovenia and Spain.

2. Group 2: countries that have reduced their emissions: Belgium, France, Germany, Denmark, Luxembourg, Sweden and the United Kingdom.

3. Group 3: countries with increases in emissions from 1980 to 1990 and a subsequent reduction, perhaps as a result of the productive structural changes since they are countries moving from a planned economy to a market economy: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia.

Concerning sectors, Table 1 shows the mean of CO_2 per capita emissions for each sector and subsector in 1990 and 2012. We can observe a reduction in the industrial and energy sectors but an increase in the agricultural sector. Countries belonging to group 2 and, to a larger extent, countries in group 3, are responsible for this increase. When looking at the sources of emissions in the energy sector, the transport sector stands out with a 27.8% increase between 1971 and 2012. This increase was partially offset by decreases in the electricity sector (-22%) and the manufacturing sector (-53%) led by the most developed European countries in group 2. All countries have increased emissions in the transport sector. These findings reflect the effectiveness of the mandatory measures imposed on the sectors covered by the IPPC Directive and included later in the ETS. Agriculture stays out of the ETS, as well as transport whose inclusion in the ETS was late and partial; only the aviation sector is included in the ETS since 1st January 2012, in accordance with Directive 2009/29/EC.

Table 1: Mean of CO_2 emissions in sectors and subsectors (1971-2012)

Year	1971	1980	1990	2000	2012
Agriculture	-	-	0.8861	1.0598	0.9613
Industry	-	-	0.5780	0.5567	0.3648
Energy	-	-	9.5662	8.1165	7.4379
Power Generation and Heating	2.2071	2.7949	3.9308	3.2090	3.0612
Manufactures	2.9605	2.6359	2.1484	1.4097	1.0137
Transport	0,8894	1.1248	1.6098	1.9497	2.0569
Other Fuel Emissions	1.7977	1.8442	1.5902	1.2749	1.0419

3.2. Absolute convergence

Relying on the model of Barro and Sala-i-Martin (1992), we have considered different periods to control for possible structural changes. The results in Table 2 show that all parameters β are significant and negative, which demonstrates the existence of convergence across EU countries in all the periods analyzed. The results are in line with those obtained by Jobert *et al.* (2010) for EU countries and also with Papanopoulou and Pantelidis (2009) and Criado and Grether (2011) for OECD countries.

Table 2: Beta-convergence by periods

	2012	2000	1990	1980	1970
β de 1960	-0.0092 (0.0002)***	-0.0101 (0.0002)***	-0.0107 (0.0005)***	-0.0112 (0,0008)***	-0,0112 (0.0016)***
v	1.27%	1.31%	1.30%	1.27%	1.29%
R^2	0.55	0.48	0.39	0.26	0.15
β de 1970	-0.01 (0.0003)***	-0.0113 (0.0004)***	-0.0119 (0,0006)***	-0.0109 (0,001)***	-
v	1.32%	1.39%	1.36%	1.16%	-
R^2	0.53	0.49	0.44	0.27	
β de 1980	-0.0114 (0.0005)***	-0.0140 (0.0008)****	-0.0156 (0.0013)***	-	-
v	1.44%	1.66%	1.71%	-	-
R^2	0.37	0.34	0.32		
β de 1990	-0.0105 (0.001)***	-0.0175 (0.003)***	-	-	-
v	1.21%	1.94%	-	-	-
R^2	0.13	0.10			
β de 2000	-0,0068 (0.003)***	-	-	-	-
v	0.71%				
R^2	0.08	-	-	-	-

Notes: Standard error in brackets. *** significant 1%; ** significant 5%; * significant 10%.

Concerning sectors (Table A.1 in the appendix), the results show weak convergence in the agricultural sector. The industrial sector exhibits convergence throughout the period under study. In the energy sector, there is evidence of absolute convergence between 1990 and 2000 but no convergence in the following period. In the energy subsectors we find convergence in all subperiods as shown in Tables A.2, A.3, A.4 and A.5 in the appendix, but a different evolution across countries. Group 1 and 3 have registered increases of 3.4% and 89.5% respectively; group 2 has reduced emissions by 39.7% (see Table A.6 in the appendix).

