



Quantification of the effects of legal and administrative border obstacles in land border regions

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1. AIM OF THE STUDY

The physical border is not the only factor responsible for hindering gross domestic product (GDP) growth. Regulatory barriers, resulting mainly from fragmentation of the Single Market due to different national legal frameworks, continue to affect the markets for services and products between land border regions. These differences in legal systems negatively affect the growth patterns of land border regions. For instance, they limit the use of productive assets, denying the achievement of economies of scale due to a restricted market size, the integration of labour and financial markets, with the result of a sub-optimal use of productive assets and a GDP loss especially for border regions.

This study aims at quantifying the aggregate economic costs in terms of **loss of GDP and employment** due to legal and administrative barriers for land border regions, including the borders with Norway, Liechtenstein, Switzerland and Andorra.

The study relies on a methodology able to quantify to what extent the suboptimal use of productive resources can hinder the GDP growth rate due to the presence of legal and administrative barriers. The methodology analyses which productive assets are vital for regional growth in Europe, and measures whether the use of these assets is suboptimal in presence of legal and administrative barriers. As it will be shown, empirical analyses detected four assets that are inefficiently used in land border regions with respect to other regions, namely urban agglomeration, productive capacity, accessibility and trust. The loss associated to the presence of legal and administrative barriers is obtained as the **sum of GDP losses caused by the suboptimal use of each single relevant productive asset due to the presence of a legal and administrative barrier**.

The analysis considers different types of losses, namely:

- **direct losses**, defined as the loss of GDP and employment due to the suboptimal use of each asset, which turned out to be important for growth, namely urban agglomeration, productive capacity, accessibility and trust. The suboptimal use of an airport, as well as the limited possibility of exploiting potential agglomeration economies supplied by a city, are sources of GDP and employment losses;
- **indirect losses**, related to the loss of GDP and employment due to the suboptimal exploitation of the four aforementioned assets, when, through a domino effect, other related assets are suboptimally used. An example in this respect can be the limited accessibility to an airport that causes a damage to the local productive firms, lowering their production capacity, and therefore GDP and employment growth. Another example is a limited capability of exploiting potential advantages of urban size may reduce the quality of the urban service and consequently the innovativeness of the economic fabric;
- **total losses**: loss of GDP and employment due to the sum of direct and indirect losses.

Moreover, the study takes into consideration that legal and administrative barriers do not only limit the use of internal assets, but can generate a suboptimal use of resources located in neighboring regions. For this reason, losses (direct and indirect) measured in this study encompass losses related to:

- the **suboptimal use of internal assets**;
- the **suboptimal use of assets located in neighboring regions beyond borders**.

Losses (direct and indirect) are calculated:

- **by assets**, both internal and external;
- **by geographical areas**:
 - country level (all land border areas in a country);
 - single land border regions;
 - single NUTS3 areas belonging to land border regions;
- in **absolute values** (euros for GDP; number of jobs for employment);

- as a **share** of European GDP (employment) and border regions' GDP (employment).

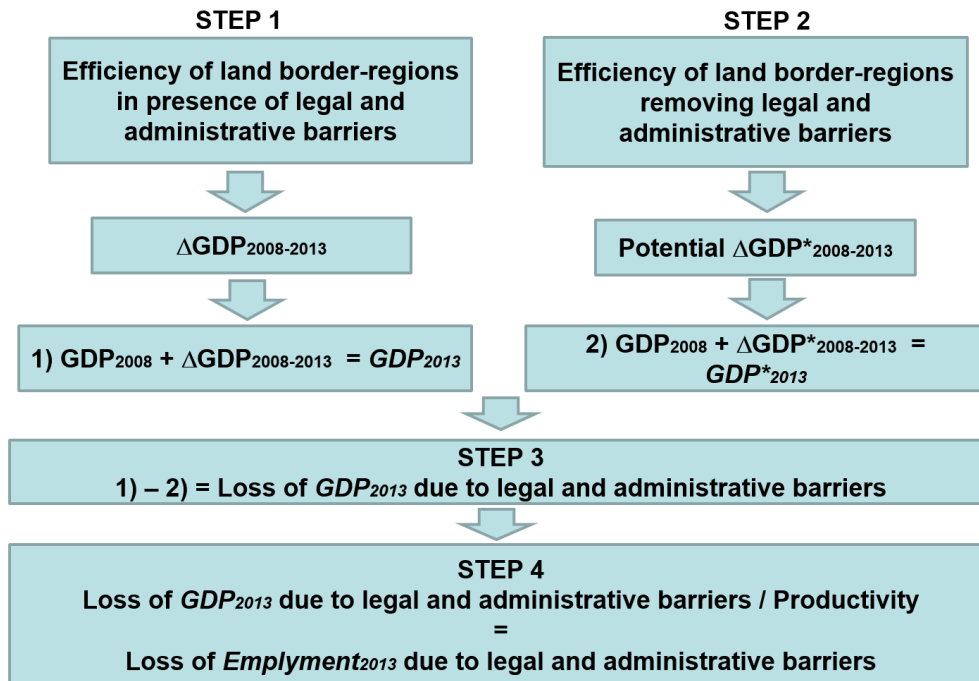
The Report is structured as follows. Section 2 presents the methodology, Section 3 reports the aggregate results, the results by country and by land border regions. Section 4 contains some concluding results.

2. METHODOLOGY

2.1. Calculation of GDP and employment loss

The methodology to measure the losses of legal and administrative barriers encompasses several steps (Figure 1), which are presented in details hereafter.

Figure 1. Methodological steps for the measurement of GDP loss due to the presence of legal and administrative barriers



Legend : * potential

Step 1. Calculation of the efficiency of land border-regions in presence of legal and administrative barriers

The first step of the methodology concerns the estimation of the (negative) effects of the presence of legal and administrative barriers due to a suboptimal use of productive assets in border regions. This step takes advantage of the study contracted by DG Regio, Collecting solid evidence to assess the needs to be addressed by Interreg cross-border cooperation programmes, Contract no. 2015CE160AT044, in which the suboptimal use of different assets was measured for different types of border obstacles, legal and administrative ones included among many others.¹

¹ The technical appendix presents the technicalities of the estimate of the regional growth model, and all econometric results.

This step comprises the estimation of a regional growth model, which assumes the following form:

$$\Delta Y = \alpha + \sum_k \beta_k * control_k + \gamma * border + \delta_i * assets_i + \vartheta_i * border * assets_i + \mu_{ij} * border * assets_i * obstacle + \sum_{c=1..n} \rho_c * country_c + \varepsilon_{ij} \quad \forall i, j \quad (1)$$

Where ΔY is the actual regional growth rate 2008-2013, i refers to assets, j to obstacles and c to countries. δ_i is the average coefficient for the impact of each productive asset i on regional growth, ϑ_i is the coefficient for the differential impact of asset i on the growth of border regions, and μ_{ij} the coefficient the impact of each asset i on the growth of border regions characterized by legal and administrative barriers j , with respects to all other regions.²

When μ_{ij} assumes a negative and significant value, it signals that border regions with legal and administrative barriers register a lower impact on growth from a specific asset with respect to all other regions, and therefore that this asset is used in a suboptimal way.

The same estimation approach is applied to estimate to what extent the resources located in neighbouring regions help a region to grow, and how much this effect varies between regions with and without a legal and administrative barrier. The following growth model was estimated:

$$\Delta Y = \alpha + \sum_k \beta_k * control_k + \gamma * border + \delta_i * external\ assets_i + \vartheta_i * border * external\ assets_i + \mu_{ij} * border * external\ assets_i * obstacle + \sum_{c=1..n} \rho_c * country_c + \varepsilon_{ij} \quad \forall i, j \quad (2)$$

The same logic of Eq. (1) applies also in this case. When μ_{ij} is negative and significant, it suggests that an external resource i generates a lower growth rate in regions with legal and administrative barriers with respect to a region without such a barrier. Two assets, namely manufacturing activity and propensity to save of neighbouring regions, turned out to be sub-optimally used in regions with legal and administrative barriers.³

From these equations, the estimated GDP growth between 2008 and 2013 is attributed to the single territorial growth factors and to (negative) border effects.

Step 2. Calculation of the efficiency of land border-regions under the assumption of a removal of legal and administrative barriers

The second step has the aim to estimate what the GDP growth would be, if legal and administrative barriers were totally removed in land border regions. This uses of Eq. (1) and (2), assuming that legal and administrative barriers do not exist in land border regions, and

² Border is a dummy variable, taking the value 1 if the region is a border region, $assets_i$ is the continuous variable measuring the endowment of growth asset i , and obstacle is a dummy variable equal to 1 when a border region is classified as a region with legal and administrative barriers. A region is in fact classified as belonging to "regions with administrative and legal barriers" when the NUTS3 region scores higher than the EU average in the Eurobarometer question "To what extent do you consider legal and administrative barriers an obstacle for potential cooperation?".

³ Growth rates in both Eq. (1) and (2) are calculated between 2008 and 2013, while assets are measured in a previous time period, most around 2006. See the Technical Appendix for detailed information on indicators used in the analysis.

that therefore these regions were able to use their productive assets as all other regions. The growth rate obtained in this step is therefore a potential GDP growth, and, when applied to the GDP level in 2008 for each NUTS3, its potential GDP in 2013 is obtained. Summing up NUTS3 GDP, by land border region, by country and at EU aggregate level, the potential GDP level in 2013 is obtained for the different geographical areas.

Step 3. Loss of GDP

The third step comprises the calculation of the loss in GDP. The loss is obtained by **subtracting the potential GDP without barriers (step 2) from the estimated GDP (step 1) for each NUTS3 and for all aggregate areas in 2013.**

Step 4. Loss of employment

The **loss of employment** is computed by dividing the loss of GDP in 2013 in each NUTS3 area by its productivity levels in 2013. The employment loss for land border region, for country and for the EU is obtained by summing up the employment loss at NUTS3 level.

3. RESULTS OF THE LOSS ESTIMATION

3.1. Overall GDP loss assessment

Table 1 presents the overall assessment of the economic losses due to the presence of legal and administrative barriers. Table 1 presents the general appraisal of the losses in the first rows, followed by a breakdown of the losses due to the suboptimal use of regional growth assets (first the internal assets, second the external assets located in neighboring regions) because of the legal and administrative barriers. On the other hand, columns present the final appraisal of the losses in Euros (Column 2), the relative magnitude of the losses with respect to the overall GDP levels of EU 28 and EFTA countries (Column 3), and the loss with respect to GDP produced in land border regions.

Results suggest a rather relevant importance of legal and administrative barriers for land border regions; all in all, GDP loss could be around **458 billion Euros**. If legal and administrative barriers were removed, GDP in border regions could therefore increase of that value. This corresponds to about **3 per cent of EU's GDP**, or **8.7 per cent of total GDP produced in land border regions**: the removal of legal and administrative barriers would allow border regions to be 8.7 per cent richer than what they are at present.

This is a quite impressive result in terms of magnitude. However, one has to remember that:

- our estimates are gross of the costs incurred for eventually removing legal and administrative barriers. This endeavor would clearly require a consistent effort on the side of policy bodies at administrative, firm, and consumer levels, with relevant adjustment costs that would make net assessments lower;
- our results take all correlated, indirect, effects into account, i.e. all effects that a suboptimal use of relevant growth assets cause on all other assets;
- our results lie in the range of values obtained in similar evaluation exercises. The result is in line with the costs of non-Europe calculated in 2007 by Ilzkovitz et al. are around 2.2 per cent of EU GDP (Ilzkovitz et al., 2007), by Boltho and Eichgreen in 2008, which are around 5 per cent (Boltho and Eichgreen, 2008), and are lower than the 12 per cent of Campos et al. obtained in 2014 (Campos et al., 2014). Moreover, the overall assessment of the losses of non-Europe is equal to 1.6 trillion Euros in Dunne (2015), with, among the many sources, 400 billion Euros being due to the absence of a joint

digital market, and 615 billion Euros due to the absence of a single market for consumers and citizens. Along the same lines, the removal of barriers in the area of e-commerce alone amount would engender benefits equal to 748 Billion Euros, according to Goidel et al. (2016).

