Regional Science and Urban Economics 84 (2020) 103556

Contents lists available at ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

It's not about the money. EU funds, local opportunities, and Euroscepticism

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ARTICLE INFO

Keywords:
EU funds
Euroscepticism
Cohesion policy
Brexit
Regression discontinuity

ABSTRACT

Growing Euroscepticism across the European Union (EU) leaves open questions as to what citizens expect to gain from EU Membership and what influences their dissent for EU integration. This paper looks at the EU Structural Funds, one of the largest and most visible expenditure items in the EU budget, to test their impact on electoral support for the EU. By leveraging the Referendum on Brexit held in the United Kingdom, a spatial RDD analysis offers causal evidence that EU money does not influence citizens' support for the EU. Conversely, the analysis shows that EU funds mitigate Euroscepticism only where they are coupled with tangible improvements in local labour market conditions, the ultimate objective of this form of EU intervention. Money cannot buy love for the EU, but its capacity to generate new local opportunities certainly can.

1. Introduction

The European Union (EU) is increasingly seen by its detractors as distant from the real day-to-day economic challenges of its citizens and as a binding constraint to the capacity of national governments to deliver a more equitable distribution of prosperity. The inability of mainstream politics – of which the EU is seen as a natural expression – to deliver timely and credible answers to the economic needs of large strata of the electorate has been linked to electoral behaviour by a growing body of research (Guiso et al., 2017; Rodrik, 2018; Colantone and Stanig, 2018; Rodríguez-Pose, 2018). The Covid-19 pandemic has further exacerbated these tensions with polarised views in different Member States on the use of common EU resources to tackle the economic consequences of the pandemic. The (perceived) reluctance of the EU to offer timely support in a major emergency has further reinforced anti-EU sentiments in countries (such as Italy or Spain) where the severity of the pandemic has been coupled with tighter national budget constraints. Eurosceptic feelings tend to spread in the population even if EU resources are indeed made available after an inevitable negotiation stage. Therefore, it remains unclear how the concrete actions of the EU can practically influence the electoral preferences of millions of EU citizens. Economic theory unveils a number of benefits from the process of economic integration allowed for by the EU (Baldwin and Wyplosz, 2015) whose importance is magnified in times of crisis. However, the majority of these benefits materialise through adjustments in prices and quantities that are difficult for citizens to link to EU membership. Conversely, a set of concrete policy actions are intended to visibly and clearly impact the economic opportunities available to EU citizens. Among those the lion's share of financial resources goes to regional development interventions under the EU Cohesion Policy (Begg, 2008), one of the key financing sources made available by the EU to Member States in order to tackle the 2020 crisis induced by the Covid-19 pandemic.

While some evidence has been produced to show that financial disbursement through EU funds is related to lower Eurosceptic feelings (Borin et al., 2018; Albanese et al., 2019), other studies are more critical of any direct voting impacts produced by European regional policy (Bachtrögler and Oberhofer, 2018; Fidrmuc et al., 2019). This suggests that the role played by EU transfers for the development of pro-Europe attitudes is highly heterogeneous. What makes EU Cohesion resources spread 'love' for the European Union remains to be explored.

Under what conditions (if at all) can EU Cohesion Policy influence support for the European Union? Is it the capacity of EU funds to deliver enhanced economic opportunities in the areas targeted by Cohesion Policy that pays off in the ballots? If the fundamental drive for anti-system votes rests on economic motivations, improvements in local economic conditions experienced by voters in beneficiary areas should – ceteris paribus – improve their preferences for EU integration.

We address these research questions by focusing on the context offering arguably the most limpid case of a democratic vote either in

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https://doi.org/10.1016/j.regsciurbeco.2020.103556
Received 1 November 2019; Received in revised form 11 May 2020; Accepted 18 May 2020
Available online 15 June 2020
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favour or against the European Union, the 2016 United Kingdom Referendum on EU membership. The Brexit vote represents the ideal setting to investigate the impact of EU funds on Euroscepticism, not only for the nature of the vote being explicitly and uniquely centred on the EU,[1] but also because in the UK some areas have received very large proportions of financial aid in the form of EU Structural Funds over the last years. In these places, voters at the 2016 Referendum were not just choosing the future of their country within or outside the EU, but they were also expressing their preference on whether to retain EU financial support.

The impact of EU policies on the Referendum results is estimated by adopting a boundary RDD methodology. We exploit the border between a region classified as 'in highest need of financial help' by the EU at the time of the vote, West Wales and The Valley, and a region receiving a much lower intensity of EU aid, East Wales. To investigate the presence of a causal link between Cohesion Policy and 'Remain' votes, we compare voting outcomes for micro-aggregated units (electoral wards) on the two sides of the border. Our results document that EU Cohesion Policy help in 'spreading love' for the EU *only if* citizens witness clear improvements in their living standards during the funding period. Public support for EU Membership is found to be more sustained in areas receiving higher shares of EU funds and – at the same time - witnessing larger improvements in local labour market conditions. Conversely, EU funding per se appears to be unable to systematically influence voting behaviour.

We capture the economic dynamism of local areas in the pre-Brexit Referendum period through the decrease in the unemployment rate over the period in which the case-study region, West Wales and the Valley, has had access to the highest proportion of development funds from the EU. We find evidence that local areas receiving higher proportions of EU funds and displaying stronger dynamism in their labour market - possibly induced by EU interventions - are comparatively more likely to vote in favour of remaining in the European Union.

Therefore, in line with the literature assigning a key role to socio-economic dynamics in shaping Eurosceptic and populistic votes (Colantone and Stanig, 2018; Rodríguez-Pose, 2018; Guiso et al., 2017), our evidence supports the idea that the economic dynamism of local areas mediates the role of EU Structural Funds for Eurosceptic preferences. Taken together, these results indicate that voting preferences of citizens are not responsive to EU financial assistance, unless EU interventions are capable of promoting tangible improvements in their daily life, such as new employment opportunities.

This paper relates to different strands of literature. First, it contributes to the rich literature on the impact of Cohesion Policy (Mohl and Hagen, 2010; Becker et al., 2010, 2013, 2018), and more specifically the growing, yet still underexplored field of research linking EU funds with the public support for the European Union (Dellmuth and Chalmers, 2018; Bachtrögler and Oberhofer, 2018; Borin et al., 2018; Fidrmuc et al., 2019). The mixed evidence emerging from these recent studies leaves the issue of whether areas receiving higher proportions of EU Structural Funds develop a more favourable view of Europe because of EU financial help still unsolved. In addition, this literature is silent on whether the effect of EU funding on public support towards the EU materialises under key conditions in place in the territories where public investment through Cohesion Policy takes place. Our contribution aims to assess the impact of EU funds by adopting counterfactual methodologies allowing us to uncover clear causal impacts: our focus on the UK context lends itself to this type of analysis due to the Referendum on EU membership held in the country in 2016.

