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ABSTRACT
This study examines the lack of convergence among EU Member States from a structural perspective. We apply the tradable-nontradable framework (T-NT) to evaluate the heterogeneity in labour productivity before and after the great recession. We find that, across all countries, nontradables were less relevant for aggregate productivity. The low productivity growth in peripheral EU countries was accompanied by a specific structural change pattern: There was a sharp production increase of nontradables before the crisis relative to other EU countries. For most peripheral countries concerns about unfavourable sector structures remain, implying a continuation of unsustainable growth patterns. This has implications for the European Commission's macroeconomic imbalance procedures, since it allows identifying patterns of real divergence on a disaggregated level. Finally, we identify a link between sectoral growth asymmetries and the quality of domestic governance institutions. Especially differences in the legal system help to explain the observed productivity growth differentials.

KEYWORDS: TRADABILITY; LABOUR PRODUCTIVITY; GROWTH; INSTITUTIONS; EU; IMBALANCE
JEL: E01, E02, E60, O43, O47

Tradability and productivity growth differentials in EU Member States

1 INTRODUCTION

The global financial crisis highlighted dispersion in real and nominal economic indicators among EU member states. Many European economies succumbed simultaneously, which suggests that international factors played a role in the onset of the crisis. On the other hand, the fact that some EU countries were hard hit while others less suggests that also domestic factors mattered. In this respect the crisis highlighted the consequences of the divergent growth trajectories of EU countries prior to the crisis. The ECB finds evidence of divergence among the early adopters of the euro, and only little degree of real convergence among all EU countries (European Central Bank, 2015). This is in line with recent regional studies arguing that agglomeration effects become stronger with increasing levels of productivity which induces divergence processes (Petrakos, Kallioras, & Anagnostou, 2011). Yet, this contrasts evidence relying on older data that depicts the EU as a convergence club (Ezcurra, Pascual, & Rapún, 2007; Le Gallo & Dall'Erba, 2006).

Convergence patterns have traditionally been analysed by means of GDP per captita, an economic measure which solely addresses aggregate variables. However, it ignores the extent to which sectoral imbalances can build up underneath a seemingly tranquile macroeconomic surface. In this context, imbalances refer to potentially harmful developments that could adversely affect macroeconomic stability in a particular EU country or the EU as a whole. These comprise aspects such as a pronounced savings-investment gap, a real estate bubble, etc. [1] Against this background, we evaluate the macroeconomic performance of the EU member states on a more disaggregated level. We particularly focus on the supply side. The analysis draws on a two-sector model, the tradable-nontradable framework (T-NT). This versatile tool of macroeconomic modelling describes a mechanism in which a shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production structures. The T-NT approach captures by a simple extension real economic features that have profound economic implications. The presence of nontradable goods affects the economy along a multitude of dimensions, ranging from productivity, price determination, export potential and current account balances to the effects of macroeconomic policy.

The analysis is structured into three parts:

First, the T-NT approach and its macroeconomic implications are presented in an EU context. We observe a rather stable ratio of tradables to nontradables in countries that weathered the crisis well, while countries in the periphery experienced a sharp increase of nontradables before the crisis. In other words, the T-NT approach identifies a pattern of divergence among EU-countries on a two-sector level.

Second, productivity developments are reflected against this conceptual framework. We find that the productivity levels of tradables are higher than of nontradables. A descriptive regression analysis reveals that tradables are more relevant for aggregate productivity. In addition, productivity growth rates differ substantially across EU countries. Hence there is no evidence of a catching-up effect.

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[1] See https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/macroeconomic-imbalance-procedure/dealing-macroeconomic-imbalances_en#overviewoftheprocedure (retrieved on 6 November 2017).

Third, the results are put into an economic policy context, comprising both EU-wide policies and domestic policy reforms. The results suggest that the asymmetric productivity growth rates across EU Member States can be largely explained by differences in the quality of the domestic public administration and the local legal system.

Our contribution to the literature is threefold:

First, we expand the application of the T-NT approach to a sectoral productivity analysis and link it to an institutional context. This characterises a new element to the literature on convergence or divergence patterns within EU countries.

Second, we utilize the T-NT approach within a structural analysis of EU Member States in order to explain the growth differentials that became obvious in the aftermath of the crisis. While the tradable-nontradable framework has gained popularity in research on exchange rate mechanisms, its application to structural rebalancing is – despite its practical relevance – yet ignored.

Eventually, our study contributes to economic policy at both the individual country and EU level. The present application of the T-NT approach has implications for the European Commission's macroeconomic imbalance procedures, since it allows identifying patterns of real divergence on a disaggregated level. Moreover, it allows identifying an unsustainable sectoral composition of growth, which is still observable in many peripheral EU countries.

2 THE T-NT APPROACH

This paper relies on the tradable-nontradable (T-NT) approach, a two sector perspective of the economy, which links to a long standing strand of economic research on structural change and productivity. Such models typically perceive the economic structure to comprise a 'modern' (progressive, urban, here: tradable) and a 'traditional' (stagnant, rural, here: nontradable) sector (Baumol, 1967; Baumol, Blackman, & Wolff, 1985; Krüger, 2008; Lewis, 1954; McMillan, Rodrik, & Verduzco-Gallo, 2014; Ngai & Pissarides, 2007). The T-NT framework splits the production of an economy into two parts, one whose goods and services are tradable, and one whose output is consumed domestically and therefore regarded as nontradable.

At the core of the approach-NT framework is the distinction between tradables and nontradables. Nontradable goods can, by definition, only be consumed in the economy in which they are produced; they cannot be exported or imported. Tradable goods in turn can be exchanged internationally at negligible cost.[2] The basic version of the tradable-nontradable-goods-model is a partial equilibrium model; however, it has repeatedly been incorporated in large scale macroeconomic models (Anderson et al., 2013; Kumhof, Muir, Mursula, & Laxton, 2010). The approach is prominently and increasingly used in studies on exchange rate fluctuations (Benigno & Thoenissen, 2008; Burstein, Eichenbaum, & Rebelo, 2006; Corsetti, Dedola, & Leduc, 2008; Dotsey & Duarte, 2008; Engel, 1999; Ruscher, Wolff, European Commission, & Directorate-General for Economic and Financial Affairs, 2009). Only few

[2] Tradability is determined by two factors. The first is transport costs. The lower the transport costs relative to the total price of a good, the more likely it will be that this good is traded internationally. However, technological progress is likely to render some traditionally nontraded goods to tradable ones. This applies in particular to the service sector, where several kinds of financial services, including private banking, insurance, etc. are nowadays considered as tradable, whereas some decades ago they were perceived to be nontradable. The second factor is the extent of trade protectionism. Impediments to trade by means of tariffs and trade quotas create an obstacle to the flow of goods across national borders. These impediments comprise an artificial barrier to trade.

studies apply the T-NT approach in a different context. For instance, (Tesar, 1993) argues that the incorporation of nontraded goods helps to explain the low cross-country consumption correlations and the high correlation between savings and investment. Based on this, nontradable goods can be introduced in macroeconomic models, which is crucial to explain international business cycle characteristics (Stockman & Tesar, 1995).

A series of theoretical and empirical studies the potential of the T-NT approach in explaining major elements behind the Latin-American debt crisis of the 1980s (Sachs, 1987, 1989; Sachs & Larraine, 1993). These findings describe boom-bust cyclces, and thus are relavant for the recent European crisis. The presence of nontradable goods mirrors the internal structure of production, which tends to change with the trade balance. In particular, as domestic absorption rises or falls relative to income (so that the trade balance rises or falls), the mix of production in the economy between tradable and nontradable goods changes too. This implies that any imbalance on the demand side – described usually in the form of a trade or current account imbalance - is replicated by a corresponding imbalance on the supply side. Hence in the process of generating a trade surplus, the production of tradable goods has to increase while the production of nontradable goods has to decline. In other words, the trade surplus comes about not merely because of a fall in demand, but also because of a shift in the composition of output: away from nontradable goods production towards more tradable goods production. This helps explain why domestic booms are usually associated with increasing current account deficits.

