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Structural change in times of increasing openness: assessing path dependency in European economic integration *

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Abstract

This paper analyzes the dynamics of structural polarization and macroeconomic divergence in the context of European integration, where the latter is primarily understood as an increase in economic and financial openness. In the process of estimating the dynamic effects of such an openness shock on 26 EU countries, we develop a taxonomy of European economies that consists of four groups: core, periphery, and catching-up countries in Eastern Europe as well as financial hubs. We show that these four country groups have responded in a distinct way to the openness shock imposed by European integration and argue that the latter should be seen as an evolutionary process that has given rise to different path-dependent developmental trajectories. These trajectories are linked to the sectoral development of European economies and the evolution of their technological capabilities. We propose a set of interrelated policy measures to counteract structural polarization and to promote macroeconomic convergence in Europe.

Keywords: Europe, path dependency, European integration, economic openness, competitiveness

JEL Codes: B5, F6, F45.

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1 Europe between convergence and divergence

Once upon a time, the perspective of deepened economic integration on the European continent seemed to provide a route to successive economic and political convergence of Europe's nation states. In particular, the establishment of the European Monetary Union (EMU) and the introduction of the Euro had raised high hopes for rapid convergence among member states (e.g. Blanchard and Giavazzi, 2002). Until the financial crisis of 2007/2008, a series of empirical patterns were indeed pointing towards a process of convergence: increasing integration in terms of trade and investment had resulted in a catching-up process of Eastern European countries (Goedemé and Collado, 2016), the integration of financial markets had reached unexpected heights (Baldwin et al, 2015; Hale and Obstfeld, 2016), and the successive harmonization of environmental legislation, labor standards and consumer protection regulation had contributed to a partial unification of regulatory environments within Europe. Until the crisis started, most economists and policy-makers therefore reckoned that the Eurozone as well as the wider part of the European Union were undergoing a process of widespread convergence. This belief was strengthened by the fact that major macroeconomic indicators, such as unemployment, economic growth, per-capita-income and interest rates, were indeed converging in pre-crisis times (Gräbner et al, 2017), which was widely interpreted as evidence for overall economic progress within Europe (Giavazzi and Spaventa, 2010).

However, even before the crisis, the simultaneous divergence of current account balances had already indicated that the convergence of certain macroeconomic indicators might not reflect long-term structural changes to the benefit of all EU countries (Simonazzi et al, 2013; Storm and Naastepad, 2015b; Gräbner et al, 2017). Rather, the observed catching-up process of periphery countries was in large part driven by expansions of private indebtedness and by the corresponding emergence of large-scale housing bubbles in some countries (e.g. Storm and Naastepad, 2016; Heimberger and Kapeller, 2017). Capital flows and private debt expansion were fostered by the harmonization of interest rates across Eurozone countries and the corresponding regulatory integration of financial markets (Baldwin et al, 2015; Celi et al, 2018). However, after the financial crisis, the debt-driven growth-models of the Eurozone's periphery countries quickly turned out to be unsustainable: the underlying structural polarization between core and periphery countries became apparent (Gräbner et al, 2017), as the catch-up tendencies observed after the turn of the century had merely obfuscated the emerging structural polarization among EU countries, and large parts of the convergence process eventually proved to be unsustainable.

In this paper, we aim to rationalize the complex dynamics of convergence, divergence and

polarization in Europe with reference to theories of path-dependency in international trade (Myrdal, 1958; Krugman, 1991), where past "success breeds further success and failure begets more failure", which leads, "to a 'polarisation process' which inhibits the growth of such [manufacturing, *the authors*] activities in some areas and concentrates them in others" (Kaldor, 1980, p. 88). Theoretically, we argue that European countries follow different developmental trajectories, which are shaped by mechanisms that give rise to path-dependency (Dobusch and Kapeller, 2013), such as the presence of increasing returns to scale (in manufacturing) and network externalities that arise from differences in technological capabilities (Arthur, 1989) as well as rules and standards that can only be changed at high costs (Heinrich, 2014).

We take the increase in economic and financial openness and international economic integration as a conceptual starting point for exploring convergence and divergence in Europe's more recent past. Using data for 26 EU countries covering the time period from 1960 to 2016, we employ the local projections method proposed by Jordà (2005) to estimate how several macroeconomic variables have responded to the openness shock brought about by European economic integration. Based on our regression results, we use a hierarchical cluster analysis that points us toward a taxonomy of developmental trajectories across European countries. In this empirical context, we also check whether we are able to identify systematic structural differences in the response of EU economies to increasing economic and financial openness.

We can preview the results as follows: our findings suggest the existence of four structurally different developmental trajectories prevailing in the European Union. While large parts of the debate so far have focused on the different developments in Eurozone core countries (called 'northern export-oriented capitalisms' in the political economy literature; see e.g. Iversen et al, 2016) and Eurozone periphery countries (debt-led Southern European capitalisms, e.g. Johnston and Regan, 2016; Behringer and van Treeck, 2017), we propose a typology of four country groups. This typology consists of core and periphery countries, financial hubs and catching-up countries. Our findings stress that – due to different growth models operating within the EU (e.g. Stockhammer, 2015; Gräbner et al, 2017) – we can neither expect convergence to occur endogenously, nor can we hope to develop adequate policy conclusions without taking the structural differences between these four country groups seriously. By developing our typology of European countries, we contribute to various streams of literature that make use of such typologies. First, the debate in macroeconomics focuses on whether country groups that vary in terms of their growth models have been affected differently by European (monetary) integration (e.g. Stockhammer, 2015; Stockhammer and Wildauer, 2016; Gräbner et al, 2017). Second,

the comparative political economy literature analyzes whether different varieties of European capitalism and their specific sets of institutions have been equally able to cope with increasing trade and financial openness (e.g. Iversen et al, 2016; Baccaro and Pontusson, 2016; Bohle, 2018; Regan, 2017; Vermeiren, 2017; Johnston and Regan, 2018). Third, structuralist scholars have studied how the uneven distribution of income and technologies as well as the asymmetric power relations between core and periphery reinforce existing inequalities (e.g. Simonazzi et al, 2013; Cimoli and Porcile, 2016; Celi et al, 2018). Fourth, the innovation literature engages with the role of technological capabilities in shaping path dependent trajectories of European countries by focusing on the relevance of non-price competitiveness and sectoral composition (e.g. Dosi et al, 2015; Storm and Naastepad, 2015b; Baccaro and Benassi, 2017). In our analysis, we bring together these four strands of the literature by studying the effects of increasing economic openness on macroeconomic developments as well as by inspecting trends and changes in the sectoral composition of exports in EU countries in the process of European economic integration.

The remainder of the paper proceeds as follows: the next section aligns our contribution with the existing literature. We proceed by studying the impact of increasing European economic integration on macroeconomic developments in the European Union (section 3). Our results suggest that country-specific characteristics in the response to the openness shock variable have to be taken into account. Section 4 builds upon this observation and provides both empirical and theoretical arguments for the co-existence of currently diverging developmental trajectories in Europe. Section 5 exploits this taxonomy and shows that the four country groups have indeed responded differently to the openness shock of European integration. Section 6 concludes by suggesting policies that take the various developmental trajectories into account and are geared towards achieving technological and economic convergence in Europe.

2 Literature review and theoretical starting point

This section aligns our contribution with the existing literature by elaborating on its theoretical origins in structuralist and evolutionary theory.

While our analytical approach is informed by a pluralism of theoretical perspectives (Dobusch and Kapeller, 2012), it is closely related to the work of Latin American economists whose contributions later became known under the label of 'structuralism' (for an overview see Bárcena and Prado, 2016). This literature has been characterized by a focus on income inequality and technological change as well as by a critical view of the concept of comparative advantage. Structuralists consider development as a path dependent process, which is why they tend to delineate

groups of countries according to their structural features and developmental trajectories. In its simplest form, this approach postulates the existence of 'core' and 'periphery' countries with political and economic power being distributed strongly in favor of the core. Structuralist theory thus suggests that the location in the core-periphery nexus is essential for understanding the developmental dynamics in a particular country. Given the interest of evolutionary economists in technological change and self-reinforcing learning activities, they have a natural affinity for the classical structuralist idea according to which the uneven distribution of technological capabilities is essential for understanding the emergence of the core-periphery duality in the first place (see e.g. Dosi et al, 1990, 2015; Caldentey, 2016; Cimoli and Porcile, 2016).

In this paper, we will argue that the structural distinction between core and periphery is indeed highly relevant for understanding the effects of European integration. However, our empirical analysis on how openness shocks have affected macroeconomic developments in different countries goes beyond the structuralist literature by arguing that existing classifications of EU countries along core and periphery lines need to be enriched by two additional country groups: first, a group in which the financial sector plays an outstanding role; second, a group consisting of economies that are currently catching up to the richer economies. By doing so, we apply structuralist thought to the analysis of the EU – an approach that has become increasingly popular in recent years (e.g. Simonazzi et al, 2013; Storm and Naastepad, 2015c; Stockhammer, 2015; Celi et al, 2018).[1] Given this theoretical starting point, our main hypothesis is that European economic integration has impacted differently on EU countries belonging to different groups along the core-periphery nexus, and has reinforced initial differences in technological endowments of European countries.

In this context, our paper builds on the following insights from the current literature. Stockhammer (2015) identifies the major source for divergence in the EMU in a rise of inequality and the resulting decrease of aggregate demand. The increase in inequality in EU member states resulted in the emergence of several variants of either an export-led or a debt-led growth model, where the latter was rendered infeasible after the crisis (see also Gräbner et al, 2017). Due to the resulting polarization in core (i.e. export-oriented) and periphery (i.e. debt-oriented) countries, this argument is closely tied to structuralist thought. When elaborating on the reasons why some countries have seen the emergence of a debt-led rather than an export-led growth

[1]Current investigations are predated by early European dependency theorists such as Musto (1981), who predicted more than 30 years ago that the unequal structures of EU member states, in particular in terms of technological capabilities, will lead to structural crises, which can only be prevented by using active industrial and structural policies. Our conclusions presented in section 6 align very well with the policy implications developed by Musto (1981).

model to compensate for the downward pressure in aggregate demand caused by increasing income inequality, Gräbner et al (2017) stress the relevance of non-price competitiveness, which is essential for being successful in international markets: many periphery countries simply were not able to substitute successfully domestic demand with exports because they were lacking technological capabilities to ensure non-price competitiveness and corresponding export success. This argument relates to the work of Storm and Naastepad (2015b) as well as Dosi et al (2015), and stresses – in a very structuralist spirit – the relevance of technology gaps, i.e. the uneven distribution of technological capabilities between core and periphery regions in Europe. We will provide ample evidence for this channel in section 4.3. In the quest for understanding increasing inequality as a root cause of the crisis, Stockhammer (2015) also highlights the role of financial deregulation, which allowed for the accumulation of large current account deficits and surpluses, as well as increased speculation of very rich households. Furthermore, financial liberalization policies since the late 1980s have hampered the development of Southern peripheries by amplifying the risk of speculation and by dismantling their national control mechanisms (see Celi et al, 2018, p. 234-240).

Finally, the literature has pointed out that institutional factors also contribute to economic divergence between European countries. Aside from highlighting the absence of an adequate political and fiscal governance structure (see also De Grauwe, 2012), Celi et al (2018) criticize the lack of directed industrial policies in the EU. By entering the EU, Southern European countries lost important instruments for fostering industrial development, but were obliged to implement liberalization policies, in particular in the area of financial regulation. As a consequence, these countries were unable to catch up in terms of their productive capabilities, and the technological gaps to the core widened further. This development was further amplified by the establishment of the Eurozone: the absence of flexible exchange rates lead to an over-valuation of the Euro for technologically lagging countries, which has harmed their export performance and undermined technological upgrading (see also Bagnai and Mongeau Ospina, 2017).

In this context, Simonazzi et al (2013) stress the dependency of periphery countries to the core (particularly Germany). They argue that current-account imbalances in the Eurozone are strongly linked to the German economic model, which is characterized by domestic wage restraint and a change of main import destinations from the South to the East, both mainly at the expense of Southern periphery countries. As long as Germany does not adjust its own export-led growth model, national policies implemented in single periphery countries are insufficient for overcoming the institutional shortcomings leading to polarization and crisis in the Eurozone.

In sum, these results cast doubt on the conventional interpretation of the European Monetary Union as a 'convergence machine' (e.g. Goedemé and Collado, 2016), and lead us to the following three conjectures, which will guide the empirical exercises to come:

First, we expect EU countries to be clustered into heterogeneous country groups, which do not exhibit an endogenous tendency for economic convergence (despite increasing institutional integration and economic openness). To the contrary, in the absence of active policy interventions we contend that European economic integration will reinforce existing inequalities. Second, given the multitude of explanations for the polarization patterns surveyed above, we are sceptical as to whether a dichotomous classification into core and periphery countries can satisfactorily describe the observed complex patterns. Third, we follow the classical structuralist focus on technological gaps in explaining polarization patterns. Therefore, we conjecture that the dynamic distribution of technological capabilities in the EU is important for explaining polarization.

3 The macroeconomic effects of openness shocks in the EU: local projections on the aggregate level

To provide an empirical analysis of convergence and polarization dynamics across the EU's member countries, we first take a broad look at the macroeconomic effects of increasing trade and financial openness. We do so by estimating the dynamic response of several key variables to increasing economic openness. A large literature is concerned with measuring economic openness in terms of trade and finance, leading to a broad range of available openness indicators (for a review see Gräbner et al, 2018). In this paper, we are particularly interested in the effects of European economic and monetary integration, which has lowered transaction costs and led to a harmonization of several institutional aspects (e.g. De Grauwe, 2012). In effect, in pre-crisis times it also triggered the harmonization of interest rates across, and increased capital flows between countries, which fueled lending from the EMU core to the periphery (e.g. Lane and Wälti, 2007; Hale and Obstfeld, 2016; Fuller, 2018). Against this backdrop, we construct a dummy variable the following way: for countries that have used the Euro since its inception in 1999, we use 1999 as the year from which the dummy variable is set to 1. For countries that have not used the Euro since its inception, we use their entry to the EU as the year from which the dummy variable is set to 1. For EU countries that are currently not part of the Eurozone, we set the dummy to 1 when the respective country entered the EU or pegged its currency to the Euro. (See the supplementary material for more detailed information on the variable construction.)

For the reasons explicated above, this dummy variable captures more dimensions of economic integration than only its monetary aspect: being part of the same currency area also decreased general transaction costs, reduced exchange rate uncertainty between Eurozone countries and increased price transparency (for a thorough exposition see e.g. De Grauwe, 2012). Arguably, the treatment that is captured by the dummy variable is exogenous, since it goes back to an exogenous change in the institutional framework, which was not motivated by responding to macroeconomic conditions. In the appendix, we provide more information about this indicator and we replicate all estimations with a continuous measure for economic globalization, where the latter robustness check shows that the results remain qualitatively unchanged.

We estimate the effect of the openness shock dummy variable on eight variables: the unemployment rate; GDP growth; the current account balance in percent of GDP; the share of the financial sector in total value added (in percent); the exports to GDP ratio; the wage share (in percent of GDP at factor cost); GDP per capita (in 1000 dollars at purchasing-power parity); the public debt to GDP ratio; and exports to GDP. We chose this set of variables — the response to the openness shock variable being what we want to estimate — as they play a prominent role in discussions on European macroeconomic developments.