Second, the paper speaks to the literature analysing the causes of anti-establishment, extremist and populist votes, which has been booming in recent years (Barone et al., 2016; Autor et al., 2016; Algan et al., 2017; Halla et al., 2017; Guiso et al., 2017; Dustmann et al., 2017; Boeri et al., 2018; Rodrik, 2018). The electoral victory of 'Leave' supporters at the Brexit Referendum of 2016 is commonly regarded as one of the first signs of the recent anti-systemic and populistic wave characterising Western politics. To our knowledge, our paper is the first to specifically focus on the conditions under which public investment may shape this kind of electoral preferences.

In order to elicit citizens' preferences for the EU we leverage the Brexit vote. Therefore, our paper also contributes to the literature on the determinants of Brexit. In this literature, recent contributions have highlighted the primary role of economic conditions faced by voters to explain the Referendum result (Becker et al., 2017; Colantone and Stanig, 2018; Arnorsson and Zoega, 2018; Alabrese et al., 2019; Fetzer, 2019). As such, it may be expected that EU policies – having enhanced the economic performance of some UK poorer regions (Di Cataldo, 2017; Di Cataldo and Monastiriotis, 2020; Crescenzi and Giua, 2020) – may influence the political preferences of voters as well. The works focusing specifically on the relationship between EU funds and the Brexit Referendum have obtained mixed results. They either report a significant association, suggesting that areas receiving more money from the EU have voted Remain more (Huggins, 2018) or report no significant relationship (Fidrmuc et al., 2019). These studies, however, are performed for relatively large aggregated units and without attempting to identify causal impacts. In addition, the divergent results might suggest the omission of more fundamental local factors mediating the impact of EU funds on electoral support for the EU.

The remainder of the paper is organised as follows. Section 2 discusses institutional background, case study and data; section 3 presents the empirical setting and the models; section 4 reports the empirical results; section 5 discusses and interprets the findings; section 6 concludes.

2. Institutional background and data

2.1. EU Cohesion Policy in the UK at the time of the Brexit Referendum

One third of the total budget of the European Union is absorbed by the EU Cohesion Policy. For the ongoing (2014–2020) programming period, the EU is spending 352 billion euros on Cohesion Policy, most of which is directed towards economically disadvantaged territories across the continent, i.e. the regions classified as 'less developed'. Investment projects financed with these resources are intended to build new infrastructure, foster innovation, promote the development of businesses, generate employment opportunities and tackle social exclusion.

In the UK, this investment policy has extensively financed disadvantaged territories since the early 80s. Eligibility for EU funding is assigned to so-called 'NUTS2'[2] regions before the beginning of each EU seven-year programming period. During the ongoing 2014–2020 EU budget period, the UK regions classified as 'less developed'– and hence entitled to receive the highest form of EU financial support – were West Wales and the Valleys in Wales, and Cornwall and the Isles of Scilly in England (Fig. 1). These two regions, the poorest of the country, are those with a regional GDP per capita below 75% of the EU average (European Commission, 2014). Both of them received the status of 'less developed' in the year 2000, and have been continuously financed by

[1] While any election featuring Eurosceptic parties enables voters to express anti-EU preferences, what makes the Brexit Referendum unique is that all voters opting for 'Leave' – even if not explicitly driven by resentments against the EU – expressed a clear and unambiguously Eurosceptic choice. Differently, votes for anti-Europe parties at national elections may be completely unrelated with their Eurosceptic platform.

[2] The NUTS classification (Nomenclature of Territorial Units for Statistics) is a system used to divide the EU territory in homogeneous units for statistical purposes. The NUTS1 level represents major socio-economic areas, often corresponding to the national level. The NUTS2 level identifies sub-national regions (often with administrative autonomy) and is used to determine eligibility for EU Cohesion Policy funds.

Fig. 1. Eligibility for EU funds to 'less developed' regions at the time of the Referendum on Brexit. Note: units are NUTS2 regions; red: 'less developed' regions during 2014-2020 EU programming period.

the EU via this funding scheme since then (Di Cataldo, 2017). Taken together, these regions account for less than 4% of the total UK population, yet they were entitled to receive around 26% of the total amount of EU development funds allocated to the UK. Remaining EU funds in the UK have been spread across all other regions of the country.

In areas considered 'in highest need of financial help' by the EU and highly-financed through Cohesion Policy, EU funds represent a considerable source of public investment. This is also due to the way in which ordinary public resources are disbursed by the UK Government across the country. While EU funds are concentrated in less developed areas, the UK Government gives a limited importance to initial socio-economic disadvantage in its funding allocation.[3] Hence, while in richer UK regions EU funds represent a small portion of total public expenditure, in poorer areas the total investment for economic development would have been much lower in absence of Cohesion Policy. To see this, we can compare EU and UK expenditures in Wales in 2014 as an example. In that year, West Wales and The Valley received around €290 million in EU funds, while total EU expenditure in Wales (including East Wales) sum up to €305 million. The total UK Government capital expenditure for 'Economic affairs' (a spending category roughly corresponding to the main objectives of EU funds) in Wales in the same year amounts to £845 million. Hence, about 30% of total capital investments in Wales have been made through Cohesion Policy, a percentage which is much higher if we only focus on West Wales and The Valley.

For the 2014–2020 period, the UK is the second largest net contributor to the EU budget, after Germany. The difference between expenses towards the EU and received funds from Brussels amounts to around 10 billion Euros (House of Commons, 2018). In light of this, it is not surprising that a recurring argument brought forward by proponents of Brexit during the Referendum campaign was that leaving the EU would save financial resources to be spent on other priorities, such as financing the public healthcare system. Conversely, EU Cohesion Policy was barely mentioned during the campaign. The arguments used by Eurosceptic leaders, and the highly unequal distribution of EU funds across the country – with richer regions receiving little in per capita terms, and poorer regions receiving much more – implies that, in order to study the impact of Cohesion Policy on the Referendum's outcome, it is worth focusing our attention on areas where EU expenditure truly represents a vital portion of total public investment. Moreover, the high degree of heterogeneity across the UK implies that empirical models trying to capture the effect of EU funds on Brexit by focusing on the entire country (Becker et al., 2017) may fail to account for key idiosyncratic and unobservable characteristics of highly-funded territories.

2.2. Wales as a case-study

The Welsh Nation is divided into two NUTS2 regions, East Wales and West Wales and The Valley, one of which is entitled to receive the highest form of EU aid.[4] The geographical boundary between these two regions was set up in 1998, determining the regions' eligibility for EU funding during the 2000–2006 programming period (Gripaios and Bishop, 2006). West Wales and The Valley was considered a 'less developed' region by the EU for the first time in 2000, and has maintained its status until today. This has entitled the region to receive large portions of EU funds, equal to around 2 billion Euros during each of the 2000–2006, 2007–2013, and 2014–2020 periods. In comparison, East Wales has been committed by the EU around 300 million Euros for each of the 7-year budgetary periods.