Table 1. Overall assessment of the GDP losses due to the presence of legal and administrative barriers

Table	GDP loss due to legal and administrative barriers	GDP loss as percentage of EU+EFTA GDP 2013	GDP loss as percentage of all land border regions GDP 2013
Total GDP loss	-457,738,679,232 €	3.16%	8.74%
90% confidence interval			
Min	-76,743,955,808 €	0.53%	1.47%
Max	-844,805,292,240€	5.83%	16.13%
Internal assets			
Agglomeration economies	-24,770,815,840 €	0.17%	0.47%
Productive capacity	-73,577,385,440 €	0.51%	1.40%
Accessibility	-128,317,250,784 €	0.89%	2.45%
Trust	-86,208,547,264 €	0.60%	1.65%
External assets			
Manufacturing activity	-70,381,249,408 €	0.49%	1.34%
Propensity to save	-74,483,430,496 €	0.51%	1.42%

While methodologies used to appraise these losses differ, all reports converge on the need to take any such assessment with great care. Any such appraisal necessarily depends on the methodology adopted, the quality of information available in the data used, and on a number of issues that may possibly bias the final result. This explains why a large difference in the estimations of the costs of non-Europe exists in the literature, going from 2.2 per cent to 12 per cent.

Our case does not differ. Appraising the losses associated to an intangible barrier like legal and administrative barriers necessarily entails some degree of uncertainty that, rather than casting doubts on the chosen methodology, only reinforces the case for a careful reading of any such exercise.

To be on the safe side, and to manage the uncertainty linked to any estimation, we also present the cost estimates in 90 per cent confidence interval; this allows us to know with 90 per cent probability the range within which the "true" value falls. The interval ranges between two negative values – indicating that a loss does exist – a **minimum loss of 1.47 per cent of land border GDP** and a **maximum loss of 16.13 per cent** (between 0.5 and 5.8 per cent of EU and EFTA Countries' GDP). Inside this interval, nevertheless, the estimated figures presented in Table 1 represent an average among border effects across the 454 NUTS3 land border regions.

Losses can next be broken down by the sources that caused them; the methodology in fact allows to highlight the suboptimal use of single regional growth factors, and attribute to each of them a GDP loss.

Suboptimal use of accessibility turns out to be the main source of losses associated with legal and administrative barriers. It is reasonable to assume that both business and leisure travelers face relevant losses due to the incomplete homogenization of rules and contracts across borders, hampering their ability to use good transport infrastructure located across boundaries. Nearly 0.9 per cent of European GDP and 2.45 per cent of land border regions' GDP is in fact lost by land border regions due to the suboptimal use of their accessibility.

Less expected but highly interesting is the finding related to limited trust, which is associated to 0.6 per cent of European GDP loss and 1.65 per cent loss of all land border regions' GDP. Legal and administrative barriers also substantially decrease the positive impact of

collaborative attitudes, rubricated as trust-oriented relations. Of comparable magnitude is also the loss due to an imperfect exploitation of productive capacity: regions specialised in manufacturing can be hampered in fully reaping the benefits of such specialisation because firms can incur in additional costs, on exports and in reaching economies of scale. This situation is associated with a GDP loss equal to 0.51 per cent of European GDP, and of 1.40 per cent of land border GDP.

Lastly, legal and administrative barriers are also associated with significant losses on potential agglomeration economies. On the one hand, the relatively peripheral location of several border regions makes land border regions less likely to host large urban agglomerations (although some of the surveyed regions do). On the other hand, the administrative and legal barriers can hamper the growth rate of larger urban areas, resulting in a loss of 0.17 per cent of the European GDP and 0.47 of land border regions. Moreover, legal and administrative barriers, such as in retail trade, informal tariffs and differences in contract regulation, make cross-border economic interactions less likely.

Legal and administrative barriers also hamper the effective use of external assets, and in particular other regions' productive capacity and propensity to save. As for the former, proximity to regions specialised in manufacturing activities could in principle grant easier access to both manufactured good on the consumer side and jobs on the producer side. However, when rules and administrative regulations differ across the border, this potential access could be hampered, thus failing to stimulate local growth. This situation is associated with a loss of GDP equal to around 1.34 per cent of land border regions' GDP. By the same token, the propensity to save in nearby regions could potentially translate into additional local investment. However, administrative and legal differences could prevent the effective use of these additional resources for internal growth, resulting in a loss of GDP equal to 1.42 per cent of land border regions' GDP.

3.2. *Spatial distribution of GDP losses*

While the general findings have already shed important light on the extent to which EU's GDP growth is hampered by the existence of legal and administrative barriers, their spatial breakdown can offer more insight into its distribution.

Figure 2 shows the GDO loss by country (histograms, left scale), where the light blue bar indicates the average EU+EFTA mean and the share of each Country's GDP produced in border regions (red dots, right scale).⁴

The histogram displays a quite rich and diversified set of results. Countries on the left of the light blue bar incur losses higher than the EU+EFTA mean. These countries include both small and large ones, both western and eastern countries; in 6 over 14 cases, the high losses are associated to a high presence of border regions, but in most cases this relation is not evident.

These findings become clearer in Figure 3, where countries are classified along two axes, the vertical axis measuring the geographical exposure to potential border losses (high share of GDP in border regions) and the horizontal one measuring losses associated to legal and administrative barriers, in both cases, with respect to the EU+EFTA mean.

Some countries (for instance, Latvia, Sweden, Slovakia and Lithuania) produce a non-negligible share of their GDP in border regions, but are able to keep their losses lower than the mean. On the other hand, some countries located in the lower-right part of the graph face remarkable losses despite having a minor share of GDP produced in border regions (this is for instance the case of UK, Greece, Ireland, Spain, and Italy). At evidence, there exists a case for more efficient management of border losses, and for the opposite (inefficient management). Countries in the other two quadrants (high share / high losses and vice-versa) behave in line with the expectations.

⁴ Countries are ranked in decreasing order of GDP loss due to legal and administrative barriers.

Figure 2. GDP loss as a percentage of border regions' GDP (histograms) and border regions' GDP as a share of Country GDP (red dots)

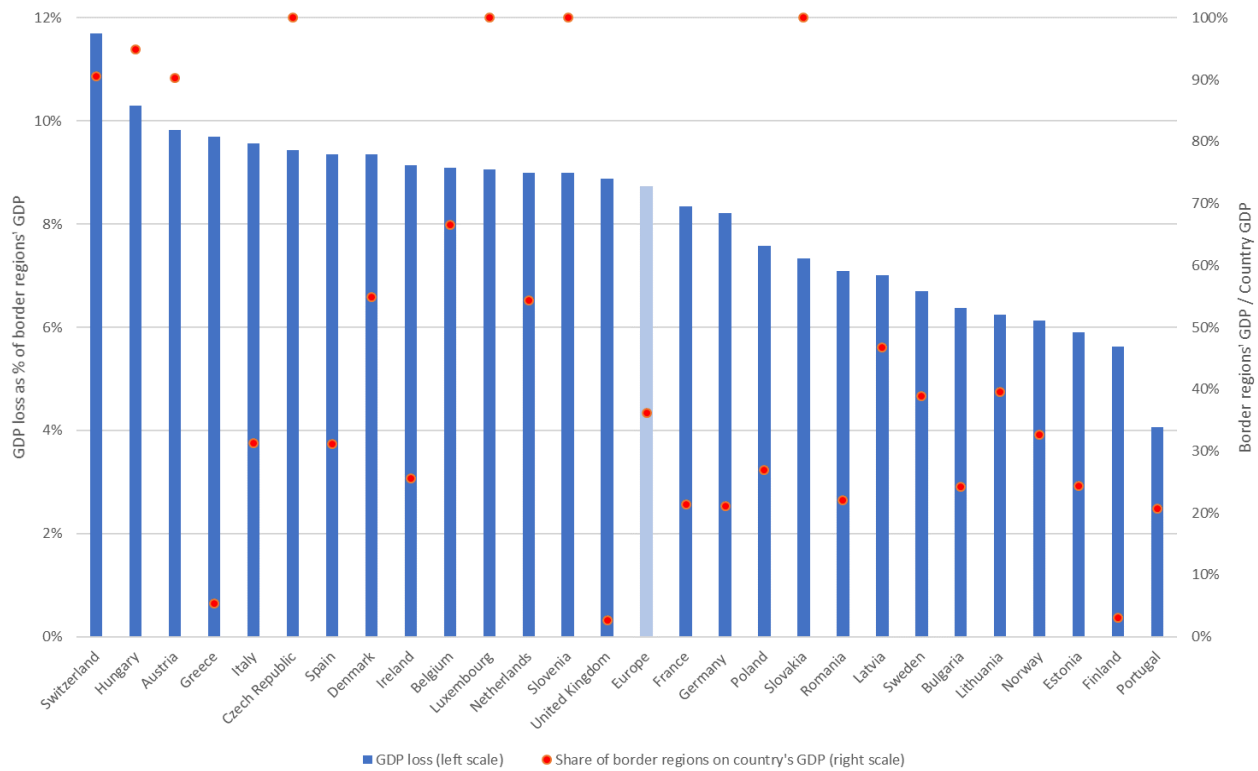
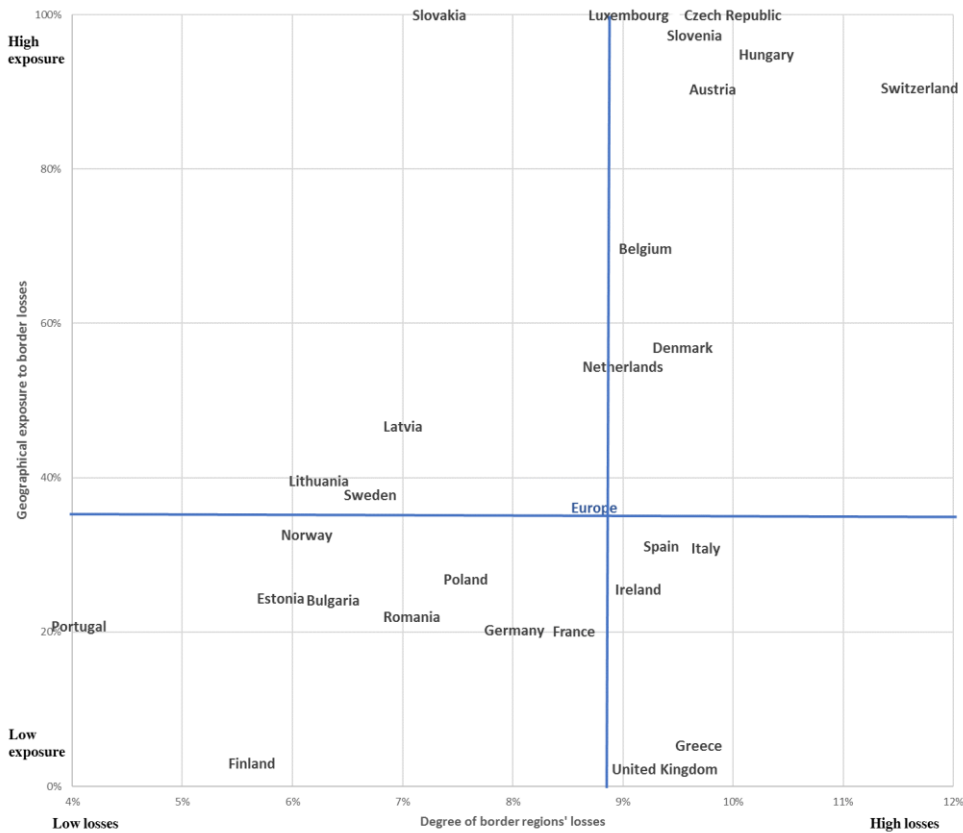


Figure 3. A taxonomy of legal and administrative barriers losses by country (GDP)