We compose a data set for 26 EU countries, which comprises all current EU member countries except Great Britain and Croatia for reasons of data availability, and covers the time period 1960-2016. Data were obtained from AMECO (wage share, current account balance, GDP growth, unemployment, public debt); the World Bank (exports to GDP); and the KLEMS database (share of finance in value added). The panel data are unbalanced.

In order to estimate the effects of openness shocks, we use the 'local projections' method of Jordà (2005) for constructing impulse-response functions, which has recently been employed in several papers in the macroeconometric literature (e.g. Jordà and Taylor, 2016; Romer and Romer, 2017; Nakamura and Steinsson, 2018).[2] The basic idea of the local projections method — translated into the research framework of this paper — is to estimate separately the dynamic effects of the openness shock variable that we introduced above on the eight variables of interest based on the following regression equation:

$$y_{i,t+k} - y_{i,t} = \beta^k OS_{i,t} + \delta^k Z_{i,t} + \zeta_i^k + \eta_t^k + \epsilon_{i,t}^k \tag{1}$$

[2]The local projections method is a robust estimation procedure. Even though the econometric technique is well-suited for the question at hand, we cannot completely rule out the potential for non-linear responses that might be caused by structural breaks such as the introduction of the Euro – a problem that haunts virtually all panel-econometric techniques.

where y represents the respective 'shock-dependent' macroeconomic variable of interest, expressed in terms of its projected future change $y_{i,t+k} - y_{i,t}$ in country i from year t to year $t+k$; β^k is the estimated coefficient that represents the effect of the openness shock variable ($OS_{i,t}$) on the shock-dependent variable y; $Z_{i,t}$ represents a vector of additional control variables that should be understood as 'pre-treatment variables' (i.e. controls determined before the 'treatment' of the openness shock takes place, see Nakamura and Steinsson, 2018); ζ_i^k are fixed effects at the country level included to control for time-independent country-specific characteristics; η_t^k are fixed effects related to time, which allow us to control for global shocks that hit all countries equally; finally, $\epsilon_{i,t}^k$ represents the error term.

The 'local projections' method relies on estimating a series of k (fixed effects) regressions based on equation (1); the regressions are then used to construct the effect of the 'openness shock' on the shock-dependent variable of interest by plotting the estimated openness shock coefficients β^k for each time period k ($k = 1, ..., k = 8$). Setting the time horizon at eight years ($k = 8$) allows for assessing the dynamic effect of the openness shock on the shock-dependent variable during the eight years following the shock. Jordà (2005) shows that the standard linear projection is a direct estimate of the typical impulse response, as derived from a traditional vector autoregression (VAR) model. The uncertainty around the impulse-response-functions can be directly inferred from the standard errors of the estimated coefficients without any need for Monte Carlo simulations.

Figure 1 shows the results. The local projections are performed from year zero, with the first impact of the openness shock felt in the first year. The path of the local projection is then constructed to year eight, where Figure 1 shows the deviations from the levels in year zero (Jordà and Taylor, 2016). Gray areas indicate the confidence bands of the impulse response functions. For all the estimations in Figure 1, we use panel-corrected standard errors (PCSE).[3]

For exemplification purposes, we consider the response of the unemployment rate. As pre-treatment control variables in the unemployment panel, we control for GDP growth and capital accumulation; we also include a lag of the shock-dependent variable as well as lags of the pre-treatment control variables, since these variables might also have an effect on (future) changes in the unemployment rate (see vector $Z_{i,t}$ in equation (1)). Details on pre-treatment controls for estimating the response of the unemployment rate and the other dependent variables to the openness shock are available in the supplementary appendix. Unemployment falls slightly by

[3] Beck and Katz (1995) argue that the OLS-PCSE estimator is well-suited for panel models such as ours and allows us to avoid biased standard errors due to contemporaneous correlation across units and unit level heteroscedasticity.

about 0.3 percentage points in the first two years after the openness shock but then increases in response to rising openness (+1 percentage points in year 5), before the response reverts back towards zero. In this context, the results of the openness shock on the GDP growth rate in our sample of 26 EU countries complement the unemployment results: on average, GDP growth responds negatively within the first four years, but over the next years, the response reverts back to (above) zero.

The impulse-response functions in Figure 1 suggest the following: First, the current account balance in % of GDP is pushed upwards by several percentage points within the first years before the response declines. Second, the share of the financial sector in total value added does not change much in response to the openness shock. Third, the wage share increases slightly over the first three years, but the effect in year 8 after the openness shock is virtually indistinguishable from zero. Fourth, the average response of GDP per capita is negative over the medium-term, but the effect takes several years to materialize (due to substantial standard errors). Fifth, the average response of public debt is basically indistinguishable from zero. Sixth, income inequality starts to increase in response to the openness shock in the medium-term.

Finally, exports to GDP are slightly pushed upwards in the short-term, but the effect declines over time. Notably, we investigated the robustness of the results discussed here by using a different openness shock variable, namely changes in the KOF economic globalization index (Gygli et al, 2019), which is a composite index that measures economic globalization along de facto (such as trade to GDP) and de jure criteria (such as hidden import barriers). While the KOF-variable has less of a clear-cut interpretation compared to our dummy-variable approach, its main advantage is that it offers a continuous instead of binary measure of economic openness taking different facets of the latter into account. Against this backdrop, it is important to note that the results for the impulse-response functions are qualitatively similar for most parts of our sample, as can be verified in the supplementary appendix.

The results presented so far portray the *average effect* of the openness shock variable on the respective shock-dependent variable. However, based on our theoretical considerations in section 2, we would expect the effects to be heterogeneous across EU member countries. To test this conjecture, we take a closer look at the country fixed effect estimates (ζ_i^k in equation 1).

In doing so, we exploit the fact that the country-fixed effects may be seen as a catch-all variable for time-independent country characteristics such as geography, size and stable institutions of the respective country (e.g. Wooldridge, 2010). In other words, similar country-fixed effects point to a similarity in unobserved country-characteristics, while a broad divergence between

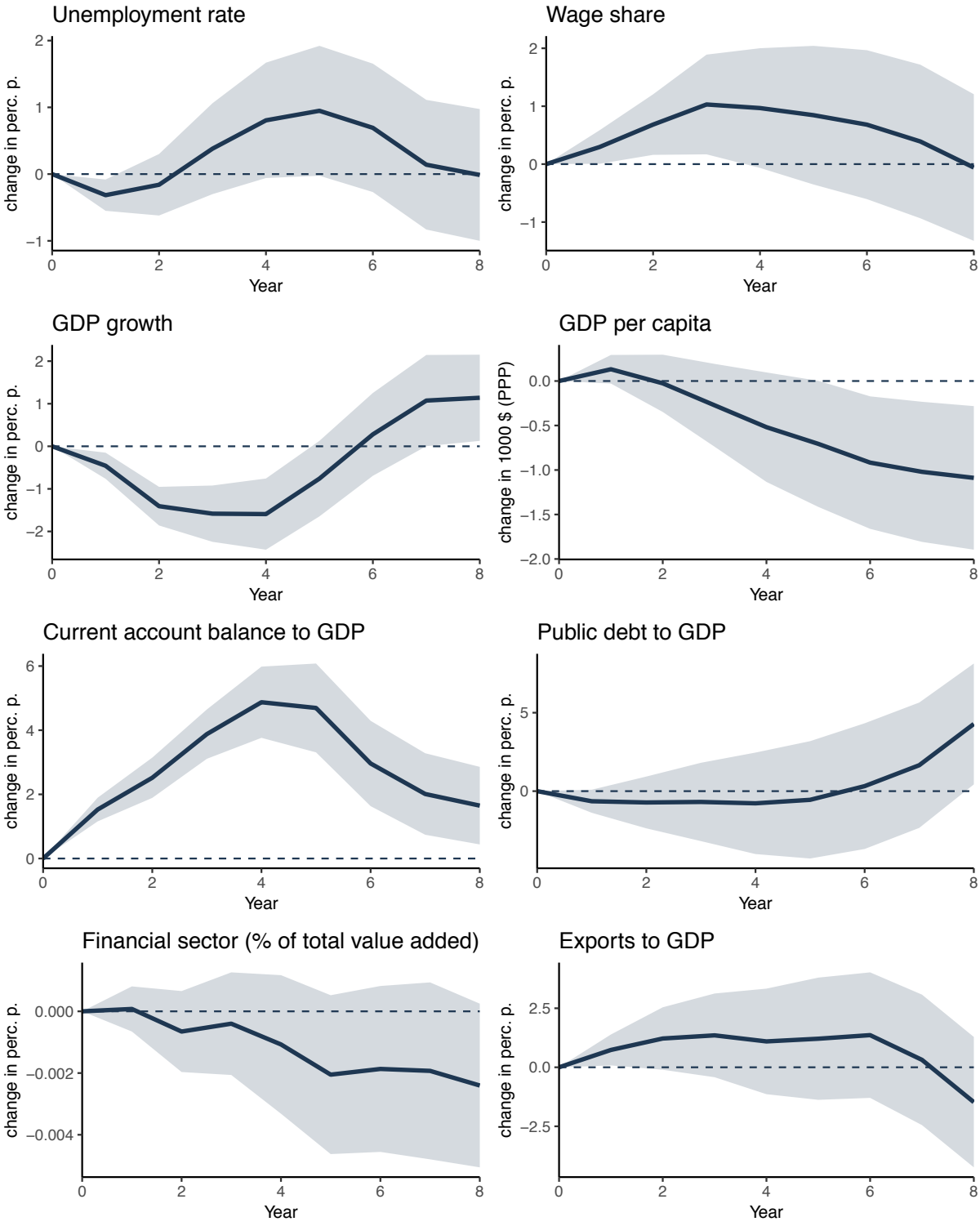


Figure 1: The effect of openness shocks in a sample of 26 EU countries. Data: AMECO, KLEMS, World Bank (see data appendix for details); own calculations. The country sample consists of 26 EU countries. Impulse-response functions were derived from local projections (see equation (1) and details on pre-treatment controls in the supplementary appendix). Standard errors are PCSE-corrected (Beck and Katz, 1995) and, hence, robust to cross-section heteroskedasticity and autocorrelation in the residuals.

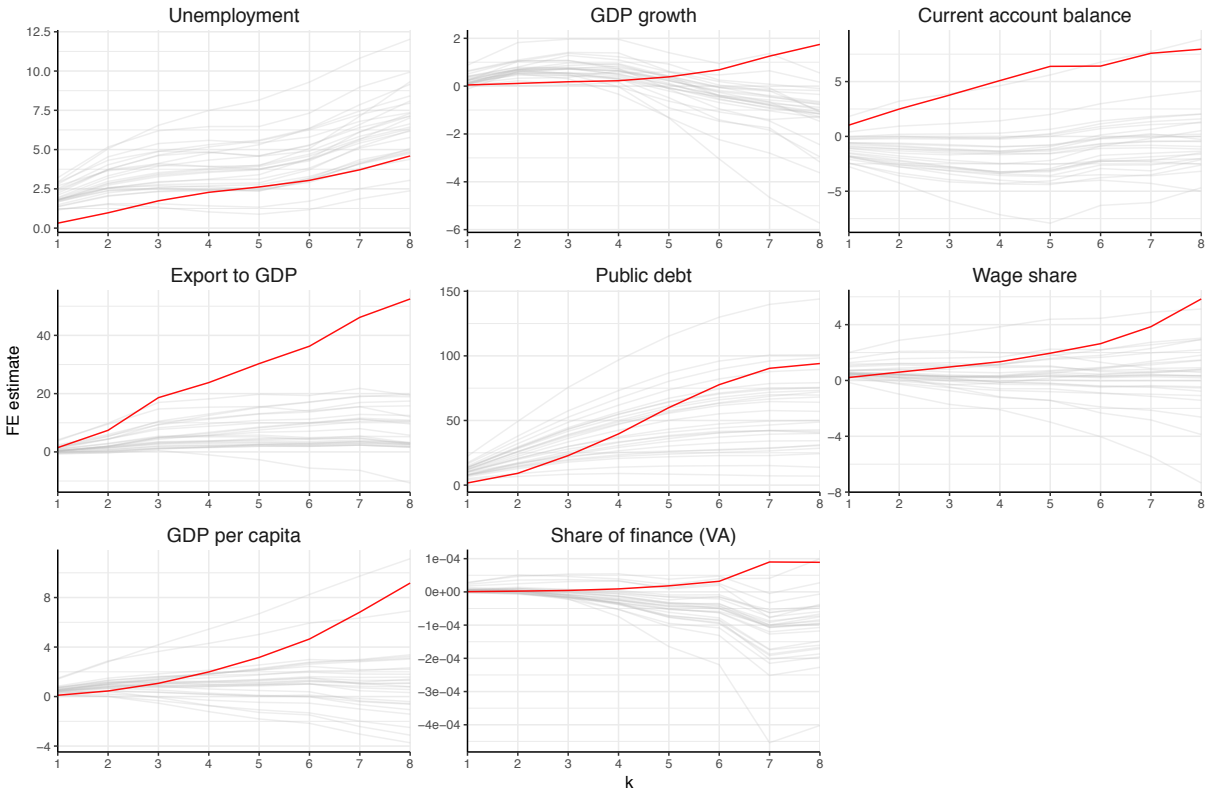


Figure 2: The evolution of the estimated country fixed effects estimates over the local projections horizon (k=1,..., k=8). The grey lines represent the obtained country fixed effects for each country. The red lines illustrate how the heterogeneity of the estimates increases over time by representing the variance of the estimates. For the sake of visibility, the variance of public debt estimates was divided by 10.

the estimated country-specific intercepts would suggest the presence of a sizeable amount of heterogeneity among the units of observation. Figure 2 plots the fixed-effects estimates as acquired in our local projection setup and shows that differences in fixed-effect estimates are large and increasing over the projection period. While the first outcome suggests that unobserved individual country characteristics matter for how countries are affected by openness shocks, the increasing variation in the estimated country fixed effects over time implies that the increase in openness coincided with an increase in structural heterogeneity among the units of observation. In the next section, we will investigate whether a more in-depth analysis of the country-fixed effects can highlight similarities in the reactions of certain subgroups to increasing European economic integration.

4 Openness shocks and path dependent developments in Europe: a typology for countries

The country fixed effects estimates from the previous section suggest that the increase in economic openness in Europe has amplified the structural differences among European economies due to the heterogeneous effect of openness on different countries. We now aim for gaining a clearer understanding of this observed heterogeneity. To this end, we start with an inductive approach and analyze the country fixed effect estimates obtained in the previous section by using hierarchical cluster analysis. In doing so, we try to identify suitable subgroups of the European countries in our data set and complement this inductive approach with theoretical considerations. Then we use sectoral export data to study the reasons underlying this structural change in European countries.