Geolocalised data on EU funds beneficiaries[5] for the 2007–2013 period allow us to visualise the geographical distribution of EU development projects across Wales. Fig. 2 shows that a very large portion of financial resources have been received and spent in the vicinity of the border between East and West Wales, on the Western side. The concentration of projects on the South-Eastern side of the boundary, clearly visible in Fig. 2, corresponds to Cardiff, Wales' capital. This city acts as 'managing authority' for all EU funds in the Welsh Nation, that is, it is responsible for receiving funds from Brussels and redistributing them within Wales. While most of the beneficiary-level expenditure data record the location of their actual beneficiary, others are still registered with the Welsh Government Offices in Cardiff. Much of this

[3] This is exemplified by the fact that UK national expenditure for 'Economic affairs' in the richest region of the country, the London metropolitan area, is comparable to the amount invested in Wales (£711 per person and £751 per person, respectively, in 2014). Data on UK Government spending retrieved from https://www.gov.uk/government/collections/public-expenditure-statistical-analyses-pesa.

[4] Unlike other European countries, UK NUTS2 regions are used exclusively for EU funding purposes, having no administrative or political meaning (Gripaios and Bishop, 2006). This makes local areas belonging to neighbouring NUTS2 regions more similar than in other countries, as the regional boundaries used for EU funds eligibility are often unrelated to any social, political or cultural characteristics.

[5] We are thankful to Julia Bachtrögler for kindly sharing these data with us. For further details on this dataset on EU funds beneficiaries for the 2007–2013 period across the European Union see Bachtrögler et al. (2019). The dataset also provides details on the declaration date of each regional list of beneficiaries. In the case of the operational programme 'West Wales and the Valleys', the submission date was the 25th of August 2016. As such, all beneficiaries at the time of the Brexit Referendum (23rd June 2016) are accounted for.

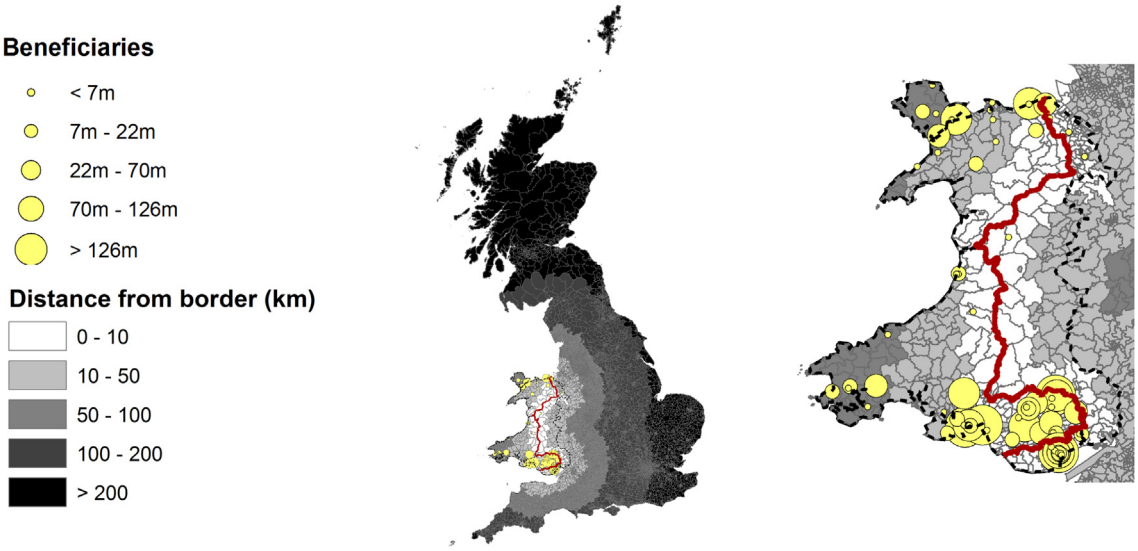

Fig. 2. Distance from treatment border and EU funds beneficiaries in Wales. Note: the dashed line indicates the border of Wales, the red thick continuous line indicates the treatment border between East Wales and West Wales.

money has likely been spent across Wales, mainly on the Western side.[6] However, given that we are unable to say what exact proportion of the funds officially recorded in Cardiff has been spent somewhere else, our estimates are performed both with and without Cardiff wards in the sample (cfr. Section 4.2) and our preferred specifications are the latter, i.e. excluding Cardiff.

A further issue with beneficiary-level data is that they only cover approximately 60% of total EU funds to Wales. The remaining 40% is either not recorded in the beneficiaries' dataset, or are projects with no single beneficiary and distributed across many different locations. For this reason, data on beneficiaries do not seem appropriate to identify 'treated' wards, as several wards in which expenditures are not recorded might have in fact received European funds.

Even with these important limitations, beneficiary-level data allowed us to identify a clear discontinuity in terms of EU resources spent on the two sides of the border (Fig. 2). A large share of the EU projects implemented in West Wales appear to be concentrated in the white area of Fig. 2, i.e. less than 10 km away from the boundary separating the region from East Wales. This pattern can be further appreciated in Figure A1 in the Appendix, displaying average EU spending per capita in distance bins on both sides of the East Wales-West Wales border (both including and excluding Cardiff).

In addition, in Table A1 (panel A) we regress the proportion of EU funds per capita on a dummy variable defining whether a ward belongs to West Wales, excluding Cardiff from the sample. For all samples considered (all wards of Wales, wards within 50 km and wards within 10 km from the East-West border) we obtain a positive and significant coefficient of the West Wales dummy, indicating that West Wales' wards near the border have received and spent comparatively more EU funds than East Wales' wards – approximately 400–500 Euros per inhabitant more, on the basis of 2007–2013 beneficiary data. Hence, the setting in Wales appears suitable for a causal investigation of the impact of EU funds on Brexit Referendum results, although the limitations in the beneficiary data make them not fully reliable, when it comes to understanding the intensity of EU funding in eligible wards.

When analysing the impact of EU funds on local electoral outcomes, Cornwall may seem an additional ideal case study. Wales and Cornwall are the two UK regions classified as 'less developed' for EU funding purposes at the time of the Referendum (Fig. 1). However, from what geolocalised data on EU funds beneficiaries suggest, funding in Cornwall has mainly been spent in wards located away from the border separating Cornwall from Devon.[7] This can clearly be seen in Table A1, reporting EU funds per inhabitant in the region. It can be noted that a significant difference in EU funding is visible only when moving away from the Cornwall-Devon border, but not within 10 km from the border. The table also shows that the number of observations in the vicinity of the border between Cornwall and Devon is much lower than in the case of Wales, for the same distance thresholds. In addition, it should be noted that the geo-localisation of a significant portion of EU funding is missing, with expenditure distributed across several locations within Cornwall. As a result, the information in our possession does not provide sufficient evidence that Cornwall would be a setting suitable for a causal RDD analysis. Therefore, it is discarded as an additional case-study.

2.3. Data

To measure Eurosceptic ('leave the EU' vs. 'remain in the EU') votes at the 2016 UK Referendum on Brexit we rely on unique data on the Referendum results at the level of electoral wards, made available to us by the British Broadcasting Corporation (BBC). This database has been compiled by BBC experts by sending individual emails to all UK Constituencies after the Referendum was held, on the basis of the UK Freedom of Information (FOI) Act, and combining together all responses in a homogeneous database at the ward level.