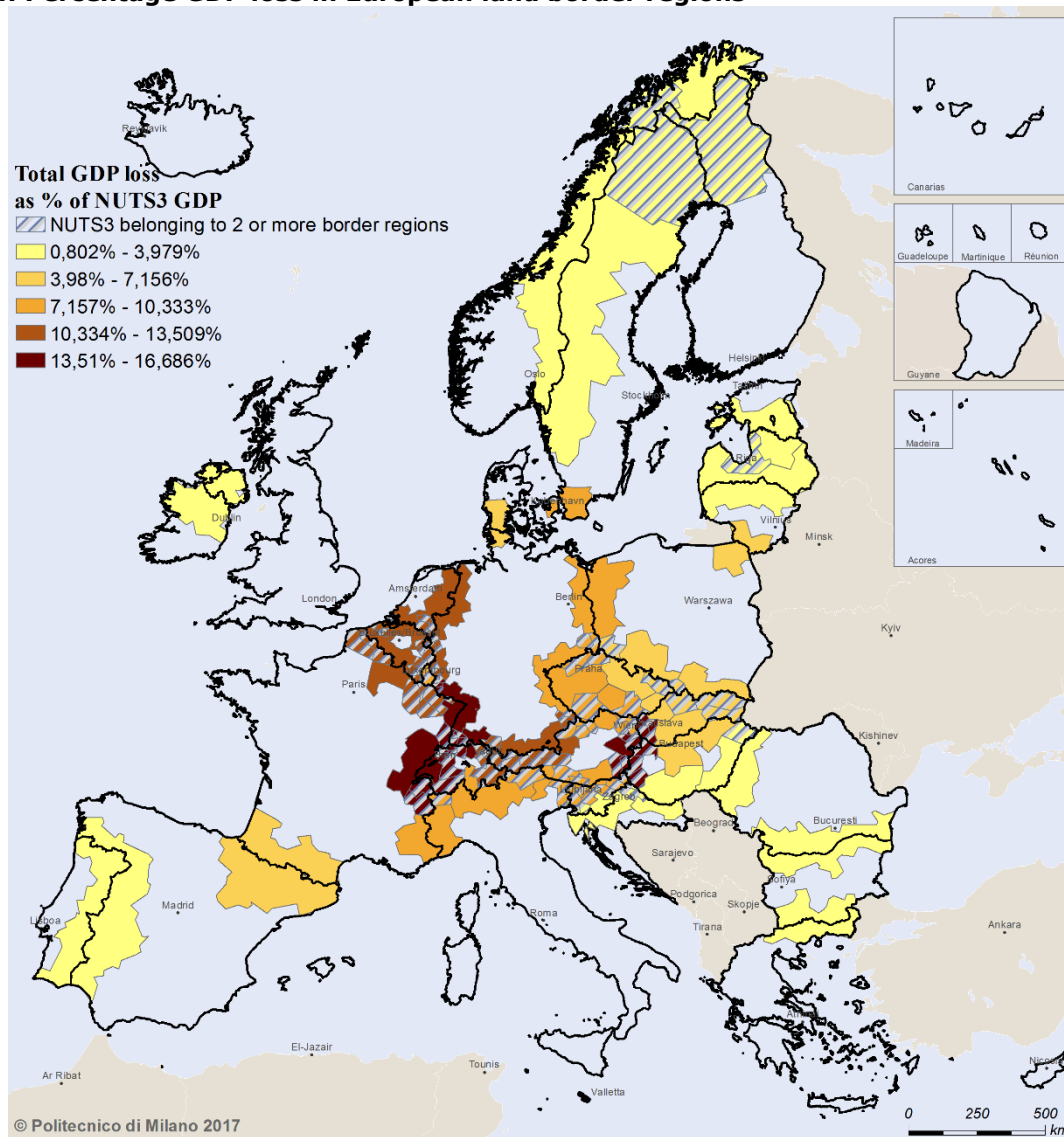
Legend: Geographical exposure to border losses = share of border regions' GDP on country GDP

Degree of border regions' losses = level of losses

Another explanation for such result can be the relatively lower endowment of strategic assets in the land border regions of countries showing a low border impact; a lower endowment means lower case for suboptimal use of the asset itself. These results call for a future analysis of the reasons of such countries' diversity in loss control, which is out of scope of this study.

At an even more detailed level of spatial disaggregation, results at land border regions level show (Figure 4) that major losses (dark brown) are incurred by areas located along borders in central EU+EFTA countries (borders between Netherlands and Belgium, France and Germany, France and Switzerland, Austria and Slovakia), where the highest potential integration is registered.⁵

Figure 4. Percentage GDP loss in European land border regions



⁵ A methodological clarification is here needed. Some NUTS3 regions belong to two or more land border regions. Since color intensities in Figure 4 represent the level of losses sustained, different land border regions typically face different cost levels, thus blurring the picture for areas where NUTS3 regions are shared by two or more land border regions. In the absence of rational ranking criteria, for regions where overlapping of different colors is possible, in figure 4 the color prevailing is that of the land border regions that comes first in alphabetical order. In figure 4, this possible kink is marked with diagonal lines, thus suggesting that in those areas underlying NUTS3 regions may be represented with different colors depending on the land border region they belong to.

With some exceptions, lower GDP losses characterize land border regions located in Mediterranean and Eastern countries, all sharing intra-EU land borders. Another reason, which especially holds for Scandinavian countries, is the lower necessity of integration, being areas of limited population and economic activities.

The same type of map can be drawn for the determinants of overall losses due to the suboptimal exploitation of the regional growth assets in the presence of legal and administrative barriers.

3.3. Overall employment loss assessment

As anticipated in Section 2.1, our methodology also allows to translate our findings on the GDP losses due to legal and administrative barriers into their employment counterparts. Table 2 represents the equivalent of Table 1 for total employment losses, with the breakdown by loss determinants.

Table 2. Overall assessment of the employment losses in terms due to the presence of legal and administrative barriers

	Employment loss due to legal and administrative barriers	Employment loss due to legal and administrative barriers	Employment loss as percentage of EU+EFTA Employment 2013
Total employment loss	-6,371,630	3.01%	8.61%
<i>90% confidence interval</i>			
<i>Min</i>	-1,061,489	0.50%	1.43%
<i>Max</i>	-11,764,156	5.57%	15.90%
Internal Assets			
Agglomeration economies	-336,089	0.16%	0.45%
Productive capacity	-1,001,681	0.47%	1.35%
Accessibility	-1,734,062	0.82%	2.34%
Trust	-1,274,432	0.60%	1.72%
External Assets			
Manufacturing activity	-987,190	0.47%	1.33%
Propensity to save	-1,038,176	0.49%	1.40%

In absolute terms, the presence of legal and administrative barriers still existing in land border regions cause a loss of a little bit more than 6 million jobs. This means a 3 per cent of employment of Europe+EFTA countries and 8.6 per cent of employment of land border regions.

Overall employment losses are associated with an ineffective exploitation of accessibility, trust, productive capacity, and agglomeration economies, in decreasing order of relevance. A non-negligible role is also played by the ineffective exploitation of the propensity to save and

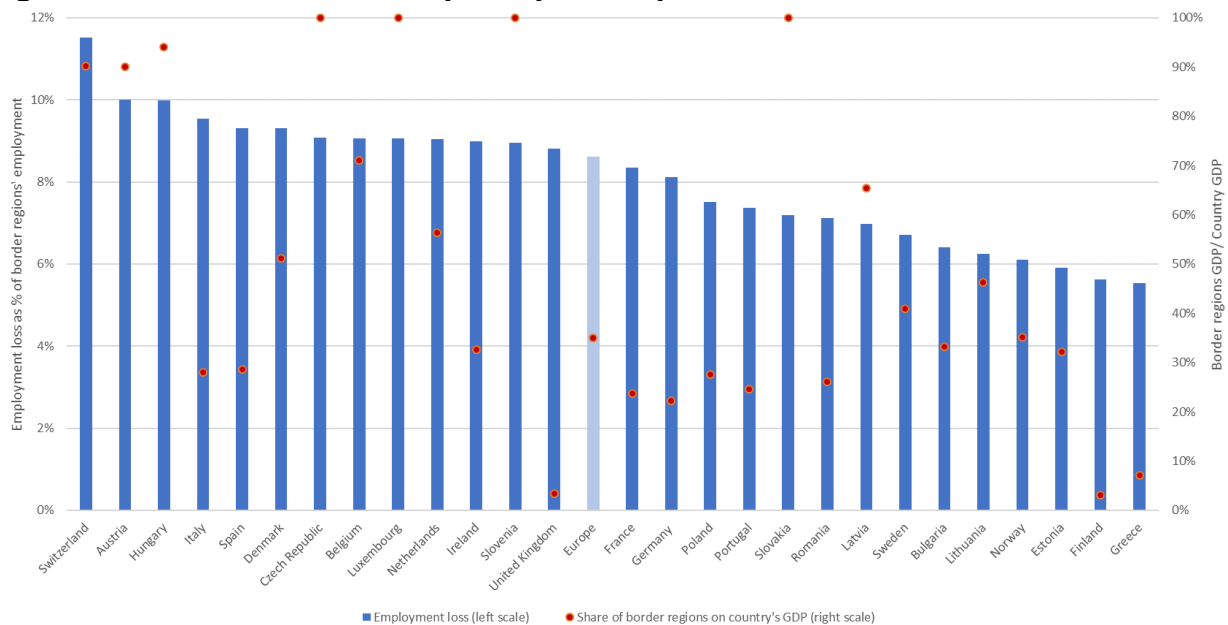
manufacturing activities of nearby regions, the access to which is hampered by the legal and administrative barrier faced by firms and consumers across land borders.

3.4. Spatial distribution of employment losses

As with GDP, much insight into employment losses can be gained by breaking down data at different levels of spatial disaggregation. In Figure 5, for instance, percentage employment losses are shown for all countries (blue bars), along with the average EU losses (light blue bar). Again, since countries could be more or less potentially exposed to these employment losses because of a higher or lower frequency of border regions in their national economies, the share of each Country's GDP produced in border regions is shown in Figure 5 (red dots).

Figure 5 shows that some correlation exists between geographical exposure to potential losses and actual losses, but also that some room for maneuver exists for the efficient containment of these losses. Countries such as Latvia, Lithuania, Slovakia, Czech Republic and Slovenia, seem to be particularly effective in losing relatively less jobs than expected on the basis of their geographical exposure to border-induced losses, while Italy, Spain, Greece, Ireland and UK seem to pay a relatively high price in terms of jobs lost.

Figure 5. Employment loss as a share of border regions' employment (histograms) and border regions' GDP as a share of Country GDP (red dots)



3.5. Direct and indirect losses

An interesting issue is to distinguish, inside total losses, those that are directly dependent on suboptimal use of single assets from indirect ones, related to a "domino" effect. In statistical-econometric terms, direct losses are estimated considering all assets at the same time in Eqs. (1) and (2), while direct and indirect (total losses) were previously estimated in section 3.1, considering one single asset at the time.⁶

⁶ Indirect losses are obtained by subtracting direct losses from total losses. The new estimates have also the advantage to avoid multicollinearity among assets. In practical terms, this means that the estimated coefficients μ_{ij} of each asset measure the effects of that particular asset, and not those of the other assets present in the equation. The new estimates therefore measure the efficiency of each asset after having controlled for its correlation with other assets. Steps 2 to 4 were repeated with the new estimates, and the **direct losses** were in this way obtained.

Estimates of Eqs. (1) and (2) contain one single asset at the time. This means that the suboptimal use of each asset can depend on the suboptimal use of the asset itself, and on the suboptimal use of its related assets, that are not included in the equation.

Table 3 reports the results for both GDP and employment losses. Direct GDP losses are around 1.20 per cent of the EU+EFTA's GDP, corresponding to about 3.3 per cent of total land border regions' GDP. This finally suggests that about one third of total GDP losses is due to direct effects, while about two thirds of the overall losses is generated by indirect effects. Similar considerations can be made on employment losses. This result confirms the "balanced" nature of development processes, in which the presence of a combination of assets, strongly linked to one another, is fundamental.

Table 3. Assessment of direct and indirect GDP and employment losses due to legal and administrative barriers

	Losses due to legal and administrative barriers		
	Absolute values	Percentage on European and EFTA countries	Percentage on <i>all</i> land border regions
Direct GDP loss	-172,813,858,062 €	1.19%	3.30%
Indirect GDP loss	-284,924,821,170 €	1.97%	5.44%
Direct employment loss	-2,271,227	1.07%	3.07%
Indirect employment loss	-4,100,403	1.94%	5.54%

This result suggests that policies oriented to the reinforcement of a single growth asset (like the reinforcement of transport infrastructure alone) generates GDP and employment growth to a more limited extent than a policy able to act on different related assets all together (firms, education, urban services,...).⁷ In our case, on the negative side, indirect, cross-asset effects account for the double of direct losses, in both GDP and employment terms.

4. ROBUSTNESS CHECKS

In order to validate the results presented above, a robustness check has been run, and concerns the way in which regions with legal and administrative borders have been identified. In the analysis presented above, regions are classified as "regions with administrative and legal barriers" when the NUTS3 region scores *higher than the EU average* in the Eurobarometer question "To what extent do you consider legal and administrative barriers an obstacle for potential cooperation?". Legal and administrative barriers were in this case either present or absent, captured through a dichotomous variable (yes/no).