4.1 Hierarchical clustering of country fixed effects

In order to identify potential clusters of countries that show similarity in their unobserved country characteristics in response to European economic integration, we analyze the country fixed effects obtained in the previous section by using hierarchical cluster analysis (HCA, Tan et al, 2005, p. 515ff). The general idea behind HCA is to separate a set of objects into disjunctive groups, called clusters, where members of the same cluster are similar to each other, but distinct to members of other clusters. In contrast to partitional clustering, hierarchical clustering produces a set of nested clusters that are organized as a tree, usually represented as a dendogram or a factor map (see figure 3 below), which also allow for tracking the relation between clusters (see also Tan et al, 2005, p. 526).[4]

The results are presented in Figure 3. Obviously, Luxembourg is quite distinct from the rest, which can be seen as a first indication that the intuition of separating countries in which the financial sector plays an outsized role into a proper sub-group might be a fruitful approach. The countries can be separated into four further groups. The cluster on the bottom consists of Austria, Denmark, Sweden, the Netherlands, Finland, and Germany. These are the typical 'core countries'. The cluster on top, consisting of Spain, Cyprus, Portugal, Greece, Italy, France and Belgium corresponds – with the exception of Belgium and (maybe) France – to the classic conception of a European periphery. The remaining two clusters include the Eastern European catch-up countries, Malta and Ireland. Interestingly, these countries are separated into two

[4]Specifically, we apply Ward's minimum variance method. More details on the method selection process are given in the appendix.

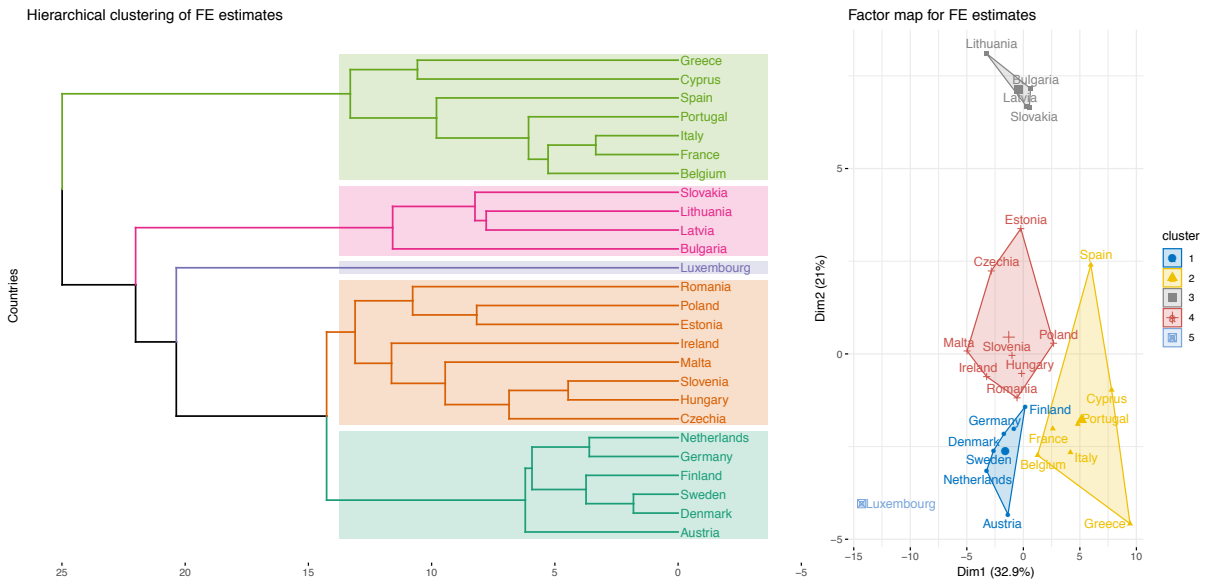


Figure 3: The resulting clusters of countries. Panel (a) illustrates the entire result using a dendogram, panel (b) illustrates how close the countries are to each other by using a factor plot. A factor plot only considers the two most distinguishing dimensions, which together account for about 61.7 % of total distance.

clusters, of which the smaller one consists of Slovakia, Lithuania, Latvia and Bulgaria, while the other one comprises all other Eastern European countries as well as Malta and Ireland. This result is consistent with recent findings that highlight the presence of different sub-groups in the Eastern European countries (see e.g. Bohle, 2018), which exhibit different degrees and intensities in the overall catch-up process observable in Eastern Europe.

All our clustering results are robust, not only with regard to different cluster algorithms, but also regarding the exclusion of smaller economies, such as Malta, Luxembourg, and Cyprus. An extensive robustness analysis exploring all these avenues is presented in the appendix.

In summary, although hierarchical clustering is a purely inductive way of analyzing data that does not exploit theoretical insights other than that involved in variable selection, the results are largely consistent with classifications used in the previous literature.

4.2 A country taxonomy for the EU: delineating clusters with theory and descriptive statistics

Previous taxonomies usually focused on particular subsets of the EU's member countries. The most common distinction is that of a Eurozone core and a Eurozone periphery (e.g. Simonazzi et al, 2013; Iversen et al, 2016). Since the Eastern European countries are difficult to accommodate in this dichotomous classification, they are – if considered at all – usually treated as a third category (Bohle, 2018).

Category	Distinguishing characteristics	Members
Core	High GDP per capita levels Importance of industrial production Production of complex products Relatively low unemployment	Austria, Belgium, Denmark, Finland, Germany and Sweden
Periphery	Lower export shares Relatively high public debt Tendency to current account deficits Relatively high unemployment	Cyprus, France, Greece, Italy, Portugal, and Spain
Catch-Up	Relatively low levels of wages and GDP per capita High degree of foreign ownership Small service sector, but (partly) important manufacturing sector	Bulgaria, Romania, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia, Slovakia
Finance	High debt levels of private firms Important share of finance in terms of gross output High foreign investment inflows Large incomes from wealth taxes	Luxembourg, Netherlands, Malta, and Ireland

Table 1: Country taxonomy for 26 EU countries. Own illustration.

Table 1 summarizes our country groups, which departs slightly from the results of our clustering analysis: although the overall clustering results are intuitive, the focus on the country fixed effects estimates as inputs for the clustering may still understate important differences with regard to some of the EU countries' specificities in terms of their national regulations and institutions. As can be seen, we go beyond previous classifications and suggest categorizing the European Union's members into four categories: core, periphery, catching-up countries in Eastern Europe, and financial hubs. While the classification of core – as those countries chracterized by high standards of living, a modern and highly competitive production sector and low unemployment (see figure 4a) – and periphery countries – as those countries with less competitive firms, higher unemployment rates and especially burdensome levels of debt (see figure 4b) – is rather standard, the group of financial hubs and catch-up countries, as well as the classification of France deserves further explication:

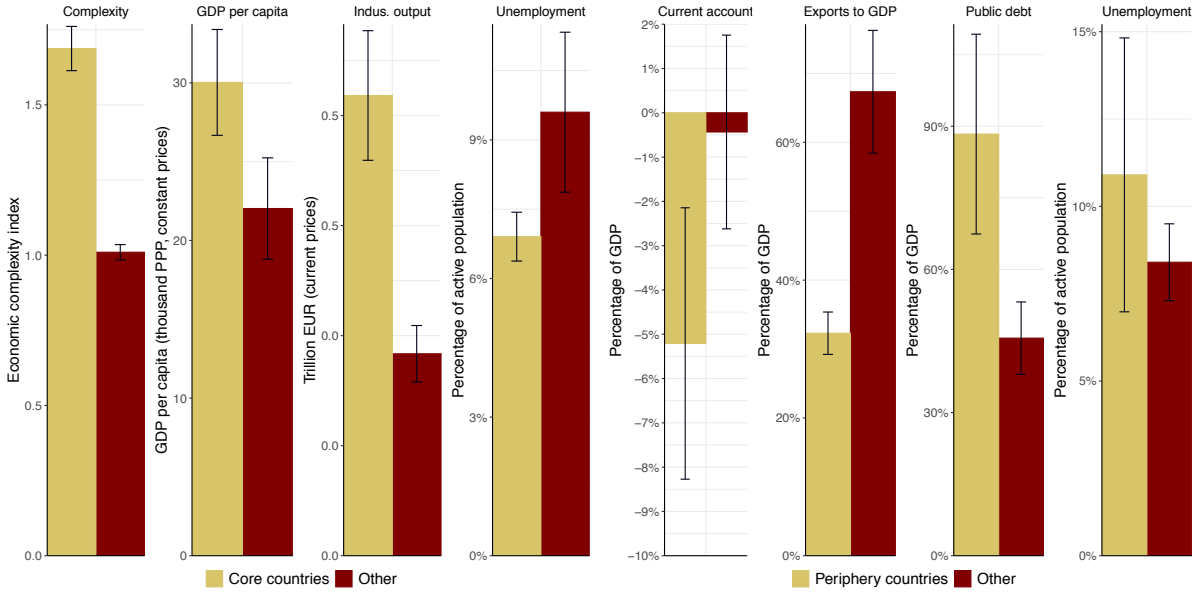
First, we add a proper group for financial hubs in the EU because the financial sectors in Luxembourg, the Netherlands, Malta and Ireland are outsized compared to other European countries (e.g. Karwowski et al, 2017; European Central Bank, 2016; Schwan, 2017, note that the UK is not part of our EU country sample).[5] In our data, this is reflected by a disproportionate

[5]The existence of a proper group of 'financial hubs' should not eschew the fact that (i) Europe as a whole is more financialized than most other world regions and (ii) financialization has played an important role for the development in the Southern periphery countries, e.g. by facilitating speculative bubbles (for more details see p. 234ff in Celi et al, 2018). However, the countries in our 'financial hubs' group are particularly financialized,

amount of foreign direct investments as well as high levels of private sector debt, an exceptional share of the finance sector in gross output and relatively large incomes derived from the taxation of wealth (see figure 4c). On top of that, these four countries also feature an exceptionally large 'shadow banking sector' (Beyer and Bräutigam, 2016, and chart 2 in European Central Bank, 2016), where 'shadow banking' is understood as the non-banking part of the financial system, characterized by looser regulations and thinner public safety nets for financial institutions (Ban and Gabor, 2017). Moreover, Luxembourg, Ireland, the Netherlands and Malta have followed particularly liberal and finance-friendly policies geared towards attracting foreign capital and the associated rents and profits from other (European) countries. The Netherlands has a prominent role as a hub in the 'shadow banking system' (Bakk-Simon et al, 2012; Broos et al, 2012; Beyer and Bräutigam, 2016). Ireland has been using a low-tax and low-financial-regulation regime to attract multinational companies as well as leading global financial services firms. These low-regulation policies have played an essential part in the Irish export-led growth model (e.g. Barry and Bergin, 2012; Zucman, 2014). Malta implemented finance-friendly policies that have led to an exceptional growth of its banking sector over the last two decades. Notably, a majority of the banking-sector's total assets in Malta are foreign-owned (e.g. European Central Bank, 2016). Finally, Luxembourg is a financial center with favorable tax policies for high-net worth individuals and institutional investors, leading to an outsized role of finance in the overall economy (e.g. Johannesen and Zucman, 2014; Zucman, 2015). These considerations lead us to classify these countries as financial hubs, rather than as core or periphery countries.

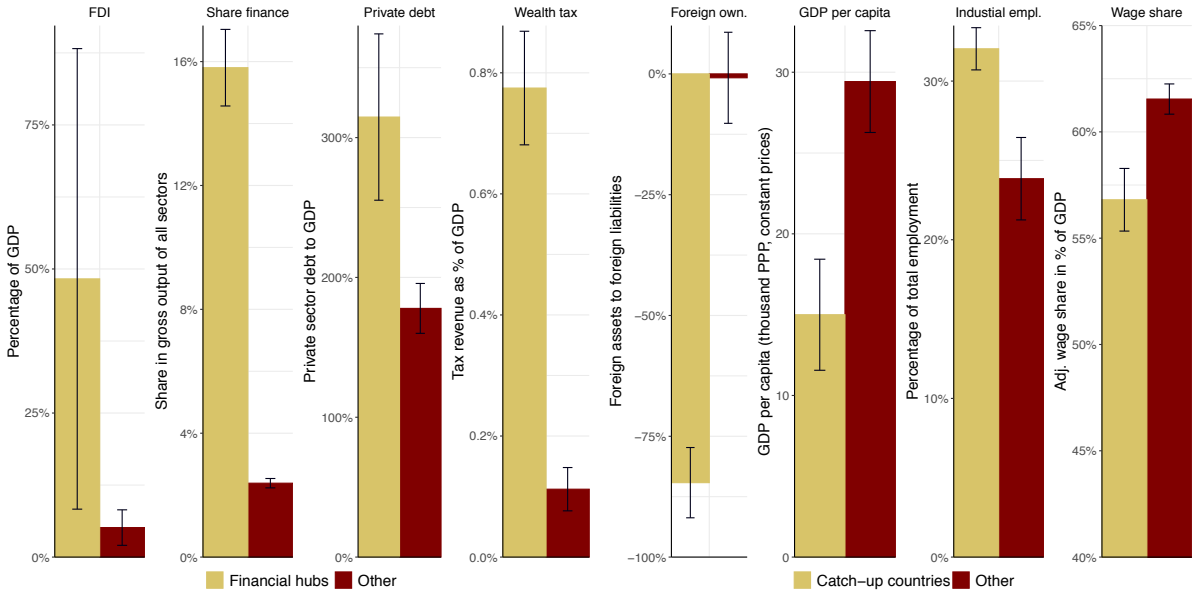
Second, the Eastern European countries are often termed catching-up countries; they consist of Bulgaria, Romania, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia and Slovakia. These countries still display relatively low levels of income, low levels of wages and employment standards and large capital inflows. Moreover, the data indicate a weak foreign ownership position of the Eastern countries (captured in a negative difference between foreign assets and foreign liabilities of more than 75%). At the same time, their share of the industry sector in terms of employment is large in comparison to the other countries in our data set (see figure 4d). But along with these similarities, there are also important differences among Eastern countries. Most notably, while we can observe a certain catch-up process in terms of technological capabilities, particular for the Visegrad countries, no such process can be observed in the Baltics (see also below, as well as figure 6 in the supplementary material; for more details,

where we follow the definition of Epstein (2005, p. 3) who sees 'financialization' as "the increasing role of financial motives, financial markets, financial actors, and financial institutions in the operation of the domestic and international economies." On financializaton, see also Hein et al (2008), Palley (2013) and Celi et al (2018).



(a) Core countries compared to the rest.

(b) Periphery countries compared to the rest.



(c) Financial hubs and the rest.

(d) Catch-up countries and the rest.

Figure 4: A comparison of our four country groups with the rest of our sample. The averages refer to the period 2000-2015 and are unweighted. In the appendix, we show the population-weighted data, which do not differ markedly. Whiskers indicate the variation of the variables over time and correspond to the temporal mean +/- one standard deviation.

see Bohle, 2018). Nevertheless, we decided to treat these countries as a single cluster and leave a more detailed classification for future research.

Finally, while the clustering approach suggests that France is currently part of the periphery, classifying this country is difficult and one might also consider it as part of the core (such as, e.g., Artis and Zhang, 2001; Campos and Macchiarelli, 2018). The country can be seen as an intermediate case between core and periphery and its location in the core-periphery nexus is not necessarily in line with its important political role in the EU, which is also determined by its size and its historically close relation to Germany (Gräbner et al, 2017). Nevertheless, we argue that if one focuses on the economic factors, France is closer to the periphery than to the core – especially if we take into account its development in terms of technological capabilities (see section 4.3 and figure 6 in the supplementary material).

4.3 Structural change and the sectoral development of nations: assessing the directedness of technological change

While the previous sections focused primarily on the effects of European economic integration on macroeconomic indicators, we now turn to the mechanisms underlying macroeconomic convergence and divergence between countries. As suggested by the structuralist literature surveyed in section 2, we focus on analyzing the dynamic distribution of technological capabilities. To this end, we use data on trade and economic complexity (Hidalgo and Hausmann, 2009) to construct a measure for the direction of technological change relative to the rest of the world.