3.3. Conditional convergence

Conditional convergence takes into account individual differences among countries, therefore we have included in the model the following explanatory variables: initial CO_2 emissions, GDP per capita (calculated from real GDP at 2005 prices and annual population), urban population (measured as a percentage of the total population), renewable energy consumption (calculated as a percentage of the total energy consumed), consumption of fossil fuels (as a percentage of the total energy consumption) and the industrial added value as a percentage of the total added value[2].

We have estimated three different models: a fixed-effects model in relation to the initial level of CO_2 emissions, another fixed-effects model with emissions lagged one period, and a dynamic model using the generalized method of moments (GMM) for panel data. Table 3 shows the results of the estimations conducted. All three models have explanatory power, so we should accept the hypothesis of conditional convergence across countries, being GDP per capita, use of fossil fuels and the economic weight of the industrial sector the main significant variables. These results are similar to previous studies, such as Jobert *et al.* (2010), who find conditional convergence in EU emissions, with GDP and industrial weight influencing the differences among countries.

Table 3: Conditional convergence

Variable	FE[a]	FE[b]	GMM (DPD)
Constant	-0.177 (-0.97)	-2.57 (-3.30)***	-2.26 (-2.77)***
Log CO2 initial	-0.017 (-4.20)***	-	-
Log $CO2_{t-1}$	-	-0.41 (-11.06)***	-0.38 (-10.70)***
Log GDPcap	0.0106 (5.03)***	0.15 (4.87)***	0.15 (4.78)***
Log Urban Population	0.0042 (0.04)	-0.24 (-1.46)	0.34 (-1.85)*
Log Renewables	0.0002 (0.17)	-0.01 (-1.01)	-0.01 (-1.49)
Log Fossil	0.0155 (3.34)***	0.65 (6.38)***	0.65 (6.12)***
Log Industry	0.0059 (0.88)	0.032 (0.98)	0.06 (2.05)**
R^2	0.68	0.51	0.51
S.E. regression	0.0065	0.043	0.041
J-statistic	-	-	1.17(0.28)***
F-statistic	33.7582***	8.86***	-

Notes: T statistic in brackets. *** significant 1%; ** significant 5%; * significant 10%. [a] Model of time fixed effects with heterocedascidity correction of White. [b] Model of time and country fixed effects with heterocedascidity correction of White. [c] Number of instruments in GGM estimaton: 7.

[2] For reasons of data availability, we only analyze the period between 1990 and 2012. We have excluded Croatia, Estonia and Slovenia due to missing data and Luxembourg for being an outlier.

With respect to sectors, we report the results corresponding to the GMM models. Some discrepancies arise in the industrial sector between the model relating to the initial level of emissions and the models with the variable lagged. The first shows conditional convergence with GDP per capita and urban population as explanatory variables while the other models show absolute convergence. In the energy sector, we find evidence of conditional convergence, with GDP per capita, population, use of fossil fuels and the weight of the industrial sector as explanatory variables.

Concerning subsectors, there is conditional convergence in the electricity subsector linked to GDP per capita, the use of renewable energies, the use of fossil fuels and the weight of the industrial sector. A similar conclusion is reached in the manufacturing and construction sector, where the explanatory variables are GDP per capita, urban population and the use of fossil fuels. Regarding the transport subsector, we find significant coefficients in GDP per capita. Finally, for other sources of emissions, the evidence of conditional convergence depends on the use of fossil fuels as a significant predictor (Tables 4 and 5).