Our dataset is completed with information on socio-economic, labour market and demographic ward-level characteristics extracted from the UK Census (2001 and 2011) conducted by the UK Office for National Statistics (ONS). All variables on employment and industrial structure are normalised by the number of 16–74 year old residents in each ward. We use these variables to test the balancing properties of

[6] Some of the funds reporting the Welsh Government in Cardiff as beneficiary have been geocoded in the area where the money has been spent by exploiting the description of the projects. As an example, one of the largest projects in the data is described as the '*Dualling of the A465 between Tredegar and Brynmawr*'. While this is officially recorded with the Welsh Government (Department for Economy, Science & Transport) as beneficiary, it was possible to locate the investment in West Wales, in the exact place where the A465 road is.

[7] A 'visual' representation of this, through a map similar to Fig. 2 (but specifically on Cornwall), is available upon request from the authors.

our setting and to study the conditioning impact of EU funds on the Referendum results. Our analysis also exploits data on the geographical distance in km of each electoral ward from the border between East Wales and West Wales, calculated with the ArcGIS software. Finally, the dataset is completed with information on EU funds beneficiaries in Wales discussed in section 2.2. Descriptive statistics for all variables used in the analysis are reported in Table A2 in the Appendix.

3. Empirical design

3.1. Identification strategy and empirical models

The fundamental identification problem of our analysis lies in the difficulty of controlling for any element correlated with European policies and potentially influencing voting preferences. A large number of unobservable local area characteristics may be confounding our estimates. To get around this issue, we exploit the geographical distribution of Cohesion Policy support in Wales to estimate the effect of Cohesion Policy on the Brexit Referendum through a regression discontinuity design (RDD) approach. The boundary separating the Welsh area highly-funded by the EU (i.e. West Wales and The Valley) and a less funded area (i.e. East Wales) is used to define the treatment and control group in a quasi-experimental setting. The analysis is performed at the level of electoral wards. Fig. 2 illustrates the wards in Britain and their distance from the treatment border. As mentioned above, if EU beneficiary data were more accurate, we would have used this source to define a continuous 'treatment' variables based on actual expenditure. However, given that the exact location of around 40% of total EU spending remains unknown, we are forced to follow the existing literature on this topic, identify the treatment in the eligibility status (dummy variable taking value 1 for all wards belonging to West Wales and The Valley) and conduct our test in a sharp spatial RDD setting.

From the seminal work of Holmes (1998), spatial RDD has been applied to different fields of investigation. This counterfactual method is particularly suitable to capture the effects of 'spatially-targeted' policies, as it allows to exploit geographical distance as a forcing variable that randomly defines treatment and control units (Black, 1999; Lalive, 2008; Dell, 2010; Lee and Lemieux, 2010; Gibbons et al., 2013; Giua, 2017). The underlying idea behind the spatial RDD approach is that any characteristics must be smoothly distributed across the boundary, with the exception of the treatment itself (Black, 1999). By balancing observational units according to their distance from the boundary, the treatment (in our case: eligibility for the highest form of EU aid) is smoothly distributed across the boundary and its impact is isolated from any possible confounding factor, provided that assignment to the treatment cannot be manipulated.

Our spatial forcing variable is hence the geographical distance from the regional border. To allow for more flexibility in our estimates, the forcing variable enters in the model specifications as polynomials up to the third order. In addition, following a consolidated practice in spatial RDD studies (Holmes, 1998; Black, 1999; Jofre-Monseny, 2014) our specifications are based on samples made of units in the immediate proximity of the border. In our core specifications this entails focusing on (1) all wards of Wales, or (2) all wards within 50 km from the treatment border, or (3) all wards within 10 km from the treatment border. The baseline model is as follows:

$$R_w = \beta_0 + \beta_1 T_w + \sum_{\rho=1}^{3} \gamma_\rho (f_w)^\rho + T_w \sum_{\rho=1}^{3} \gamma_\rho (f_w)^\rho + e_w$$

Where R_w is the share of Remain votes in the Brexit Referendum in ward w; T_w is the treatment variable, a dummy equal to 1 for wards belonging to the Welsh region most targeted by EU Cohesion Policy (West Wales and The Valley) and 0 otherwise; f_w is the forcing variable, the distance from the border in km, also interacted with the treatment variable. f_w enters either linearly or as a third order polynomial. Standard errors are clustered at the level of Local Authority.[8]

Besides identifying the average treatment effect (ATE) of EU regional policy on voting outcomes, our analysis aims at capturing how the effect of EU transfers on Euroscepticism varies with changes in living conditions in the areas targeted by the policy. In particular, we estimate the effect of EU funds on voting preferences in presence of 'labour market dynamism', proxied by the reduction of unemployment between 2001 and 2011. The heterogeneous average treatment effect (H-ATE) model is estimated as follows:

$$R_w = \beta_0 + \beta_1 T_w + \beta_2 U_w + \beta_3 (T_w \times U_w) + \sum_{\rho=1}^{3} \gamma_\rho (f_w)^\rho + T_w \sum_{\rho=1}^{3} \gamma_\rho (f_w)^\rho + e_w$$

Where U_w represent the socio-economic and labour market dynamism of local areas, to which EU regional policy is intended to contribute and that might ideally be improve by successful EU interventions in line with the key priorities of EU Cohesion Policy. The variable U_w proxies the creation of job opportunities in ward w in the pre-Referendum period. All other parameters are the same as in model (1). The H-ATE is estimated by the interaction term between the treatment dummy and the continuous U_w variable.

3.2. Balancing test

The underlying assumption of a boundary RDD setting is the smooth distribution of all relevant (observable and unobservable) characteristics across the treatment border. We test the balancing properties of our empirical setting by checking for a correlation between the treatment dummy variable and a whole set of socio-economic and demographic variables. These variables are extracted from the UK Census. They are all measured in 2001 (i.e. at the time in which West Wales was granted the status of 'less developed' status by the EU), or, in the case of dynamic variables (e.g. Unemployment decrease) they are measured as differences between 2001 and 2011. The model is estimated for wards within 50 km from the treatment border, controlling for distance in km and adding polynomials of level three to assign higher weights to wards located near the border.[9]

The results of the test are reported in Table 1. For all variables we find no evidence of a significant difference across the border. This increases our confidence that the empirical setting fulfils the requirement for an RDD, i.e. treatment and control groups being equal for all relevant characteristics except for the eligibility for European funds. Being balanced according to the geographical distance from the boundary, we can assume that the wards belonging to the treated and untreated regions offer an 'as good as random' scenario where all characteristics are smoothly distributed among the two groups (Blundell and Dias, 2009). The wards' difference in terms of electoral preferences on Brexit will be attributed to the unique factor with a discontinuous geographical distribution, i.e. the Cohesion Policy treatment.

4. Results

4.1. ATE and H-ATE estimates

Table 2 provides the results of the estimation of the baseline model,

[8] Local Authorities (LA) are local administrative units in the UK. In Wales there are 22 LAs in total, of which 15 are in West Wales and The Valley. The territory of LAs corresponds to that of electoral Constituencies.

[9] The balancing test has also been conducted for different samples - all Wales and 10 km from the border. The results report no systematic difference between treatment and control groups. The only significant element in these samples is human capital, marginally significant at 10% level. As a robustness test, we have replicated all our main estimates with the inclusion of human capital as control in the regressions. All key findings of the paper are confirmed. These results are available upon request from the authors.