In particular, we compare trade volumes of all countries on the SITC-V2 4-digit product level over the two time periods 1995-1999 (pre-Eurozone and pre-crisis) and 2010-2014 (post-Eurozone and post -crisis) to assess the changes in a country's export basket. For each country, we regress the log of the positive and negative difference in the value of exports on the average product complexity (PCI, see Hidalgo and Hausmann, 2009) and weight the observations according to the share of the product in the country's export-basket in 2012-2014. This allows us to understand, for a given country, whether export values change more drastically for more or less complex products. The weights ensure that we pay more attention to products that have recently played an important role in the country's export-basket.

Define P_c^+ as the set of products for which country c has increased its exports in 2010-2014 as compared to 1995-1999 and $\phi_{c,i} = 1$ if $i \in P_c^+$ and zero otherwise. We then estimate the following two equations for each country:

$$\log\left(\sum_{t=2010}^{2014}\phi_{c,i}\pi_{c,i,t}-\sum_{t=1995}^{1999}\phi_{c,i}\pi_{c,i,t}\right)=\beta_c^{+}\overline{\mathrm{PCI}}_{c,i}+\epsilon_{c,i}\quad\forall i\in P_c^{+}\tag{2}$$

and

$$\log\left(\sum_{t=1995}^{1999}(1-\phi_{c,i})\pi_{c,i,t}-\sum_{t=2010}^{2014}(1-\phi_{c,i})\pi_{c,i,t}\right)=\beta_c^{-}\overline{\mathrm{PCI}}_{c,i}+\epsilon_{c,i}\quad\forall i\notin P_c^{+}\tag{3}$$

In both equations, $\pi_{c,i,t}$ is the total export of product i by country c in period $t\in(\{1995,...,1999\},\{2010,...,2$ and $\overline{\mathrm{PCI}}_{c,i}=\sum_t\left[\frac{\pi_{c,i,t}}{\sum_t\pi_{c,i,t}}\mathrm{PCI}_{i,t}\right]$, where $\mathrm{PCI}_{i,t}$ is the product complexity of product i in year t as defined in Hidalgo and Hausmann (2009). The weights $\omega_{c,i}$ for the WLS estimation are given by $\omega_{c,i}=\frac{\sum_t\pi_{c,i,t}}{\sum_i\sum_t\pi_{c,i,t}}$, i.e. the share of product i in the country's export basket in 2012-2014. This way, we obtain two estimates for each country, $\hat{\beta}_c^{+}$ and $\hat{\beta}_c^{-}$, the first for the products for which the country has increased its export value, and the second for the remaining products.

By calculating a weighted average of these two coefficients, one arrives at a final estimate for the direction of technological change in the countries under investigation. To this end, define

$$\gamma_c^{+}=\sum_{t=2010}^{2014}\phi_{c,i}\pi_{c,i,t}-\sum_{t=1995}^{1999}\phi_{c,i}\pi_{c,i,t}\tag{4}$$

as the sum of increases in exports of country c and

$$\gamma_c^{-}=\sum_{t=1995}^{1999}(1-\phi_{c,i})\pi_{c,i,t}-\sum_{t=2010}^{2014}(1-\phi_{c,i})\pi_{c,i,t}\tag{5}$$

as the sum of all the absolute values of the losses in exports of country c. Then the final estimate for the direction of technological change in country c is defined as follows:

$$\theta_c=\frac{\gamma_c^{+}}{\gamma_c^{+}+\gamma_c^{-}}\hat{\beta}_c^{+}-\frac{\gamma_c^{-}}{\gamma_c^{+}+\gamma_c^{-}}\hat{\beta}_c^{-}\tag{6}$$

If $\theta_c>0$, this indicates a relative increase in exports of more complex products for this country. In other words, if $\theta_c>0$, more complex products become relatively more important for this country's export-basket (vice versa for $\theta_c<0$). Figure 5 provides an illustration of the results. It shows the respective regression lines as well as the composition of the underlying data for the cases of Greece and Germany with regard to expanding products (i.e. $i\in P_c^{+}$). It indicates that greater expansion of exports in Germany (right panel) is associated with higher product complexity, while greater expansion of exports in Greece (left panel) is associated with a lower technological complexity, partially driven by a reversal towards being a producer of primary inputs (such as refined oil).

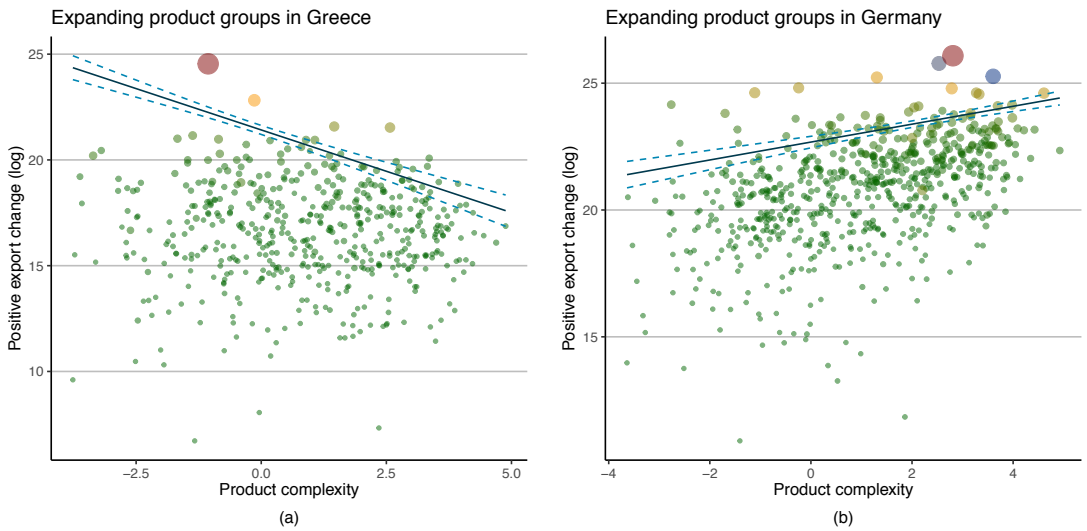


Figure 5: The directedness of technological change in Greece and Germany. While export expansion in Germany is positively correlated with product complexity, the inverse holds for Greece. The size and color of the points represent the average share of the products in the countries' export basket in 2012-2014. The regression line stems from the WLS estimation as described above. Dashed lines illustrate the estimation errors. Data: Atlas of Economic Complexity in its 12-2017 version (see data appendix for details); own calculations.

Although the country-specific results do not always show such clear trends as in the examples given in Figure 5 (for details on the other EU countries see the appendix), in sum they point to a clear pattern of the sectoral developments across Europe from the perspective of international competitiveness: we find that higher levels of overall complexity before the onset of the Eurozone (in 1999) are, on average, associated with stronger gains of complexity measured in terms of the expansion and decline of individual sectors for the larger part of the observed countries (Figure 6, upper panel). While this result is broadly consistent with the Kaldorian prediction that "success breeds success" (Kaldor, 1980), a more nuanced interpretation of this overall quadratic relationship is given in the lower panel of figure 6: although the catching-up of Eastern Europe has an imprint on overall developments, patterns consistent with Kaldorian effects can be identified within the Eastern European countries, where they are rather pronounced, as well as (with a weaker intensity) among all the remaining EU countries. Thereby, large parts of the variety in the results for the Eastern European catch-up economies seem to be moderated by their geographical proximity to Europe's industrial core (Stöllinger, 2016).

The patterns of technological change as depicted in Figure 6 also allow us to emphasize four further observations. First, there is still considerable heterogeneity within the typically proposed country-groups: core countries differ in their development, mirroring the fact that some of these countries struggle to hold on to their position, while others, mostly Germany, have managed to expand their technological dominance (e.g. Storm and Naastepad, 2015a). In fact, Germany is

the only example of the core countries that finds itself above the value predicted by a quadratic model fitted to the data. Second, the upper panel of Figure 6 shows that we cannot find a single periphery country with a decidedly positive technological development: Portugal is the only periphery country that manages to surpass the predicted value, albeit this country has started from a relatively low level of complexity. Third, we find that while most Eastern catch-up countries perform better than the prediction, two exceptions are actually located markedly below the regression line. This indicates that the economic catch-up process of Eastern European countries is not necessarily tied to a technological catch-up process, as evidenced most forcefully by the outliers Bulgaria and Lithuania. Fourth, the heterogeneity among financial hub countries is particularly large, but can be explained by their different financialization strategies: Ireland's role as a corporate tax haven manifests itself in a massive technological upgrading (e.g. Regan and Brazys, 2018), while the more asset-based strategies of the Netherlands and Malta are associated with more pronounced deindustrialization (e.g. Visser et al, 2016).

As international competitiveness and technological capabilities are of prime importance for assessing the future developmental trajectories within given political and institutional constraints (Hidalgo and Hausmann, 2009; Cristelli et al, 2015), it is important to note that we cannot observe convergence in terms of technological capabilities in the current European framework. Quite on the contrary, our results point to the possibility that some countries in Eastern Europe might indeed manage eventually to catch-up to the core (Czech Republic, Poland, Hungary and Slovakia), while others (such as Bulgaria or the Baltic countries) are much more likely to join the European periphery (Stöllinger, 2016).

5 The accentuation of polarization through openness shocks: local projections on the disaggregated level

On the basis of the taxonomy of countries developed in this paper, we proceed by further corroborating our intuition that the four country groups – core, periphery, and catching up countries, as well as financial hubs – respond differently to openness shocks. In order to estimate the dynamic response of eight key variables to an impulse of increasing openness that results from exogenous changes in European economic integration, we again make use of the econometric framework introduced in section 3: we estimate impulse-response functions based on regression equation (1), but this time separately for each of the four country groups.

Figure 7 shows the dynamic effects of the openness shock variable on our four main shock-

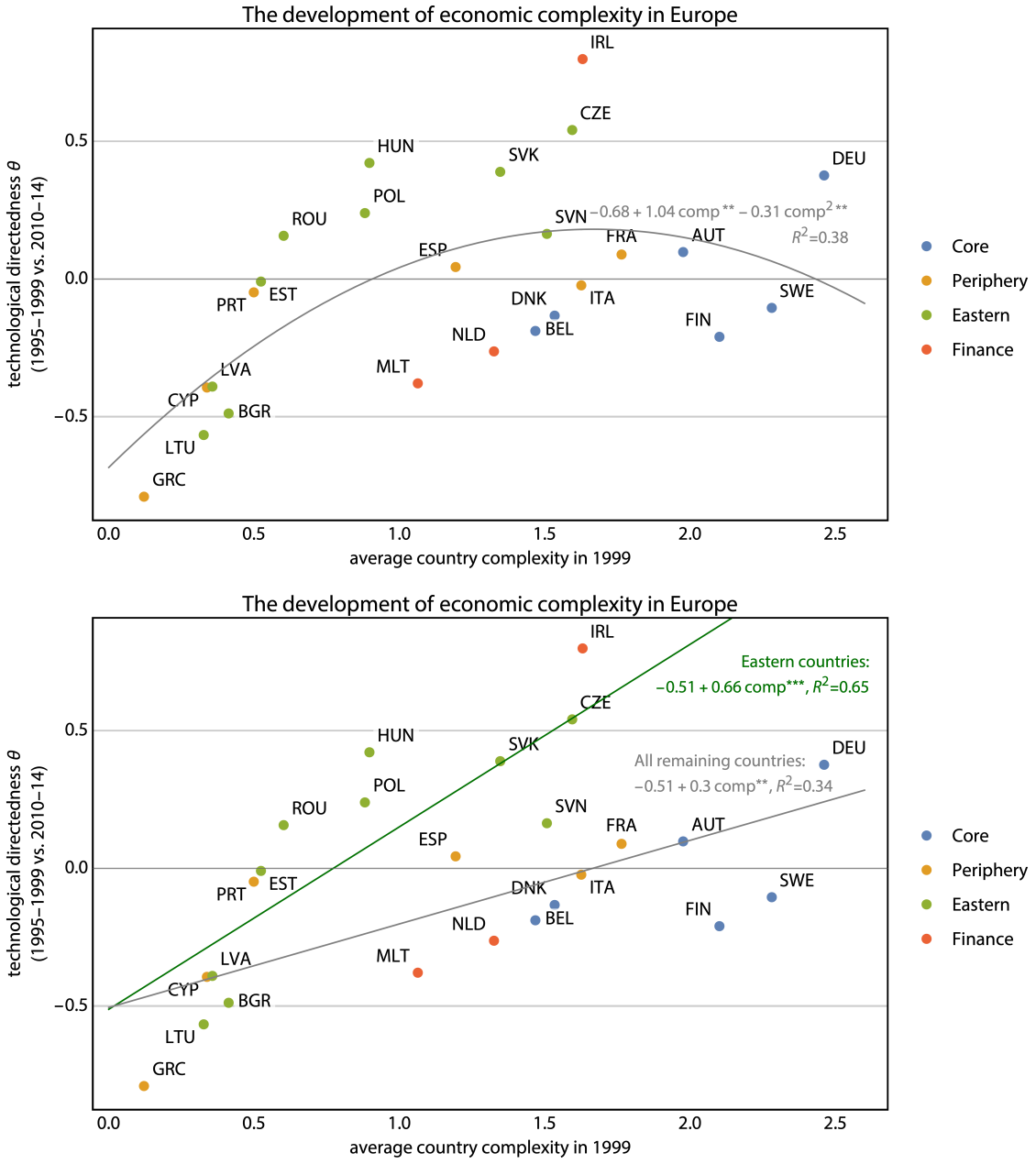


Figure 6: Technological capabilities and structural change. Data: Eurostat; Atlas of Economic Complexity in its 12-2017 version; own calculations.

dependent variables (with four additional variables covered in Figure 8).[6] The first column is based on the subsample for the six EU core countries; the second column for the six EU periphery countries; the third column for the four financial hubs; and the fourth column for the ten catch-up countries. (See the taxonomy in table 1 for details on the country groups.)

We find support for our hypothesis from section 2 on average, unemployment rates in the four country groups have responded differently to the openness shock. While the response of unemployment in the core subgroup is basically indistinguishable from zero, unemployment has been strongly pushed upwards in the Southern periphery (by about three percentage points in the medium-term). While the particular developmental model in the financial hubs has allowed their economies to respond with a slight decline in the unemployment rate in the years after the openness shock, the Eastern European countries have, on average, seen a decrease in the unemployment rates in the first two years after the shock, followed by a medium-term increase in unemployment that only dissipates several years after the shock. The results for GDP growth basically correspond to the results regarding unemployment: we do not see much of an effect in the core and in the financial hubs, but there is clearly a negative response in the periphery, and a phased response in Eastern Europe. The openness shock variable has clearly had a negative effect on GDP per capita in the periphery. Furthermore, we see an initial negative effect for the group of core countries, though, in this case, GDP per capita returns to its initial level once a couple of periods have passed; but the financial hubs benefiting from their finance-friendly growth models – which may harm other European countries by fostering a race-to-the-bottom in regulatory standards – have seen a positive response of GDP per capita. Furthermore, Figure 7 shows that the wage share, on average, has responded positively in core countries but negatively in periphery groups, while the impact on the wage share in financial hubs and Eastern European countries is more difficult to differentiate from zero.