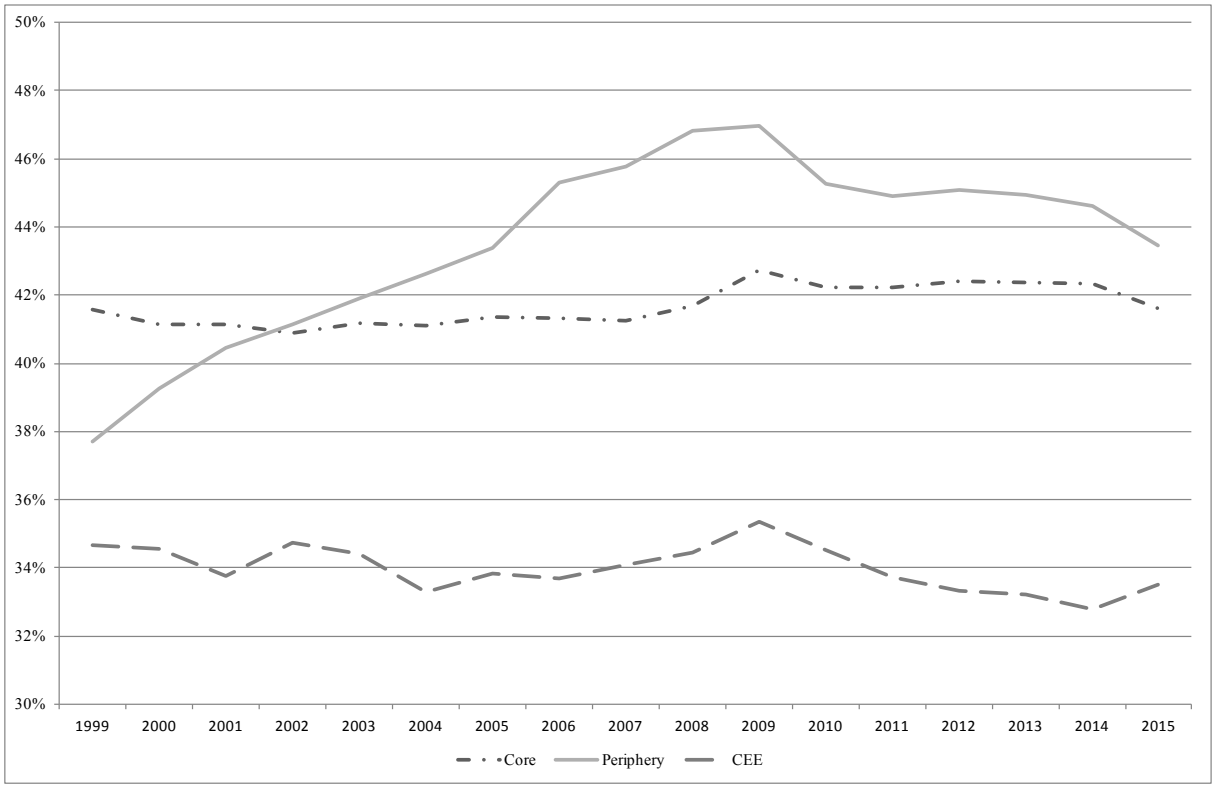
These features are next used to study the developments of economic structures across EU Member States, and thereby establishes a link to the structural change literature (Baumol et al., 1985; McMillan et al., 2014), which documents a decline of the manufacturing share and the rise of the business service sector as economies increase their aggregate productivity (Herrendorf, Rogerson, & Valentinyi, 2013; Krüger, 2008). This pattern has also been documented for the EU Member States and the United States, even though the shift from manufacturing to services may be partly due to statistical reclassifications (Bernard, Smeets, & Warzynski, 2017).

Figure 1 shows the corresponding path of nontradable goods production[3] as a share of GDP for three country groups[4]: (1) "Core" EU countries, (2) "Periphery" EU countries, and (3) "CEE" EU countries. The figure describes the imbalance on the supply side by means of the output composition which is characterised by the share of nontradable and tradable goods production. As such the figure highlights the change in the sectoral composition of production across various EU member states over time. The figure points out several characteristics which are in line with the implications of the T-NT-concept.

[3] A detailed discussion on the classification of tradable and nontradabel goods and services is provided in the appendix.

[4] We refer to Estrada et al. (2013) among others for the motivation for this particular country group classification. The "Core" economies include Austria, Germany, France, the UK, the Benelux countries (Belgium, the Netherlands and Luxembourg) and the Scandinavian countries (Denmark, Sweden and Finland). The countries of the group “Periphery” are comprised as follows: Greece, Italy, Cyprus, Ireland, Portugal, Matla and Spain. And finally the "CEE" countries are the Eastern, and Central Eastern European countries: Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia.

Figure 1: Nontradable goods share



Note: The graph shows the share of nontradable goods in total value added for three country groups between 2000 and 2016.

The boom in the "Periphery" countries prior to the outbreak of the global financial crisis is associated with a significant increase in the share of nontradable goods production. For the country group as whole, the share increased by nearly 10 percentage points: from a low of 37 percent in 1999 up to nearly 47 percent by the end of 2009. The rise occurred homogeneously in all countries of this group[5]. In contrast to that, the change in the share of nontradable goods production was negligibly small in the "Core" economies; for the group as a whole this share remained fairly constant until the global financial crisis.

The correction of the unsustainable output composition in the "Periphery" countries was characterised by a remarkable reallocation of resources: away from the nontradable goods sector towards the tradable goods sector. The excessive unemployment rates as well as low degree of capacity utilization rates in general in the "Periphery" countries within the European debt crisis show in how far these countries face a structural adjustment process on the production side[6]. The supply side rebalancing is replicated on the demand side – the current account the GDP ratio improved significantly (Atoyan, Manning, & Rahman, 2013; Tressel et al., 2014).

[5] The strongest increase was observed in Greece where the share of nontradable goods production was at a level of around 41 percent in 1999 and increased to above 53 percent in 2012.

[6] The drop was strongest in the case of Ireland, followed by Cyprus. These two countries' nontradable goods share in gross value added has now reached a level which is comparable to the one prior to the boom episode of the 2000's. In the case of the remaining countries of this group, the process of supply side rebalancing is still ongoing.

The observation that an unsustainable composition of output aggravated the recession in the "Periphery" countries is supported by the pattern of the "Core" EU economies: Their nontradable goods production share has been surprisingly constant across the last 15 years; it fluctuated slightly within a narrow band with 41 percent as a lower and 43 percent as an upper boundary. Moreover, the "Core" countries' nontradable goods share has been significantly lower than the one of the "Periphery" countries. Hence the "Core" economies faced lower structural impediments to growth as they were able to adhere to increased exports once global demand conditions improved.[7]

As concerns the "CEE" countries, the picture concerning the evolution of the share of nontradable goods is again distinct to the former two groups. The difference can be pinned down to two elements: (i) the first refers to the fact that the share of nontradable goods production is comparably low in these countries; for the group as a whole the average share of nontradable goods across the time span considered in Figure 1 is around 34 percent; the corresponding numbers for the "Core" and "Periphery" economies are, 40 percent and 44 percent respectively; (ii) for the country group as a whole, the share of nontradable goods production has been trending downwards. There is some degree of heterogeneity across CEE countries. Hungary, Lithuania, Poland and Slovenia are characterised by an explicit downward trend; whereas in Latvia and Croatia the share of nontradable goods production is on an upward sloping path. The share is rather constant in the remaining economies of this country group.

The mirror picture of the low and declining share of nontradable goods production in the "CEE" countries is that the tradable goods sector's share is high and increasing. This in turn highlights the - on average - high export shares of the "CEE" countries. In fact export shares of these countries increased, on average, within the last decades and are still rising. Referring to the T-NT-model, the adherence to higher export shares requires a higher share of domestic input factors for production devoted to the tradable goods sector. The declining share of nontradable goods production stands in stark contrast to the pattern of the "Core" economies and hence characterizes one source of increasing divergence between "CEE" and "Core" EU countries.