A robustness check was run to see whether our estimates on the GDP and employment loss were subject to a change when the precise intensity by which legal and administrative barriers are perceived by inhabitants is taken into consideration as a continuous variable. It is therefore possible to take a more nuanced picture of the losses engendered by the barriers, using the continuous indicator. Estimates of Eqs. (1) and (2) were rerun with the new variable.

Table 4 presents the results, showing that losses estimated remain in the same order of magnitude of the previous baseline estimates (Tables 1 and 2), namely 3 per cent of EU +

⁷ This fact is confirmed by empirical analyses on the complementary role of different elements of "territorial capital" on regional growth. See, Camagni, 2009; Capello et al, 2011; Perucca, 2014.

EFTA GDP and 9 per cent of border regions' GDP and similar results are achieved as far as employment loss is concerned. This result provides evidence of the solidity of the approach undertaken in this study.

Table 4. Robustness check: GDP and employment losses with different degrees of perception of legal and administrative barriers

	Losses due to legal and administrative barriers		
	Absolute values	Percentage on European and EFTA countries	Percentage on <i>all</i> land border regions
Total GDP loss	-471,608,485,024 €	3.26%	9.00%
Total employment loss	-6,202,440	2.93%	8.38%

5. CONCLUSIONS

The study has presented an empirical measurement of the losses in terms of GDP and employment associated with legal and administrative barriers in land border regions.

Our analysis continues to dig deeper into the quantification of the costs of imperfect European integration, since:

- i. the Single Market is still far from complete. Barriers are still present;
- ii. key policies in support of the Single Market have not been put in place completely;
- iii. fragmentation in legal and administrative frameworks is still strong.

The estimated GDP loss is in line with the "costs of non-Europe" obtained by several previous studies, namely:

- **458 billion euros**, which accounts for **3% of European GDP and 8.8% of total land border regions' GDP**.

This translates into a loss of employment by:

- a little more than **6 million jobs**, which means **3% of total European employment and 8.6% of land border regions' employment**.

Even accepting a "tight" confidence interval – of 90% probability of capturing the "true" effect of legal and administrative barriers – the result confirm a loss of GDP and employment.

Estimates remain robust to different measurement of legal and administrative barriers.

Among the multiple territorial capital assets that generate regional growth, fourth of them proved to be both relevant and particularly sensitive to legal and administrative border barriers, and on these our analysis was focused: accessibility, productive capacity, agglomeration economies linked to urban size and trust attitudes of people. The last asset may look less relevant with respect to the other three as more immaterial and therefore more volatile. This impression is not true in present times, as the trust element lies at the basis of such virtuous attitudes and processes as cooperation capability, reduction of transaction costs, long distance synergy and complementarity networks. In fact, directly and indirectly this asset generates the second largest economic loss – after sub-optimal use of existing accessibility.

The presence of legal and administrative barriers generates a sub-optimal exploitation of the above-mentioned assets, with direct effects on GDP employment, but also indirect effects, due to the complementarity among the different assets and the "balanced" nature of development processes. These latter indirect effects proved to be responsible for the major part of total losses (two thirds of the total).

The quantitative relevance of the economic and employment impact of legal and administrative barriers in single countries (and regions) may depend on many factors:

- the importance of land border regions in the national economies and their numerosity (share of GDP); this factor was proved in many but definitely not the majority of cases;
- the absolute relevance of the single growth assets, which represents in our opinion the most important factors;
- the capability of reducing the impact of border barriers through appropriate governance practice – which still remains an open issue.

At the country level, results show that some countries as **Latvia, Lithuania, Sweden and Slovakia** experience a lower than average GDP loss, even if their exposure to border problems is higher than the European average. Some other countries are in the opposite situation: in front of a smaller than average GDP produced in land border regions, their loss is higher than the EU average: **United Kingdom, Ireland, Italy, Spain and Greece** are in this situation.

At land border region level, **higher losses are registered in land borders in central European countries** (between Netherlands and Belgium, France and Germany, France and Switzerland). With some exceptions, lower losses characterize land border regions located in Mediterranean and Eastern countries. These results are mainly linked to the b. factor indicated above, the absolute size of growth assets.

Our findings implicitly convey important policy messages. A first message is that the decision to curb funding to EU border-regional policies would have severe consequences on the EU's economy, especially in light of the relatively limited costs that could arguably be associated to the process of removing legal and administrative barriers (OECD, 2009).

Several reasons coming from our study's results support such a statement:

- losses tend to accrue to economic powerhouses of the EU economy, where the highest endowment of growth factors and agglomeration economies are present and therefore the highest sensitivity to sub-optimal use of these resources;
- losses identified in this study typically affect areas with strong integration potential, viz. wealthy areas where GDP and employment increases could be potentially relevant, if legal and administrative barriers were removed;
- losses affect different types of growth assets in the same order of magnitude, calling for an equilibrated distribution of funds, whereby some growth assets must be simultaneously reinforced in some specific regions in order to enhance their impact on growth (Meyer, 1963);
- losses affect different types of growth assets following a strong domino effect. In fact, these losses mostly come from the mutual influence of different regional growth assets on other assets' efficiency. Once again, a policy aiming at a balanced reinforcement of assets would be rather welcome.

A second policy message is that huge policy outcomes could be achieved through relatively inexpensive interventions on the regulatory, administrative and institutional spheres, which allow a better exploitation of **existing** growth assets and territorial capital elements. This does not mean that investments on development assets are not needed. But here again, the analysis shows that these investments should not touch single assets but a wider array of complementary assets.

A third policy message is that assets most directly affected by the legal and administrative barriers are those that are most often mentioned as fundamental to the European integration project, such as the integration among national economies, the decrease of geographical remoteness, and the creation of inclusive and cohesive societies (EU, 2017). The presence of legal and administrative barriers causing a suboptimal use of such assets could jeopardize the achievement of the European project.

Lastly, policies aiming at removing legal and administrative barriers could also favour the achievement of a more cohesive society, thanks to a better exploitation of intangible growth assets such as trust.

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APPENDIX

This appendix shows the maps at land border regions level with the costs due to the inefficient exploitation of various regional growth assets (as explained in Section 2, those for which their impact on regional growth is hampered by the presence of legal and administrative barriers).

Figure 5 shows percentage GDP loss in European land border regions due to the inefficient exploitation of agglomeration economies. The map is not unlike the overall losses shown in Figure 4, with the highest losses being paid by areas hosting large urban agglomerations (in particular the Randstad in the Netherlands, the area with Lyon and Geneva across the French-Swiss border, and the Copenhagen-Malmö area which represents a land border region due to the recently built Øresund bridge).

Figure 5. Percentage GDP loss in European land border regions due to the suboptimal use of agglomeration economies

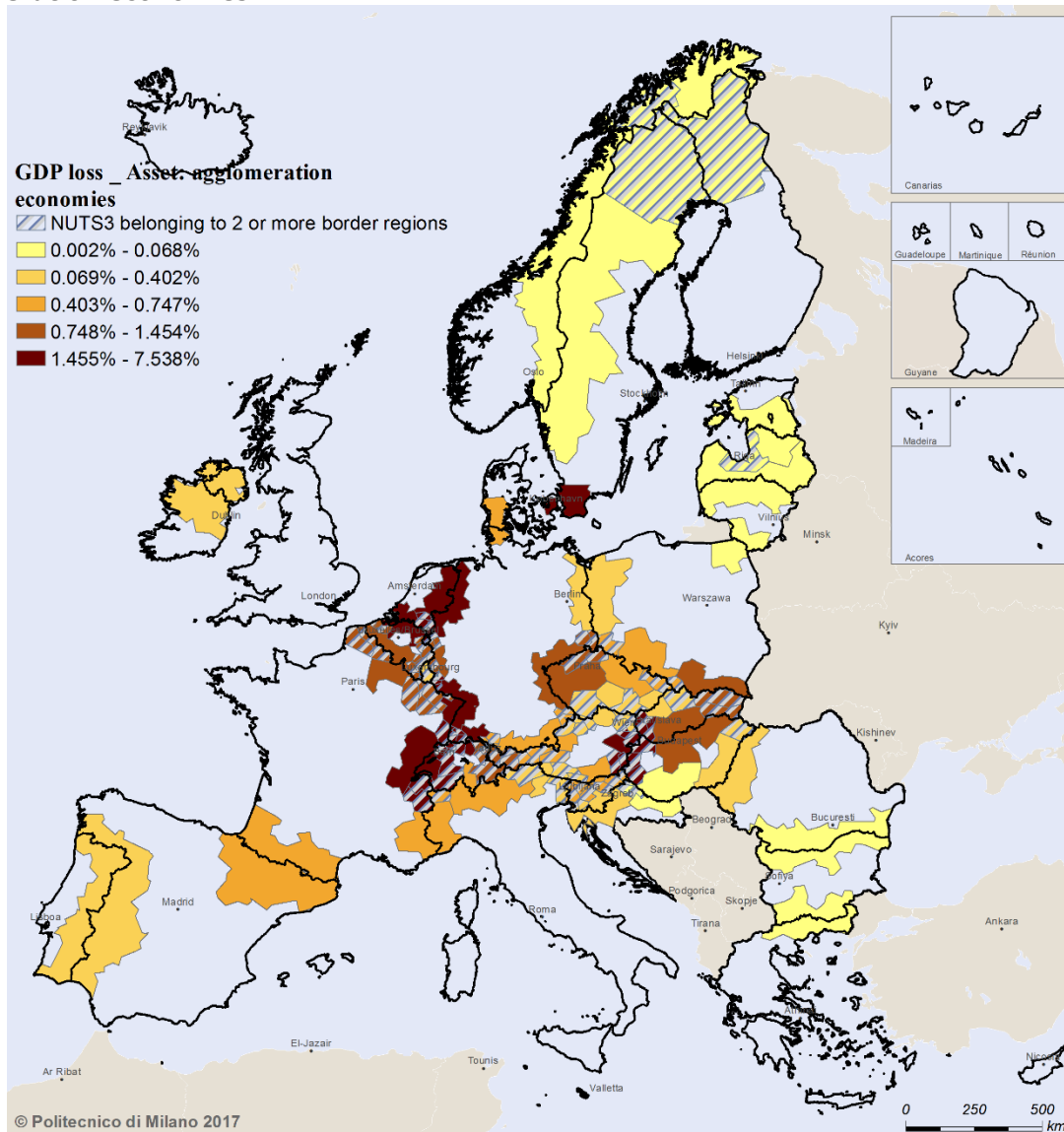


Figure 6 shows instead percentage GDP loss in European land border regions due to the suboptimal use of productive capacity. For this second factor legal and administrative barriers become particularly relevant in Countries such as Germany, Austria, France and Italy where labor markets could be well exploiting possible scale economies in production, but fail to fully reap the benefits of such factors across the borders precisely because of legal and administrative barriers.