From Figure 8, we can see the response of four additional variables to an impulse of increasing openness. We again find pronounced differences in the dynamic effects across our four country groups: while public debt goes down in response to the shock in the financial hubs and does not change markedly in the Eastern European countries, it increases strongly in the core but even more so in the periphery countries, with the effect increasing over time. Furthermore,

[6]Note that, while the standard errors in Figure 1 are panel-corrected standard errors (Beck and Katz, 1995) and, hence, robust to heteroskedasticity and autocorrelation in the residuals, we have not been able to perform the same adjustment for the country subgroups in Figures 7 and 8. The reason is that the PCSE-correction requires that the number of years covered is not too much larger than the number of countries in the cross-sectional dimension of the data. When we subset the full country sample into our four groups, this requirement is not fulfilled because the number of countries in the regressions drops markedly. As a consequence, the gray standard error bands depicted in Figures 7 and 8 might be too small, i.e. we might somewhat underestimate the degree of uncertainty around the point estimates in the impulse-response function.

Figure 8 shows that the effect of the openness shock is close to zero for the EU core, only turning positively significant eight years after the shock. The average response of the current account balance in periphery countries to the openness shock is positive. This rather unexpected result can be explained by the substantial improvements in current accounts that followed once austerity measures were put in place in the periphery from 2010 onwards. In the financial hubs, the current account has been pushed upwards, while for the Eastern European countries, the current account tended to improve over the first years after the openness shock before it deteriorated. In terms of the effect of openness on the share of the financial sector in value added, we find that there is an upward pushing response in the periphery; in the core, the average effect on the size of finance is less pronounced, while the share of the financial sector even goes down in the Eastern European countries. We do not find an effect for the group of financial hubs, which might be due to the fact that these policies had already been in place before.

Finally, in terms of the effect of increasing openness on exports to GDP, we find that the average response of the core is negative after eight years, while there is an increase in the periphery group. For the Eastern European countries, the response is on the positive side, while the financial hubs tend to see a boost in exports to GDP in the short-term, followed by a reversal in the years to follow. As in section 3, we have again checked the robustness of the results discussed here by using the KOF economic globalization index (Gygli et al, 2019) as an alternative openness shock variable. *Grosso modo*, the results for the impulse-response functions of the four country groups are qualitatively similar (see the supplementary appendix).

Summing up, the four country groups on which we elaborate in this paper have responded to openness shocks in a distinct way. The results indicate that the complex dynamics of macroeconomic convergence and structural polarization in Europe can be better understood if one takes into account how the response of these country groups to European economic integration (which is characterized by increasing trade and financial openness) has shaped their developmental paths. In fact, European (monetary) integration should be seen as an evolutionary process that has given rise to path-dependency. Notably, the results discussed in this section portray the average response of the relevant shock-dependent variable to the openness shock variable in the respective country group. In other words: while the analysis in this paper has shown that there are strong reasons for distinguishing core, periphery, and catching-up countries, as well as financial hubs, it is still important to keep in mind that, although member countries of a particular group share important features, the experiences of the individual members within those country groups have not been completely homogeneous. Bohle (2018), for example, points

to differences in the growth regimes and configurations of Eastern European capitalisms, as she distinguishes between a dependent export-driven regime in the Visegrad countries and a dependent debt-driven regime in the Baltic States. Similarly, one could argue that within the group of core countries, Germany – with its superior (non-price) competitiveness and strong export sector, its size and political power – is of particular relevance for understanding current developmental trajectories (e.g. Simonazzi et al, 2013). Nonetheless, our results in this paper suggest that important insights into the complexity of path dependent trajectories in Europe can be gained by accounting for country clusters that can be distinguished based on important characteristics that separate them from other country groups.

6 Conclusions and policy implications

This paper has analyzed the effects of increasing economic and financial openness on macroeconomic performance in the context of European integration. Using a data set of 26 EU countries, we have shown that country-specific characteristics have to be accounted for in order to understand how openness shocks have shaped path dependent developmental trajectories. Our results suggest that the focus on a dichotomy of core and periphery countries in the existing literature might fall short of explaining the nuances of current developmental trajectories in Europe. Indeed, we find that a taxonomy consisting of core and periphery countries, as well as financial hubs and catching-up economies is more suitable when it comes to understanding the evolutionary process that has been triggered by European integration – a process that has given rise to different path-dependent trajectories, partly by shaping new paths and opportunities, partly by reinforcing pre-existing tendencies. By using sectoral export data to study structural change, we illustrate that Europe is currently characterized by non-convergence in terms of technological capabilities, which are of prime importance for prospects of future economic development (e.g. Hidalgo and Hausmann, 2009; Dosi et al, 2015).

The observed polarization in Europe provides a rationale for reconsidering current economic policies and institutions (see also Celi et al, 2018). Current EU-level initiatives can be found in the Europe 2020 strategy approved in 2010 (European Commission, 2010). Its goals include making European economies more knowledge and innovation intensive, and to render them more sustainable in environmental and social matters. In order to reach these targets, the Commission has focused on a horizontal industrial policy approach by proposing commonly shared development aims and by trying to ensure framework conditions that are favorable to industrial competitiveness, as opposed to a more targeted (vertical) industrial policy anchored

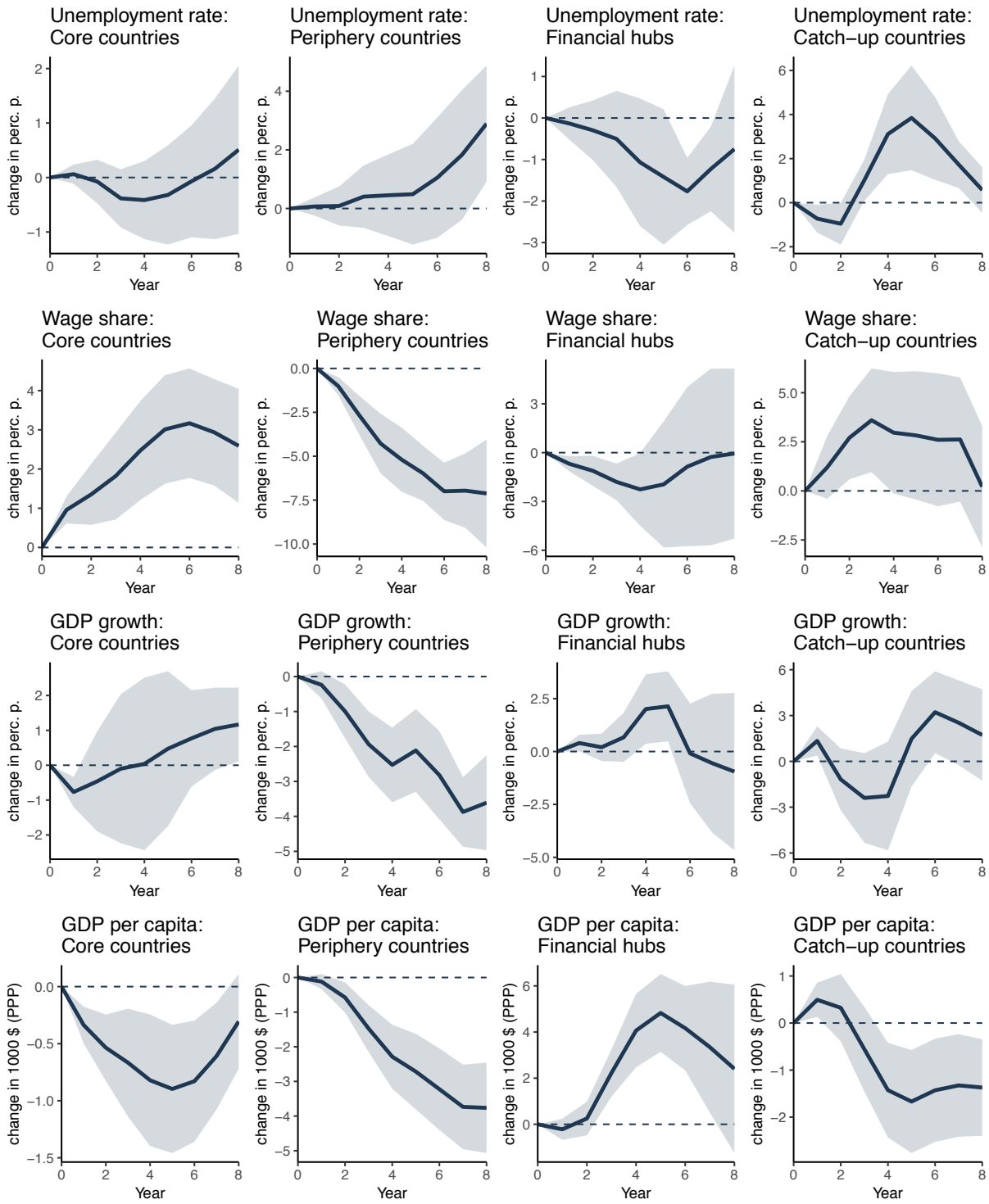


Figure 7: Response of four key variables to openness shocks. Data: AMECO, World Bank (see data appendix for details); own calculations. Impulse-response functions were derived from local projections (see equation (1) and details on pre-treatment controls in the supplementary appendix). Core countries in column 1 refers to the subgroup of six core countries; Periphery countries in column 2 refers to the subgroup of six periphery countries; Financial hubs in column 3 refers to the subgroup of four financial hubs; Catch-up countries in column 4 refers to the subgroup of ten Eastern European countries. See table 1 for the exact taxonomy of countries.

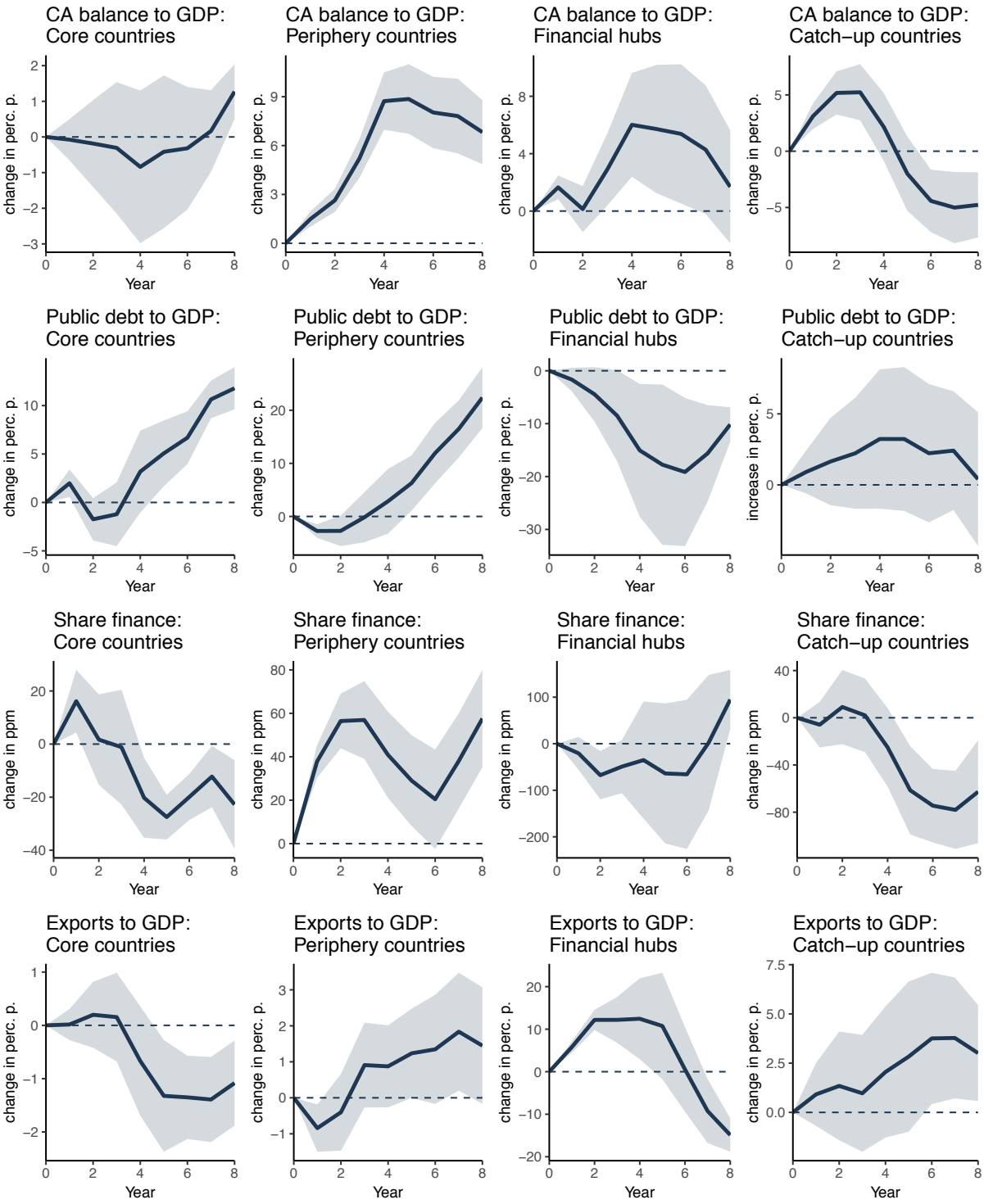


Figure 8: Response of four key variables to openness shocks. Data: AMECO, KLEMS (see data appendix for details); own calculations. For details on the country groups, see notes in figure 8.

in the consideration of national specificities and targets specific sectors and firms (Pianta, 2015; Peneder, 2017). Another policy initiative concerned with industrial policy was launched in 2014 and is referred to as the Industrial Compact (European Commission, 2014). It is mainly concerned with reviving industrial activities in Europe and shows some similarity to the Europe 2020 strategy (Pianta, 2015). Furthermore, the Commission President Jean-Claude Juncker came up with the so-called Investment Plan for Europe in 2014. It sets up the European Fund for Strategic Investment (EFSI), which consists of funds both from the EU and the European Investment Bank. The aim of the fund is to provide finance to private initiatives and thereby to mobilize a multiple of private sector funds. As of December 2017, €51 billion of funding were approved, to which €257 billion private funds were related (European Commission, 2017).

In line with existing proposals for alternative economic policies (see e.g. Cimoli et al, 2015; Celi et al, 2018; Mazzucato, 2015; Pianta, 2015), our results suggest a targeted approach to industrial policy. Figure 9 summarizes our policy proposals. Specifically, in light of the increasing polarization, it will be necessary to enhance economic capabilities in the European periphery and to increase non-price competitiveness in these countries. This will involve substantial public sector investment, which should be seen as a European project. A public investment strategy would not only modernize and diversify existing economic structures; it would also provide the necessary demand stimulus to lift major parts of Europe out of stagnation. Such an initiative could be financed through additional revenues or through external financing. While the former could consist of a European corporate tax or a European wealth tax, the latter might come from the European Investment Bank or the ECB (see also Pianta, 2015). In exchange, the expansion of balance sheets in the periphery's banking sector needs to be constrained to avoid future doom-loops between bank risks and sovereign risks that push up public debt (e.g. Beck, 2012).

Making Europe more equitable must involve a continuation of the catch-up process in Eastern European countries in terms of living standards, which involves assuring that wages grow faster than in the rest of Europe and labor standards be adjusted to the higher levels prevalent in other European countries. Yet, convergence policies would not only increase living standards, but also provide a stimulus to aggregate demand and reduce inner-European tensions related to migration and job displacement. In order to make sure that the respective countries retain and further improve their competitiveness, such a policy has to be accompanied by targeted (vertical) industrial policies (see e.g. Cimoli et al, 2015; Mazzucato, 2015).