3 TRADABILITY AND PRODUCTIVITY

An important element that promotes a switch in the composition of production is the relative price of trade to nontraded goods. The concept of the relative price between nontradable and tradable goods gives rise to another implication which addresses the link between prices and productivity. Without the possibility of exports or imports, local demand and supply of nontradables must balance. Without international trade, a drop in domestic demand cannot be met by an increase of net exports, and domestic prices can differ from foreign prices without setting in motion a shift of international demand. Moreover, the fact the nontraded goods are not traded across borders implies that their prices are determined by domestic factors only. In the case of tradable goods, their prices obey the law of one price because of arbitrage. This implies that aggregate real exchange rate movements are driven entirely by cross-country

[7] For instance, Germany reported a strong increase in exports once domestic demand faded as the European debt crisis emerged. The strong rebound in German exports after the financial crisis occurred at a point in time when global demand strengthened. As Tressel and Wang (2014) highlight, Euro Area countries have experienced significant differences in the demand for their exports. Between 2008 and 2012, total trading partners' demand for German exports grew by 4.7 percent, compared to 2.8 percent for France, 1.8 percent for Spain, 1.7 percent for Italy, 0.5 percent for Greece, and -0.3 percent for Portugal. These differences reflect the country's export specialisation. Export demand growth was more sluggish in "periphery" countries due to the specialisation in slower growing markets outside the euro area (in the case of Greece and Italy) or due to a lower share of exports to non euro area countries (Spain, Portugal).

movements in the relative prices of nontraded to traded goods within countries (Sachs & Larraine, 1993; Wickens, 2011).

The extent to which the presence of nontraded goods matters for price determination in turn also has important implications for productivity. The price of nontraded goods can be shown to depend directly on the relative productivity in the two sectors (Sachs & Larraine, 1993). Hence, high productivity in the tradable goods sector implies high wages in terms of tradable goods, but high productivity in the nontradable goods sector means low input per unit of nontradables production. The price of nontradable goods therefore depends on the relative productivity in the two sectors rather than on the productivity in either sector individually (see also Balassa (1964)who shows that productivity differentials between developed and developing countries are much higher in the tradable goods sector than in the non-traded goods sector).

3.1 Productivity differences between sectors

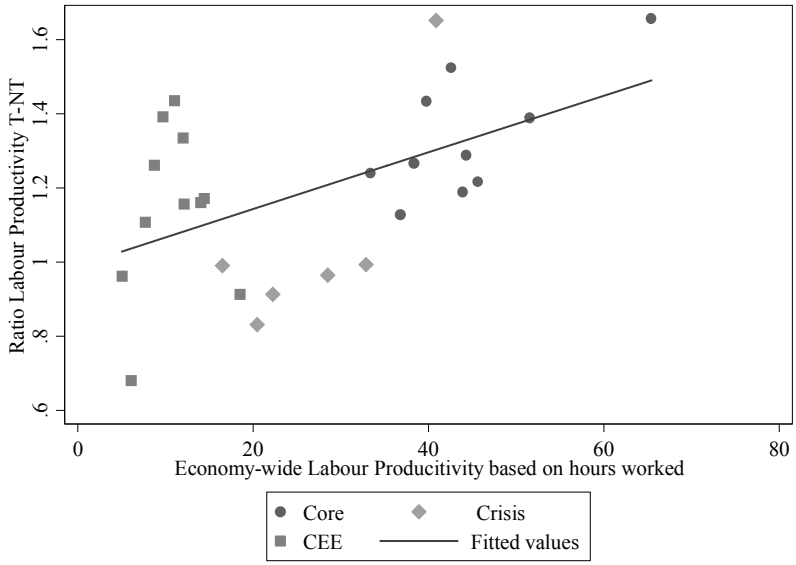
Two sector models typically assume a more and a less productive sector. For instance, such a productivity gap has been shown in a worldwide sample between agriculture as the 'traditional', less productive sector and non-agriculture as the modern sector. This gap widens as developing countries increase their GDP per capita, and then becomes smaller the further countries develop (McMillan et al., 2014).

In the present framework, tradables are perceived to be more relevant for aggregate productivity than nontradables. There should be a productivity gap between the two sectors that can be explained systemically. Eurostat data on value added and hours worked allow for the computation of labour productivity indicators for EU Member States. Splitting the sample into a tradable and a nontradable sector supports the notion of a gap. The labour productivity of tradables is, on average across all countries and years, 19 percent higher than for nontradables.[8]

Plotting the ratio of tradable to nontradable labour productivity against the economy-wide labour productivity reveals a log-linear relationship (see Figure 2). The higher the economy wide labour productivity, the higher the gap between tradables and nontradables becomes.

[8] This results hinges on an outlier correction where sector L [Real estate activities] – consider the Apenndix for a detailed description of the data and the sector split. The figures for sector L are upward biased since imputed rents are included. Including the real estate sector would lead to a higher labour productivity of nontradables by around 7 percent.

Figure 2: Labour Productivity Ratio of T to NT versus Total Economy



Note: The graph shows the relationship between the labour productivity of nontradables (NT) versus tradables (T) and the economy wide labour productivity across countries. The figures are arithmetic means covering the entire period. The sector 'Real estate activities' (L) is excluded, since it introduces a bias due to the presence of imputed rents.

Identifying whether tradables and nontradables differ in their effects on aggregate productivity we implement a regression technique proposed by Herrendorf et al. (2013). The logarithm of an economy's aggregate labour productivity (based on hours worked, in 2010 Euros) is regressed on the labour productivity of tradables and nontradables. Cognisant of endogeneity issues, we use this method as a descriptive tool showing that the industrial structure is relevant for differences in aggregate productivity (Herrendorf et al., 2013; Peneder, 2003). The regression equation takes the form of:

$$log(LP_{i,j,t}) = a_i + b_i\, log(LP^{GDP}_{j,t}) + e_{i,j,t} \qquad \text{(Eq. 1)}$$

$$where\ e_{i,j,t} \sim i.i.d.\ N(0, \sigma^2)$$

where a_i is an intercept for sector i across a sample of j countries, and b_i is the elasticity of sector i's labour productivity with respect to the aggregate labour productivity (real value added of the total economy per hour worked). The regression can be interpreted as deviations from a reference country given by Herrendorf et al., (2013):

$$log(LP_{i,j,t} / LP_{i,ref,t}) = b_i\, log(LP^{GDP}_{j,t} / LP^{GDP}_{ref,t}) + (e_{i,j,t} / e_{i,\,ref,t}) \qquad \text{(Eq. 2)}$$

$$\text{where } e_{i,ref,t} \sim i.i.d.\ N(0, \sigma^2_{ref})$$

If the coefficient b_i takes on the value of one, the productivity of the sector in question equals aggregate productivity. Hence, if $b_i = 0$ there is no systematic sector variance associated with aggregate outcomes. A coefficient larger than one indicates a strong influence on aggregate productivity of a given sector. Hence, we first define two sectors to implement this regression approach: tradables and nontradables. The descriptive statistics are provided in Table 1 in the Appendix.

The regression results show coefficients below one for nontradables, and coefficients above one for tradables (see Table 2). The difference between the coefficients becomes more pronounced if country fixed effects are considered. The specification explains a substantial degree of the observed variance, with one notable exception. The within R^2 of the country fixed effects estimator for nontradables explains approximately 10 percent, which is vastly lower than the corresponding R^2 for tradables. This indicates strong country-specific influences affecting the relationship between sectoral and aggregate productivity.

Table 1: Elasticity of tradable and nontradable labour productivity on aggregate productivity

	(1)	(2)	(3)	(4)
Estimator	FE	FE	OLS	OLS
Dep. Var. in nat. logs.	NT	T	NT	T
Economy wide LP (nat. logs)	0.57**	1.18**	0.89**	1.06**
	(0.073)	(0.037)	(0.042)	(0.022)
Constant	1.41**	-0.56**	0.43**	-0.21**
	(0.238)	(0.121)	(0.146)	(0.071)
Observations	384	384	384	384
R^2	0.94	0.99	0.94	0.99
R^2 within	0.10	0.94		

Note: This table reports the regression results for the elasticity of tradables (T) and nontradables (NT) on aggregate productivity. Standard errors in parentheses; overall R^2 and robust s.e. in (1) and (2); clustered s.e. in (3) and (4). Significance levels: ** $p<0.01$, * $p<0.05$, + $p<0.1$.

The results are robust to alterations of the econometric specification, and remain qualitatively unchanged if labour productivity is based on persons employed instead of hours worked, or if economy-wide size weights (hours worked or persons employed) are considered in the estimation. The coefficients also remain similar if time effects are included (either by a crisis dummy taking on the value of one for years after 2008 and zero otherwise, or by four year period dummies). These findings are in line with previous findings (Herrendorf et al., 2013), and support the notion that aggregate productivity is not independent from the sector composition (Duarte & Restuccia, 2010; Krüger, 2008; McMillan et al., 2014; Peneder, 2003).