Table 1
Balancing test.

Sample: 50 km from border										
Dep. var:	Unempl. Rate	Long-term unempl.	Youth unempl.	Unempl. decrease	LTU decrease	Youth U decrease	Highly-educated	Log population	18-24 yo population	Non-white population
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
West Wales	0.00438	0.00184	0.0127	−0.00223	−0.00153	−0.000248	−0.0198	0.112	−0.00367	−0.00363
	(0.00309)	(0.00129)	(0.00884)	(0.00352)	(0.00210)	(0.000899)	(0.0196)	(0.237)	(0.00884)	(0.00783)
Observations	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057
R-squared	0.086	0.123	0.054	0.077	0.085	0.027	0.087	0.159	0.116	0.354
Dep var.:	Employment in: Agriculture	Manufacturing	Construction	Mining	Public admin	Wholesale & retail	Finance	Real estate	Health services	Transport
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
West Wales	−0.0125	0.00520	0.000665	0.000654	0.00324	−0.00157	−0.0033	−0.00269	−0.00124	−0.00265
	(0.0129)	(0.0183)	(0.00339)	(0.00149)	(0.00402)	(0.00502)	(0.00364)	(0.00363)	(0.00611)	(0.00299)
Observations	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057
R-squared	0.0420	0.195	0.029	0.051	0.027	0.177	0.171	0.104	0.023	0.199

Note: clustered standard errors at local authority level in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Sample: all wards located 50 km or less from the treatment border, excluding wards from Cardiff. All models estimated with polynomials of order three interacted with forcing variable and treatment variable. Dependent variables measured in 2001 in all specifications but columns (4), (5), (6), where they are obtained as difference between 2001 and 2011.

which tests the causal link between EU funds in West Wales and 'Remain' votes in the Brexit Referendum. The model is specified with the forcing variable entering linearly or as third-order polynomial and by using different RDD bandwidths based on the distance from the border between East Wales and West Wales. The sample may be composed by all wards of Wales, or by wards within 50 km or 10 km from the border on both sides. Our preferred estimates are obtained with third-order polynomials of distance, following the AIC criteria.

As shown in Table 2, in all these different specifications the coefficient of the treatment dummy is not statistically significant. We find no average treatment effect, or no evidence that Welsh wards located in the region receiving higher EU funds have voted comparatively more for either 'Remain' or 'Leave', conditioning on the distance from the border. We interpret this finding as evidence that more EU funds would not change the feelings and attitudes of citizens towards the EU[10].

The visual representation of this result is illustrated in Fig. 3. The observations are linearly fitted on the two sides of the border. The Figure displays no significant jump at the treatment border, confirming that, on average, people living in areas receiving the highest-possible level of EU financial aid have not voted differently at the Brexit Referendum from citizens living in much less funded areas.

Having established that a higher intensity of EU funding per se had no average effect on the Referendum's outcome, our next step is to examine whether EU funds can play a role if they are combined with the economic transformation of local areas, i.e. exactly the local structural transformation that the EU Cohesion Policy is intended to promote through the Structural Funds. In particular, we place our attention on how the local labour market has evolved in the period preceding the vote[11,12]. Territories displaying a higher local labour market dynamism, where socio-economic conditions have improved while EU funds have been flowing in, may be interpreted by citizens as a success of European policies and therefore produce a stronger sense of EU belonging, translating into more support for the EU and more 'Remain' votes.

While pro-Europe positions may be fuelled by the perceived success of EU policies, the opposite can also be true. Worsening economic and labour performance of local areas targeted by Cohesion Policy may make these constituencies more likely to vote against EU membership. Individuals experiencing social exclusion, job losses, or deprivation are more prone to develop feelings of discontent with 'mainstream' politics. This is particularly true if socio-economic decline is spatially concentrated, as widespread disadvantage in local communities of 'left behind' places leads to the development of negative collective emotions and political discontent (Rodríguez-Pose, 2018; Altomonte et al., 2019). In areas eligible for EU Structural Funds, voters may assign the responsibility for declining economic trajectories and for their deteriorating living conditions to the process of EU integration (through competition in the product and factor markets as well as higher environmental and quality standards), blaming the EU for the failure of public policies to mitigate these effects and compensate losers. This would induce local citizens to vote against the EU.

We calculate the change in unemployment between the two latest available Censuses, i.e. 2001 and 2011. As West Wales obtained the status of 'less developed' region from the EU in 2000, this variable approximates labour market conditions in the region at the beginning of the period of high funding, before EU funds for 'less developed' regions could produce large effects. The difference between unemployment in

[10] This result reinforces the evidence obtained by Fidrmuc et al. (2019). By running a simple OLS analysis they find that EU regional development funds at NUTS2 level are not significantly associated with UK voters' decisions at the Referendum on Brexit.

[11] As the main objective of EU regional policy is the promotion of 'smart, sustainable and inclusive' growth in recipient territories (European Commission, 2014), improvements in the economy and the generation of employment opportunities represent the expected outcome of policy interventions.

[12] In absence of GDP data at the ward level we rely on information about the unemployment rate, extracted from the Census. Wards are well-suited units to capture localised unemployment clusters. This is because most ward boundaries have been used by the UK Office for National Statistics to draw Output Areas (for which labour market and Referendum data are not available), a geographical classification of socially homogeneous areas in terms of household tenure and population size.

Table 2
Baseline RDD results - ATE model.

Dep. variable: Share of Remain votes						
	Wales (1)	<50 km (2)	<10 km (3)	Wales (4)	<50 km (5)	<10 km (6)
West Wales	0.00763	−0.0319	−0.00636	−0.0127	0.00354	−0.00715
	(0.0207)	(0.0191)	(0.0171)	(0.0166)	(0.0200)	(0.0175)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	823	1315	422	823	1315	422
Mean of dep. variable	0.465	0.467	0.447	0.465	0.467	0.447
R-squared	0.075	0.102	0.004	0.327	0.140	0.027
Best polynomial degree (AIC)				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

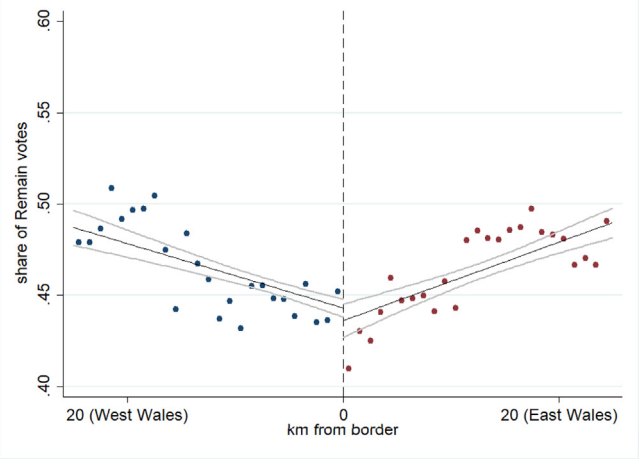

Fig. 3. ATE model - RDD plot. Note: each data point represents the bin sample average for distance from treatment border, the straight line is a first-order polynomial in distance from border fitted separately on each side of the treatment boundary. Sample of Wales wards. 95% confidence intervals are shown.