The core countries (especially Germany) have been running significant current account sur-

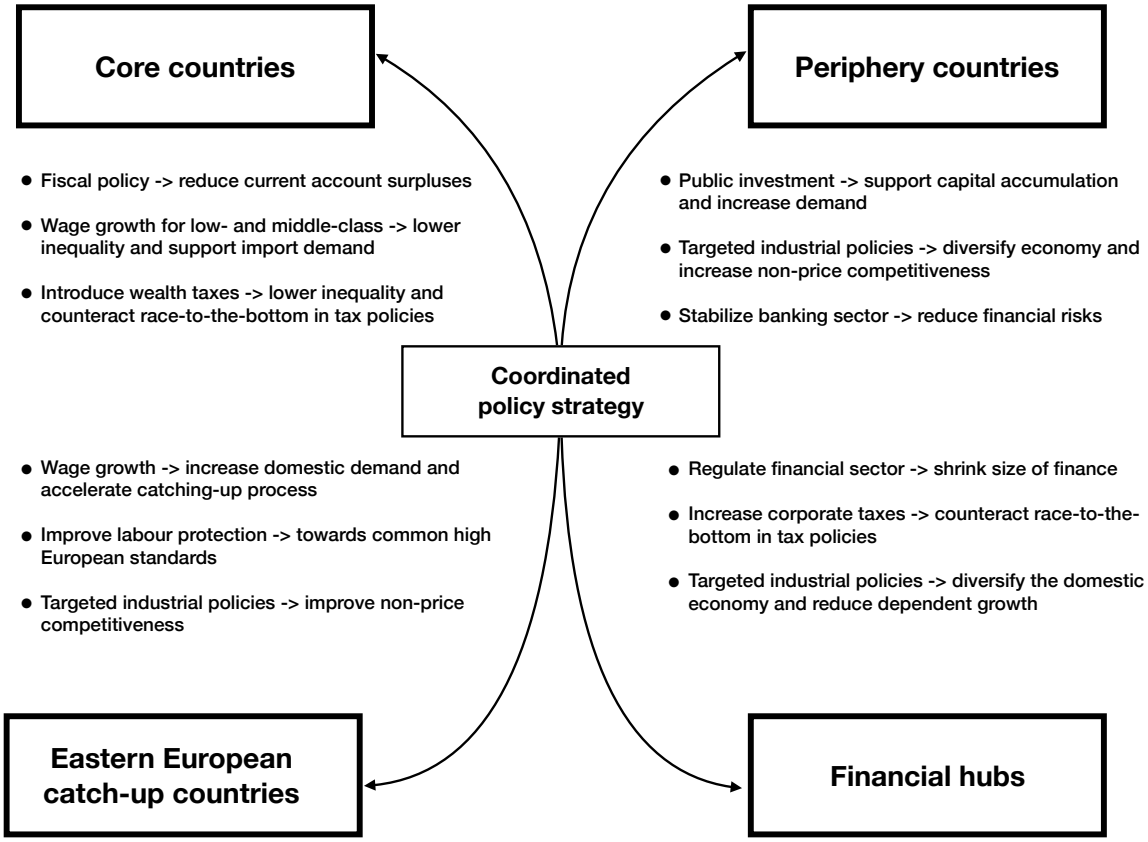


Figure 9: Coordinated policy strategy for supporting convergence and stability in Europe. Own illustration.

pluses for several years (e.g. Gräbner et al, 2017). This means that they possess considerable resources to improve the social cohesion of their societies by reducing unemployment and tackling social inequality through policies that tend to support the domestic economy and reduce the current account. One of these policies consists of increased spending on public infrastructure in order to create more equality of opportunity while at the same time reducing unemployment by adding to aggregate demand. Another possibility is to pursue policies that lead to higher wage growth for the low- and middle-class (e.g. by minimum wage laws, centralized wage bargaining and labor protection legislation).

Finally, in terms of moving towards more sustainability in Europe, we argue in favor of a re-regulation of the financial sector, especially in the financial hubs. Here, the goal must be to shrink and restrict the financial sector in order to dampen effectively the impact of destabilizing speculation, tax evasion and the relocation of assets. Moreover, the observation of particularly low corporate taxes in the financial hubs (which attract corporate profits through tax incentives) suggests that a European initiative leading to a substantial increase in the corporate tax rate is required to counteract the existing race-to-the-bottom in regulatory standards (e.g. Egger et al, 2019). Increasing corporate (as well as wealth and inheritance) taxes would also provide the public sector with the necessary resources to pursue targeted industrial and social policies.

Compliance with Ethical Standards:

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Structural change in times of increasing openness: assessing path dependency in European economic integration

Supplementary material*

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Abstract

We first describe the data used, including from where and how we have obtained these data in section A. Second additional information on our openness shock dummy variable is provided in section B. Section C then explains the pre-treatment control variables used for constructing the impulse-response functions from local projections in sections 3 and 5 of the main paper. Then, we provide robustness results to sections 3 and 5 by using an alternative openness shock variable in section D. Fifth, additional results related to the clustering analysis in section 4 of the main paper are introduced and discussed in section E. Sixth, we provide more general and disaggregated results for the measure for technological directedness introduced in section 4.3 of the main paper (section F). Finally, we present a robustness check for the country taxonomy data discussed in section 4.2 of the main paper: section G includes population-weighted averages for all data presented in this context.

*Supported by funds of the Oesterreichische Nationalbank (Austrian Central Bank, Anniversary Fund, project number: 17383). The data as well as all code required to replicate the empirical exercises in the paper is available at Github: https://github.com/graebnerc/structural-change. The raw data is also published as Gräbner et al. (2019).

A Data

Tables 1 and 2 list all variables and their original sources. This data has then been further processed. For example, in sections 3 and 5 we present impulse-response functions derived from local projections for eight shock-dependent variables. For this purpose we take the raw data from table 1 and calculate future changes as illustrated in equation 1 in section 2, and add lags and differenced lags as described in section C. All code used to process this data can be found in the Github repository associated with this project.[1]

Sections 3 and 5: shock-dependent variables for local projections		
Variable	**Unit**	**Data source**
Adjusted wage share	Ratio to GDP	AMECO
Current account balance	In % of GDP	AMECO
Exports to GDP	In % of GDP	World Bank (WDI)
GDP growth	Yearly growth rate	AMECO; own calculations
GDP per capita	PPP (constant 2011 int. $)	World Bank
Public debt	In % of GDP	AMECO
Share of financial sector in value added	In % of all sectors	EU KLEMS
Unemployment rate	In % of active population	AMECO

Sections 3 and 5: further control variables		
Variable	**Unit**	**Data source**
Capital accumulation	Real gross fixed capital formation/real net capital stock·100	AMECO; own calculations
Economic Complexity Index (ECI)	Index	Observatory of Economic Complexity
Boom-bust patterns in housing (HBOOM)	Deviation (see explanation in text below)	Own calculation based on AMECO)

Table 1: Data used for the regressions in sections 3 and 5.

The data were obtained for 26 EU countries: Bulgaria, Romania, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia, Slovakia, Belgium, Denmark, Germany, Austria, Sweden, Finland, Greece, Spain, France, Italy, Portugal, Cyprus, Ireland, Luxembourg, Malta, Netherlands. Croatia is not considered because it only entered the EU in 2013 and, hence, has a rather short history of 'openness' within the EU. We do not include Great Britain first because the country is expected to leave the EU and second because not all data are available.

[1] For the concrete steps necessary to re-create the data see the readme at https://github.com/graebnerc/structural-change

Section 4: country taxonomy		
Variable	**Unit**	**Data source**
Population	Total de facto population, inluding both Sexes of 1 July of the year indicated.	1000 people UNPD
GDP per capita	Constant 2011 international dollar (PPP)	Worldbank (NY.GDP.PCAP.PP.KD)
Industrial output, excluding construction	Million EUR in current prices	Eurostat (nama_10_a64)
Public debt	Public debt to GDP ratio	AMECO
Private debt	Private debt to GDP ratio[2]	OECD
Adjusted wage share	Adjusted wage share to GDP ratio	AMECO
Employment in industry	Share of total employment	WDI
Employment in services	Share of total employment	WDI
FDI	Net inflows from foreign investors, divided by GDP	WDI
FDI: asset stock	Millions of current US dollars	Lane-Milesi-Ferreti (LMF) database
FDI: liabilities stock	Millions of current US dollars	LMF database
Wealth tax revenue	Tax revenue as percent of GDP	OECD (tax codes 4200, 4500 and 4600)

Section 4.3 (direction of technological change)		
Variable	**Unit**	**Data source**
Export value	Export value in US dollars (current prices), product classification according to SITC-V2 on the 4-digit level.	"The Atlas of Economic Complexity", CID at Harvard University
Export share	In % of total exports or the country under study in this year	"The Atlas of Economic Complexity", CID at Harvard University

Table 2: Data used for the empirical exercises in section 4.

Variable	Mean value	Standard deviation	Observations
Adjusted_wage_share	59.7219	5.9167	416
Capital_accumulation	9.5255	3.8034	416
complexity_HH	1.1803	0.4989	366
Current_account_balance_to_GDP	-1.5352	6.4546	416
employm_indus	26.9966	6.1808	416
exp_to_gdp	59.2575	34.5636	416
fdi_in_gdp	11.7765	39.5804	412
finance_share_GO	0.0447	0.0728	413
foreign_ownership	-0.3303	0.5508	312
GDP_growth	2.3734	3.8052	416
GDP_pc_PPP	23872.8365	11140.8164	416
Gini_net	28.7736	3.5992	375
ind_output_meur	238342.7123	390811.4893	413
population	16594.9771	21332.4670	416
Private_sector_debt_to_GDP	198.4120	79.0244	313
Public_debt_to_GDP	55.4600	32.8206	416
size_of_finance	4.4669	7.2762	413
Tax_Wealth	0.2125	0.5047	317
Unemployment_rate	8.9781	4.3508	416

Table 3: Summary statistics for the data.

The full time period of the dataset ranges from 1962 to 2016. The panel data are unbalanced. Although the eight shock-dependent variables were available for all 26 EU countries, the data coverage in the time dimension varies.

As an additional control variable we construct a proxy for boom-bust patterns in housing (HBOOM). This variable is defined as the deviation of the ratio of employment in the construction sector to total employment in all domestic industries from its mean ($\cdot 100$).

Table 3 shows the summary statistics for the variables used for the local projections and the country taxonomy.

B Openness shock variable

Our openness shock variable (used for the estimations in sections 3 and 5) focuses on exogenous changes in institutional aspects of European economic integration: as EU countries share relevant institutions and a common currency (De Grauwe, 2012), we construct a dummy variable the following way: for countries that use the Euro since its inception in 1999, we use 1999 as the year from which the dummy variable is set to 1. For countries that do not use the Euro since its inception, we use their entry to the EU as the year from which the dummy variable is set to 1.

Two countries require special attention: Denmark and Sweden. For Denmark we set the dummy variable to 1 in 1999, since this is the year in which Denmark pegged its currency to

Country	Openness shock	Justification
Austria	1999	Eurozone entry
Belgium	1999	Eurozone entry
Bulgaria	2007	EU entry
Cyprus	2004	EU entry
Czech Republic	2004	EU entry
Denmark	1999	National currency pegged to Euro + descriptives of other openness indicators
Estonia	2004	EU entry
Finland	1999	Eurozone entry
France	1999	Eurozone entry
Germany	1999	Eurozone entry
Greece	2001	Eurozone entry
Hungary	2004	EU entry
Ireland	1999	Eurozone entry
Italy	1999	Eurozone entry
Latvia	2004	EU entry
Lithuania	2004	EU entry
Luxembourg	1999	Eurozone entry
Malta	2004	EU entry
Netherlands	1999	Eurozone entry
Poland	2004	EU entry
Portugal	1999	Eurozone entry
Romania	2007	EU entry
Slovakia	2004	EU entry
Slovenia	2004	EU entry
Spain	1999	Eurozone entry
Sweden	1995	EU entry

Table 4: Timing and justification of openness shock

the Euro, and descriptive statistics of other openness indicators (such as Trade/GDP) suggest this to be a convincing date for the shock variable. For Sweden we use their entry to the EU as the year from which the dummy variable is set to 1.[3] Table 4 summarizes our specification of the dummy variable.

To corroborate the robustness of our results we also run all estimations, as well as the clustering, with a specification in which we use the EU entry for all countries as the year from which the dummy variable is set to 1. As can be seen from figure 1, the result is very robust, with Romania being the only exception. Note, however, that Romania is located in between the core and the larger catch-up cluster. The results for the local projections are extremely similar.[4]

[3] Another country which might be classified differently is Greece, since it entered the European Exchange Rate Mechanism with the Euro in 1999, but entered the Eurozone in 2001. We run all calculations with both options and get extremely similar results. In the main paper the logically more consistent option with the shock occurring in 2001 is reported.

[4] We do not report the figures here due to space considerations, but they can easily be reproduced using the R code published alongside the paper.

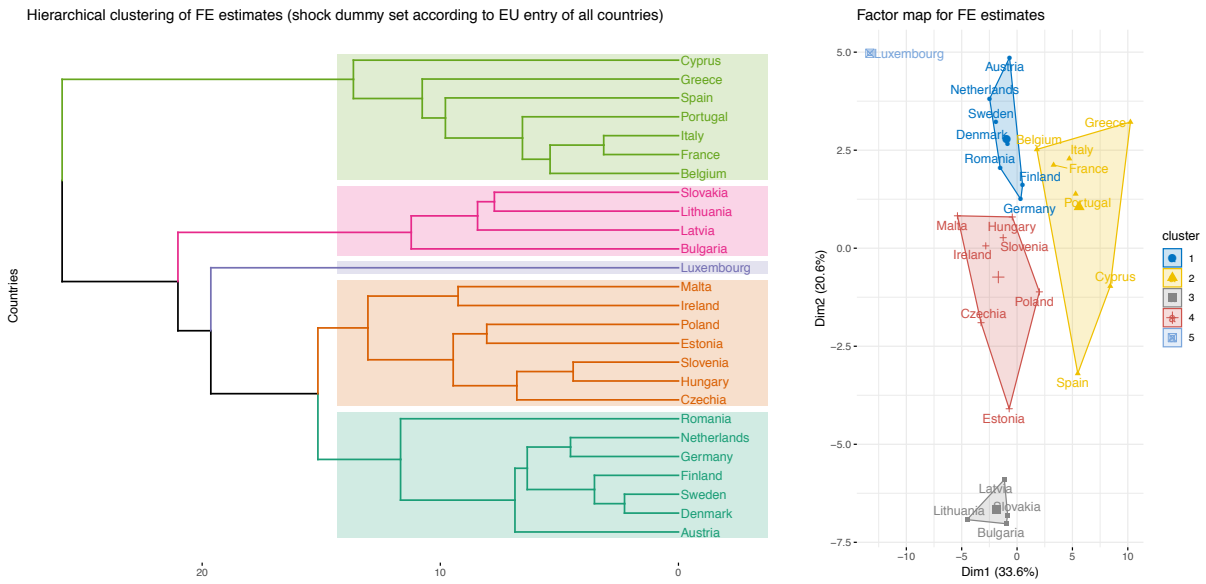

Figure 1: The resulting clustering when the shock variable is set to 1 once a country enters the European Union.