3.2 Productivity growth potential from a structural change perspective

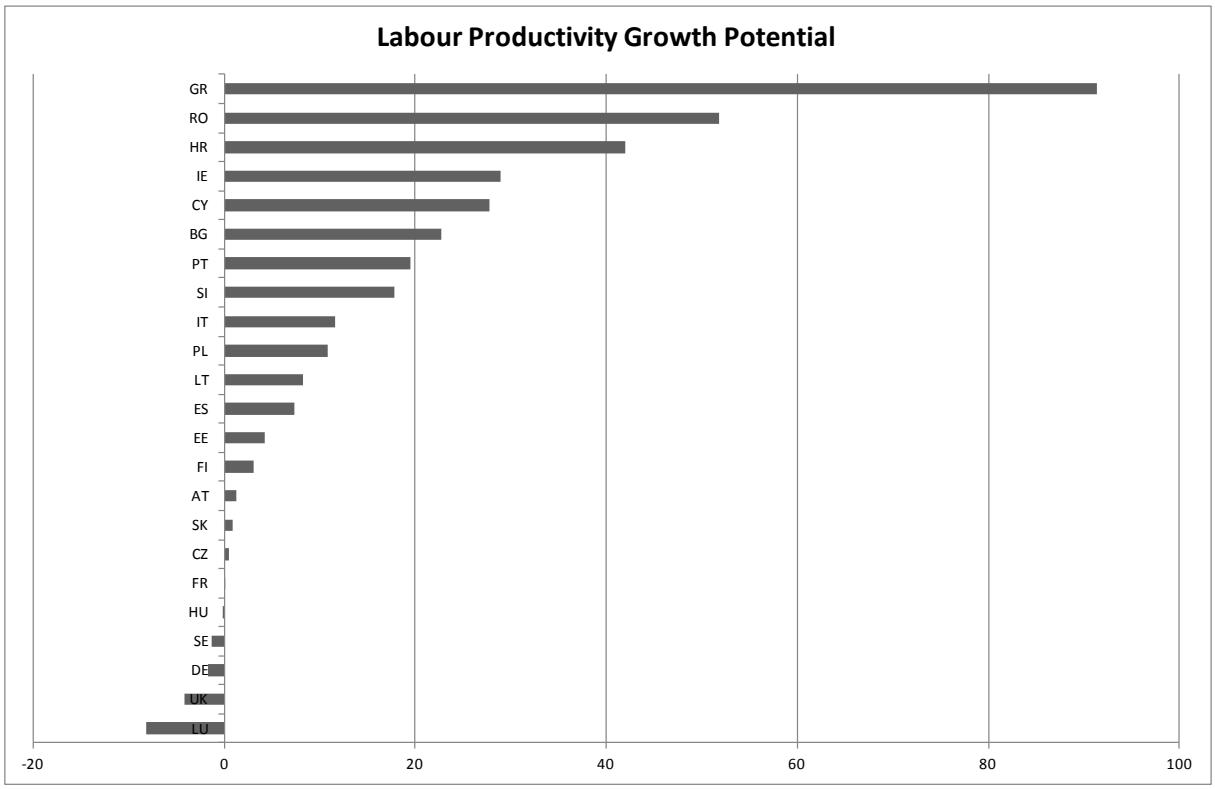
The regression results indicate that tradables are more relevant for aggregate productivity than nontradables. This is in line with another implication of the T-NT approach: the sector composition is a determinant of aggregate productivity. Hence, a shift towards tradable sectors should decrease the gap in aggregate income levels. In other words, structural change in favour of tradables is therefore desirable, especially for less productive economies. A shift towards low productive activities (i.e. the nontradable sector) is likely to be growth reducing.

It is unclear to what degree the productivity gap at the aggregate level can be attributed to sub-optimal sector composition. We implement a hypothetical structural change scenario to explore this question. First, we construct an artificial economy by calculating the mean sector composition (i.e., the employment shares) of the three most productive economies (Belgium, Denmark and the Netherlands). Second, the sector specific labour productivities across countries are multiplied by the synthetic employment shares. Third, a hypothetical aggregate

productivity index is calculated, and confronted with the status quo of aggregate labour productivity. This allows identifying the growth potential that countries can realise if they were able to adjust their sector composition to the structure of highly productive benchmarking countries.

The results show that the labour productivity of especially Greece, Romania, Croatia, Ireland, Cypress Bulgaria, Portugal, Slovenia and Italy would benefit, if they were able to implement the sector structures of the most productive countries. The CEE economies which are part of the 'manufacturing core' seem to have mirrored the structures of highly productive economies such as Germany or Austria. This is in line with other results on the economic structures of the EU (Stehrer 2016). The UK and Luxemburg would lose from an adjustment of industrial structures, which can be explained by their peculiar industrial structures which are dominated by highly productive financial sectors (see Figure 3).

Figure 3: Labour Productivity Growth Potential due to Structural Change



Note: The graph shows the potential growth in aggregate labour productivity. It confronts aggregate labour productivity (mean values for 2000-2014) with aggregate labour productivity if the economic structures (labour share composition) of the three most productive economies are assumed (Denmark, Netherlands and Belgium; Luxemburg has not been considered even though its highly productive economy as an outlier due to its small size).

Such a structural change scenario hinges on differences in labour productivity between sectors, which decreases as countries grow in aggregate productivity. As countries' economy-wide labour productivity increases, the growth potential resting on sectoral reallocation becomes smaller. The coefficient of variation of labour productivity across industries is negatively correlated with aggregate productivity (ρ: -0.80; p-value: 0.000). This is in line with previous results that document falling productivity gaps as incomes increase (Duarte & Restuccia, 2010; McMillan et al., 2014; Restuccia & Rogerson, 2013). Certainly, such an analysis has caveats. A sector composition is the outcome of an economy's comparative advantages, which are shaped by a country's institutional quality and its factor endowments.

This implies that economic structures cannot be simply adjusted. It seems that higher shares of the nontradable sector are rather a symptom of a lack of opportunities in tradables. There are other influences within the broad field of 'competitiveness' that shape the sector composition, such as economic institutions and comparative advantages (Chor, 2010; Nunn & Trefler, 2013).

3.3 Productivity growth differences

Structural differences across countries and sectors point towards a nuanced picture of productivity growth. We therefore analyse changes in aggregate productivity across countries at the sector level using a conventional shift-share analysis[9]. The technique decomposes annualised labour productivity growth into a (i) structural and (ii) a within-sector component. The structural component captures the contributions arising from changes in the sectoral composition of employment. The within-sector contribution in turn is an indicator of productivity upgrading in given structures. The methodology also involves an interaction term between the former two components. This element shows the joint effect of changes in employment shares and sectoral productivity. The effect is positive if sectors with above-average productivity growth increase their share in total employment. It is negative if sectors with growing employment shares have below-average productivity growth, or if the shares in total employment of sectors with high productivity growth are also declining. The indicator is a reflection of adjustment frictions which are depicted in Baumol type models (McMillan et al., 2014; Ngai & Pissarides, 2007).

The results show that in the pre-crisis period, more than three quarters of the labour productivity increases could be attributed to the within sector effect. In the post-crisis period this share increased to more than 90 percent. This implies that structural changes became almost negligible after the crisis, which indicates rebalancing mechanisms. Contrasting these findings against previous results on productivity growth patterns provides a mixed picture. Approximately half of the productivity growth in catching-up countries has been found to occur within industries (Duarte & Restuccia, 2010), which is not found in the present data.[10]

There are substantial differences across countries, not only with respect to aggregate labour productivity growth, but also to the composition of labour productivity growth. In the pre-crisis period, Sweden, Finland and Austria exhibited the highest growth rates, which were largely driven by within productivity increases. The lowest annualised productivity growth was found in Italy, Spain, Poland and Bulgaria. In the post-crisis period, the aggregate productivity growth dropped. The three best performing countries were Denmark, Sweden and the Netherlands, and the lowest productivity increases after 2008 were observable in Greece, Bulgaria and Finland (see Table 3).

The variation across countries can be summarised in the mean contribution to labour productivity growth in country groups, comprising the Core Countries in Northern and Western Europe, the Periphery and the New Member States in CEE (see Table 4).

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[9] See the Appendix for technical details on the applied methodology.