2001 and unemployment in 2011 captures the *decrease in unemployment* in ward *w* over a 10-year period preceding the Referendum. At least in part, this decrease may have been produced by EU development interventions.

As for model (1), model (2) is estimated using different bandwidths and with the forcing variable entering with different polynomial degrees. The results are shown in Table 3. First, it can be noted that, again, the West Wales dummy alone reports an insignificant coefficient across all specifications. The variable approximating local labour market dynamism, Unemployment decrease, is computed in such a way that a higher value corresponds to a higher reduction in the unemployment rate. This variable displays a significant and positive coefficient in some specifications – confirming the role of labour market dynamics as a driver of Euroscepticism – and it is insignificant otherwise. Crucially, the interaction term between the treatment dummy and the variable proxying labour improvements (U decrease) returns a positive and significant coefficient in all but one specifications. This indicates that wards within the highly-funded West Wales where labour market conditions have improved the most before the Referendum have been more prone to vote in favour of remaining in the EU. The estimated marginal effects for both West Wales and East Wales, obtained with a 10 km bandwidth, are displayed in Figure A2. A one percentage point reduction in unemployment in West Wales wards translates into approximately a 1.8pp increase in Remain votes, while in East Wales a similar decrease in unemployed is linked to an increase of around 0.5pp Remain votes, i.e. a differential of over 1 percentage point.

4.2. Robustness checks

The results in section 4.1 suggest that citizens living in areas eligible for the highest amount of EU Structural Funds and experiencing improvements in their local labour market have been more inclined to express a pro-Europe vote at the Referendum on Brexit. In this section, we test the robustness of this result in a number of ways.

First, our preferred samples are obtained by excluding wards of Cardiff, for the reasons explained in section 2. Table A3 in the Appendix reports the results of the H-ATE model obtained if Cardiff wards are included in the sample. Again we find that EU funds for 'less developed' regions have had no direct impact on the Referendum, while financial aid from the EU is associated with a higher share of Remain votes if combined with reductions in unemployment taking place in beneficiary areas.

As a second test on the H-ATE results, we modify the bandwidths used to define the treatment and control sample. More specifically, we test the results using wards located within 5 km, 15 km, 30 km, and 40 km on the two sides of the treatment border. The results, shown in Table A4 in the Appendix, confirm that the combination of high EU funding and improved labour conditions is significantly related to fewer Eurosceptic votes.

As a third robustness test, we adopt different proxies for labour market improvements to interact with the treatment dummy variable. We again rely on the Census and compute the variation in long-term unemployment rate and youth unemployment rate[13] in a similar way to how the unemployment decrease variable has been created. That is, we calculate the difference between the variables' latest available value (Census 2011) and their value when West Wales obtained the status of 'less developed' region (Census 2001). While similar to the original variable on unemployment rate, these indicators capture slightly different dynamics. The long-term unemployment change reflects the capacity of the labour market to absorb more marginalised workers, often socially excluded, while the variation in youth unemployment describes how difficult it is for people to find their first jobs. The results of these tests are reported in Tables A5 and A6 in the Appendix. In all specifications the interaction terms have positive coefficients, most of the time statistically significant. This appears to confirm that the creation of labour

[13] Following International Labour Organisation (ILO) definitions, long-term unemployment rate corresponds to people seeking employment for one year or longer. Youth unemployment refers to unemployment of the 18–24 year old population.

Table 3
EU funds, unemployment reduction, and Brexit – H-ATE model.

Dep. variable: Share of Remain votes						
	Wales (1)	<50 km (2)	<10 km (3)	Wales (4)	<50 km (5)	<10 km (6)
West Wales	0.0190	−0.00556	0.00223	−0.00509	0.00895	0.00114
	(0.0207)	(0.0191)	(0.0157)	(0.0166)	(0.0197)	(0.0167)
U decrease	0.430***	−0.588	0.546**	0.416***	−0.566	0.485**
	(0.132)	(0.650)	(0.213)	(0.109)	(0.636)	(0.202)
West Wales x U decrease	1.361*	1.573**	1.114*	0.587	1.559*	1.173*
	(0.770)	(0.793)	(0.680)	(0.453)	(0.812)	(0.667)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	802	1.057	415	802	1057	415
Mean of dep. variable	0.465	0.466	0.447	0.465	0.466	0.447
R-squared	0.181	0.191	0.139	0.374	0.209	0.154
Best polynomial degree (AIC)				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. U decrease: ward-level unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

opportunities for the most disadvantaged and for the youngest tends to be linked with a stronger support for EU membership in areas eligible for EU transfers.

Displacement effects of place-based policies may be substantial (Einio and Overman, 2020). As a fourth test, we attempt to minimise any bias that may have been produced by spillovers driven by the possibility that wards from East Wales located next to the border have themselves being influenced by European policies. Some projects may have been implemented across the border, benefiting both regions, while some others may have attracted commuters from the Eastern side. To discard the hypothesis that the main results are driven by spillovers, we perform a new set of estimates, adopting the same sample for the treated wards, while removing all wards within 10 km from the Eastern side of the border. The control group is then shifted 10 km away from the border.[14] Due to this change in sample, the model is no longer estimated as a spatial RDD, i.e. assigning more weight to observations located near the border by means of controlling for distance. Given that balancing properties no longer apply to the samples, we include in the model a set of observable covariates as controls. We add all variables used for the balancing test reported in Table 1. By using this methodology we estimate both the direct impact of EU funds and the effect of Structural Funds in wards where conditions have improved the most. The results of these estimates, illustrated in Table A7, confirm the insignificant role of EU funds for Brexit (columns (1)–(3)) if not combined with positive labour market dynamics (columns (4)–(6)).

In one additional robustness test, we replace the West Wales treatment dummy with our beneficiary variables in Table A8. While this indicator only covers a portion of all EU money spent in Wales (approximately 60%), as shown in Table A1 the variable correlates well with the West Wales dummy. We control again for Census characteristics and test the model for all Welsh wards (columns (1), (3), Table A8) and all Welsh wards excluding Cardiff (columns (2), (4), Table A8). When testing the relationship between beneficiaries of EU funds and the Brexit Referendum once again we find no evidence that high recipients of EU resources have voted differently from less funded areas, and we also confirm that highly-funded wards in which unemployment has decreased more have voted Remain more.

[14] This implies that by definition Cardiff wards are excluded from the sample, given that they are all located less than 10 km from the treatment border.

Finally, we further test the robustness of the significance of our main coefficients by introducing a bootstrapping procedure. When using Local Authorities for standard errors clustering we have a maximum of 52 clusters, which is a relatively low number, equal or lower than the rule of thumb for the minimum number of clusters for the standard clustering procedure (Bertrand et al., 2004). We therefore replicate the estimates in Tables 2 and 3 bootstrapping standard errors. We adopt the wild-bootstrapping procedure using the *boottest* command (Roodman et al., 2019). We bootstrap clusters adopting, again, Local Authorities as clusters. Standard errors and t-statistics are obtained performing 999 replications and with Rademacher weights. The results, shown in Table A9, report wild-bootstrapped t-statistics in parenthesis. In terms of statistical significance, these estimates appear perfectly in line with our main specifications in Tables 2 and 3.