Table 4: Conditional convergence. Results by sectors

Variable	Agriculture	Industry	Energy
Constant	1.12 (0.59)*	-1.47 (1.34)	-1.96 (0.8)**
Log CO_2 initial	-	-	-
Log $CO_{2\ t-1}$	-0.30 (0.044)***	-0.062 (0.034)*	-0.372 (0.035)***
Log GDPcap	0.21 (0.03)***	0.13 (0.13)	0.138 (0.029)***
Log Urban population	-0.70 (0.165)***	0.117 (0.44)	-0.365 (0.178)**
Log Renewables	0.014 (0.01)*	-0.004 (0.02)	-0.013 (0.009)
Log Fossil	-0.05 (0.07)	-0.065 (0.11)	0.62 (0.10)***
Log Industry	-0.03 (0.02)	-0.04 (0.083)	0.056 (0.027)**
R^2	0.35	0.32	0.51
S.E. regression	0.034	0.095	0.040
J-statistic	5.76 (0.02)**	0.97 (0.32)***	3.298 (0.07) ****

Notes: Standard error in brackets; *** 1% significant; ** 5% significant; * 10% significant.

Table 5: Conditional convergence. Results in the energy subsectors

Variable	Electricity	Manufacturings	Transport	Others
Constant	-3.69 (1.55)**	2.63 (1.89)	-3.38 (1.404)**	-3.153 (1.66)*
Log CO_2 initial	-	-	-	-
Log $CO2_{t-1}$	-0.468 (0.041)***	-0.441 (0.13)***	-0.237 (0.057)***	-0.117 (0.037)***
Log GDPcap	-0.174 (0.056)***	0.29 (0.10)***	0.301 (0.062)***	0.156 (0.098)
Log Urban population	0.076 (0.293)	-1.65 (0.62)***	0.158 (0.308)	0.102 (0.506)
Log Renewables	-0.047 (0.017)***	-0.012 (0.028)	0.021 (0.013)	0.043 (0.025)*
Log Fossil	1.11 (0.234)***	0.384 (0.22)*	-0.071 (0.078)	0.269 (0.132)**
Log Industry	0.253 (0.057)***	-0.037 (0.087)	0.044 (0.042)	-0.015 (0.083)
R^2	0.41	0.31	0.31	0.26
S.E. regression	0.075	0.138	0.066	0.098
J-statistic	4.47 (0.03)**	0.07 (0.79)***	2.84 (0.09)**	3.132 (0.08)**
Number of instruments	7	7	7	7

Notes: Standard error in brackets. *** 1% significant; ** 5% significant; * 10% significant.

3.4. Sigma convergence

Figure 1 shows the evolution since 1924 of the standard deviation of the natural logarithm of CO_2 emissions, measured in tons per capita. We observe a slightly negative trend until the 80s (excluding the Second World War period) and stabilization thereafter. We thus conclude that there has been no σ-convergence across European countries since the 80s. Similar results in terms of σ-divergence have been produced in previous studies such as Aldy (2006) and Criado and Grether (2011) for OECD countries.

Figure 1: σ-convergence (all countries)