Shock-dependent variable	**Pre-treatment controls**
Current account balance	Unemployment rate
Exports to GDP	Unemployment rate
GDP growth	HBOOM
GDP per capita	HBOOM, unemployment rate
Public debt	Capital accumulation
Share of financial sector	Capital accumulation, HBOOM
Unemployment rate	GDP growth, capital accumulation
Wage share	GDP growth, unemployment rate

Table 5: Pre-treatment controls included in the regressions on which the impulse-response functions in sections 3 and 5 are based. Note that we also include one lag and one differenced lag of the shock-dependent variable as well as lags of all the pre-treatment control variables.

C Notes on estimating impulse-response functions derived from local projections

Table 5 provides a list of pre-treatment controls that we included in the regressions (see vector $\boldsymbol{Z}_{i,t}$ on regression equation (1) in section 3). The choice of the pre-treatment control was based on two criteria: First, which variables might – from a theoretical perspective – also impact the shock-dependent variable? Second, is the variable available over a reasonably long time period for all 26 EU countries?

D Robustness checks: Using an alternative openness shock variable

A large literature deals with the question on how to measure exogenous changes in trade and financial openness (see Gräbner et al., 2018, for a review). As already explained, the baseline results presented in sections 3 and 5 are based on a dummy variable that captures exogenous changes in the institutions of countries (in terms of entering the Eurozone/the EU) as an openness shock. Here, we provide a robustness check by using the KOF economic globalization index, which is a hybrid composite index that measures economic globalization along de facto measures (such as trade to GDP) and de jure measures (such as hidden import barriers). The interpretation for the results is that as the globalization index increases by 1 percentage point, the shock-dependent variables changes by an amount as represented by respective y-variable label. The results are qualitatively similar to the findings presented in the paper in section 3.

Note that we restricted the time dimension for this robustness check to the period 1990-2014. We do so for two reasons: first, we do not want to capture the change in the KOF economic openness index from the 1960s to 1980s; second, this way we can actually capture the whole period of European integration (of the Eastern European countries) after the fall of the Soviet Union, as well as the pre-crisis period of the Eurozone countries.

Figure 2 is showing a reproduction of our baseline specifications using the KOF economic globalization index instead of the dummy variable as the openness shock variable. For the underlying econometric approach, see section 3 of the main paper, in particular regression equation (1). The country sample consists of the same 26 EU countries. Standard errors are PCSE-corrected (Beck and Katz, 1995) and, hence, robust to cross-section heteroskedasticity and autocorrelation in the residuals.

Figures 3 and 4 represent the corresponding robustness checks for Figures 7 and 8 in section 5 of the paper. Again, we substitute the dummy shock variable with the KOF index for economic globalization and obtain qualitatively similar results.

E Details on the clustering analysis in section 4.1

We decided to use Ward's minimum variance method based on a comparison of all common clustering algorithms suitable for our case (see table 6). The corresponding clustering coefficient is satisfactory and suggests our results are reliable.

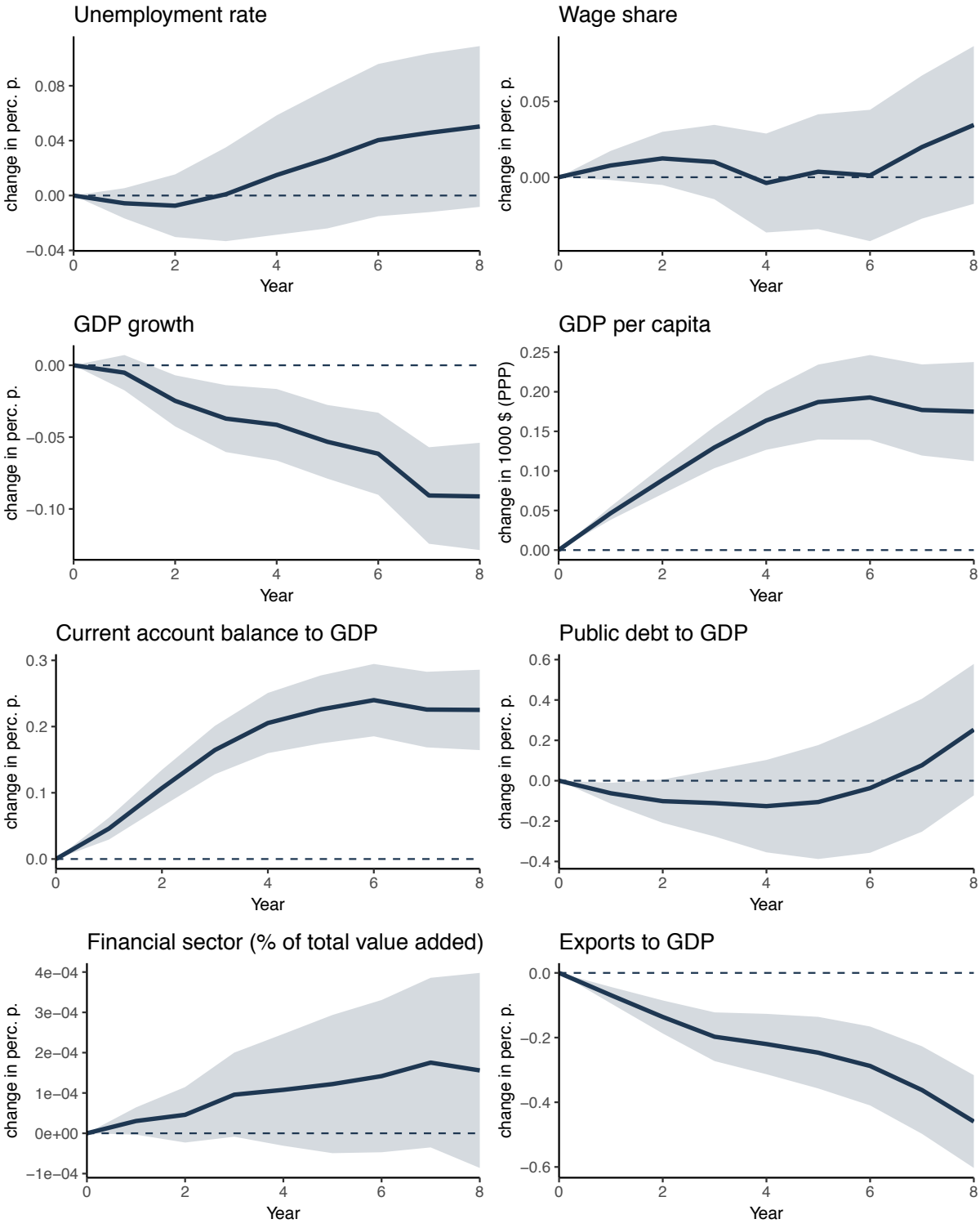

Figure 2: Robustness check for Figure 1 in the paper. Instead of the binary dummy variable of the main paper, the KOF economic globalization index is used.

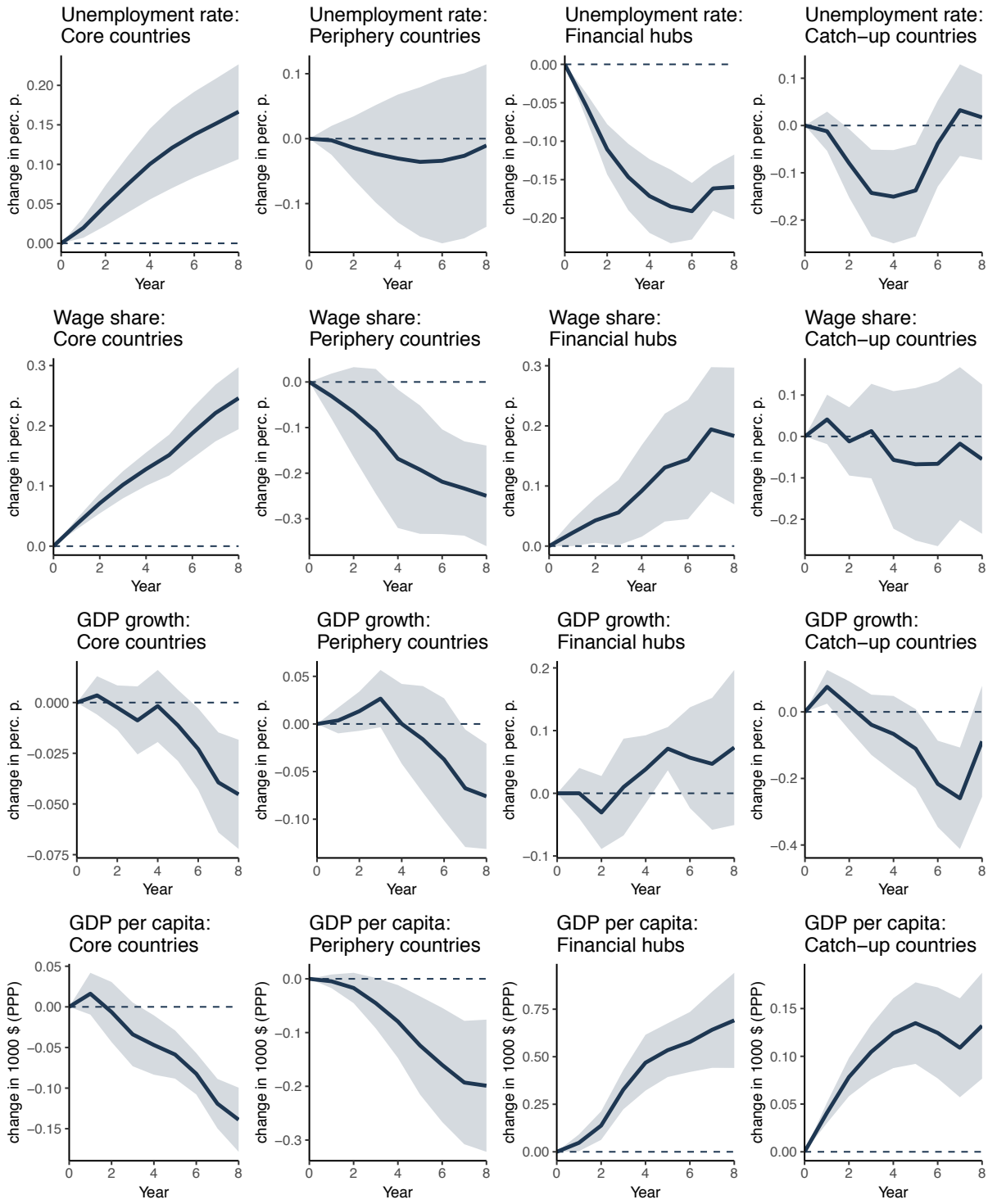

Figure 3: Robustness check for Figure 7 in the main paper.

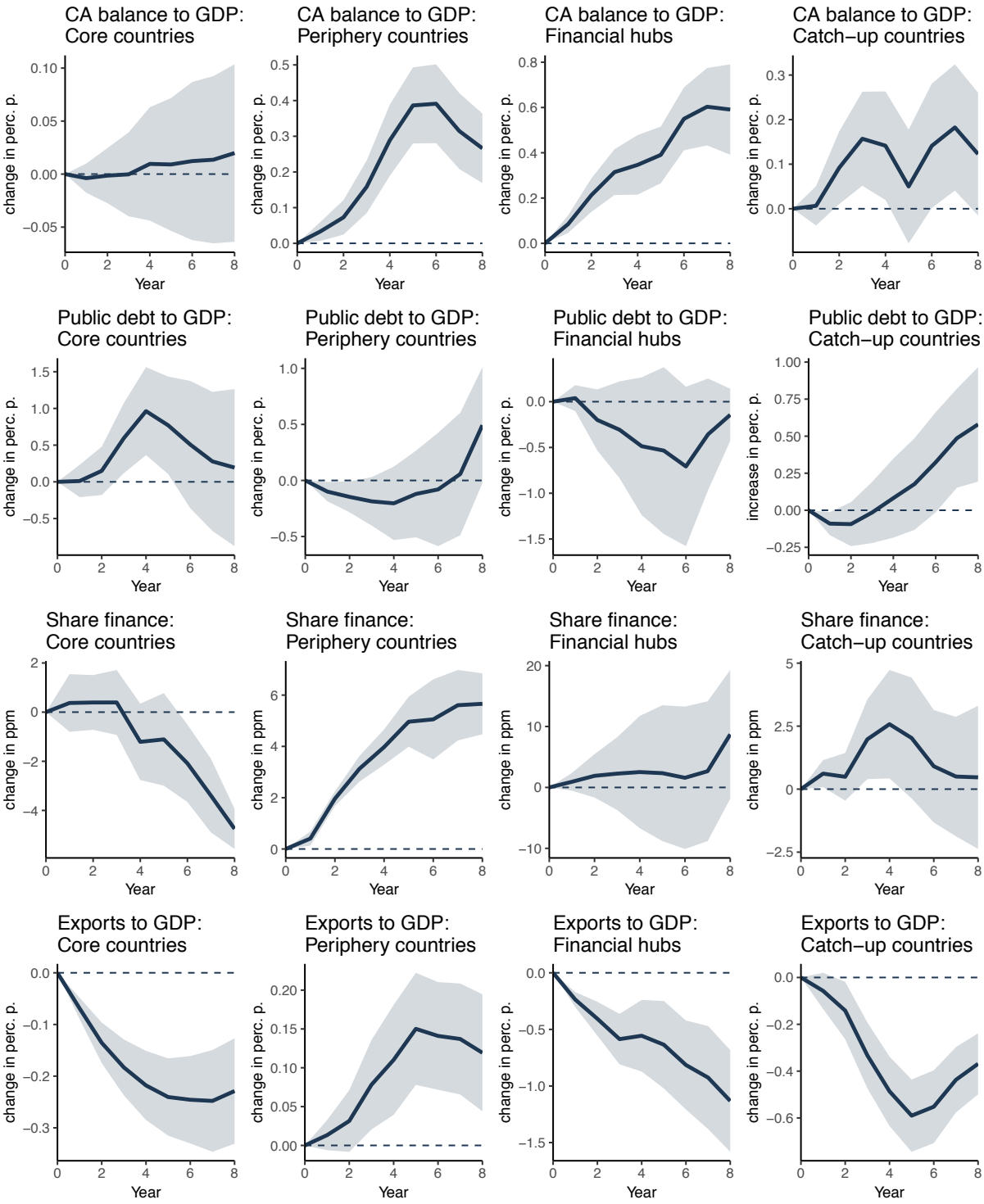

Figure 4: Robustness check for Figure 8 in the main paper

	Algorithm	Clust. coef.
1	agnes_ward	0.71
2	agnes_complete	0.69
3	diana_divisive	0.68
4	agnes_average	0.61
5	agnes_single	0.53

	Algorithm	Clust. coef.
1	agnes_ward	0.76
2	agnes_complete	0.73
3	diana_divisive	0.71
4	agnes_average	0.67
5	agnes_single	0.58

Table 6: Clustering coefficients for different clustering algorithms. The left table provides the coefficients for the clustering used in the main table, the right table the coefficients for the robustness check using only immediate responses.