[10] Data restrictions affect this analysis. Data for Malta, Croatia, Poland, and Hungary are not available for the period before 2009 and hence the entire period. Data for Malta and Hungary are missing in the sample after 2008. In the pre-crisis period, Poland is reported from 2003 onwards. Data for Ireland is unreported due to outliers with respect to the price deflators. These affect in particular the sectors H (Transportation), L (Real Estate), R (Arts, Entertainment) and S (other service activities). In addition, there is a break in the employment time series in the year 2011.

The results show that the highest labour productivity increases were observable in the Core countries. These were largely driven by within productivity growth contributions of tradables, which corresponds to the previous observation that certain sectors systematically contribute more to aggregate growth than others (Peneder, 2003).

In the pre-crisis growth pattern, the CEE countries also grew substantially. While their pattern with respect to tradables and nontradables resembled that of Core countries, the growth rates were lower. A similar picture is observable for the period between 2009 and 2014.

Labour productivity growth in the pre-crisis period was modest in periphery countries. Positive growth contributions came from a shift towards nontradables. In the re-balancing phase after 2008, labour productivity growth remained at the same level. The ratio of contributions of tradables to nontradables became more similar to the ratio of the Core and CEE countries, however.

Overall, there is no evidence for a convergence effect with respect to productivity growth across the country groups. The most productive countries exhibit the highest productivity growth rates.

The contributions of structural change (i.e. the between sector contribution and the interaction effect) show a mixed pattern, and often cancel each other out. This suggests a rather weak impact of structural change on aggregate productivity growth, which is in line with previous research (Peneder, 2003). The effect of structural change dropped close to nil across all country groups after the Great Recession. This indicates that structural adjustment in terms of changes in the sector composition largely came to a halt. Productivity increases almost exclusively occurd within sectors.

Table 2: Results of the labour productivity decomposition across countries (pre and post crisis)

	Pre crisis (2000 – 2008)				Post crisis (2009 - 2015)				Total Period (2000 - 2015)			
Country	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**
AT	0.52	0.12	-0.03	0.61	0.42	0.04	-0.01	0.45	0.41	0.08	-0.02	0.46
BE	0.63	-0.04	-0.08	0.50	0.45	-0.04	-0.05	0.36	0.50	0.02	-0.15	0.37
DE	0.55	0.03	-0.04	0.54	0.54	-0.05	0.00	0.48	0.44	0.00	-0.05	0.39
DK	0.18	0.16	-0.07	0.27	0.86	-0.04	-0.02	0.80	0.45	0.11	-0.12	0.44
FI	0.57	0.10	-0.09	0.58	0.25	-0.04	-0.03	0.17	0.28	0.09	-0.11	0.25
FR	0.38	0.09	-0.05	0.42	0.40	0.01	-0.01	0.40	0.39	0.03	-0.06	0.36
UK	0.41	0.20	-0.11	0.50	0.19	0.04	0.00	0.22	0.24	0.13	-0.08	0.29
LU	-0.34	0.43	-0.12	-0.03	0.46	0.07	-0.10	0.44	-0.08	0.30	-0.17	0.05
NL	0.65	-0.05	-0.09	0.51	0.63	-0.05	-0.06	0.52	0.51	-0.03	-0.07	0.41
SE	0.73	0.08	-0.07	0.74	0.75	-0.04	-0.03	0.68	0.63	0.04	-0.10	0.57
CY	0.16	0.14	0.00	0.29	0.05	0.25	-0.01	0.28	0.10	0.19	-0.03	0.26
ES	0.04	0.21	-0.14	0.11	0.39	0.02	-0.02	0.39	0.24	0.13	-0.11	0.26
GR	0.09	0.60	-0.34	0.34	-0.19	0.05	-0.02	-0.16	-0.08	0.38	-0.20	0.09
IT	-0.02	0.07	-0.06	0.00	0.30	0.02	-0.02	0.30	0.07	0.06	-0.06	0.07
PT	0.19	0.05	-0.04	0.20	0.13	0.08	-0.01	0.20	0.15	0.07	-0.03	0.19
BG	0.10	0.05	-0.02	0.13	0.13	0.03	0.00	0.16	0.11	0.04	0.00	0.15
CZ	0.45	0.05	-0.03	0.48	0.32	-0.01	-0.01	0.30	0.32	0.02	-0.01	0.34
EE	0.46	-0.01	-0.03	0.42	0.28	0.02	-0.07	0.23	0.38	0.38	0.38	0.38
HR	n.a.				0.14	0.11	-0.03	0.22	n.a.			
LT	0.41	0.10	0.00	0.50	0.35	0.02	-0.01	0.35	0.33	0.07	-0.03	0.38
LV	0.25	0.30	-0.19	0.37	0.27	0.01	-0.03	0.24	0.25	0.21	-0.16	0.30
PL	0.07	0.04	0.00	0.11	0.28	0.03	-0.01	0.30	0.15	0.04	0.01	0.20
RO	0.22	0.13	0.03	0.38	0.27	0.04	-0.04	0.27	0.23	0.10	-0.03	0.30
SI	0.36	0.30	-0.10	0.57	0.23	0.03	-0.01	0.26	0.22	0.22	-0.11	0.32
SK	0.57	0.02	-0.05	0.54	0.40	0.00	0.00	0.41	0.46	0.02	-0.06	0.42

Table 3: Results of the labour productivity decomposition across country groups by tradability

	2000-2008				2009-2015				2000-2015			
	Within	**Between**	**Inter.**	**Total**	**Within**	**Between**	**Inter.**	**Total**	**Within**	**Between**	**Inter.**	**Total**
Core												
NT	-0.05	0.17	-0.03	0.09	0.01	0.05	-0.01	0.06	-0.02	0.15	-0.03	0.09
T	0.48	-0.06	-0.04	0.38	0.48	-0.07	-0.02	0.40	0.40	-0.07	-0.06	0.27
Total	0.43	0.11	-0.07	0.46	0.50	-0.01	-0.03	0.45	0.38	0.08	-0.09	0.36
Periphery												
NT	-0.08	0.24	-0.07	0.09	0.06	0.03	0.00	0.09	-0.02	0.16	-0.04	0.09
T	0.17	-0.03	-0.04	0.10	0.08	0.05	-0.02	0.12	0.12	0.01	-0.04	0.08
Total	0.09	0.21	-0.12	0.19	0.14	0.08	-0.02	0.20	0.10	0.17	-0.09	0.17
CEE												
NT	0.02	0.09	-0.02	0.09	0.04	0.01	-0.01	0.04	0.02	0.05	-0.01	0.06
T	0.30	0.02	-0.02	0.30	0.23	0.02	-0.01	0.24	0.23	0.02	-0.03	0.22
Total	0.32	0.11	-0.04	0.39	0.27	0.03	-0.02	0.28	0.25	0.08	-0.05	0.28

Note: The group of core countries contains AT, BE, DE, DNK, FI, FR, UK, LU, NL and SE. The periphery comprise CY, ES, GR, IT and PT. the CEE group consists of BG, CZ, EE, HR, LT, LV, PL, RO, SI and SK.

4 TOWARDS ECONOMIC POLICY - DOMESTIC INSTITUTIONS AND PRODUCTIVITY GROWTH

The observed asymmetries in productivity growth evoke the question about the factors that shape these differences at the country level. The institutional trade literature would argue that the presence of high quality institutions can explain performance differences (Acemoglu & Guerrieri, 2008; Chor, 2010; Nunn & Trefler, 2013). To this end we make use of two indicators from the World Bank's World Governance Indicators: Government Effectiveness and the Rule of law.[11]

The decomposition of productivity growth revealed different patterns with respect to the sources of aggregate growth. In the Core European countries the within productivity growth contributions dominate aggregate growth, i.e. the productivity upgrade in a given sector structure. In the countries of the Periphery productivity contributions from structural change are more important, i.e. the growth contribution that is due to a change in the sector structure. It is likely that these are subject to different underlying dynamics, and that the impact of domestic institutions differs between those two indicators. To obtain a long-run picture covering more than one business cycle, we use the cross-sectional productivity growth figures between 2000 and 2014 at the industry level.

To link countrywide institutions with productivity growth at the industry level, we apply a method aiming at overcoming identification issues by a quasi difference-in-difference estimator. We implement a technique which was originally proposed by Rajan and Zingales (1998) and extended by a bias correction by Ciccone & Papaioannou (2007, 2009). The idea of the estimator is to assess the extent to which industries benefit differently from the quality of the institutional environment; that is, well functioning institutions have a different impact on different industries. Hence, we take into account both the variance of country level indicators and cross-industry variation in the tradability of goods and services.