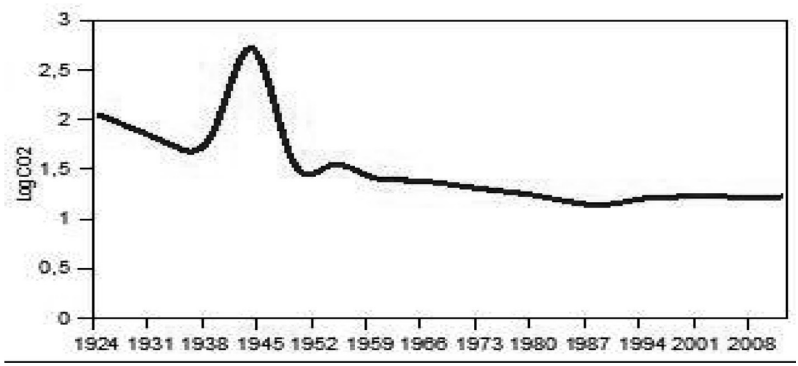
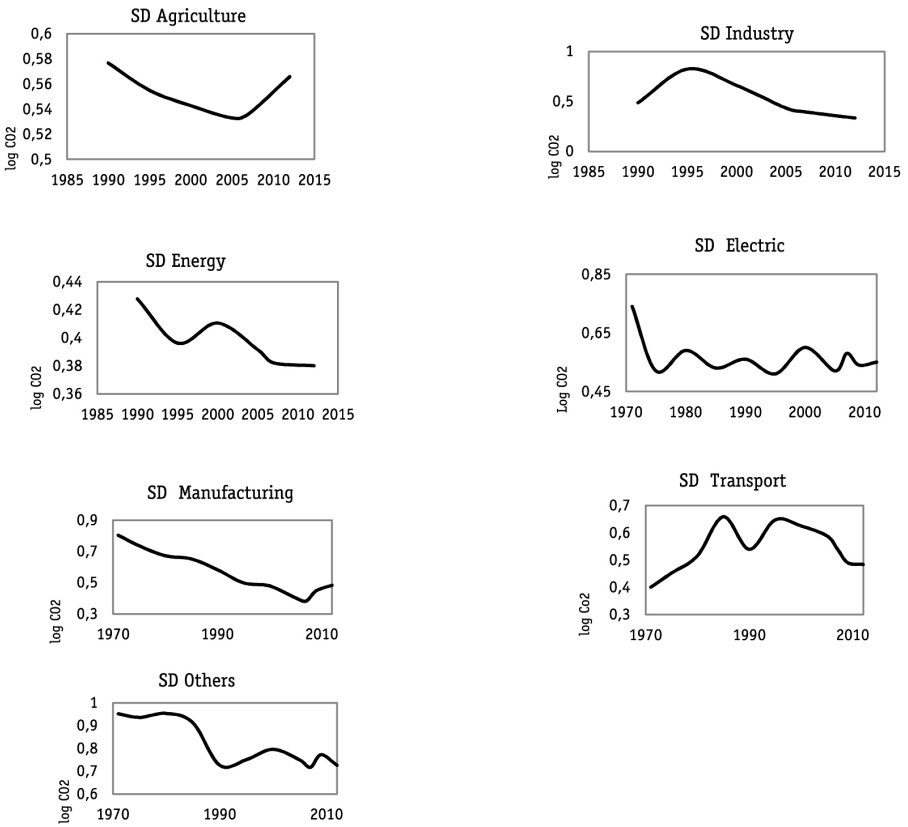


Figure 2 shows the evolution of the $lnCO_2$ standard deviation in all sectors and subsectors considered. The industrial sector and the electricity sector have reduced their variation relative to the mean, with their dispersion tending to stabilize from 2005 onwards. The agricultural sector shows a turning point in 2007, with an increase in its dispersion from then on. As far as the energy sector is concerned, the manufacturing sector shows clear evidence of sigma-convergence with a reduction of the dispersion of about 40%, occurring steadily throughout the period 1971-2012. The other subsectors also have reduced their dispersion if we compare the initial and final values but these reductions happen in the first years of the sample: up until 1985 in the electricity and heat subsector, and up until 1990 in other sources of emissions. The transport sector shows a higher dispersion over the period.

Figure 2: Sigma convergence by sector and subsectors



3.5. Stochastic convergence

To identify stochastic convergence we check for the existence of unit roots in the series to detect whether, after a shock, the series returns to the trend (stationary) or it is affected permanently (unit root). The variable under study is the natural logarithm of the rate of emissions from each country relative to the annual average of the whole set of countries. We observe different patterns with several changes in trend and in levels at different times. To detect when the structural change happens in each country, we use different approaches based on the Bai-Perron test (1998) with trimming = 0.25. Table 6 summarizes the moments when structural changes happen in each country. The periods that contain the most breaks correspond to the early 70s, with the first oil crisis, and 1991-1993, when a financial crisis coincided with the transition of Central and Eastern European countries to market economies and the implementation of environmental protection measures.

