3 Micro-founded measurement of regional competitiveness in Europe

Gábor Békés and Gianmarco I.P. Ottaviano

3.1 Introduction

Enhancing 'competitiveness' is a popular objective of economic policymaking, both at national and the regional levels. International regional competitiveness recently was developed into the smart, sustainable and inclusive growth objectives of the Europe 2020 policy programme[18]. While a huge amount of development funding is allocated to help meet these objectives, the concept of 'competitiveness' remains rather mysterious and is often debated. There is neither any generally accepted definition nor any robust agreement on how to measure it. While this is true for both nations and regions, the focus of this chapter is on the regional level.

The regional level is important because regional diversity within the European Union is substantial, and regional disparities matter at the national level in a context in which GDP per capita differences between regions within EU countries are comparable to the differences between the more- or less-developed EU countries. For instance, while Romania has a per capita GDP that is 32 percent of the per capita GDP of Germany (at PPP), the poorest Romanian region (North-East) has a per capita GDP that is just 26 percent of the per capita GDP of the richest (Bucharest). As a result of pronounced regional disparities, even within the same country, people living in poor regions have much fewer work opportunities and, as long as local services are financed by local governments through local taxation, also much less access to education and health care. This is why measuring 'regional competitiveness' as a driver of regional economic performance has been considered an objective worth pursuing.

18. http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm.

In this chapter we will do three things. First, in section 3.2 we discuss the conceptual underpinnings of why it is interesting to unpack the economic performance of a country into the economic performance of its regions. In particular, based on the academic literature, we will discuss how 'proximity' matters in the sense that several key interactions between people and firms that are at the core of economic performance peter out very rapidly as distance increases, making the local context the scale at which most of the action takes place. On the other hand, we will argue that, once the local context is targeted, the economy becomes extremely 'granular' in the sense that local economic performance even more than national performance ends up being driven by the fortunes of a handful of firms that are large (at least in the local context). In other words, it is the importance of 'proximity' that makes 'granularity' more salient.

Second, in section 3.3 we explore the implications of 'proximity' and 'granularity' for how one may want to think of and measure 'regional competitiveness'. The basic idea is that, if 'proximity' makes the regional dimension crucial and 'granularity' implies that a few large firms determine regional destinies, a natural way to assess regional performance is to look at how large firms fare across regions. We will then argue that, given available data, an effective way to gauge how large firms fare is to look at their ability to access and penetrate world markets. In this respect, we will propose a pragmatic definition of 'regional competitiveness'. This type of firm typically accounts for dominant shares of employment, sales and profits. Such firms are more capital intensive and pay higher wages. They invest more in capital and human resources. They are the main drivers of innovation. Our approach is practical because it measures 'regional competitiveness' in terms of actual rather than potential outcomes, and focuses on an outcome variable that is correlated but more easily measurable that several other obvious outcome variables.

Third, in section 3.4 we discuss the data needed to compute our proposed measure of 'regional competitiveness', if this data is are currently available for EU regions and how its availability could be improved. We note here that the administrative definition of 'region' does not necessarily coincide with the relevant definition based on the intensity of actual interactions between people and firms. This is an old issue with a long tradition on which we have little to add, apart from stressing that data is typically collected according to the administrative definition and this is the definition that matters most in terms of regional policies. Section 3.5 offers some conclusions. Two illustrative examples are presented in the Annex.

To our knowledge, the closest research to ours is Konings and Marcolin (2011), who use firm-level data to assess the competitiveness of Belgian and German regions. In

line with our work, the concept that the authors use does not *"engage in measuring different potential drivers of productivity (with the risk of omitting some), but will directly capture the productivity level of firms that are active in a particular region"*. Similarly, they note the importance of large firms, arguing that by using firm-level data they are *"also able to analyse the dependence of regions on a few large firms, which reveals potential vulnerability in terms of relocation threats"*. The data is derived from EU company accounts contained in the Amadeus dataset by Bureau Van Dijk (BvD) for 2005 and 2008 for medium and large-sized companies. Konings and Marcolin (2011) compute labour productivity (value added per worker), and calculate the ratio of the average labour cost and average labour productivity, to obtain a measure of the relative cost of a unit produced – the preferred measure of competitiveness. Our method is an alternative that focuses even more on the 'outcome' of competition, but is nevertheless likely to be correlated with the Konings and Marcolin measure.

Two caveats are in order in relation to the research in this chapter. First, because the ideal data is not available, this chapter should be taken as a methodological contribution to the policy debate on 'regional competitiveness' rather than an attempt to precisely measure 'regional competitiveness'. Accordingly, we will use the available data to provide specific examples rather than an overall assessment of 'regional competitiveness' across the EU. Moreover, our examples serve only to take snapshots of the situation at one point in time, leaving aside the question of how patterns evolve through time. Second, we do not take any stance on the relationship between 'regional competitiveness' and 'regional convergence' in economic performance. One might want (all) regions to be 'competitive' because one wants them to compete. From this perspective, competition between regions might be considered good in itself. However, competition is a dynamic process and one should not expect necessarily a balanced distribution of economic activities at any point in time. Because of the pull of 'proximity', one might even expect some degree of (sound) regional imbalances at all points in time.

3.2 A new foundation for regional policy: performance of regions is driven by localised externalities and granularity

Why is it interesting to unpack the economic performance of a country into the economic performance of its regions? The answer has to do with the concepts of 'proximity' and 'granularity'.

3.2.1 Proximity

Firms compete not only on the basis of their internal capabilities, resources and business networks, but also in the context of the business environments they come from. Institutions, regulations, demand conditions and many other factors in their countries of origin determine the quality and the availability of their inputs (from labour to intermediate goods and services) and their sales opportunities. As suggested by a long line of academic and business consultancy studies, national determinants are essential.

However, several key interactions between people and firms that are at the core of economic performance are effective at a smaller scale than the country level. These processes include labour market interactions, knowledge spillovers, trade transactions between collaborating firms and even mutual trust. The fact that some important economic interactions are constrained by proximity is one of the reasons why the concept of 'regional competitiveness' might be worth exploring. Even within a country, regions can offer rather varied business environments, including variation in labour force quality, in agglomeration and diversity of firms, in research and development infrastructure, and in urban services.

Agglomeration forces

Concentration of economic activity in some regions within a country, or in some cities within a region, has been identified as a key driver of economic performance.