In this set-up, tradability is the vehicle through which the identification occurs. Tradability measures the average value added share of each industry. It is a steady index which moderates the impact of institutional characteristics across heterogeneous industries. The distribution of the tradability index seems to be remarkably stable over time (see Appendix).

Hence, the basic regression equation is:

$$PG_{c,i} = \alpha + \beta\,(INST_{c,t} \times TRAD_i) + \mu_c + \mu_i + e_{c,I} \qquad \text{(Eq. 3)}$$

$$\text{where } e_{c,i} \sim i.i.d.\ N(0, \tilde{\sigma}^2)$$

[11] Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The indicator encompasses aspects such as the quality of public administration, infrastructure, education and health. This indicator has been argued to be a powerful indicator and is closely associated with per capita income (Lee and Whitford 2009) and the spread of democracy (Magalhães 2014). The second indicator captures another general aspect – the Rule of Law. It quantifies the perceptions of the extent to which agents have confidence in and abide by the rules of society. It measures the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. It measures both de jure and de facto aspects of the rule of law. Like government effectiveness, Rule of Law is a composite indicator which has been linked to economic growth (Haggard and Tiede 2011). See http://info.worldbank.org/governance/wgi/pdf/ge.pdf and http://info.worldbank.org/governance/wgi/pdf/rl.pdf (accessed on 27th of July 2017).

$PG_{c,i}$ is the productivity growth indicator from the previous shift-share analysis. Two indicators are used: (i) the "within productivity growth contributions" and (ii) the structural change contributions, defined as the sum of the "between contributions" and the "interaction effects". $INST_c$ denotes a country-specific institutional indicator (Rule of Law or Government Effectiveness), and $TRAD_i$ is an industry-level tradability measure. i indexes industries and c countries; μ_c and μ_i are country and industry specific effects, respectively. Table 5 in the Appendix provides descriptive statistics of the variables used.

This method has been criticised due to its susceptibility to biases. For instance, the tradability index may contain industry characteristics that are affected by other influences. Productivity growth may reflect both global as well as country-specific demand and productivity shifts unrelated to tradability (Ciccone & Papaioannou, 2007, 2009). We therefore implement an instrumental variable regression to control for a possible bias which was proposed by Ciccone & Papaioannou (2007).[12]

The impact of the quality of the institutional environment on productivity growth is captured by the coefficient β. This coefficient is identified, because country and industry specific effects are included in the regression. In addition, the estimator minimises endogeneity issues with regard to institutional quality and productivity. The interaction term allows inferring the causal effect of institutional quality on the respective productivity growth contribution, while controlling for observable factors that have been omitted from the regression equation, which might be potentially correlated with national policy characteristics (Bravo-Biosca, Criscuolo, & Menon, 2016).

The results of the regression are presented in Table 6. The estimates for the "within" growth contribution are positive. This shows that productivity growth is fostered by good governance. The sign of the parameter estimates for β once the structural change measure is used ("Str. Change") is negative in both specifications. This means that countries with better governance achieve negative contributions to labour productivity growth from structural change. It has previously been shown that the growth contributions of structural change are potentially negative (Peneder, 2003). This effect becomes more stable in the present estimates, which consider tradability as the vehicle through which institutional quality affects industrial performance. All estimated coefficients are statistically significant.

[12] This two-step methodology estimates industry indicators that reflect industry characteristics in a (hypothetical) country facing representative demand, technology and policy shocks. The first step computes the least squares prediction for the industry indicators (IND) based on a regression on country and industry-specific effects, as well as the interaction of the respective country-level institutional indicator ($INST_{ct}$) with industry effects. The benchmarking countries are not used in this estimation to assure that the predictions do not capture specific effects of the benchmark-country (to technically implement the estimator we generate an artificial country by averaging the figures for Denmark and Sweden). In the second step, the IV is generated by predicting the industry-specific indicators for the averaged values of the benchmark countries. This variable is equal to the estimated industry fixed effect plus the benchmarking country value of the institutional quality variable multiplied by its industry-specific coefficient (for a detailed discussion of the estimator see Ciccone and Papaioannou 2009, 2007).

Table 4: Regression results explaining productivity growth contributions

	Government Effectiveness		Rule of law	
	(1)	(2)	(3)	(4)
	Within	Str. Change	Within	Str. Change
Trad*INST	0.0466*	-0.0684**	0.0430*	-0.0667**
	(0.020)	(0.018)	(0.021)	(0.017)
Constant	-0.0079	0.0268**	-0.0084	0.0286**
	(0.007)	(0.006)	(0.007)	(0.006)
Observations	414	414	414	414
R-squared	0.568	0.575	0.565	0.571

Note: Underidentification tests are highly significant (p-value: 0.000), Sargan statistics are unreported, because the equations are exactly identified. Growth contributions of the period 2000-2014. Significance levels: ** p<0.01, * p<0.05, + p<0.1

4.1 Growth potential from institutional change

These results can be used to simulate the effects of a hypothetical institutional reform on aggregate productivity. Aggregate productivity comprises the sum of within industry productivity gains and productivity growth contributions from structural change. We use the underlying distributions of instutional quality across countries to assess the effects of a hypothetical reform. The vehicle is the tradability index.

We assume that the Government Effectiveness indicator improved its value from the 25th percentile of the sample, which is observed in Latvia, to the level of the 75th percentile that is observed in Luxemburg. The estimated impact of the reform is the difference of two products: the estimated β coefficient times the average tradability index times the institutional indicator for the 25^{th} percentile on the one hand and the 75^{th} percentile on the other hand (see Eq. 3 above).

An improvement from the 25^{th} to the 75^{th} percentile of the Government Effectiveness indicator would lead to an increase of the within-sector contribution to productivity growth of 1.2 percent points, from 0.8 (25^{th} percentile) to two percent (75^{th} percentile). The within productivity growth contributions are only part of aggregate productivity growth, however. The growth contributions of structural change need to be considered, too. Using the same hypothetical reform, one obtains a negative contribution to productivity growth of a slighty bigger magnitude. The estimated difference between the 25^{th} and the 75^{th} percentile amounts to -1.7 percentage points.

The weighted sum of both effects (i.e. the within and the structural change effect) constitutes the estimated effect for the aggregate labour productivity growth rate due to a hypothetical policy reform. An optimal ratio between these effects does not exist, which is why we rely on both the present dataset and findings from the literature (McMillan et al., 2014). One may assume a 70-30 ratio of the within to the structural change effect. This would lead to an estimated acceleration of labour productivity growth of approximately 0.31 percentage points due to a hypothetical institutional reform scenario.

An alternative scenario could be the reform of the legal system, measured by the Rule of Law indicator. If the index were to improve from its 25th percentile (Lithuania) to the level of the 75th percentile (Netherlands), the within sector growth contributions would increase from 0.7 percent to 1.8 percent. Using the estimation results for structural change, one obtains again negative contributions to productivity growth. This reduces the positive results from within industry productivity growth by the same magnitude, i.e. by one percentage point. Applying the same 70-30 ratio to these figures shows similar growth potential - 0.28 percentage points - from a hypothetical institutional reform as before.

Hence, differences in the quality of institutions explain the bulk of the long-run productivity growth differential across Member States. Certainly, such policy reform scenarios are hypothetical. Also, the magnitude of the effect is driven by the ratio which is assumed apriori. In the present data, the ratio would be nine to one, which is driven by the negative interaction effect that is part of the structural change effect. The ratio applied roughly corresponds to the ratio of within- to between-sector productivity contributions (as opposed to the within versus structural change ratio).

This analysis gives a broad indication of the productivity growth potential of institutional reforms. Yet, it obviously hinges on some critical assumptions limiting the general validity of the estimated effects. For instance, the coefficient of interest is an interaction effect and thus a quasi-linear estimate. Other nonlinearties are not controlled for, such as possibly decreasing returns of institutional quality. Similarly, the cross sectional method cannot capture lag structures. On the one hand, evidence previously presented in this study suggests productivity growth potential from structural change in some countries. On the other hand, the effects of institutional reform on the growth contributions from structural change are negative. It is likely that this concerns an unobserved lag structures argument, in which industries first gain in size at the expense of productivity, and then later onwards experience growth in productivity. It may also relate to path denpendence, which is not considered in the present estimations. These issues are beyond the scope of this paper, however, and left for future research.