Table 6: Bai-Perron test, dates of structural changes

Country	Year	Country	Year	Country	Year	Country	Year
Austria	1986, 1999	Estonia	1992	Italy	1972, 1985, 1999	Portugal	1984, 1999
Belgium	1984, 1998	Finland	1972, 1993	Letonia	1973, 1986, 1999	Romania	1983, 1998
Bulgaria	1972, 1990	France	1972, 1985, 1999	Lithuania	1991	Slovakia	1974, 1990
Croatia	1982, 1996	Germany	1973	Luxembourg	1980, 1994	Slovenia	1980, 1994
Cyprus	1991	Greece	1974, 1999	Malta	1974, 1993	Spain	1973, 1986, 1999
Czec Republic	1974, 1989	Hungary	1974, 1987	Netherlands	1978, 1991	Sweden	1972, 1991
Denmark	1972, 1993	Ireland	1983, 1999	Poland	1974, 1989	United Kingdom	1975, 1987, 2000

To analyze the stochastic convergence by sectors we apply first the test for structural change proposed by Bai-Perron (1998), then we apply the ADF test to check for a structural change and finally, the test proposed by Carrion *et al.* (2009) to check for several structural changes. Table 7 shows the list of countries in the main economic sectors which have rejected in some cases the existence of a unit root and, consequently, their emissions converge. The most countries exhibit convergence in all three main sectors considered. The countries in bold print (Greece and Luxembourg) satisfy the conditions to accept absolute convergence.

We apply the same procedure to the energy subsectors. We observe a higher number of countries that do not converge in both tests (ADF and Carrion). These results underline the fact that focusing on the energy sector is a priority when seeking to reduce emissions in the EU. When considering the sector as a whole, a few countries diverge, but the results are very different when we analyze the data by subsectors. The transport sector is particularly notable: half the countries (according to the Carrion test) do not converge and the emissions are growing, as mentioned earlier. The detailed results are available upon request.

Table 7: Stochastic convergence by countries and sectors

Sector	Test	Convergence			No convergence		
		G1	G2	G3	G1	G2	G3
Agriculture	ADF	Austria, Cyprus, Croatia, Finland, Greece, Italy, Netherlands, Malta, Portugal, Eslovenia, Spain	Belgium, France, Denmark, Germany, Luxembourg, Sweden, United Kingdom	Bulgaria, Czec Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia	Ireland		
	Carrión	Austria, Croatia, Finland, Greece, Ireland, Italy, Netherlands, Malta, Portugal, Eslovenia, Spain	Belgium, France, Denmark, Germany, Luxembourg, United Kingdom	Bulgaria, Czec Republic, Estonia, Hungary, Lithuania, Slovakia	Cyprus,	Sweden	Latvia, Poland, Romania
Industry	ADF	Austria, Croatia, Finland, Greece, Ireland, Italy, Netherlands, Malta, Portugal, Eslovenia	Belgium, France, Germany, Luxembourg , Sweden, United Kingdom	Bulgaria, Czec Republic, Hungary, Latvia, Lithuania, Romania, Slovakia	Cyprus, Spain	Denmark	Estonia, Poland
	Carrión	Austria,Croatia, Greece, Ireland, Italy, Malta, Spain	Belgium, Denmark, Luxembourg, Sweden, United Kingdom	Bulgaria, Czec Republic, Hungary, Latvia, Poland, Slovakia	Cyprus, Finland, Netherlands, Portugal, Eslovenia	France, Germany	Estonia, Lithuania, Romania
Energy	ADF	Austria, Cyprus,, Finland, Greece, Ireland, Italy, Netherlands, Malta, Portugal, Eslovenia, Spain	France, Denmark, Germany, Luxembourg, Sweden, United Kingdom	Bulgaria, Czec Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia	Croatia	Belgium	
	Carrión	Austria, Croatia, Finland, Greece, Ireland, Italy, Netherlands, Portugal, Eslovenia, Spain	Belgium, France, Denmark, Germany, Luxembourg, Sweden, United Kingdom	Bulgaria, Czec Republic, Estonia, Hungary, Latvia, Poland, Romania, Slovakia	Cyprus, Malta		Lithuania

4. Conclusions

Two main insights are drawn from the results obtained in this study. When considering global emissions by country, only weak absolute convergence across countries is found. Nevertheless, there is clear evidence of conditional convergence, with GDP, the weight of industrial sector and the use of renewable energies being the main drivers of divergence.

Concerning the specific sectors, we observe an increase of emissions in the agricultural sector, but a reduction in the industrial and energy sectors. More specifically, different patterns arise in the energy subsectors, where emissions from manufacturing and electricity have notably been reduced, while those from transportation have increased for all countries.