Firms agglomerate to benefit from 'Marshallian externalities' such as the spreading of knowledge among similar industries, a greater pool of labour to choose from or the ability to access indivisible goods such as conference venues or airports. Hence, when operating within proximity of each other, firms can save on transaction costs and enjoy greater productivity. This is argued, for example, in so-called 'new economic geography' models (see eg Fujita, Krugman and Venables, 1999; or Baldwin *et al*, 2003) and in models of regional growth with knowledge spillovers (Ciccone and Hall, 1996). These models suggest that interactions between people and firms with a positive value greater than that signalled by market prices ('positive externalities') can arise through several channels, such as sharing indivisible goods, saving on the costs of matching workers with firms, and learning from each other (Duranton and Puga, 2004). When 'positive externalities' require people and firms to be close to each other, they generate 'agglomeration forces' leading to the geographical co-location of economic activities. At the same time, competition between co-localised people and firms for locally scarce

resources generates 'dispersion forces' that cut into the benefits of agglomeration.

In 'new economic geography' models, proximity has several major implications. First, when firms co-locate, they offer more job opportunities and hence attract people. This increases the size of the local market and reduces the need to import final goods from elsewhere, thus reducing the average transport cost embedded in the consumption bundle of local residents. Second, proximity also entails cheaper transport between firms, because the producers of intermediate goods are located closer to their end users. Third, the total factor productivity (TFP) of firms (ie their efficiency in using given amounts of inputs to produce output) might also increase because of knowledge spillovers from other producers. As long as all these effects entail some degree of 'externality', the impact of proximity on income will be more than proportional to the number of co-located firms.

A fourth implication is related to labour productivity in larger and denser areas, particularly in cities (Puga, 2010). This greater efficiency of labour might be partly explained by productivity gains at the firm level translated into gains of marginal labour productivity. It is also explained by 'spatial sorting' as richer job opportunities where firms co-locate are disproportionately seized by more talented people. Several studies find that about half of the earning surplus achieved in denser areas comes from spatial sorting. However, there are some aspects of larger and denser urban areas that are conducive to learning and personal improvement fostered by peer pressure, more valuable experience and easier access to a variety of educational services.

Agglomeration and dispersion forces are in practice quite hard to disentangle. However, their combined effect on labour productivity can be estimated and has been found to be positive. For example, Ciccone and Hall (1996) and Ciccone (2002) find that the elasticity of labour productivity to people's density is 6 percent and 5 percent on average in the US and the EU respectively. These early findings are in the ball park of recent estimates for European countries that control for firm selection and the exogenous attributes of different urban areas (Duranton *et al*, 2012).

Both agglomeration and dispersion forces may strengthen each-other back and forth. This 'cumulative causation' – as devised by Myrdal in 1957 – may be present between agglomeration and innovation as this is stressed by models of regional growth. These models add to the 'new economic geography' perspective a dynamic dimension in terms of endogenous growth spurred by technological progress and localised knowledge spillovers. From this perspective, innovation is key, with agglomerated production and agglomerated innovation reinforcing each other. For example, Minerva

and Ottaviano (2009) provide a model in which economic interactions between regions are affected by both the transport costs of exchanging goods and the communication costs of exchanging knowledge. When innovation takes place in a region, this generates faster growth and higher income, which in turn increases demand and local profits. But higher profits make additional innovation more attractive. This leads to faster growth so that cumulative causation between agglomeration and growth kicks in.

Distance decay

By now there is a large body of evidence suggesting that the impact of agglomeration decays rapidly with distance. This pattern is observed for various types of economic interactions such as trade in intermediate inputs or knowledge cross-fertilisation spillovers in academia or business.

Firms trade with one another by buying and selling raw materials, intermediates or capital goods ('demand and cost linkages'). To save on transport costs, they often cluster together, especially within sectors. Duranton and Overman (2005) consider manufacturing sectors in Britain and investigate the extent of co-location of firms within sectors and the role of distance. They find that about half of the four-digit sectors are localised and localisation mostly takes place at small scales below 50 kilometres.

Gains from proximity to other companies are localised – also when considering trade relationships. For instance, Amiti and Cameron (2007) use the theoretical framework developed by Fujita, Krugman and Venables (1999) to estimate the benefits of agglomeration arising from vertical linkages between Indonesian firms using a manufacturing survey of firms at Indonesian district level. Their results show that positive externalities arising from demand and cost linkages are quantitatively important and highly localised. Strengthening cost linkages (through better access to suppliers) or demand linkages (through closer proximity to corporate customers) from the 10th to the 90th percentile raises wages and thus labour productivity by more than 20 percent. These productivity gains are, however, highly localised, spreading over only a short distance: 90 percent of the spillover is observed in close proximity to the firm (within 108km for proximity to customers and within 262km for proximity to suppliers).

Spatial concentration enhances productivity and drives wages higher – but only when there are productivity shocks. Using US data, Rosenthal and Strange (2008) estimate the relationship between agglomeration externalities related to human capital and workers' wages at Metropolitan Statistical Area (MSA) level with 1239 spatial units at hand. First, the spatial concentration of employment is found to be positively related

to wages, with the urban density premium being driven by proximity to college-educated workers. Second, these effects decline sharply with distance: benefits of education and gains from being close to educated people fall dramatically with distance. In particular, the wage-increasing effect of being close to educated people falls by 75 percent as the distance rises from 5 to 15 miles.

Knowledge spillovers – the transfer of scientific or practical information between companies – is a key motivation for investment support programmes offered in most countries and regions. Lychagin *et al* (2010) measure spillovers from knowledge laboratories in the US. They use a measure of geographic proximity based on the distribution of the locations of inventors working for firms instead of the firm HQ addresses to better capture the flow of scientific knowledge. They find that 90 percent of knowledge transmission happens within a few hundred kilometres of labs, and spillovers are small or virtually non-existent beyond 500km.Anderson, Quigley and Wilhelmsson (2009) consider knowledge spillovers in Sweden after a policy intervention aimed at decentralising post-secondary education throughout the country. They use annual estimates of output per worker for each of 284 local civil divisions to measure local productivity. Innovative activity is found to be related to the comprehensive records of patent awards, which also include the inventor's home address. Estimates clearly suggest that productivity gains are highly localised. The spillovers from researchers employed at old and new institutions are concentrated: roughly 40 percent of the cumulative gain in productivity materialises within 10km of the old institution. For new universities, this attenuation effect is even greater.

All in all, estimates suggest that positive externalities are typically effective in a narrow radius of 5-25km for interactions between people and 50-150km for interactions between firms. Hence, proximity matters and this makes it useful to unpack the economic performance of a country into the economic performance of its regions.

3.2.3 Granularity

In most countries, a handful of firms are responsible for a large proportion of economic activity, including export sales and foreign direct investment[19].