5 SUMMARY

This article provided diagnostics of the European growth performance from a tradable-nontradable perspective, which splits the production into goods and services that are either tradable or nontradable. Not all tradable goods and services are effectively traded. From a purely structural perspective, a larger share of tradable goods is associated with not only greater export potential, but also with a higher degree of competitiveness.

The descriptive statistics highlight that the share of nontradable goods production increased significantly in the peripheral countries of the EU prior to the financial crisis. Against this background the output composition of the "Periphery" countries was rather distinct to the one of "Core" and "CEE" EU countries, where it remained more or less flat or even declined on average. The "Periphery" countries in turn were those which faced the severest recessions – in particular as regards the duration, less as concerns the amplitude of the economic downswing. This characterises the extent to which the output composition in the "Periphery" countries rendered increasingly unstable prior to the crisis. This aspect identifies one important pattern of divergence between these two country groups prior to the crisis. For the current episode, there is evidence that this gap closes. The picture is though rather different when considering the “CEE” countries. Their declining share of nontradable goods production stands in stark contrast to the pattern of the “Core” economies and hence characterizes one source of increasing divergence between “CEE” and “Core” EU countries.

The two-sector macroeconomic approach is expanded by a productivity analysis along sector-levels. The sector information paints a more diverse picture than the macroeconomic pattern. Economies that perform poorly at the aggregate level may exhibit highly productive sectors. Nevertheless, tradable sectors were found to be a substantial determinant of aggregate labour productivity, much more so than nontradables.

Hence the sector composition is a determinant of aggregate productivity, implying productivity growth potential from hypothetical structural adjustments. These show that the labour productivity of especially Greece, Romania, Croatia, Ireland, Cypress, Bulgaria, Portugal, Slovenia and Italy would grow in aggregate productivity if they were able to implement the sector structures of the most labour productive countries in the sample - Belgium, Denmark and the Netherlands.

A conventional shift-share analysis decomposed productivity growth before and after the crisis into a within sector and a structural change effect. In the pre-crisis period, core countries exhibited the highest labour productivity growth rates, which were largely driven by within productivity increases. The lowest annualised productivity growth was found in Italy, Spain, Poland and Bulgaria. The economies that later suffered from structural imbalances showed productivity growth which was largely driven by structural change, i.e. by the between and the interaction effect. There was a shift in the relevance for productivity growth towards nontradable sectors. In the post-crisis period, the aggregate annual labour productivity growth dropped, and the countries in the core again performed best. The lowest productivity increases were observable in Greece, Bulgaria and Finland. Productivity growth from structural change nearly came to a halt across all EU economies.

Eventually, these results are relevant for economic policy. The T-NT framework has implications for the European Commission's macroeconomic imbalance procedures, and should therefore be considered in the European Semester. The T-NT approach allows identifying patterns of real divergence on a disaggregated level, and is able to characterise an unsustainable sectoral composition of growth, which is still observable in many peripheral EU countries. The tradability framework was also used to link productivity growth to domestic institutions. The results show that the presence of an efficient public administration and a sound legal system explain a substantial share of the growth differences across EU Member States.

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Appendices

CLASSIFICATION OF TRADABLE AND NONTRADABLE GOODS

In much of the literature addressing tradable and nontradable goods, the distinction is drawn along sectoral lines of the production accounts. The idea of this approach is to classify and measure tradable and nontradable sectors, and to further disaggregate tradables into import and export sectors, for analysis and comparison. Much of the work done concerning the specification of tradable and nontradable goods was undertaken by Dwyer (1992). This contribution extended the work of Knight and Johnson (1997) who have also contributed to the literature on tradables and nontradables. They define a tradable item as "a domestically produced good or service if it is actually traded internationally (as are exports) or if it could be traded internationally at some plausible variation in relative prices". This leads to the important conclusion that the difference between a commodity being tradable and a commodity being traded is the result of the profitability of trade. This definition follows the definition of Dwyer (1992). Knight and Johnson further note that the tradables category will include domestically produced goods and services that replace imports.

Dwyer (1992) pointed out that the lack of an existing methodology hindered efforts by previous authors to classify and study differences between tradable and non-tradable components. Without any existing methodology, the identification of tradable and non-tradable sectors has been subjective and static (see comments of, among others, Goldstein et al., 1980; Goldstein and Officer, 1979; and Knight and Johnson, 1997). The key point of critique concerned the use of a priori reasoning in producing a subjective classification which could in turn be both a source of weakness for existing research and the reason for lack of such research on this topic.

Dwyer (1992) uses a classification system to determine the relative size of tradable and nontradable sectors, the size and composition of export and import sectors (as subsets of the tradable sector) and the internal competitiveness of each sector. This set-up is based on a theoretical approach comprising a small open economy with traded and nontraded goods sectors, where the relative prices of traded and nontraded goods determine resource allocation.

Drawing on the literature, we apply a methodology that has the advantage of removing the subjectivity of previous specifications of tradables and nontradables. This approach is flexible enough to allow industrial sectors to move between classifications over time. This is of particular importance as industries change over time and the same applies to the feature of tradability of goods and services.

The applied methodology operates in the following steps:

(i) identify the export share of each industrial sector, and define a threshold above which this sector can be characterised as export orientated;

(ii) sum up the production volume of those industries which are defined as export orientated to create a measure characterizing the tradable goods sector;

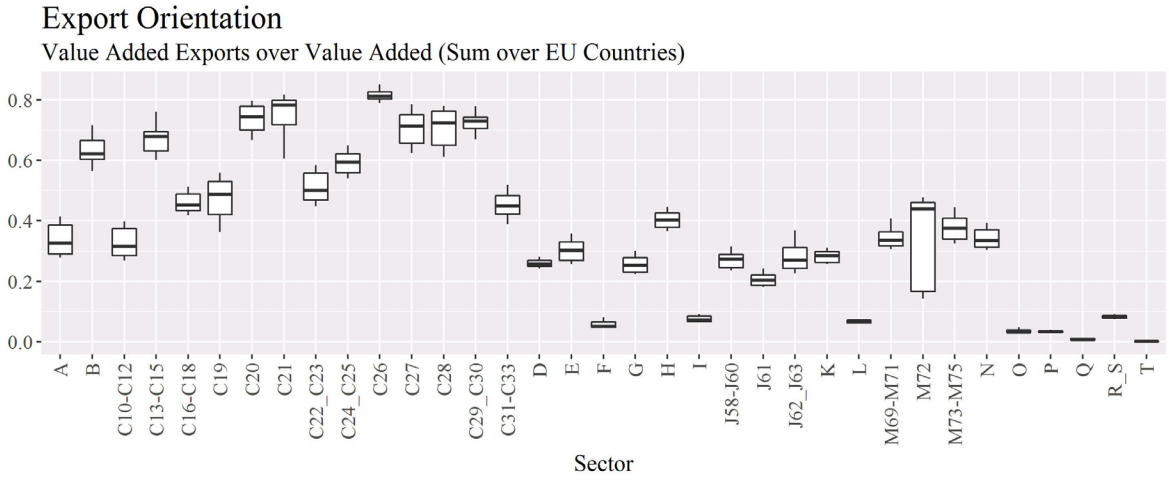
(iii) sum the production volume of the remaining industries to establish a measure for the nontradable goods sector.

Even though an objective methodology is given, the approach still leaves one degree of subjective judgment; this concerns the decision on the threshold value. A threshold value is chosen in a way that the classification guarantees stability, while also maintaining representativity of the tradables sector as well as stability throughout the business cycle. In

this context, the stability property would be flawed if an industry repeatedly moves between classifications over time. Against this background the threshold is chosen such that the resulting classification is not subject to an unstable industry composition (Knight and Johnson, 1997). Using a stable definition of tradability is also justified against the background of the period analysed, which covers 14 years. It has been shown that industries change their properties with regard to tradability, but such processes take decades to necessitate reclassifications (Dixon et al. 2004).

Figure 5 and Table 7 give an overview concerning the sectoral categorization of each industry into tradable and nontradable goods. Tradability and nontradability are defined by considering EU-wide aggregates. Then the same nontradable goods and services classification is imposed on each EU member state and related to the value added of nontradable goods production to GDP in order to obtain the corresponding share of nontradable goods production.

Figure 4: Average induced value added export intensities, 2000-2014



Note: Aggregate value added exports both extra and intra EU.