Figure 6. Percentage GDP loss in European land border regions due to the suboptimal use of productive capacity

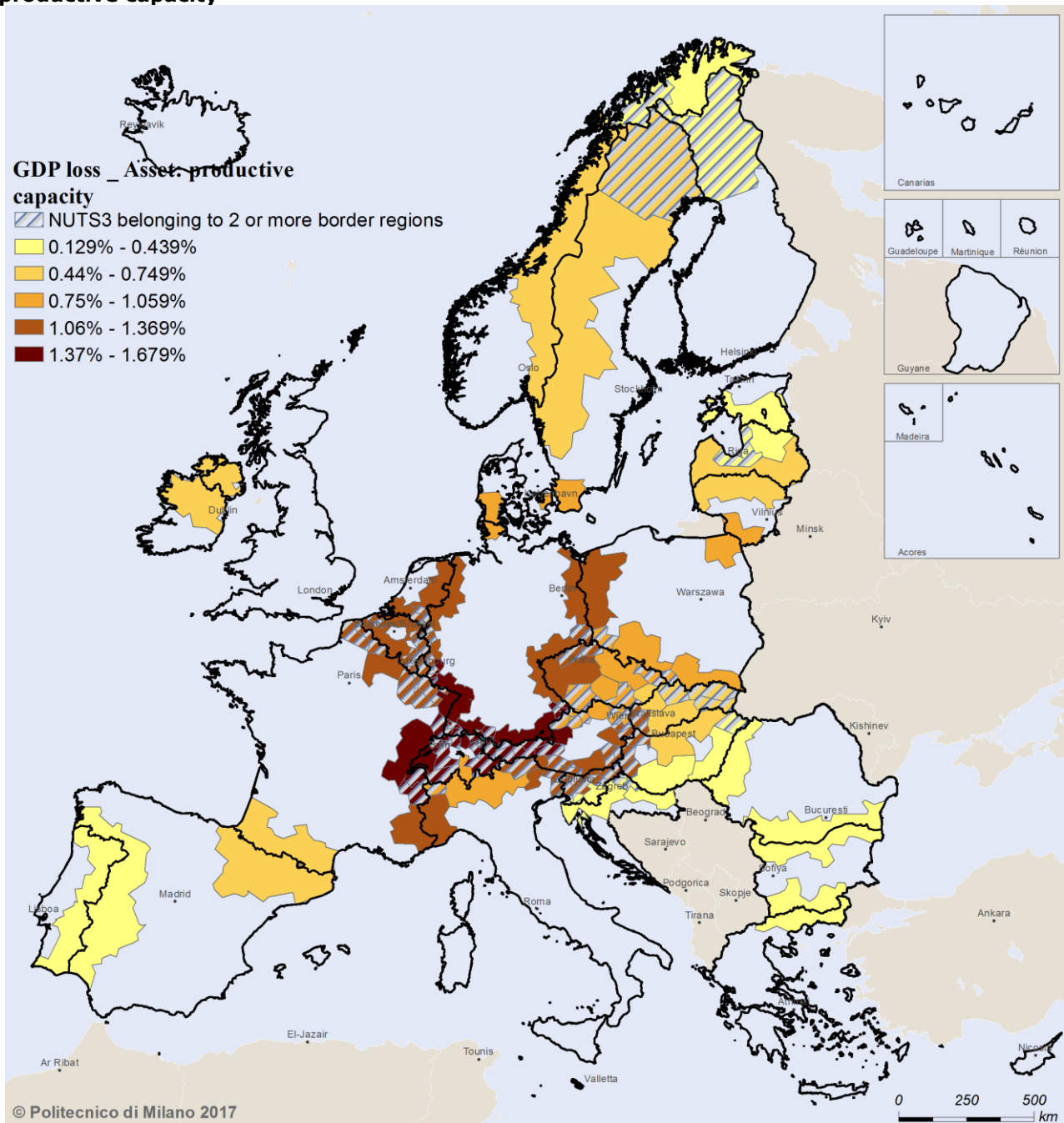


Figure 7 illustrates GDP losses in European land border regions due to the inefficient exploitation of trust. Not surprisingly, these represent only a minor issues in Scandinavian countries that are already well endowed with this asset, while more relevant problems are generated along the French-German and French-Swiss borders.

Figure 7. Percentage GDP loss in European land border regions due to the inefficient exploitation of trust

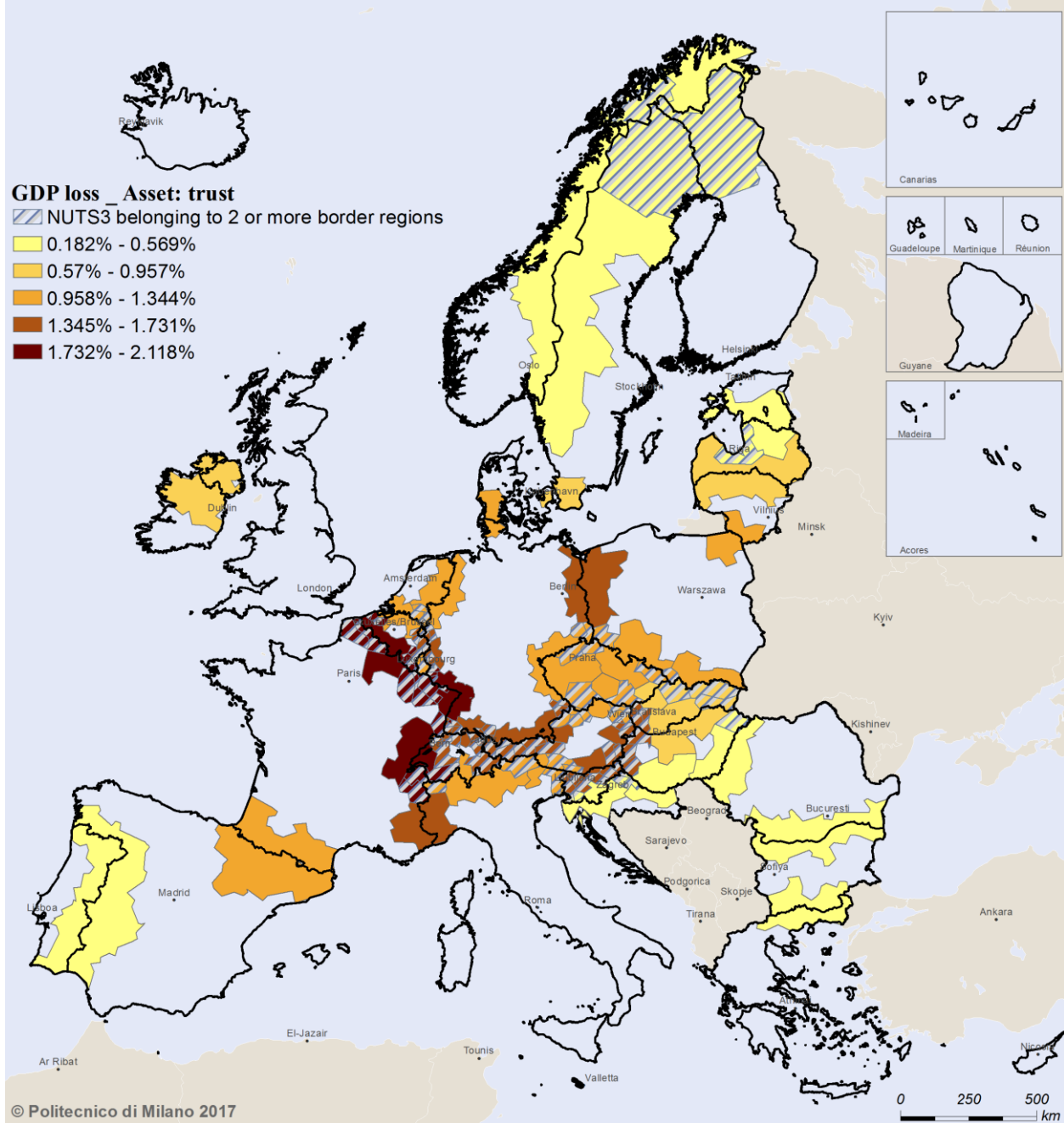


Figure 8 presents percentage GDP losses in European land border regions due to the inefficient exploitation of accessibility. The overall loss is concentrated in central economic areas that could exploit more their advantage deriving from a central location if legal and administrative barriers were completely removed.

Figure 8. Percentage GDP loss in European land border regions due to the inefficient exploitation of accessibility