The investigation conducted offers several useful policy implications. When considering the emissions by country, three main statements can be made. The first one is the appropriateness of the bubble system to move towards the 2020 targets concerning energy efficiency and emissions reduction. Since a visual inspection of the data reveals different country patterns, specific measures and targets should be implemented and fixed for each country. The second implication is the effectiveness of the IPPC regulation and the European carbon market to curb GHG in the industrial and manufacturing sectors, which could be associated to the reported emissions decline in the industrialized countries. A third implication is the influence that economic structure and technology have on emissions. The stochastic convergence tests show a great heterogeneity across countries, providing different patterns with several changes in trend and in levels at different times, being the early 70s and 90s the periods with more breaks, coinciding with the oil crisis and financial crisis respectively. The conditional convergence analysis reveals that these cross-country differences are explained mainly by GDP, the use of fossil fuels and the weight of the industrial sector, i.e, the economy's sectoral structure. These determinants may explain the evolution of countries involved in a transition process to a market economy. They increased their emissions in the eighties and reduced them notably in the following decades as a consequence of the structural and technological changes that occurred in this period.

Since the early 2000s, the EU is taking action in several areas to meet the 2020 targets (20% cut in GHG emissions from 1990 levels, 20% of EU energy from renewables, 20% improvement in energy efficiency). Concerning emissions, domestic targets for every member state has been set according to national wealth, from a 20% cut for the richest countries to a maximum 20% increase for the least wealthy. This action is in line with the results obtained in the conditional convergence analysis, according to which GDP appears as the main driver of divergence. With respect to renewable energy, EU member countries have also taken on binding national targets to increase the share of renewables in their energy consumption by 2020. These targets also vary to reflect countries' different starting points for renewables production, and ability to further increase it from 10% in Malta to 49% in Sweden. Again, our results support this action, given that the use of fossil fuels is significant to explain the conditional convergence.

The analysis performed by sectors also yields some important insights. The stylized facts show a decrease of emissions in the energy and industrial sectors jointly with an increase in agriculture. By subsectors, a substantial reduction is observed in manufacturing and electricity (53% and 22% respectively), while a 30% increase is found in the transport subsector. We

find absolute convergence in the agricultural, energy and industrial sectors, which is weak in the former sector. When analyzing deeper the energy sector, absolute convergence is present in electricity and manufacturing but not in transport and other minor subsectors. However, all sectors and subsectors exhibit conditional convergence. Sigma-convergence is present in industry and energy sectors but not in agriculture, neither in the transport sector. These results reinforce the appropriateness of setting the national reduction targets of emissions according to each country's per capita income and to focus in other economic sectors currently not included in the ETS. The EU emissions trading system is a key tool for cutting GHG from large-scale facilities in the power and industry sectors, as well as the aviation sector, but the ETS only covers 45% of the EU's global emissions. Therefore, a target has been established for the sectors not included in the ETS, such as housing, agriculture, waste and transport (excluding aviation). According to the target, the emissions from these sectors in 2020 have to be -on average- 20% lower than in 2005. National emission reduction targets have taken on binding annual targets until 2020 under the "Effort-sharing decision". Our results support the view that these actions are in the right direction, moreover when considering the 2050 roadmap, which envisages an 80% reduction of emissions below 1990 levels. The roadmap also shows how the major sectors responsible for emissions can transition to a low-carbon economy in a cost-effective way. These are the sectors considered in this paper, namely, energy generation, industry, transport, buildings and construction, as well as agriculture.

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APPENDIX

Table A.1: Absolute convergence by sectors

Sector		2012	2000
Agriculture	β de 1990	-0.002 (0.001)***	-0.004 (0.002)***
	v	0.19%	0.46%
	R^2	0.02	0.03
	β de 2000	0.001 (0.001)***	-
	v	-	-
	R^2	0.01	
Industry	β de 1990	-0.018 (0.001)***	-0.009 (0.002)***
	v	2.28%	0.95%
	R^2	0.34	0.05
	β de 2000	-0.026 (0.002)***	-
	v	3.21%	-
	R^2	0.40	
Energy	β de 1990	-0.01 (0.001)***	-0.019 (0.003)***
	v	1.30%	2.10%
	R^2	0.17	0.13
	β de 2000	0.004 (0.001)***	-
	v	-	-
	R^2	0.03	

Notes: Standard error in brackets. *** significant 1%; ** significant 5%; * significant 10%.