Table 5: Tradability at the Nace 1-digit level

Section	Title	Division	Tradable (1) or Nontradable (0)
A	Agriculture, forestry and fishing	01 - 03	1
B	Mining and quarrying	05 - 09	1
C	Manufacturing	10 - 33	1
D	Electricity, gas, steam and air conditioning supply	35	1
E	Water supply; sewerage, waste management and remediation activities	36 - 39	1
F	Construction	41 - 43	0
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	45 - 47	1
H	Transportation and storage	49 - 53	1
I	Accommodation and food service activities	55 - 56	0
J	Information and communication	58 - 63	1
K	Financial and insurance activities	64 - 66	1
L	Real estate activities	68	0
M	Professional, scientific and technical activities	69 - 75	1
N	Administrative and support service activities	77 - 82	1
O	Public administration and defence; compulsory social security	84	0
P	Education	85	0
Q	Human health and social work activities	86 - 88	0
R	Arts, entertainment and recreation	90 - 93	0
S	Other service activities	94 - 96	0

References:

Dwyer, Jacqueline. 1992. 'The Tradable Non-tradable Dichotomy: A Practical Approach'. Australian Economic papers, December, pp 443-458.

Knight, Genevieve and Leanne Johnson. 1997. 'Developing Output and Price Measures for Australia's Tradable and Non-tradable Sectors'. Australian Bureau of Statistics (ABS) Working Paper No. 97/1.

DATA

There is a lack of harmonised productivity data at the Nace 2-digit level, which this report addresses by drawing on several data sources. It mainly uses Eurostat information, but also makes use of WIOD data for the tradability indicators (see also Box 2.1).

The period considered covers the years 2000 to 2014, which can be interpreted as a bit more than one business cycle. This poses challenges on a competitiveness study which hinges on structural characteristics. The bulk of the data are available from 2000 (or 1995), which falls within the period in which imbalances have built up due to a lack of overall competitiveness. This is reflected in economic structures by an increase of the share of nontradables in crisis countries. Hence, the results of this study are to be interpreted cautiously from a structural change perspective, since the data also show crisis dynamics. In other words, many countries have built up imbalances in the years before 2008/2009, and were then subject to rebalancing mechanisms.

To compute a labour productivity indicator, data from the Annual National Accounts (nama64) provided by Eurostat have been compiled, consisting of 64 industries. In order to obtain compatibility with the structure of WIOD data, 36 industry aggregates were defined. Next, labour productivity has been defined. First, real value added has been defined as value added (B1G_CP_MEUR) divided by the deflator (B1G_PD10_EUR) using 2010 as base year. Second, real value added has been weighted by the hours worked (EMP_DC_THS_HW) or – alternatively - per person employed (EMP_DC_THS_PER).

Productivity information (based on hours worked) at the Nace 2-digit level is missing for 1,749 observations, which approximates to 12 percent of the sample. The countries concerned are Cypress, Estonia, Croatia, Hungary, Ireland, Latvia, Lithuania, Luxemburg, Malta, Poland and Sweden. Using persons employed for the definition of labour productivity does not substantially change the availability. A total of 8 percent of the sample is missing. The countries affected are Bulgaria, Cypress, Estonia, Croatia, Ireland, Latvia, Lithuania, Luxemburg, Malta, Poland, Romania, Sweden and Slovakia.

An analysis of the interplay of economic structures with productivity requires additivity (i.e. the sum of sector shares must equal one hundred percent), which is not given in the Nace 2-digit data. Hence, this study draws on one digit data, which are fully available. Nace 2-digit information can be used for the subsequent regression analysis that does not require a balanced panel.

Alternatively, Eurostat's Structural Business Statistics (SBS) offer information on Nace 2-digit industries. However, these time series also contain missing values, and are available from 2005 onwards, which poses a difficulty with structural analysis.

The data contain 27 EU Member States (data for Malta is not available). The descriptive statistics show great variety of economy-wide labour productivity, with Luxemburg exhibiting the highest and Bulgaria the lowest labour productivity. Agriculture as well as Real estate activities have been excluded to reduce the bias. The most productive sector appears to be sector D (Electricity, gas, steam and air conditioning supply) and sector B (Mining and quarrying). The least productive sectors are F (Construction), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), I (Accommodation and food service activities, N (Administrative and support service activities), S (Other service activities) and Q (Human health and social work activities).

Notably, two sectors – A 'Agriculture, forestry and fishing' and L 'Real estate activities' - have been excluded in the descriptive statistics due to outliers. These might be due to regulations and subsidy policies in Agriculture and due to imputed rents in Real Estate.

Sector A includes crop and animal production, hunting and related service activities, forestry and logging, and fishing and aquaculture. The sector Agriculture shows the lowest productivity figures within almost all countries (Estonia, Netherlands, Sweden, Slovakia, Spain and the United Kingdom).

Sector L includes buying and selling of own real estate, renting and operating of own or leased real estate, and real estate activities on a fee or contract basis. Notably, this also includes imputed rents of owner-occupied dwellings, which increases the value added substantially. Only Denmark, Netherlands, the Czech Republic and the United Kingdom show sectors other than real estate as their most productive sector.

More generally, the analysis does not include Section T which contains , Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use‘ and Section U containing ‚Activities of extraterritorial organisations and bodies‘.

DESCRIPTIVE STATISTICS

Table 6: Descriptive statistics of labour productivity across sectors

	Obs.	Mean	Std. Dev.	Min	Max
Total Economy	147	-0.07	1.72	-7.76	3.61
Tradables	147	0.56	3.76	-14.60	9.86
Nontradables	147	-0.92	1.43	-7.31	2.68

Note: This table reports the descriptive statistics of labour productivity based on hours worked and persons employed for the total economy, tradables and nontradables.

Table 7: Descriptive statistics

	Within Prod. growth in (p.p.)	**Str. change prod. growth (in p.p.)**	**Gov. Eff.**	**Rule of Law**	**Tradability**
Mean	1.63	0.13	1.21	1.14	0.24
Std. Dev.	4.66	4.08	0.64	0.62	0.18
Min.	-13.28	-25.82	-0.25	-0.13	0.01
Max.	30.40	18.65	2.16	1.96	0.63

Note: Structural change is defined as the sum of the between sector contribution to productivity growth and the interaction effect.

SHIFT-SHARE-ANALYSIS

Aggregate labour productivity is defined as the ratio of total value added (X) to total labour (Y). Aggregate productivity can then be interpreted as the sum of sector specific productivity levels weighted by the employment share in the economy, where sector specific labour productivity $\left(\frac{x_{it}}{y_{it}}\right)$ is defined as the ratio of value added (x) to labour (y) of sector i at time t. Aggregate labour productivity can be expressed as follows:

$$\left(\frac{X}{Y}\right)\cdot = \sum_{i=1}^{N} x_i / \sum_{i=1}^{N} yi = \sum_{i=1}^{N}\left(\frac{x_i}{y_i}\right)\cdot\frac{y_i}{y}. \qquad \text{(Eq. 4)}$$

A change of aggregate labour productivity over time can be decomposed into three effects:

Between effect
$$\left(\frac{X}{Y}\right)-\left(\frac{X_{t-1}}{Y_{t-1}}\right)\cdot = \sum_{i=1}^{N}\left(\frac{x_{it-1}}{y_{it-1}}\right)\cdot\left[\left(\frac{y_{it}}{Y_t}\right)-\left(\frac{y_{it-1}}{Y_{t-1}}\right)\right] \qquad \text{(Eq. 5)}$$

Interaction effect
$$+\sum_{i=1}^{N}\left[\left(\frac{x_{it}}{y_{it}}\right)-\left(\frac{x_{it-1}}{y_{it-1}}\right)\right]\cdot\left[\left(\frac{y_{it}}{Y_t}\right)-\left(\frac{y_{it-1}}{Y_{t-1}}\right)\right]$$

Within effect
$$+\sum_{i=1}^{N}\left[\left(\frac{x_{it}}{y_{it}}\right)-\left(\frac{x_{it-1}}{y_{it-1}}\right)\right]\cdot\left(\frac{y_{it-1}}{Y_{t-1}}\right)$$

Shift-share analysis decomposes changes in aggregate labour productivity into three components: (i) between-sector productivity gains, (ii) an interaction term, and (iii) a within-sector effect (Timmer et al. 2010; McMillan, Rodrik, and Verduzco-Gallo 2014).