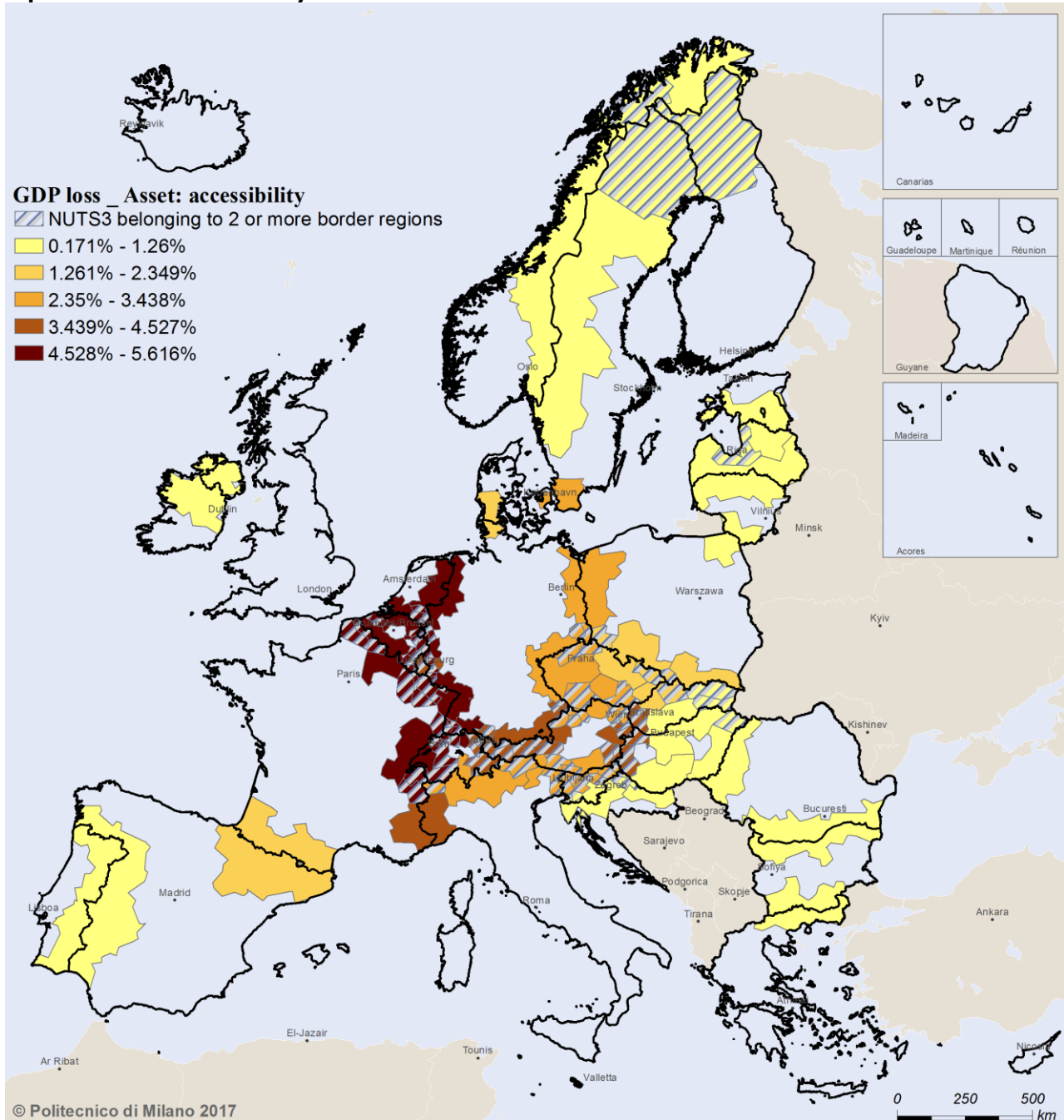


Figure 9. Percentage GDP loss in European land border regions at NUT3 level

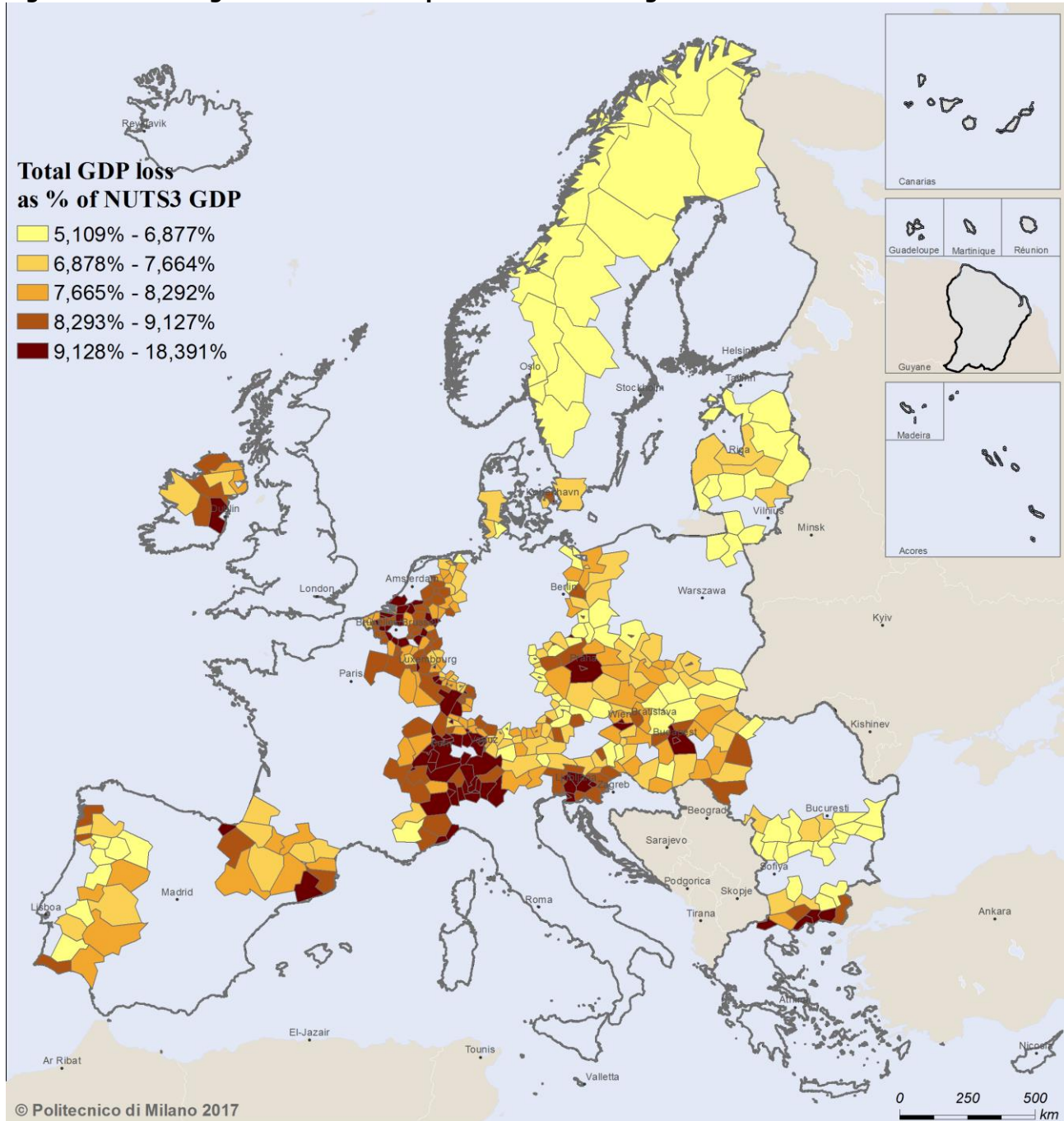


Figure 10. Percentage GDP loss in European land border regions due to the suboptimal use of agglomeration economies at NUTS3 level

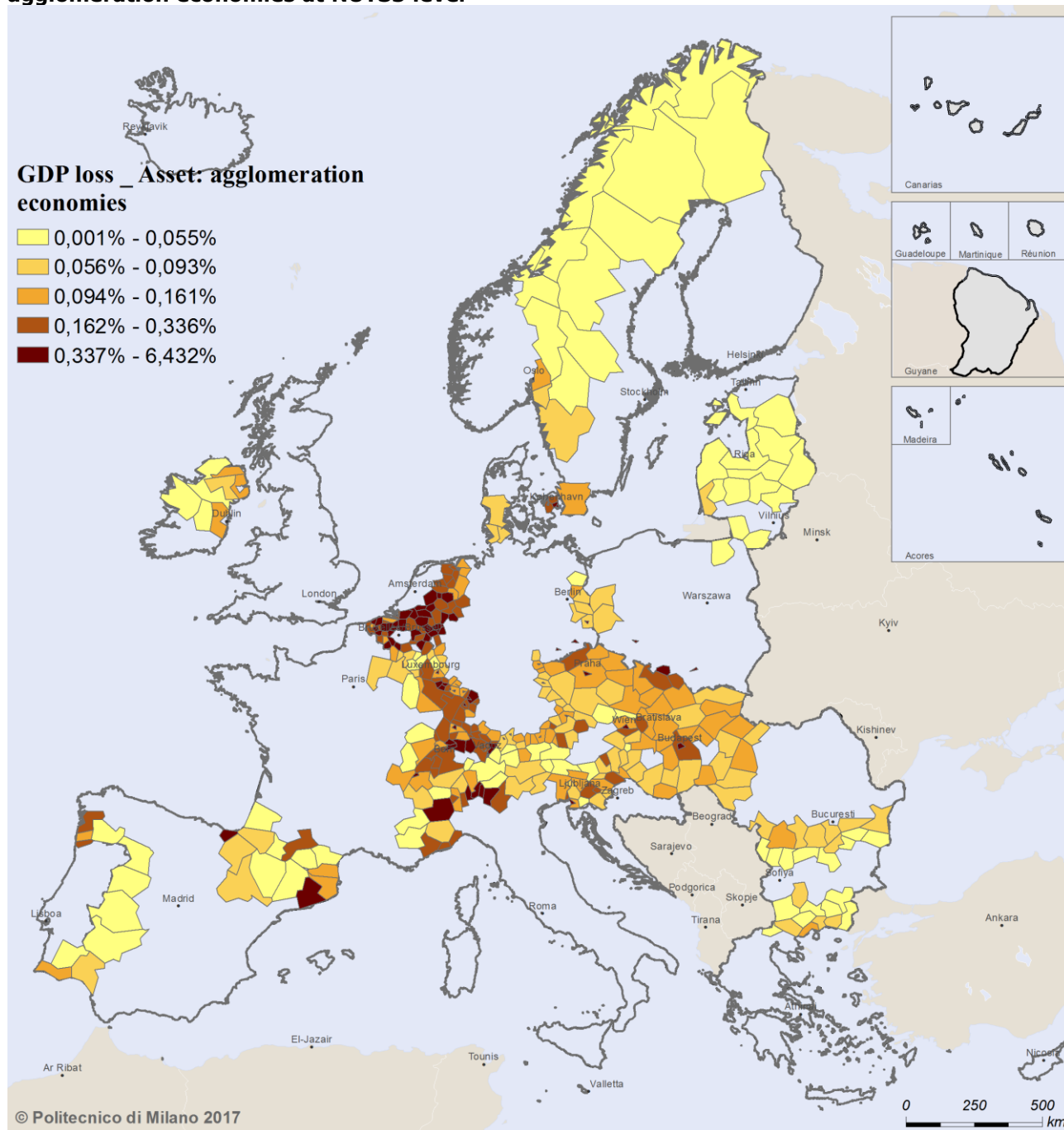


Figure 11. Percentage GDP loss in European land border regions due to the suboptimal use of productive capacity at NUTS3 level

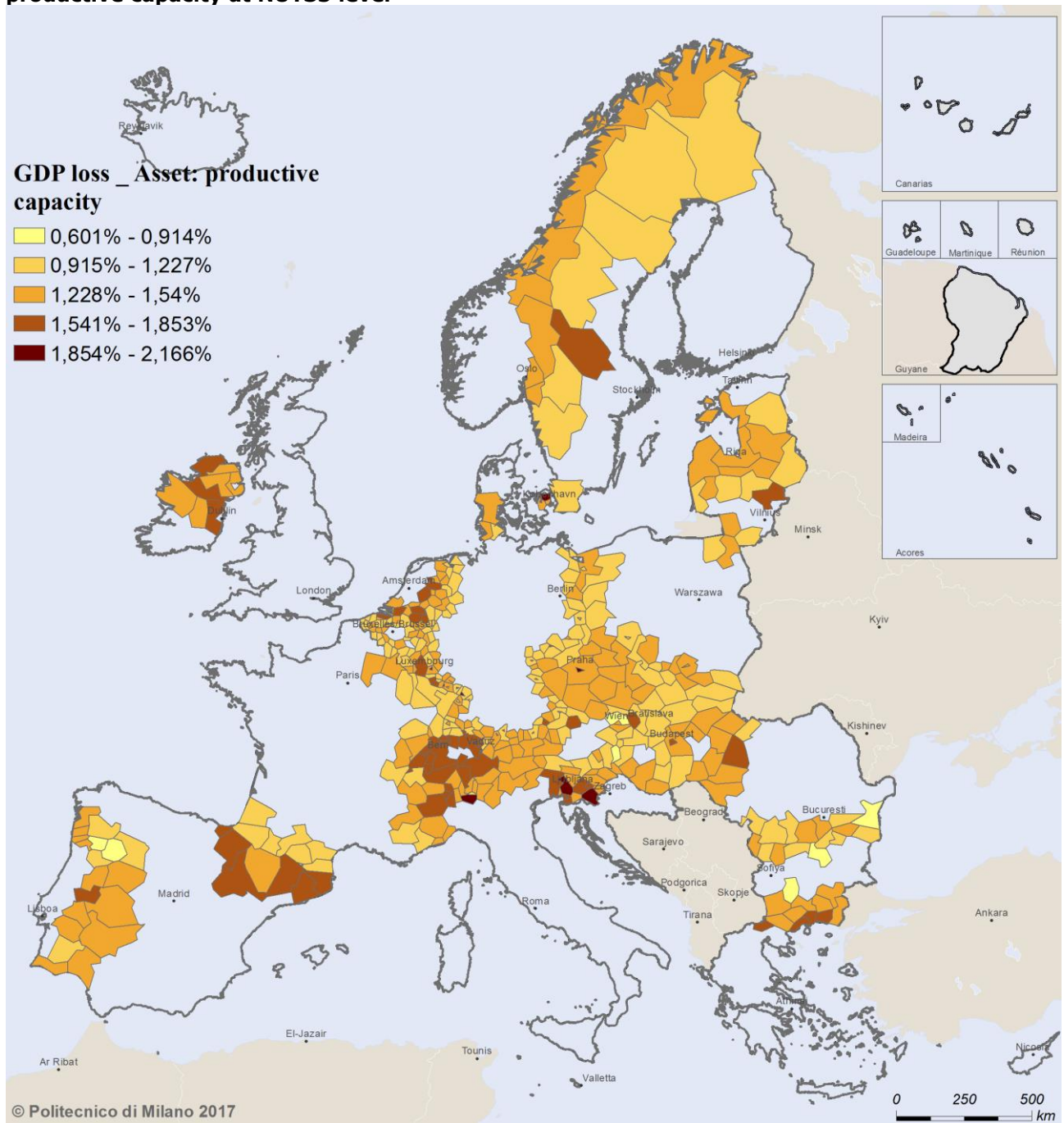


Figure 12. Percentage GDP loss in European land border regions due to the suboptimal use of trust at NUTS3 level