19. For details, see Gabaix (2011), di Giovanni and Levchenko (2011) or Mayer and Ottaviano (2007).

Dominant firms

Gabaix (2011) estimates that the business cycle movements of the largest 100 firms in the US explain a third of the aggregate movements in output growth. In European countries, even after disregarding firms with fewer than 10 employees, as most datasets do, 1 percent of the firms produce over 75 percent of output or of foreign sales. These are the dominant firms that are also important for their impact on business cycles. This dominance is exacerbated at a regional level, and the more so the finer the level of spatial disaggregation. Kleinert *et al* (2012) show how the features of a small number of large foreign-owned firms can explain several aspects of regional business cycles in France. 'Granularity' captures this idea that a few selected companies play a dominant role in regional and national economic performance. In principle, it has little to do with externalities. Firm size might follow a 'power law' (ie exhibit log-linear distribution), a property initially uncovered by Gibrat (1931) in the case of French firms. More recent research by Axtell (2001) on US firms estimates a power law with exponent 1.059 ± 0.054. This is very close to 1, a special case of the power law known as Zipf's law. In this special case, the second largest firm is half the size of the largest, the third largest firm is one-third of the largest, and so on. This can be shown to be the result of random firm growth. If different firms grow randomly with the same expected percentage growth rate (which equals the average firm growth rate) and face the same variance in percentage grow rates, the limit distribution of firm sizes converges to Zipf's law, characterised by the presence of a few dominant firms.

While other factors might also contribute to the emergence of few dominant firms (such as public intervention or imperfect competition), the key point is that the importance of 'proximity' makes the local context the scale at which most of the action takes place and, once the local context is targeted, the economy becomes extremely 'granular' because local economic performance even more than national performance ends up being driven by the fortunes of a handful of firms that are large (at least relative to the local context).

'Million dollar plants'

Granularity makes it natural for local leaders to commit public funds to attracting investment from large companies. This might imply particularly large sums in the case of large multinationals. Greenstone, Hornbeck and Moretti (2010) report that in 1991 BMW was given $115 million in grants to subsidise a new plant in Greenville-Spartanburg county in South Carolina in return for an investment creating new jobs. The cost and benefit analysis hinged on the hope that BMW would create an additional 2000

jobs and generate massive gains within the county. Comparing the economic performance of counties that managed to attract similarly large investments – called 'million dollar plants' – with those of counties that almost managed but did not quite succeed, Greenstone, Hornbeck and Moretti (2010) were able to identify the associated gains by measuring spillovers to other businesses, wages and house prices. They found that industry in the winning county benefited substantially over the five years following the investment: output rose, the TFP of existing companies grew and wages increased[20]. These gains have to be weighed against the possible monopsonistic power (in which only one buyer exists for the products or services of several vendors) of dominant firms with respect to local workers, local suppliers and local authorities (Kleinert *et al*, 2012).

3.3 'Regional competitiveness'

We now explore the implications of 'proximity' and 'granularity' for of the assessment and measurement of 'regional competitiveness'.

'Competitiveness' is a notoriously elusive concept. In its most general definition it refers to the performance of the unit of analysis relative to some chosen benchmark. Specific definitions then differ in terms of the unit of analysis, the exact measure of performance or the chosen benchmark.

Among the several definitions of competitiveness, two stand out as particularly relevant for the discussion of 'regional competitiveness': a macroeconomic definition that takes the country as the unit of analysis; and a microeconomic definition that focuses, instead, on the firm. The concept of 'national competitiveness' is often used in the analysis of a country's macroeconomic performance relative to its trading partners, with an emphasis on the factors that help explain relative export performance. These include both more qualitative factors, such as technological innovativeness, product specialisation and product quality, and more quantitative factors, such as cost-effectiveness and productivity. The problem with this approach is that, even when all factors are favourable, they do not necessarily lead to more exports because they might mostly show up as exchange-rate appreciation and better terms of trade. That is why standard measures of national competitiveness rely on a more restricted notion of relative performance related to international cost or price differentials (Riley, 2012). This is the logic underpinning the dominant use of the Real Effective Exchange Rate (REER)

20. This does not imply that subsidies were in fact a good public investment.

– with the underlying relative price and cost indicators – to measure a country's national competitiveness[21].

The use of the term 'competitiveness' to refer to relative national trade performance has been heavily criticised by economists[22], for two reasons. First, it gives the impression that trade performance is an objective worth pursuing *per se* at the national level, whereas the trade balance should be viewed as only a channel through which a country can borrow from or lend to other countries. And whether borrowing or lending are good or bad cannot be assessed in absolute terms but rather depends on the return on investment. Second, it suggests that factors, such as technological innovativeness, product specialisation, product quality, cost-effectiveness and productivity, have some value only because they help the country gain international market shares, whereas they should be considered as important per se because, even in autarky, they would affect national living standards.

A reason for this confusion between ends and means arguably lies in the application to the analysis of country performance of notions first developed to describe firm performance. From this microeconomic point of view, competitiveness refers to the fact that a firm outperforms its 'competitors' in terms of size (employment, output, revenue) and profitability thanks to everything that affects the perceived quality of the firm's products and its cost-effectiveness in supplying them. When benchmark competitors consist of all firms in the same sector *producing* in the same place, a firm's competitiveness boils down to its own ability to generate more added value from any given amount of inputs, ie from its measured total factor productivity (TFP). When benchmark competitors consist, instead, of all firms in the same sector *selling* in the same place, a firm's competitiveness is a nexus of its measured TFP and all the external factors that determine the quality-cost effectiveness of the place where the firm supplies from. These external factors link the microeconomic and the macroeconomic aspects of competitiveness (with the caveat that what is good for the firm is not necessarily good for the place where the firm operates, and vice versa).

The distinction between the macroeconomic and microeconomic definitions of competitiveness percolates to the regional level. However, when it comes to 'regional competitiveness', the notion of competitiveness as a relative performance outcome driven by a given set of factors is often lost. For example, underlying the European Commission's 'Regional Competitiveness Index' (RCI) there seems to be a notion of

21. http://www.bis.org/publ/econ39.htm; https://www.ecb.europa.eu/stats/exchange/hci/html/index.en.html.
22. See, for example, Krugman (1994).

competitiveness as a *process* with its own inputs and outputs. Specifically:

> *"...the index is based on eleven pillars describing both inputs and outputs of territorial competitiveness, grouped into three sets describing basic, efficiency and innovative factors of competitiveness. The basic pillars represent the basic drivers of all economies. They include (1) Quality of Institutions, (2) Macro-economic Stability, (3) Infrastructure, (4) Health and the (5) Quality of Primary and Secondary Education. These pillars are most important for less developed regions.*
>
> *"The efficiency pillars are (6) Higher Education and Lifelong Learning (7) Labour Market Efficiency and (8) Market Size. The innovation pillars, which are particularly important for the most advanced regional economies, include (9) Technological Readiness, (10) Business Sophistication and (11) Innovation. This group plays a more important role for intermediate and especially for highly developed regions. Overall, the RCI framework is designed to capture short- as well as long-term capabilities of the regions"*[23].