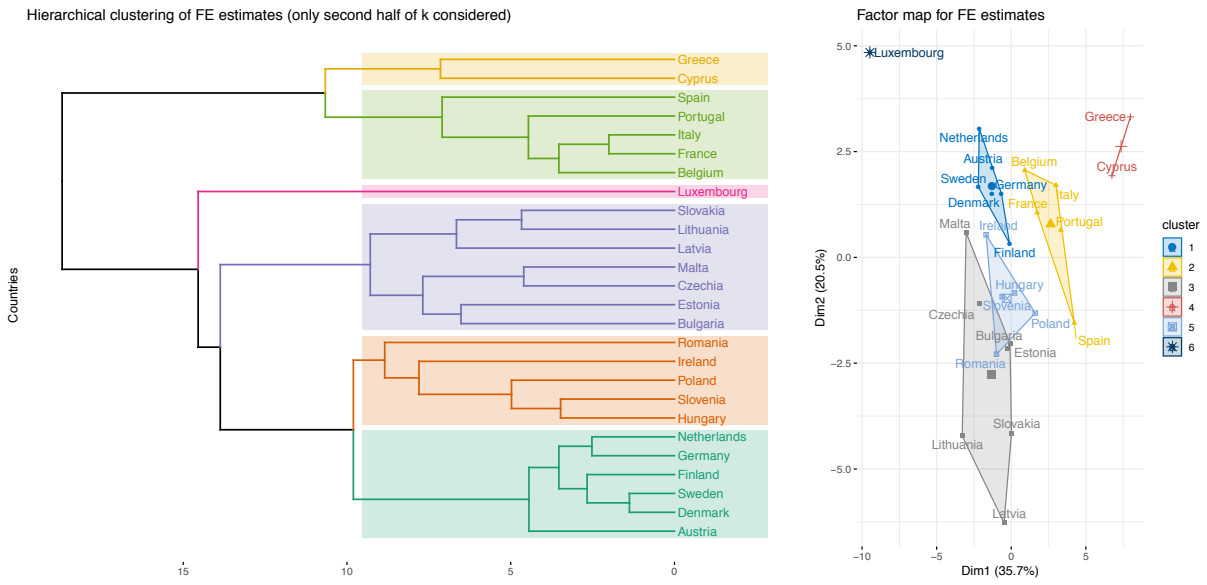

Figure 5: Clustering results considering only long-term reactions of the countries to the openness shock.

In Figure 3 of the main paper, we clustered countries based on the complete set of fixed effect estimates to exploit all the information we can get from the local projection estimations. One might, however, also argue that since we are discussing long-term path dependent processes, we should only use the country FE estimates for the later periods after the shock. While such restriction does not seem to be utterly convincing we nevertheless provide the relevant clustering results in figure 5, which underscore the robustness of the results presented in section 4.1, as they point to qualitatively similar conclusions.

Similarly, one might call into question the necessity to include very small and very financialized country such as Luxembourg, Malta or Cyprus. As shown in figure 6, the results of the analysis are robust against the exclusion of these three countries from the estimation.

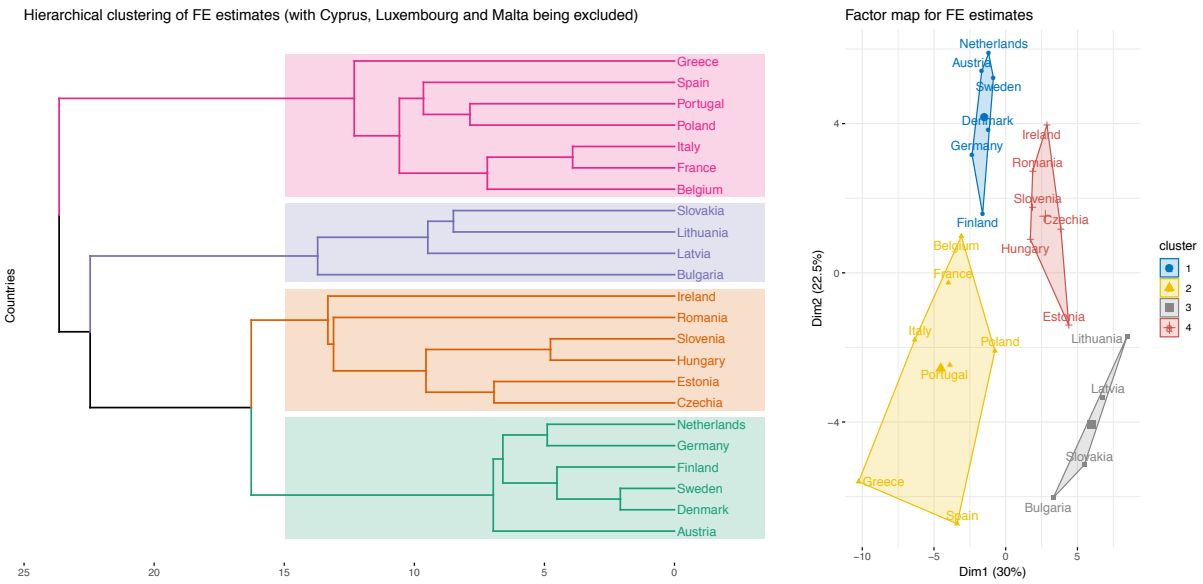

Figure 6: Clustering results with Cyprus, Luxembourg and Malta being excluded.

F Directedness of technological change

In section 4.3 of the paper, we regress the log of the positive and negative difference in the value of exports on the average product complexity, and weight the observations according to the share of the product in the country's export basket in 2012-2014. In figure 7 we provide the visualization of export expansions for all the country groups.

It becomes clear that the core countries in total show a positive relationship between positive changes and product complexity, meaning that they expanded their exports particularly for more complex products. This trend is particularly evident for Austria and Germany, and other core countries are struggling to hold their position (see discussion in the main paper). An even stronger relationship is observable for the Eastern European catch-up countries, particularly if we remove the Baltic states, which do not catch up in terms of technological capabilities at all. At the same time it is important to keep in mind that the *level* of capabilities is still much lower in the catch-up countries than in the core.

Countries in the periphery fall further behind, with their capabilities either stagnating or even worsening compared to the rest of the world. France, as often the case, takes an intermediate position, not showing a clear tendency towards more or less complex products (and by this, loosing ground in relation to the core countries).

Finally, the financial hubs generally show a negative trend, which is not surprising given the fact that their growth model does not rely on the production and the export of complex products.

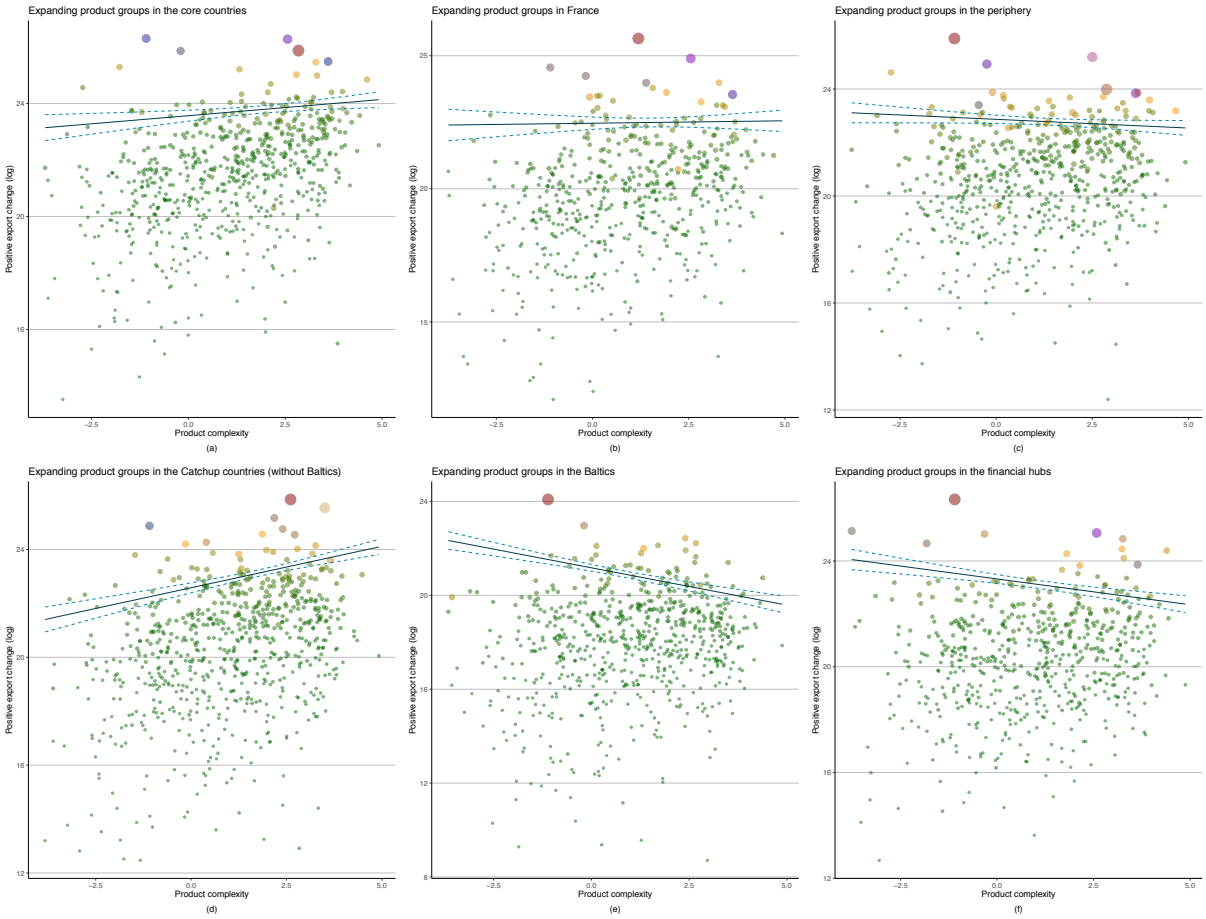

Figure 7: Sectoral development in our country groups.

G Population-weighted country group data (robustness check for section 4.2)

In addition to the plot on comparing the four different country groups with the rest of our sample in section 4.2 – where the data were based on non-weighted averages – we present the results weighted according to the population size of the countries in figure 8. The picture does not change in a substantive way, except for the case of the wealth tax revenues of the financial hubs: here, the Netherlands with their relatively large population push down the mean for the financial hubs even below the mean of the remaining countries. This is not surprising: as explained in the main text, the Netherlands follow a financialization strategy focused on a large shadow banking sector and low corporate taxes, not on the attraction of private wealth. Their relatively low revenue from wealth taxation is, thus, consistent with their classification as a financial hub.

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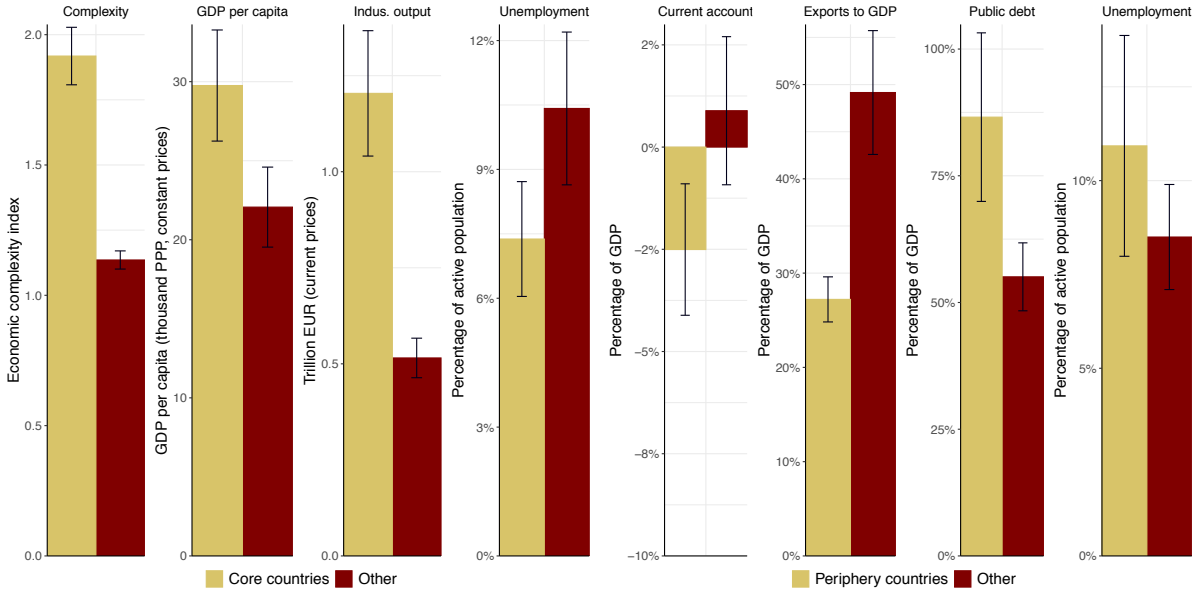
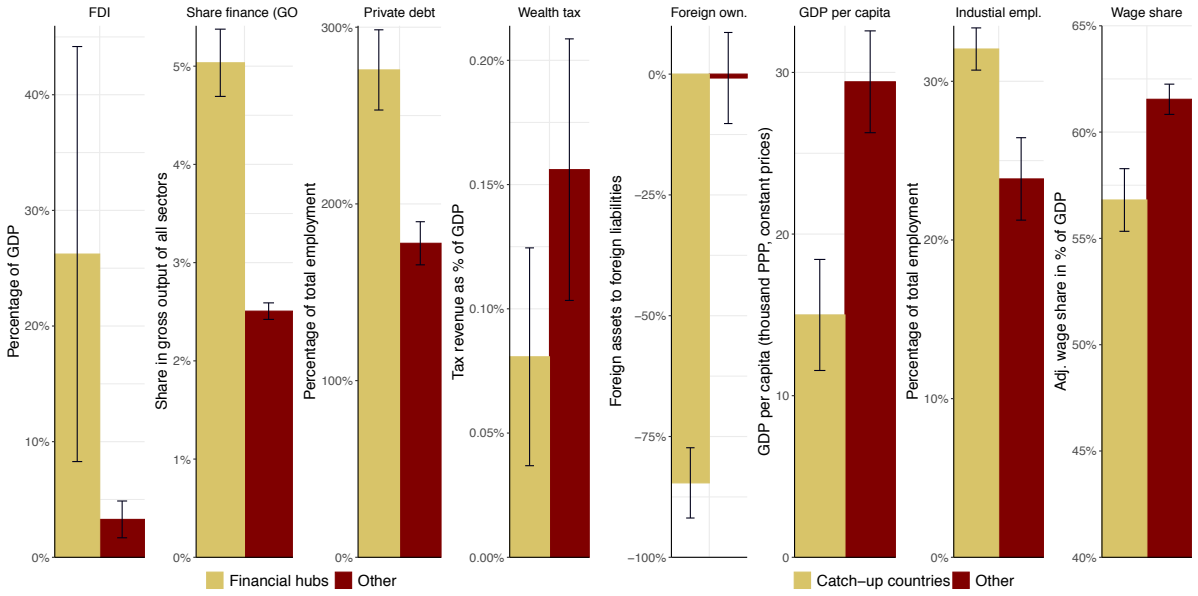


(a) Core countries compared to the rest.

(b) Periphery countries compared to the rest.



(c) Financialized countries and the rest.

(d) Catch-up countries and the rest.

Figure 8: Reproduction of Figure 4 using population-weighted averages.