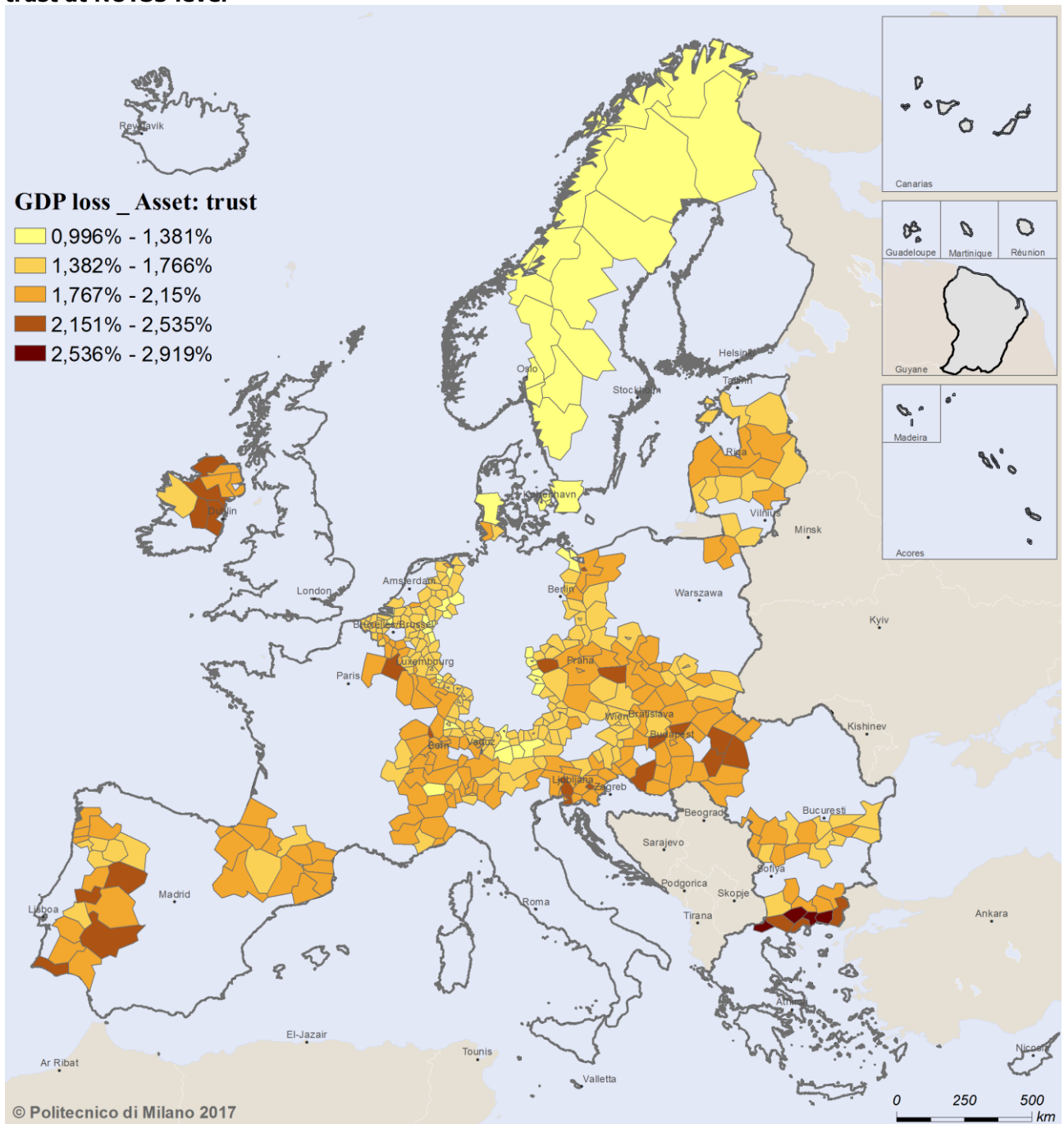
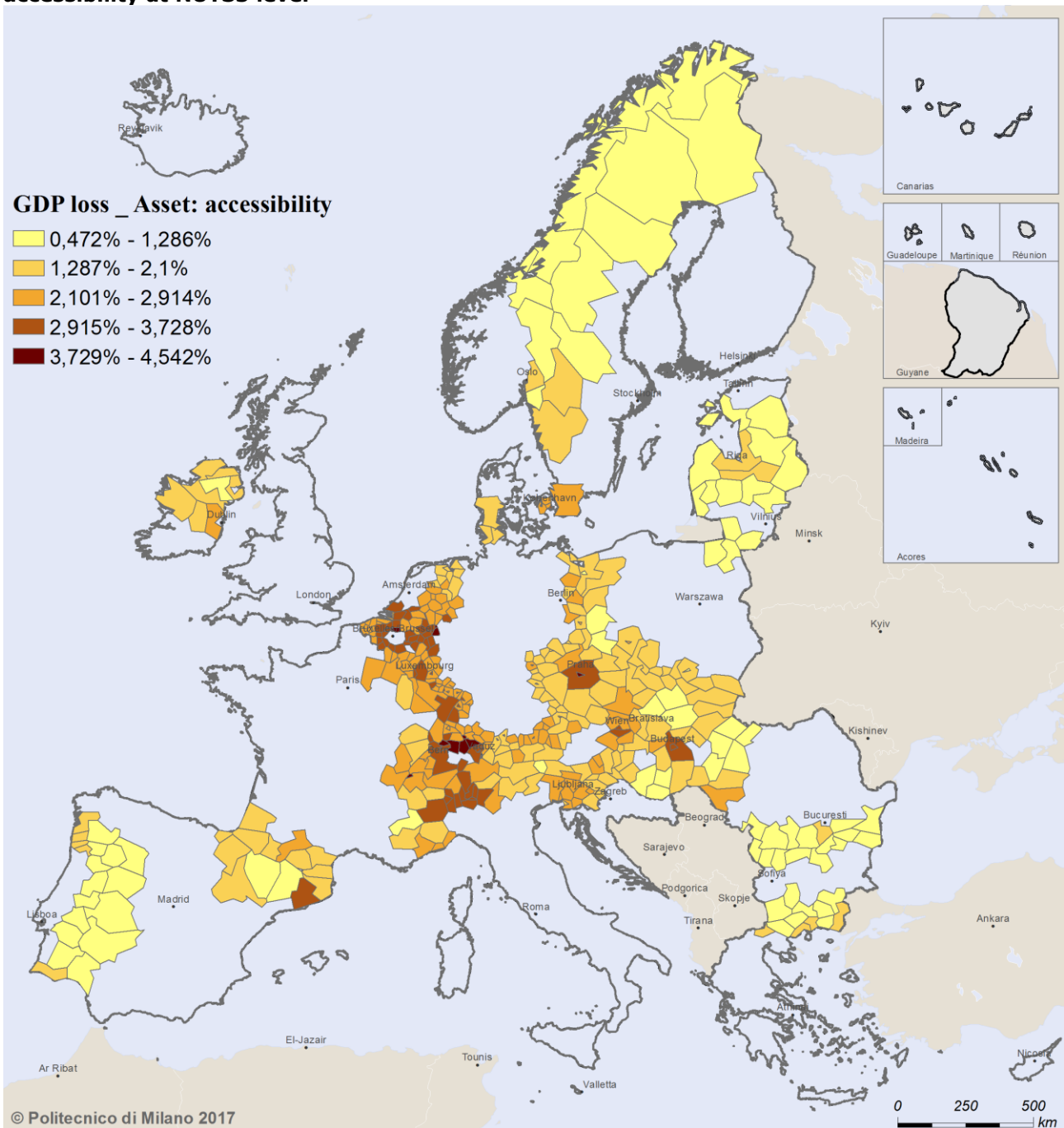


Figure 13. Percentage GDP loss in European land border regions due to the suboptimal use of accessibility at NUTS3 level



TECHNICAL APPENDIX

In this Technical Appendix, a detailed presentation of the quantitative methodology is presented with the aim to guarantee transparency of the results achieved and of the work done. The Appendix is organized by steps of the methodology, which correspond to those explained in the main report, robustness checks and the methodology to identify direct effects.

Our study does not address directly the following question: do legal and administrative barriers cause a GDP loss? Identifying causality is difficult since we would have to compare the land border region facing a legal and administrative obstacle with the counterfactual that would be the same region not facing a legal and administrative obstacle. The causality link could go both ways. A slowdown in GDP growth could push the country to implement new legal and administrative barriers because the region wants to protect itself against competition. On the other hand, it could be that legal and administrative barriers could hinder GDP growth by making trades harder.

Hence, our focus is on quantifying through an econometric exercise to what extent the GDP loss is linked to have legal and administrative barriers. In addition, we disentangle what regional growth assets are mostly associated with the slowdown in GDP.

Step 1: econometric estimation of GDP growth and computation of GDP level at 2013

The first step of the methodology presented in the report is based on the econometric estimation of equation (1) to interpret the sources of GDP growth rate from 2008 to 2013. Estimates are run on the basis of an ordinary least squares (OLS) regression with robust standard errors to allow for heteroskedasticity and be more rigorous.

$$\Delta Y = \alpha + \sum_k \beta_k * control_k + \gamma * border + \delta_i * assets_i + \vartheta_i * border * assets_i + \mu_{ij} * border * assets_i * obstacle + \sum_{c=1..n} \rho_c * country_c + \varepsilon_{ij} \quad \forall i, j \quad (1)$$

where:

- ΔY is the growth rate of the GDP from 2008 to 2013;
- controls are three dummy variables that respectively take the value 1 if the region is agglomerated, rural and urban and the logarithm of total value added in 2008;
- assets are agglomeration economies, productive capacity, accessibility, trust, manufacturing activities, knowledge, product innovation, human capital, cultural events, saving propensity, spatially lagged propensity to save and spatially lagged manufacturing activity (Table 1);
- obstacle is a dummy variable equal to 1 when a border region is characterised by legal and administrative barriers. Regions are in fact classified as "regions with administrative and legal barriers" when the NUTS3 region scores higher than the EU average in the Eurobarometer question "thinking about the cooperation between your Country and partner country X, to what extent are any legal or administrative differences a problem?". This is our measurement of legal and administrative barriers;
- border is a dummy variable that respectively take the value 1 if the region is a cross-country border region;
- country is an additional control to verify if the results are driven by some country-specific characteristics.

A large database covering the universe of EU and EFTA NUTS3 regions has been used to estimate Eq. (1), on which indicators have been built (Table A1).

Table A1. Indicators, data, source and year

Category	Indicator	Data	Source	Year
Dependent variable	Regional growth	Growth of Gross Value Added	EUROSTAT	2008-2013
Knowledge and innovation	Knowledge	Number of patent applications to the European Patent Office (EPO) per million inhabitants	EUROSTAT	2006
	Product innovation	Number of trademarks applications to the EPO per million inhabitants	EUROSTAT	2006
Knowledge and innovation generating assets	Accessibility	Location quotient of multimodal accessibility standardized with EU27 mean =1	ESPON	2006
	Agglomeration economies	Population density	EUROSTAT	2006
	Human capital	Share of working age population with ISCED 5 and 6 degrees.	EUROSTAT	2006
Regional industrial structure	Manufacturing activities	Share of GVA in manufacturing over total GVA	EUROSTAT	2006
	Productive capacity	Ratio between employed persons and working age (25-64) population	EUROSTAT	2006
Long run local economic resources	Saving propensity	Share of persons that in the European Value Study consider it important or very important to teach children the importance of thrift ^a	European Value Study	2008-2009
Regional settlement structure	Settlement structure	Dummy identifying agglomerated, urban and rural regions ^b	ESPON project 1.1.1	2005
Intangible assets	Trust	Share of EVS respondents stating that they trust fellow citizens ^c	European Value Study	2008-2009
	Cultural events	Number of cultural events on population	ESPON project 1.1.3	2004-2006

Source: Capello et al. (2017).

Legend:

a. Share of respondents "Important" or "Very Important" to the EVS question "*Here is a list of qualities which children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five: the importance of thrift*"

b. agglomerated regions are defined as those regions hosting a city of more than 300,000 inhabitants and a population density higher than 300 inhabitants/km sq. or with a population density between 150– and 300 inhabitants/km sq. Urban regions are defined as hosting a city between 150,000 and 300,000 inhabitants and a population density between 150 and 300 inhabitants/km sq. (or a smaller population density – between 100 and 150 inh./km but with a bigger centre, with more than 300,000 inh.) or a population density between 100 and 150 inh./kms sq. Finally, rural regions are those areas with a population density lower than 100 inh./ sq. km. and a centre with more than 125,000 inh., or a population density lower than 100 inh./sq. kms. with a centre smaller than 125,000 inhabitants. See also Capello and Chizzolini (2008).

c. Share of respondents to the following questions have been applied: "Most people can be trusted" to the EVS question "*Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?*"

Our analysis focuses on the estimated coefficient μ_{ij} . This coefficient measures if a land border region can exploit fruitfully a regional growth asset, even if the land border region is facing legal and administrative barriers. For instance, if the sign of the coefficient μ_{ij} is negative and statistically significant, this signals that the land border region is not able to use the regional growth asset to grow as other regions do. The inability to exploit the regional growth asset due to legal and administrative barriers hinders the land border region's GDP growth rate.

Eq. (1) is estimated for a high number of growth assets, defined as internal regional growth asset, and regional growth assets of neighbouring regions, defined as external, since they are spatially lagged. The spatially lagged assets are the regional growth assets of neighbouring regions and are discounted by the distance between each region and all other locations. Among all possible assets four of them turned out to be significant for regional growth in the presence of legal and administrative barriers: agglomeration economies, productive capacity, accessibility and trust (Table A2).

The 90% confidence interval: this methodology produces estimates of GDP losses, subject to a certain degree of error. A possible way to address this concern is to compute the 90% confidence interval which provides an upper and lower bound of the GDP loss due to legal and administrative barriers. The upper and lower bounds of the confidence interval form the range in which the GDP loss due to legal and administrative barrier, obtained by applying the methodology outlined above, could lie with 90% probability.

For what concerns the growth equation with spatially lagged assets, those that turned out to be significant for regional growth in the presence of legal and administrative barriers are two of them, namely spatially lagged propensity to save and spatially lagged manufacturing activity (Table A3).

Thanks to the estimated parameters, we were able to predict the regional GDP growth rates from 2008 to 2013 ($\Delta\mathbf{GDP}_{2008-2013}$) when the land border regions are facing a legal and administrative barriers, namely the dummy variable obstacle, the measurement of legal and administrative barriers, takes the value 1.

Subsequently, we computed the GDP in 2013 by using the predicted GDP growth rates when land border regions are facing legal and administrative barriers with the following formula (1):

$$\mathbf{GDP}_{2008} + \Delta\mathbf{GDP}_{2008-2013} = \mathbf{GDP}_{2013} \quad (1)$$

Step 2: estimation of potential growth rate and GDP level of 2013 in absence of administrative and legal barriers

In the second step, we developed a thought experiment and computed the potential GDP growth rates if the land border regions were able to get rid of legal and administrative barriers.