This notion of 'regional competitiveness' as a process drifts away from both the macroeconomic and the microeconomic definitions of competitiveness. Bundling outputs and inputs of the process together as 'pillars' creates a taxonomy that may be somewhat useful to rank regions on a set of more or less reasonable criteria, but transforms the concept of competitiveness into a magic black box of limited practical use.

Based on the macroeconomic and microeconomic traditions, we want to put forward, instead, the idea that the most useful way to think about 'regional competitiveness' is in terms of a measurable relative *outcome* driven by measurable *factors*. The only meaningful outcome that can be called 'competitiveness' of a region is the performance of its firms relative to their competitors in benchmark regions.

The focus on firm performance has several advantages. First, while it is true that what is good performance for a region's firms is not necessarily good performance for its people, in practice the two are highly correlated. Second, 'competitiveness' might be a disputed concept in the case of places, but it is a generally accepted concept in the case of firms. Third, when it comes to regional policy, much 'competition' between regions is about attracting 'competitive firms' because these hire more workers, offer better job security, pay higher wages, invest more (also in human resources), generate more revenues and profits, and therefore allow regions to raise more tax revenues for

23. http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/6th_report/rci_2013_report_final.pdf.

any given tax rate.

The fact that 'competitive firms' are better in a number of ways raises the thorny question of which measure of performance should be used to identify them. Recent developments in the academic literature on international trade come to the rescue. These developments show that all measures of firm performance are driven by firm TFP[24]. They also show that the best proxy of exceptional TFP for a firm is its export participation and intensity: whether or not the firm is an exporter, and how much it exports. Hence, exports become a crucial indicator of 'competitiveness'[25]. This bridges the macroeconomic and microeconomic views on 'competitiveness', and has the additional advantage of avoiding the direct estimation of firm TFP, which often requires unachievable standards in terms of data availability and still faces some open methodological issues[26]. Data on European firms reveals a positive correlation at the firm level between TFP and export share of revenues. Focusing on exports has also an additional advantage related to the concept of 'granularity'. As already discussed, 'granularity' captures the idea that a few selected companies play a dominant role in regional and national economic performance. Because of export costs, export participation and intensity are the best indicators that a firm belongs to that selected group because they do not require any typically noisy measure of 'TFP thresholds'.

Specifically, consider the export activities of firms located in different EU regions and active in a sector *s*. Consider a EU origin region *o* and a non-EU export destination *d* that is far enough from Europe and without former colonial, cultural or language links with any EU country to be equally 'accessible' from all EU regions (eg China). Let $L_{o,s}$ denote employment by sector *s* in region *o* and $X_{o,s}$ denote exports of sector *s* from region *o* to destination *d*. Analogously, let L_s denote total EU employment in sector *s* and X_s denote total EU exports to *d* in sector *s*. Then compute the share of region *o* in total EU exports normalised by the share of region *o* in total EU employment in the sector. We take the resulting 'normalised export share'

$$NXS_{o,s} = [X_{o,s}/X_s]/[L_{o,s}/L_s]$$

24. See, for example, Mayer and Ottaviano (2007).
25. Firms that not only export but are also directly investing abroad (FDI) are even more exceptional. Indeed, 'internationalisation' in general (ie selling to customers on a global market) is what we have in mind. However, we prefer to focus on exports because data is more easily available. Considering FDI as well would increase the importance of the top 5 percent of firms.
26. See, for example, Bartelsman *et al* (2013).

as our measure of the 'regional competitiveness' of region o in sector s. This can be rewritten as

$$NXS_{o,s} = (X_{o,s}/L_{o,s})/(X_s/L_s)$$

which is export per worker from region *o* to destination *d* relative to the EU average. Hence, our 'regional competitiveness' captures the capacity of a region's firms to outperform the firms of the average EU region in terms of exports. It is worth stressing that this does not imply that we see exporting as good in itself. Rather, we focus on exports because it is a strong indicator of the TFP of firms in the region.

According to the academic literature on which this argument is based, export proxies 'exceptional firm productivity' because firms have to be very productive in order to generate the revenues needed to cover the additional costs they face in serving foreign markets. Some of these costs arise from the fixed initial investment required to break into a market (such as the costs of creating a distribution network), others are recurrent and vary with the amounts shipped (such as transport costs and tariff barriers). Fixed export costs affect the number of producers that are able to export ('extensive margin'); variable export costs affect the amount of shipments per exporter ('intensive margin').

To capture these two aspects, we denote the numbers of exporters and producers in region *o* (in the EU) by $n_{o,s}$ (n_s) and $N_{o,s}$ (N_s) respectively. This allows us to decompose the normalised export share into two multiplicative components as

$$NXS_{o,s} = (n_{o,s}x_{o,s}/N_{o,s}/l_{o,s}) / (n_s x_s/n_s l_s) = [(n_{o,s}/N_{o,s}) / (n_s/N_s)] \times [(x_{o,s}/l_{o,s})/(x_s/l_s)]$$

where $x_{o,s}$ (x_s) denotes average export per exporter and $l_{o,s}$ (l_s) denotes average employment per producer in region *o* (in the EU) respectively. We then use the 'extensive' and the 'intensive' normalised export shares

$$NXS^{\sigma}_{o,s} = (n_{o,s}/N_{o,s})/(n_s/N_s)$$

$$NXS^{i}_{o,s} = (x_{o,s}/l_{o,s})/(x_s/l_s)$$

to measure region *o*'s 'extensive regional competitiveness' and 'intensive regional competitiveness' in sector *s*. These capture the extent to which regional competitiveness is affected by fixed versus variable export costs. In particular, the importance of the extensive margin suggests that firms have to be productive enough in order to break into the export market. This implies that regional competitiveness is driven not only

by the TFP of the average firm (which affects the extensive margin) but also by the proportion of local firms with a TFP that is high enough to overcome the fixed costs of exporting. Hence, our measure of regional competitiveness puts a premium on the concentration of firms in the upper tail of the TFP distribution ('granularity')[27]. As these are the firms that hire more workers, offer better job security, pay higher wages, invest more (also in human resources) and generate more revenues and profits, this premium is not unwarranted[28].