Table A.2: Absolute convergence in the generation of electricity subsector

	2012	2000	1990	1980
β de 1971	-0.014 (0.00044)***	-0.016638 (0.000696)***	-0.01759 (0.001106)***	-0.015909 (0,001954)***
v	2.12%	2.30%	2.21%	1.73%
R^2	0.48	0.42	0.34	0.21
β de 1980	-0.014138 (0.000673)***	-0.01896 0.001244)***	-0.024351 (0.002684)***	-
v	1.90%	2.42%	2.83%	-
R^2	0.33	0.29	0.23	-
β de 1990	-0.009710 (0.001065)***	-0.017697 (0.003087)***	-	-
v	1.10%	1.97%	-	-
R^2	0.12	0.10	-	
β de 2000	-0.015385 (0.001844)***	-	-	-
v	1.72%			
R^2	0.16	-	-	-

Table A.3: Absolute convergence in the manufacturing subsector

	2012	2000	1990	1980
β de 1971	-0.007497 (0.00036)***	-0.008681 (0.000518)***	-0.008425 (0.000674)***	-0.009605 (0,001312)***
v	0.90%	1.01%	0.92%	1.01%
R^2	0.29	0.27	0.24	0.18
β de 1980	-0.007925 (0.000498)***	-0.009103 (0.000087)***	-0.005415 (0.001105)***	-
v	0.92%	1.01%	0.01%	-
R^2	0.22	0.17	0.08	-
β de 1990	-0.017271 (0.001118)***	-0.024813 (0.003035)***	-	-
v	2.20%	2.90%	-	-
R^2	0.28	0.18	-	
β de 2000	-0.012818 (0.001955)***	-	-	-
v	1.40%			
R^2	0.11	-	-	-

Table A.4: Absolute convergence in the transport sector

	2012	2000	1990	1980
β de 1971	-0.000704 (0.000822)	-0.001833 (0.001212)	0.006852 (0.001609)***	0.006898 (0,002695)**
v	-	-	-	-
R^2	0.01	0.00	0.03	0.02
β de 1980	0.000504 (0.000708)	0.004188 (0.001171)***	0.009355 (0.001876)***	-
v	-	-	-	-
R^2	0.00	0.02	0.08	-
β de 1990	-0.001327 (0.000911)	0.006864 (0.002172)***	-	-
v	-	-	-	-
R^2	0.00	0.34	-	
β de 2000	-0.012242 (0.001151)***	-	-	-
v	1.33%			
R^2	0.24	-	-	-

Table A.5: Absolute convergence in others minor combustion subsectors

	2012	2000	1990	1980
β de 1971	-0.007321 (0.000431)***	-0.006324 (0.000542)***	-0.0104316 (0.00061)***	-0.001986 (0.000889)**
v	0.87%	0.70%	0.45%	0.20%
R^2	0.21	0.15	0.09	0.02
β de 1980	-0.0111 (0.000628)***	-0.011693 (0.000966)***	-0.010024 (0.001288)***	-
v	1.38%	1.34%	1.06%	-
R^2	0.25	0.21	0.18	-
β de 1990	-0.007774 (0.00112)***	0.035843 (0.005067)***	-	-
v	0.85%	-	-	-
R^2	0.07	0.15	-	
β de 2000	-0.007901 (0.001306)***	-	-	-
v	0.83%			
R^2	0.09	-	-	-

Table A.6: Increase of CO2 emissions in the electricity subsector by group of countries

	Group 1			Group 2			Group 3		
	1971	2012	Incr.	1971	2012	Incr.	1971	2012	Incr.
Mean	2.94	3.04	3.4%	4.06	2.45	-39.6%	1.90	3.60	89.5%

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