5. Discussion

The evidence produced in section 4 indicates that the effect of European funds on pro-Europe voting outcomes only materialises under certain conditions. We find that the dynamics of the local labour market are crucial to explain the voting preferences of citizens in the areas highly subsidised by the EU.

Job creation and unemployment reduction are among the main goals of EU policies. Therefore, citizens may view improvements in local labour market conditions as a tangible way for EU projects to deliver concrete benefits. Our results seem to suggest that people who perceive or experience personal benefits from Cohesion Policy (and possibly EU policies in general) are more prone to appreciate the policy and its promoters. This explanation would fit within the economic utilitarian theory of European integration, according to which the loyalty to the idea of Europe depends on the perceived benefits that further integration can offer (Gabel and Whitten, 1997).

While we cannot directly measure the extent to which the observed reduction in unemployment (a proxy for the creation of local labour market opportunities) is directly caused by EU policies, our findings entail that if EU projects are capable of producing strong and visible effects on local labour markets – e.g. by fostering employment for socially excluded and young people – this would translate into a lower level of Euroscepticism and higher electoral support for the EU.

The impact of EU subsidies on European attitudes, conditional on the effectiveness of EU policies, can be indirectly examined by looking at key elements facilitating the profitable use of Structural Funds. One factor increasing the local capacity to absorb EU transfer and obtain

higher economic returns from them is the presence of highly-educated individuals (Becker et al., 2013). The endowment of skilled workers enables technology adoption (Benhabib and Spiegel, 1994) and the efficient management of EU resources (Becker et al., 2013). Therefore, we can use a proxy for the local level of human capital to check whether and how this variable relates to EU funds and Euroscepticism.

We approximate the human capital stock in each ward with the share of tertiary educated individuals, relying on 2001 Census data. First, we use this variable to test whether it mediates the effect of EU funds on Brexit as in the case of labour market dynamism, estimating a new version of the H-ATE RDD model. The results, shown in Table A10, demonstrate that, although a higher proportion of skilled workers directly links with more Remain votes, there is no clear evidence that human capital plays a conditional effect on the link between EU funds and Brexit.

However, our main interest is to verify whether the effect uncovered in section 4 (i.e. the generation of new employment opportunities makes EU funds positively correlate with a pro-Europe attitude) is stronger in places endowed with highly-educated people. We do so by re-estimating the H-ATE model with unemployment reduction as a conditioning variable, similar to what we do in section 4, by splitting the sample on the basis of higher/lower than average human capital. The results of Table A11 indicate that the role of labour market dynamism as mediator of the EU funds' effect on Brexit is much stronger in areas endowed with higher human capital.

Hence, the combination of lower unemployment and higher stock of human capital are the two factors determining a larger effect of European funds on public support for the EU. In this scheme, human capital may be capturing local areas' capacity to absorb EU transfers and make good use of them, as discussed above. Another interpretation is that it reflects the *awareness* of beneficiary wards over the existence of the policy. Previous evidence suggested a strong association between the proportion of highly-educated people and the awareness of Cohesion Policy (Capello and Perucca, 2018; Osterloh, 2011). In the regions in receipt of EU funding through Cohesion Policy, EU investment efforts are better known where human capital is higher. If we follow this interpretation and apply it to our setting, the differential conditioning impact of unemployment decrease depending on the level of human capital, as shown in Table A11, suggests where voters were aware of the EU funds received by West Wales they were also more likely to relate improvements in local labour market condition to the effect of EU policies.

6. Conclusions

This paper has investigated the extent to which Eurosceptic voting preferences can be influenced by EU policies. It leverages the case of the EU Structural Funds, the key EU policy tool targeting employment and economic opportunities; i.e. the same economic challenges that have been linked to the world-wide rise of anti-system electoral preferences. The study exploits a quasi-experimental setting in the UK context, where some territories were classified as 'in highest need' of socio-economic support by the EU – and hence entitled to receive the highest form of EU funding – when the Referendum on Brexit was held. The paper investigates whether this 'special' treatment in terms of EU financial support has influenced the vote in the Referendum in beneficiary areas. The boundary between West Wales and its neighbouring region – that defines eligibility for EU financial aid - is used to identify 'treated' and 'control' units and uncover whether and under what conditions EU funding may influence electoral support for EU integration.

Regression discontinuity estimates suggest that, all else equal, wards targeted by the highest proportion of EU funds have not behaved differently from less subsidised areas in terms of support for EU membership. Conversely, voters are more prone to support EU Membership only if EU funding is coupled with tangible improvements in local labour markets. A significant decrease in the level of unemployment is robustly linked with fewer Eurosceptic votes in areas highly-funded by the European Union, vis-à-vis less well-funded territories.

This result, robust to a full battery of robustness tests, offers (for the first time) causal evidence that being in receipt of EU funds does not per se make local citizens more supportive of the European Union. Only where EU investments are combined with the generation of new employment opportunities and a positive socio-economic transformation of local territories – possibly a direct result of EU development policies – are citizens more likely to electorally support the EU as the promoter of positive change in their surrounding economic environment. Further empirical tests seem to suggest that labour market dynamism in beneficiary areas is more likely to lower Eurosceptic votes if citizens are also more aware of EU interventions, therefore linking positive change more directly with EU interventions.

These findings are in line with a growing body of evidence on economic dynamics as the fundamental driver of anti-establishment and Eurosceptic voting choices (Guiso et al., 2017; Rodrik, 2018; Colantone and Stanig, 2018; Rodríguez-Pose, 2018). Our findings confirm that support for the process of European integration is strongly influenced by economic factors, with special reference to labour market opportunities. What our original results add to the existing discourse is the role of active public policies in shaping electoral behaviour. Discomfort and resentment of EU citizens can indeed be mitigated and channelled towards constructive and internationally cooperative political options. However, what seems to matter for citizens is not access to EU funding per se, but rather the capability of these funds to concretely mitigate the lack of economic opportunities and the localised negative effects of the process of economic integration or economic shocks.

The Brexit referendum offered a unique opportunity to study the revealed preferences of UK citizens in terms of their support for the EU, an area of public policy where opinion polls and surveys have traditionally offered very unreliable insights. If this elicitation of citizens' preferences was truly unique, the economic and social challenges faced by UK voters are common to many other EU citizens. The lack of dynamism of the Welsh economy (in particular in comparison with other parts of the country) is not dissimilar to the reality of less developed regions in virtually all EU countries. These regions have received significant support from the EU to tackle their structural disadvantage with rather mixed results. The resentment and political disenfranchisement with the EU where economic opportunities have failed to materialise is a common trait of the electoral behaviour and political sentiment in the economic periphery of the EU.

Areas most heavily funded by the EU tend to develop a more favourable view of Europe if (and only if) citizens observe visible socio-economic improvements in their local communities with potential personal benefits from EU intervention. In this perspective, future support for the process of European integration is highly dependent on the capacity of all EU policies to deliver concrete benefits to be felt at the local level. Impactful policies are therefore a fundamental tool to buy-in citizens into the EU project.