A final caveat is in order. Our notion of regional competitiveness is sectoral in nature, the idea being that it does not makes much sense to try to gauge the relative performance of two regions by comparing the productivity of firms that operate in different sectors. However, the inter-sectoral perspective can also be important from a risk-sharing point of view: is it better for a region to be very competitive in fewer sectors or somewhat less competitive in a greater number of sectors? The answer depends on how risk is shared with other regions through labour and capital mobility or redistributive policies[29]. Inter-sectoral specialisation might also mat ter in terms of growth potential because specialising in some products at the country level has been shown to bring higher growth than specialising in others[30]. Both aspects, however, shift the focus from regional to national competitiveness and this goes beyond the scope of our analysis.

3.4 Measurement issues

3.4.1 Ideal data

In this section, we contrast our first best approach to the realities of data. We start by describing what an ideal dataset – building on existing but not easily accessible data – would look like, followed by a discussion of major issues and challenges. We acknowledge that while the data we need does exist, access to that data is very difficult in most countries, and coming up with a harmonised, distributed data approach is hard.

27. See Barba Navaretti *et al* (2014) for a discussion of the importance of the higher moments of the productivity distribution in explaining aggregate export performance. Duranton *et al* (2012) discuss how these moments are shaped by agglomeration economies.
28. See, for example, Gabaix (2013) for a discussion of the role of large firms in economic activity at the national level. Large firms are even more important at the regional level as implied by the notion of 'balls and bins' put forth by Armenter and Koren (2014).
29. Koren and Tenreyro (2007) show that GDP growth is much more volatile in poor countries than in rich countries for four reasons: they specialise in more volatile sectors; they specialise in fewer sectors; they experience more frequent and more severe aggregate shocks; and their macroeconomic fluctuations are more highly correlated with the shocks of the sectors they specialise in.
30. Hausmann, Hwang, and Rodrik (2007) show that, all else being equal, countries specialising in the types of goods that rich countries export tend to grow faster than countries specialising in other goods.

For any given year, the competitiveness index for a region *o* and industry sector *s* is created in several steps. The data need is quite extensive. First, we need firm-level balance-sheet data with information on the number of employees and industry classification. This data is available for almost all EU countries but often with limitations. It is missing for Croatia, for Czech Republic and Slovakia. In Poland, firms are only surveyed beyond a size limit (typically 10-50 employees).

Second, we need information about the location of the firm, at least to regional level. For several countries, a NUTS2 or NUTS3 code is directly available. In other countries, the city or the postcode of the headquarters is available in addition to financial data, although it sometimes requires merging data from corporate registries. Third, we need firm-level datasets matched with customs data with detailed information about exports, including destination countries, and ideally, products as well. Customs data is more and more available in Europe.

Provided that all data is available, the key task is to decide on aggregation details. Based on availability information[31], considering NUTS2 regions, 2 digit NACE revision 2 industry classification should work for almost all countries. We present an example of the procedure using Hungarian data in the Annex to this chapter.

Another option would be to use private/survey data, as used by Konings and Marcolin (2011). The advantage of such dataset is availability for many countries. At the same time, in the absence of trade data, it can only use balance-sheet information that is often hard to compare across countries that differ substantially in accounting and reporting standards.

3.4.2 Data problems and challenges

A: Regional definitions

Before turning to data issues to generate our preferred variable, we should acknowledge that the administrative definition of region does not necessarily coincide with the relevant definition based on interactions. A key area of study in economic geography is the modifiable area unit problem, the notion that aggregation based on different scopes and boundaries might yield different outcomes. In particular, the size of regions seems to be an important driver of some measured elasticities[32].

31. See chapter 2 of Castellani and Koch (2015) as well as http://mapcompete.eu/meta-webtool.
32. See Briant *et al* (2012) and Békés and Harasztosi (2015).

Another aspect, recognised by the EU in its competitiveness report by Annoni and Dijkstra (2013, p5) is related to accounting for employment in large cities. This is not a problem for Paris (as Ile-de-France includes commuters), but it is for London, which is actually cut into two NUTS2 regions. The problem is also particularly significant for Brussels, Prague, Berlin, Amsterdam and Vienna. Annoni and Dijkstra (2013) detail several other regional boundary-related issues.

Given data requirements, this is not a real issue for us. NUTS2 seems the realistic area of study. Looking at evidence from MAPCOMPETE, we know that data is typically collected according to the administrative definition, at NUTS2 or NUTS3 level. It is only in a few countries, such as France or Hungary, where data might be actually linked to corporate registries with information on the municipality in which the firm is located.

One potential solution might be to start with NUTS2 level, but consider some additional regional aggregation.

B: Narrow industries, small regions

Calculating this index faces a challenge specific to the use of anonymised data: data providers retain the right to suppress observations to prevent external identification of corporate data. In particular, calculating values at regional and sectoral level often runs into secrecy problems. One typical barrier to computation of each region-sector cell is a minimum requirement of firm count: each cell has to be made up of at least a few firms (3-6 depending on countries). This might be an issue when sectors are narrowly defined or regions are small. At this stage we believe this not a major issue, but it might matter for small regions and small sectors – requiring sectoral aggregation.

C: Extreme granularity – top-firm accounting

The next problem is more important because it goes to the core of our exercise. Data providers also suppress cells when one firm is too important (for example, its sales represent more than 70 percent of total sales of firms in that cell). As a result, when the sector-region cell includes the top firm in that sector, the cell result may be suppressed even if there are other firms present. Given the narrow approach, this can generate a huge bias.

These problems could be reduced by aggregating industries (such as food and beverage) or aggregating regions. This is a key reason for choosing NUTS2 as more realistic

level as opposed to NUTS3[33]. However, the large-firm problem might still arise and there is no easy fix. It can only be solved by cooperation between national statistical institutes and Eurostat.

Beyond issues relevant to this index, the main obstacle in calculating our preferred index is access to data. As argued by Koch and Castellani (2015), data availability is typically good to excellent in EU countries, but accessibility is often rather difficult. To calculate our index, one needs access to the raw data. However, because of differences between countries and lack of access points for researchers, this latter approach is rather cumbersome. Furthermore, in several countries, such as France and Germany, there are legal barriers to access.

As a result, the only possible way to calculate these indices would be to get Eurostat to coordinate a project with scientific involvement, through which national statistical offices would calculate values based on a common and harmonised approach.

D: Firms: observation and reality – from establishments to value chains

The typical unit of observation is the legal entity. This might cause problems in the presence of multi-plant firms or business groups. When part of the economic activity takes place in other location away from the headquarters, performance might be wrongly assigned. In several EU countries, there are plans to improve data quality and collect information about establishments and groups, but in the short run, this is an important caveat to any index.