In this step, we therefore assumed that the land border regions could overcome the legal and administrative barriers without incurring in any losses. This is highly unlikely, but it allows to think about what the GDP could have been in 2013 if the land border regions were able to overcome legal and administrative barriers.

Table A2. Results of estimates of Eq. 1

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
<i>Control variables:</i>					
Logarithm of total value added	-0.0220 (0.00261)	0.0157 (0.00295)	-0.0347 (0.00286)	-0.0181 (0.00261)	-0.0204 (0.00261)
Rural area	0.105*** (0.00630)	0.0628** (0.00722)	0.117*** (0.00726)	0.102*** (0.00635)	0.105*** (0.00637)
Urban area	0.0405* (0.00515)	0.00968 (0.00589)	0.0480* (0.00593)	0.0353 (0.00520)	0.0381* (0.00514)
Border regions	0.154 (0.0329)	-0.0855 (0.0129)	0.00604 (0.00486)	-0.0710 (0.0273)	0.0686 (0.00936)
<i>Assets:</i>					
Trust*border	-0.111 (0.0208)				
Trust*border*obstacle	-0.0681** (0.00516)				
Trust	0.0211 (0.0158)				
Accessibility*border		0.153** (0.0138)			
Accessibility*border*obstacle		-0.0979*** (0.00815)			
Accessibility		-0.145*** (0.0132)			
Agglomeration economies*border			0.0394 (3.03e-06)		
Agglomeration economies*border*obstacle			-0.0289* (6.97e-06)		
Agglomeration economies			0.0118 (2.21e-06)		
Productive capacity*border				0.108 (0.0401)	
Productive capacity*border*obstacle				-0.0531* (0.0130)	
Productive capacity				-0.0464* (0.0289)	
Propensity to save*border					-0.0456 (0.0322)
Propensity to save*border*obstacle					-0.0542 (0.0232)
Propensity to save					0.0499** (0.0134)
Constant	0.132**	0.114*	0.168**	0.177***	0.137**
Country fixed effects	Yes	Yes	Yes	Yes	Yes

Observations	1,295	1,291	1,153	1,296	1,296
R-squared	0.632	0.637	0.545	0.633	0.633

Beta standardized coefficients & Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table A2. cont...

VARIABLES	(6) Model 6	(7) Model 7	(8) Model 8	(9) Model 9	(10) Model 10
<i>Control variables:</i>					
Logarithm of total value added	-0.0363 (0.00270)	-0.0221 (0.00334)	-0.0479 (0.00317)	-0.0237 (0.00282)	-0.0209 (0.00262)
Rural area	0.109*** (0.00625)	0.113*** (0.00638)	0.106*** (0.00636)	0.126*** (0.00664)	0.100*** (0.00648)
Urban area	0.0440** (0.00512)	0.0461* (0.00517)	0.0420* (0.00519)	0.0500* (0.00527)	0.0311 (0.00549)
Border regions	0.0323 (0.0137)	-0.0102 (0.00462)	-0.00373 (0.00454)	0.0260 (0.00470)	0.139** (0.0136)
<i>Assets:</i>					
Human capital*border	-0.00790 (0.0503)				
Human capital*border*obstacle	-0.0428 (0.0321)				
Human capital	0.0824** (0.0533)				
Knowledge*border		0.0140 (3.99e-05)			
Knowledge*border*obstacle		0.0102 (3.51e-05)			
Knowledge		-0.00600 (3.13e-05)			
Product innovation*border			0.0171 (2.65e-05)		
Product innovation*border*obstacle			-0.00790 (5.27e-05)		
Product innovation			0.0320 (2.17e-05)		
Cultural events*border				-0.0768 (124.1)	
Cultural events*border*obstacle				-0.0163 (134.2)	
Cultural events				0.0567*** (26.87)	
Manufacturing activity*border					-0.151* (0.0684)
Manufacturing activity*border*obstacle					-0.0193 (0.0369)
Manufacturing activity					0.108** (0.0545)
Constant	0.162***	0.144*	0.208***	0.141**	0.119*
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,296	1,176	1,294	1,162	1,294
R-squared	0.633	0.593	0.630	0.501	0.637

Beta standardized coefficient & Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table A3. Results of estimates of Eq. (2)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
<i>Control variables:</i>					
Logarithm of total value added	-0.0224 (0.00263)	-0.0217 (0.00263)	-0.0209 (-0.0209)	-0.0232 (0.00261)	-0.0212 (0.00263)
Rural area	0.105*** (0.00634)	0.102*** (0.00634)	0.105*** (0.105)	0.103*** (0.00634)	0.106*** (0.00633)
Urban area	0.0386* (0.00513)	0.0374* (0.00512)	0.0385* (0.0385)	0.0379* (0.00514)	0.0392* (0.00512)
Border regions	0.0635 (0.0593)	-0.0105 (0.0306)	-0.191 (-0.191)	0.0338 (0.0519)	-0.0225 (0.0557)
<i>Assets:</i>					
Spatially lagged trust*border	0.00450 (0.0356)				
Spatially lagged trust*border*obstacle	-0.0691 (0.244)				
Spatially lagged trust	0.00908 (0.0234)				
Spatially lagged accessibility*border		0.0241 (0.0410)			
Spatially lagged accessibility*border*obstacle		-0.0136 (0.304)			
Spatially lagged accessibility		0.0295 (0.0263)			
Spatially lagged agglomeration economies*border			0.168 (0.205)		
Spatially lagged agglomeration economies*border*obstacle			0.0267 (0.000145)		
Spatially lagged agglomeration economies			-0.0143 (0.151)		
Spatially lagged productive capacity*border				0.0790 (0.0906)	
Spatially lagged productive capacity*obstacle				-0.115 (0.497)	
Spatially lagged productive capacity				0.0134 (0.0564)	
Propensity to save*border					0.182 (0.140)
Propensity to save*border*obstacle					-0.160* (0.658)
Propensity to save					-0.00667 (0.0982)
Constant	0.134* (0.0701)	0.123* (0.0642)	0.161** (0.0688)	0.131* (0.0683)	0.156** (0.0695)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,296	1,296	1,296	1,296	1,296
R-squared	0.631	0.631	0.631	0.631	0.631

Beta standardized coefficients & robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A3. cont...

VARIABLES	(6) Model 6	(7) Model 7	(8) Model 8	(9) Model 9	(10) Model 10
<i>Control variables:</i>					
Logarithm of total value added	-0.0249 (0.00263)	-0.0215 (0.00262)	-0.0210 (0.00263)	-0.0203 (0.00262)	-0.0214 (0.00263)
Rural area	0.102*** (0.00629)	0.100*** (0.00632)	0.100*** (0.00633)	0.106*** (0.00631)	0.105*** (0.00633)
Urban area	0.0360* (0.00511)	0.0359 (0.00513)	0.0355 (0.00512)	0.0397* (0.00513)	0.0387* (0.00512)
Border regions	0.0709 (0.0438)	0.0856 (0.0271)	0.0181 (0.0225)	-0.202 (0.0363)	-0.0149 (0.0443)
<i>Assets:</i>					
Spatially lagged human capital*border	-0.290 (0.216)				
Spatially lagged human capital*border*obstacle	0.229** (0.875)				
Spatially lagged human capital	0.0373 (0.133)				
Spatially lagged knowledge*border		-0.0911 (0.000791)			
Spatially lagged knowledge*border*obstacle		0.00405 (0.00856)			
Spatially lagged knowledge		0.0515* (0.000422)			
Spatially lagged product innovation*border			0.0351 (0.000671)		
Spatially lagged product innovation*border*obstacle			-0.0536 (0.00682)		
Spatially lagged product innovation			0.0509* (0.000622)		
Spatially lagged cultural events*border				0.221 (1.169)	
Spatially lagged cultural events*border*obstacle				-0.0205 (0.0108)	
Spatially lagged cultural events				-0.0149 (0.978)	
Spatially lagged manufacturing activities*border					0.141 (0.196)
Spatially lagged manufacturing activities*border*obstacle					-0.128** (0.701)
Spatially lagged manufacturing activities					-0.00124 (0.140)
Constant	0.0951 (0.0682)	0.118* (0.0636)	0.106 (0.0649)	0.156** (0.0650)	0.149** (0.0657)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,296	1,296	1,296	1,296	1,296
R-squared	0.633	0.631	0.632	0.631	0.631

Beta standardized coefficients & robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In order to achieve such a goal, we repeated the estimation of the regional GDP growth rates from 2008 to 2013 (**Δ GDP2008-2013**) from the estimated Eq, (1) by assuming that none of the cross-border regions were subject to legal and administrative barriers. In technical terms, this has been equal to provide the dummy

variable obstacle, the measurement of legal and administrative barriers, with a value of 0.

Once obtained the new parameters, the potential GDP in 2013 was estimated by using the potential GDP growth rate from 2008 to 2013 obtained through the estimates where land border regions are *not* facing legal and administrative barriers, with the usual formula:

$$\mathbf{GDP2008 + potential \Delta GDP2008-2013 = potential GDP2013 (2)}$$

Step 3: Computation of GDP loss

In the third step, the GDP loss was calculated by subtracting the potential GDP in 2013 when land border regions are not facing legal and administrative barriers (obtained from formula 2) from the GDP in 2013 when land border regions are facing legal and administrative barriers (obtained from formula 1):

$$\mathbf{Estimate\ GDP\ level\ 2013 - Potential\ GDP\ level\ in\ 2013 = Loss\ of\ GDP\ 2013\ due\ to\ administrative\ and\ legal\ obstacles}$$

Step 4: Computation of employment loss

In the fourth step, thanks to data about productivity at NUTS3 level (Eurostat database), the employment loss was obtained by solving the following identity:

$$\mathbf{Loss\ of\ GDP\ 2013\ due\ to\ administrative\ and\ legal\ obstacles / Productivity = Loss\ of\ Employment\ 2013\ due\ to\ legal\ and\ administrative\ obstacles}$$

Robustness checks

The robustness checks consider that different econometric specifications of the equation (1) can be estimated to compute the GDP loss due to legal and administrative barriers. The robustness checks verify if the loss estimates in terms of GDP loss are driven by the underlying assumptions of the econometric model adopted. If the loss estimates do not differ significantly under the different econometric models, the loss estimates are robust. In addition, estimating different econometrics specifications provides a range in which the GDP loss and employment loss could lie to consider the margin of error in our estimates.

A main robustness checks is considered. The legal and administrative barrier is not treated as a dummy variable, signaling the presence of the legal and administrative barriers, but as a continuous variable to consider that regions can perceive the legal and administrative barrier with a different intensity.

Methodology to identify total losses when regions perceive legal and administrative barriers with a different intensity.

The robustness check considers the fact that land border regions can perceive legal and administrative barriers with a different intensity. The main difference from the econometric specification (1) is that the legal and administrative obstacle is not considered as a dummy variable, taking the value 1 when the region faces legal and administrative barriers and 0 when the region does not encounter this problem. On the other hand, a continuous variable is adopted since the Eurobarometer 422 survey collects responses to the question "To what extent do you consider legal and administrative barriers an obstacle for potential cooperation?" on a continuous basis. This allows different regions to perceive legal and administrative barriers with a different intensity, which seems reasonable. Equation is estimated by OLS under the

assumption of robust standard errors. Subsequently, the same methodology outlined above is adopted to compute the GDP and employment loss when land border regions perceive legal and administrative barriers differently. This robustness check proves that the empirical results are not driven by how we define the dummy variable but the results are robust to use a continuous variable for legal and administrative obstacle.

Methodology to identify direct effects

Our methodology is based on the estimates of eq. 1, in which each asset is inserted once at the time. This implies that the GDP and employment loss are computed for each asset without controlling for the multicollinearity between these assets in the same regression.

The fact that we do not control for multicollinearity is likely to yield inflated estimates, since the estimated parameter of each asset contains the effect on growth of that asset, plus those of all its correlated assets. In conceptual terms, this means that direct and indirect effects are captured by that parameter.

In order to separate out direct from indirect effects, eq. (1) has been re-estimated by controlling for the multicollinearity between assets in the same regression. Controlling for the multicollinearity between assets allows to identify only direct effects.

This methodology does not yield estimates that are statically significant. However, the sign of the coefficient μ_{ij} remains negative which still indicates that land border regions cannot exploit fruitfully regional growth assets due to legal and administrative barriers. A plausible reason why the coefficients are not statistically significant (p-values are larger than 0.10) is due to limited degree of freedom.

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