Another measurement problem relates to multinational groups. Data on exports to non-EU countries is collected and assembled by national and EU institutions. Ideally, the final destination is recorded. However, multinational companies exercise great freedom in terms of organising in which country authorities actually carry out customs procedures. Hence, a multinational company's Czech affiliate might export to China, but this will not be picked up because the company might concentrate its customs activity in, say, the Netherlands. Once again, there is very little we can do other than acknowledge that our measure is likely to be biased towards regions that are more specialised in global commerce.

In particular, some sectors might be organised rather differently in terms of value chains and distribution networks. This might lead to countries that are specialised in

33. To see NUTS3 level data, one should aggregate sectors into a handful of macro sectors.

some sectors exporting more or less directly to non-EU countries. Industries with flatter value chains should create less bias because of the presence of distributors or specialised trading subsidiaries in some countries. For our purpose, we compare sectors instead of aggregated economies, and we may disregard the wholesale sector.

E: Business services

Trade in services is typically not as well accounted for as trade in goods, potentially mis-measuring performance of regions with strong service sectors. Fortunately, trade in services is included in firm-level data[34]. The bad news is that measurement and pricing issues might typically be of greater importance for services than for trade in goods.

3.5 Conclusion and suggestions

This chapter addressed some core issues discussed in this Blueprint. Granularity and the roles of large firms are crucial to understand why regional competitiveness and efforts to attract these firms are at the centre of many regions' and cities' policies. The focus on exporting and the separation of extensive and intensive margins also underlines that performance of regions hinges on their capacity to foster firm development. Only the most productive firms will be able to perform on global markets, and it is the growth of these firms in a given region – by reallocation of resources from less productive firms – that will generate high-paying jobs for the region's employees. Here, we have argued for a new approach in thinking about regional competitiveness and offer a new measure of this.

First, we argued that there are some solid economic arguments in favour of thinking in terms of regions as units. Proximity matters because agglomeration externalities influence firm performance, these externalities decay fast with regions being close to a relevant area for most spillovers, and granularity is key, as a few large firms matter regionally more than in countries.

Second, we made a case in favour of an index that captures performance directly rather than by averaging values from a mix of indicators. Such an 'outcome' measure has the advantage of transparency and allows for future enquiries about the relationship between outcome (firm performance) and potential drivers such as infrastructure or local R&D. Third, we proposed a measure based on firms' sales in non-EU markets. This approach has the advantages of comparability across EU countries and easy calculation.

34. Included in trade data, HS6 starting with 98 and 99.

Finally, we looked at data availability and access across Europe and concluded that our index might be calculated given available data for almost all EU countries. However, such an exercise would require either Eurostat coordination, or collaboration between a large number of institutions. We believe that what is needed at this stage is a Eurostat-coordinated effort – with potential researcher participation. Once the index is calculated, future research can concentrate on the analysis of key drivers of differences in firm performance in various regions. Coordination with national statistical institutions is also key in order to manage confidentiality issues.

Furthermore, with improved data quality, research into the importance and structure of business groups, the diversity establishment networks and accounting practices for the trade in services might shed light on potential biases in measurement.

References

Altomonte, Carlo, Tommaso Aquilante, Gábor Békés and Gianmarco I.P. Ottaviano (2013) 'Internationalization and innovation of firms: evidence and policy', *Economic Policy* 28.76: 663-700

Amiti, Mary and Lisa Cameron (2007) 'Economic Geography and Wages', *The Review of Economics and Statistics*, vol. 89(1): 15-29, MIT Press

Annoni, Paola and Lewis Dijkstra (2013) *EU Regional Competitiveness Index*, European Commission, Brussels

Armenter, Roc and Miklós Koren (2014) 'A Balls-and-Bins Model of Trade', *American Economic Review* 104.7: 2127-51

Baldwin, Richard, Rikard Forslid, Philippe Martin, Gianmarco I.P. Ottaviano and Frederic Robert-Nicoud (2003) 'Policy and economic geography: what's new?' in Richard Baldwin, Rikard Forslid, Philippe Martin, Gianmarco I.P. Ottaviano and Frederic Robert-Nicoud, *Economic Geography and Public Policy*, Princeton: Princeton University Press

Bartelsman, Eric, John Haltiwanger, and Stefano Scarpetta (2013) 'Cross-country differences in productivity: The role of allocation and selection', *The American Economic Review* 103.1: 305-334

Békés, Gábor and Péter Harasztosi (2015) *Grid and shake - Spatial aggregation and robustness of regionally estimated elasticities*, MT-DP – 2015, CERS-HAS

Briant, Anthony, Pierre-Philippe Combes, and Miren Lafourcade (2010) 'Dots to boxes: Do the size and shape of spatial units jeopardize economic geography estimations?' *Journal of Urban Economics* 67.3: 287-302

Castellani, Davide and Andreas Koch (2015) *Mapping competitiveness with European data*, Blueprint Series 23, Bruegel

Ciccone, Antonio and Robert E. Hall (1996) 'Productivity and the density of economic

activity', *The American Economic Review* 86.1: 54

Ciccone, Antonio (2002) 'Agglomeration effects in Europe', *European Economic Review* 46.2: 213-227

Duranton, Gilles and Diego Puga (2004) 'Micro-foundations of urban agglomeration economies', *Handbook of regional and urban economics* 4: 2063-2117

Duranton, Gilles and Henry G. Overman (2005) 'Testing for localization using micro-geographic data', *Review of Economic Studies*: 1077-1106

Fujita, Masahisa, Paul Krugman and Anthony Venables (1999) *The spatial economics: Cities, regions and international trade*, Cambridge, MA: The MIT Press

Gabaix, Xavier (2011) 'The Granular Origins of Aggregate Fluctuations', *Econometrica* 79.3: 733-772

Gibrat, Robert (1931) *Les inégalités économiques*, Recueil Sirey

Giovanni, Julian di and Andrei A. Levchenko (2011) 'Country size, international trade, and aggregate fluctuations in granular economies', *Working Paper* No. w17335, National Bureau of Economic Research

Greenstone, Michael, Richard Hornbeck and Enrico Moretti (2010) 'Identifying agglomeration spillovers: Evidence from winners and losers of large plant openings', *Journal of Political Economy* 118.3: 536-598

Hausmann, Ricardo, Jason Hwang and Dani Rodrik (2007) 'What you export matters', *Journal of Economic Growth* 12.1: 1-25

Kleinert, Jörn, Julien Martin and Farid Toubal (2012) 'The few leading the many: Foreign affiliates and business cycle comovement', *Working Paper* No. 116, Globalization and Monetary Policy Institute, Federal Reserve Bank of Dallas

Konings, Jozef and Luca Marcolin (2011) 'The Competitiveness of Regions. A Comparison between Belgian and German Regions', *Review of Business and Economic Literature* 56.3: 274-288

Koren, Miklós and Silvana Tenreyro (2007) 'Volatility and development', *The Quarterly Journal of Economics*, 122 (1): 243-287

Lychagin, Sergey, Joris Pinkse, Margaret E. Slade and John Van Reenen (2010) 'Spillovers in space: does geography matter?' *Working Paper* No. w16188, National Bureau of Economic Research

Mayer, Thierry and Gianmarco I.P. Ottaviano (2008) 'The happy few: the internationalisation of European firms', *Intereconomics* 43.3: 135-148

Minerva, G. Alfredo and Gianmarco I.P. Ottaviano (2009) 'Endogenous Growth Theories: Agglomeration Benefits and Transportation Costs', in Roberta Capello and Peter Nijkamp (eds) *Handbook of Regional Growth and Development Theories*, Cheltenham: Edward Elgar

Puga, Diego (2010) 'The Magnitude and Causes of Agglomeration Economies', *Journal of Regional Science* 50.1: 203-219

Riley, Jim (2012) 'Measuring the Competitiveness of a Business', *Business Blog*, http://www.tutor2u.net, 18 May

Rosenthal, Stuart S. and William C. Strange (2008) 'The attenuation of human capital spillovers', *Journal of Urban Economics* 64.2: 373-389

Annex

A: Example: Hungarian regions

Before creating variables, one needs to make some choices: (i) how to best define outside markets, (ii) what regional aggregation, and (iii) what sectoral aggregation. Here, we use all countries outside Europe[35]. As for regional aggregation, NUTS2 level is necessary to get sensible sector-level values. NUTS3 is only possible when using total economy aggregates – ie when we assume simple additivity of industry competitiveness values. For most sectors, 2-digit level is the maximum to get enough firms. For a few broad sectors, such as machinery, 3-digit level would be possible.

The first step uses firm-destination-product specific data, mostly available from customs. Product data is typically available at HS6 level. There are two alternatives to get sector-level values when exports are given at product level. The more direct approach is to sum export sales by products and apply a product-sector conversion filter to get firm-destination-sector-level export data. We suggest using 2 digit NACE rev2 industry setting. The second, easier but less precise approach is to classify all a firm's exports by the firm's primary NACE code.

For each firm-NACE, calculate $XO_{\_id\_nace}$: Firm-NACE-Export to outside Europe, $X_{\_id\_nace}$: Firm-NACE total export. Then generate $XOS_{\_id}$:=sum of $XO_{\_id\_nace}$; $XS_{\_id}$:=sum of $X_{\_id\_nace}$. As noted earlier, NXS per region and sector is calculated as (XO,s/Lo,s)/(Xs/Ls).

The second step, is to work on firm level data to calculate, for each firm, $L_{\_id}$ as the number of employees and $Y_{\_id}$ as the total sales of firms. We can generate $L_{\_id\_nace}$:= $L_{\_id\_}$ *$X_{\_id\_nace}$ /$XS_{\_id}$

35. EU28+ Andorra, Belarus, Bosnia and Herzegovina, Iceland, Liechtenstein, Macedonia, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, Ukraine, Vatican City.

In the third step, we need to merge data to have firm-NACE level observations. We sum by region-sector, to get total exports to outside EU by sector and region and to calculate number of firms per region-sector, number of firms exporting to outside EU per region-sector so that we can discuss extensive and intensive margins. Finally, we create number of employment per sector-region using L_id_nace.

Table 1 presents NXS index values for NACE2 manufacturing sectors in Hungary. Calculations are based on total non-Europe (EU28+) exports[36]. For instance, let us consider the food manufacturing sector (#10). By dividing exports value by employment, and comparing them across regions, we disregard specialisation (ie the number of firms). According to our measure, in this industry, the most competitive region is South-East Hungary, where an average-sized firm exports to outside EU twice (215 percent) the Hungarian average.

Table 1: NXS index values for Hungary

NUTS2 region	Food	Light industry	Wood	Chemicals	Raw materials	Fabr. Metal
Budapest/Centre	131%	112%	48%	116%	120%	88%
Centre-West	32%	40%	335%	35%	102%	170%
West	65%	93%	100%	45%	118%	167%
South-West	25%	165%	135%	10%	7%	6%
North	29%	46%	24%	170%	4%	64%
North-East	63%	87%	10%	159%	194%	83%
South-East	215%	107%	11%	27%	49%	31%

NUTS2 region	Electrical	Machinery	Motor	Other manuf.	**Man. average**	Business services
Közép-Magyarország	83%	102%	20%	80%	***90%***	133%
Közép-Dunántúl	293%	158%	170%	206%	***159%***	76%
Nyugat-Dunántúl	56%	207%	298%	22%	***121%***	5%
Dél-Dunántúl	91%	14%	5%	14%	***45%***	24%
Észak-Magyarország	29%	88%	84%	197%	***67%***	35%
Észak-Alföld	82%	47%	4%	136%	***78%***	N/A
Dél-Alföld	13%	28%	47%	31%	***58%***	58%

Source: Central Statistics Office Hungary. Notes: The table shows NSX values for Hungary, at 2-digit NACE2 industries and NUTS2 regions. Values are calculated with only Hungarian data, ie 100 percent would be the average region-sector value in Hungary. Red numbers are based on imputations because of suppressed data (too few firms or presence of very large firms). Business services: some selected sectors available in data.

36. We repeated this exercise for EU28 exports and found a 60 percent correlation. China alone cannot be determined at 2-digit industry level.

Considering manufacturing, the West and Centre-West regions are the most competitive on average (weighted by employment in industries), followed by the Central region (including Budapest). As is visible from the table, there is substantial variation between regions. South-West does well in food, while North is competitive in chemicals.

B: Example:EFIGE results for selected EU regions

In the absence of official data, one could use private data or survey information. One possibility could be to use Amadeus, the European firm-level database compiled by Bureau van Dijk. Data includes balance-sheet information including export sales. However, this information is not available for most countries.The EFIGE survey offers a way to compare regions in selected countries. The dataset covers 14,800 EU manufacturing firms with at least 10 employees, located in seven countries: Austria, France, Germany, Hungary, Italy, Spain and the United Kingdom. The dataset includes a great deal of information about the internationalisation activities of these firms[37].

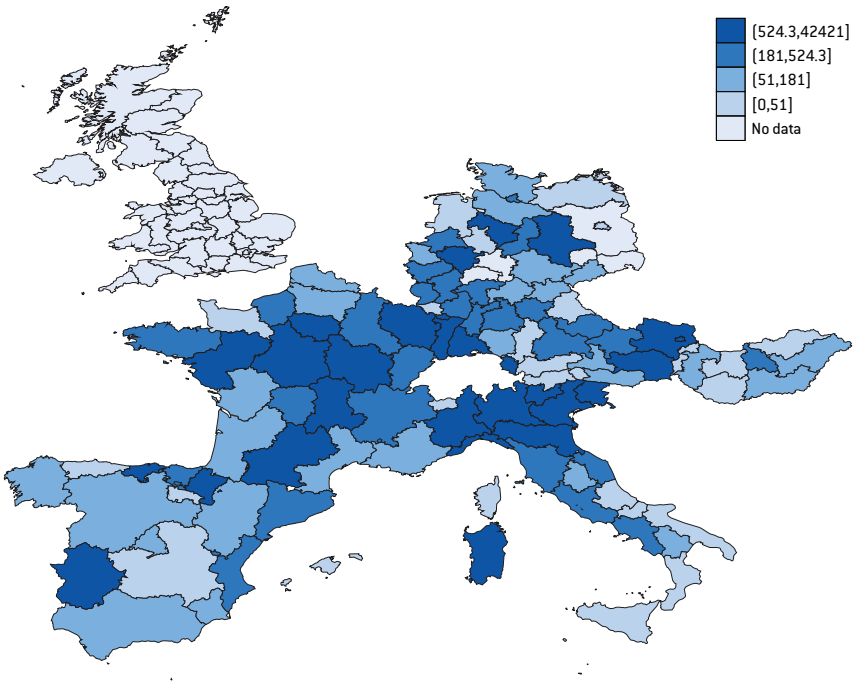
The advantage of the EFIGE dataset is that for each firm, we know the share of sales exported to outside Europe, calculated by multiplying (i) the ratio of exports to sales and (ii) the ratio of non-Europe exports to total exports. Unfortunately, the sample is not large enough to consider sectors.

Before turning to results, please note that the EFIGE dataset does not include exports values, only size of the company by workforce. To partially remedy this, we merged the data with information from Amadeus on total sales revenue. As a result, we generated our preferred index for most regions in six countries – Amadeus sales data is very poor in the UK. We also generated a simplified index, available for all regions in the sample: instead of adding up export sales in euros, we weight 'normalised export share' by labour only. Hence our second measure, is a regional labour weighted average non-Europe exports to sales ratio.

Highest index values are attained by regions in the centre of France, north west of Germany, north of Italy and some regions in Austria. Low values are attached to Hungarian regions apart from the Centre, southern Italy, the eastern part of Germany and eastern Spain. The simplified measure would put a great many UK regions on top as well.
Of course, this is just an illustration of our approach. Given data weakness, actual results should be treated with great caution.

37. For details, see Altomonte *et al* (2013).

Figure 1: Map of NSX regional competitiveness index



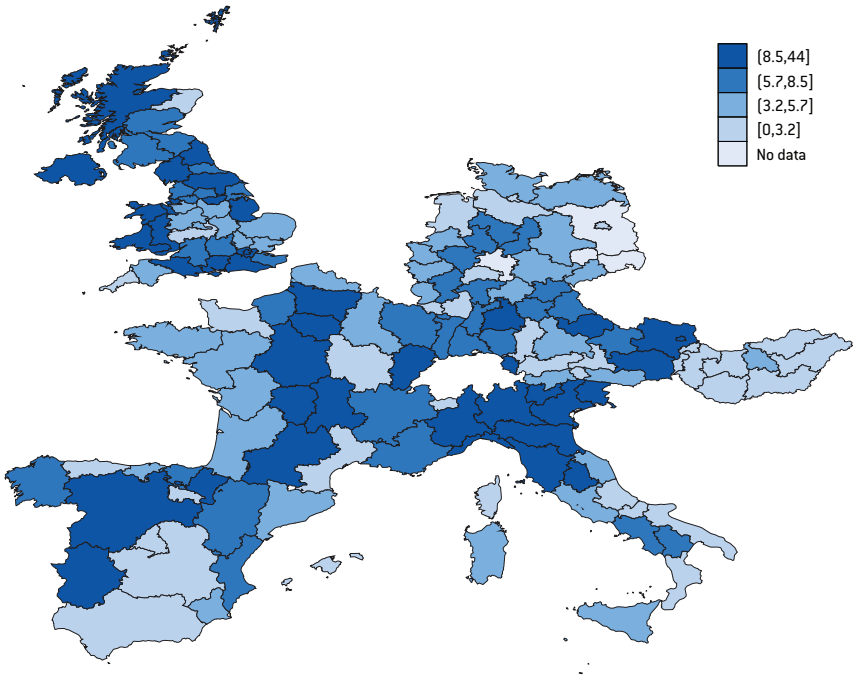
Source: MAPCOMPETE. Notes: Calculated using the EFIGE survey for 2009. The index is calculated for most but not regions in the sample in 6 EU countries (no UK data). Generated by weighing non-Europe export values by labour (as defined above).

Finally, as noted in Section 3, we can calculate extensive and intensive margins, and hence, investigate to what extent the share of firms exporting outside of the EU in a region might determine that region's performance. To do that we consider the EFIGE universe as representative, and calculate the share of firms exporting overseas compared to all firms. A simple OLS regression of the NSX index value on the share of overseas exporters suggests that the number of firms explains about 20 percent of a region's performance, while 80 percent is explained by the average non-EU export share of firms. Of course, this is just a simple exercise disregarding sectors.

For each region, we can calculate the difference between index value and its predicted value – based on the number of firms exporting overseas. Table 2 shows the relative importance of average export share – calculated as mean of regional values per country. This shows that Austria is special in the sense that the non-EU export performance of Austrian regions is well above the levels suggested by the number of firms. Of

course, this might just be a small-sample issue (fewer Austrian firms in the sample, more prone to bias), but it shows that with better data, this could be an interesting issue.

Figure 2: Map of NSX regional competitiveness index – simplified version



Source: MAPCOMPETE, EFIGE dataset. Notes: Calculated using the EFIGE survey for 2009. The index is calculated for all regions in the sample in seven EU countries. Simplified version: generated only by using number of employees as weights disregarding labour productivity.

Table 2: Relative importance of firm average

Country	Relative of firm average
Austria	2.91
France	0.50
Italy	0.20
Hungary	-0.46
Germany	-0.83
Spain	-0.86

Source: MAPCOMPETE.