On the verge of an unprecedented global recession triggered by the Covid-19 pandemic this is both good and bad news for the EU. On the bright side, under the current circumstances of tight budget constraints, the EU does not need to spend more in order to consolidate its support among European citizens. However, skyrocketing unemployment and worsening economic conditions in most deprived areas are a major challenge that calls for impactful answers and visible impacts. Money cannot buy love for the EU, but its capacity to deliver tangible impacts and generate new local opportunities certainly can.

CRediT author statement

Riccardo Crescenzi: Conceptualization, Resources, Writing - Original Draft, Writing - Review & Editing. **Marco Di Cataldo:** Conceptualization, Resources, Methodology, Data Curation, Formal analysis, Inves

tigation, Writing - Original Draft, Writing - Review & Editing. **Mara Giua:** Data Curation, Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Writing - Review & Editing.

Declaration of competing interest

None.

Acknowledgement

We thank Co-Editor Matthew Freedman and the anonymous referee for their constructive comments that have led to improvements in the paper. We are also grateful to Guglielmo Barone, Felipe Carozzi, Swati Dhingra, Peter Egger, Steve Gibbons, Vicente Royuela, and all seminar/conference participants at University of Barcelona (2017 AQR workshop), University of Rome La Sapienza (CERUP conference), LSE, Cardiff University, Polytechnic of Milan, the 2018 ERSA Congress in Cork, the RSA Winter Conference in London, the National Institute for Economic and Social Research. We thank Martin Rosenbaum at the BBC Political Programmes for sharing the data on Brexit Referendum results at ward level and Julia Bachtrögler for sharing the data on EU funds' beneficiaries in Wales. All errors and omissions are our own.

Appendix

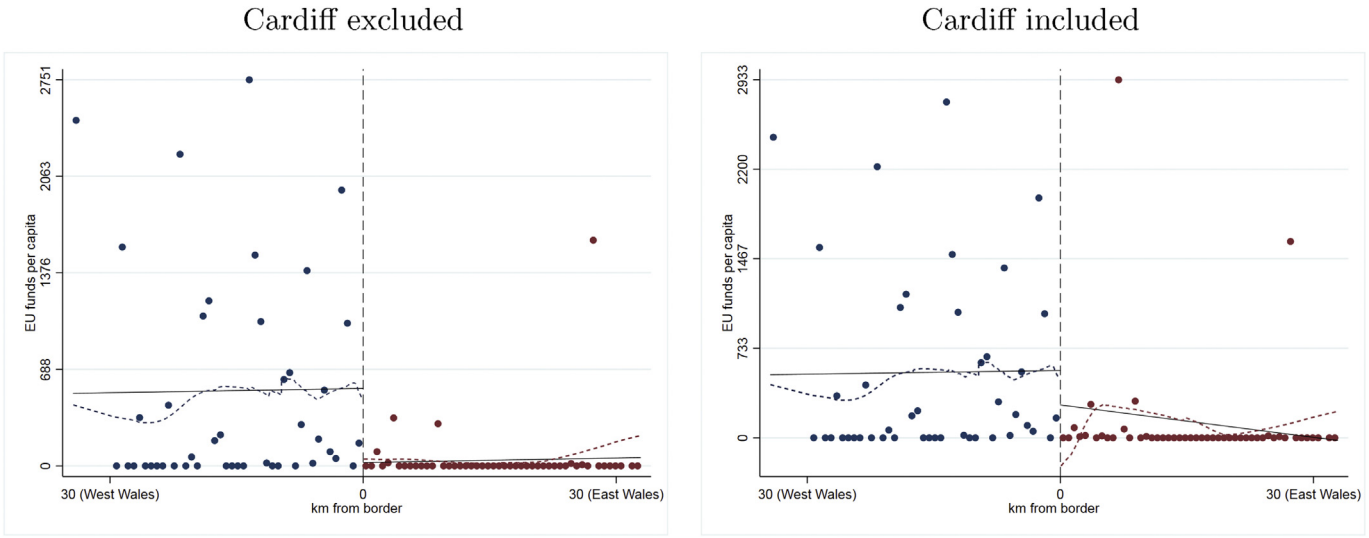

Fig. A1 EU funds across the treatment border. Note: the dashed black vertical line indicates the treatment border between East Wales and West Wales. Linear fit (continuous) and lowess (small-dashed) curves on both sides of the border threshold. Upper panel: Cardiff wards excluded; Lower: Cardiff wards included.

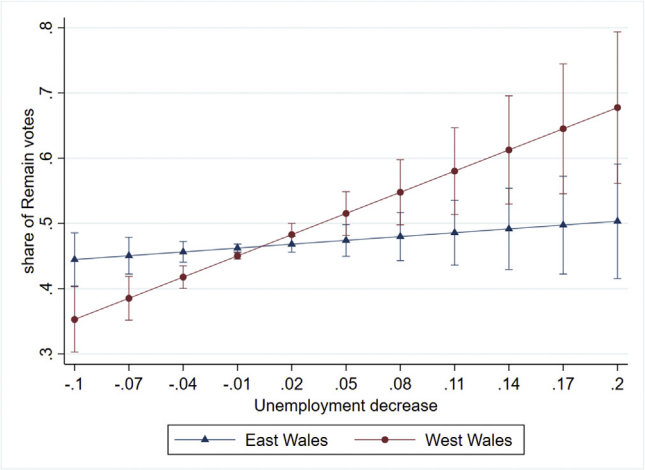

Fig. A2 H-ATE – estimated marginal effects.

Table A1
EU funds per inhabitant in less developed regions (beneficiary data).

Dep. var: EU funds per inhabitant	(1)	(2)	(3)
Panel A: Wales			
	Wales	<50 km	<10 km
West Wales	542.0***	550.0***	372.2**
	(103.7)	(122.1)	(159.0)
Observations	823	1315	422
R-squared	0.007	0.013	0.007
Panel B: South West of England			
	SW England	<50 km	<10 km
Cornwall	559.6***	42.61***	−41.66
	(70.45)	(11.66)	(29.15)
Observations	1009	222	67
R-squared	0.022	0.013	0.021

Note: clustered standard errors at local authority level in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. EU funds per inhabitant as dependent variable, calculated on the basis of available beneficiary data. Panel A, column (1): sample of all wards of Wales; Panel A, column (2): sample of wards within 50 km from the border between West Wales and East Wales; Panel A, column (3): sample of wards within 10 km from the border between West Wales and East Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Cardiff wards excluded. Panel B, column (1): sample of all wards of South West England; Panel B, column (2): sample of wards within 50 km from the border between Cornwall and Devon; Panel B, column (3): sample of wards within 10 km from the border between Cornwall and Devon. Cornwall: dummy variable taking value 1 for all wards belonging to Cornwall.

Table A2
Descriptive statistics.

	Cardiff wards excluded								
	Wales			<50 km			<10 km		
Variable	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev
Share of Remain votes[a]	823	0.47	0.05	1315	0.47	0.06	422	0.447	0.037
West Wales	824	0.681	0.466	1315	0.354	0.479	422	0.590	0.492
€ of EU funds (beneficiaries)[a]	823	398.2	3047	1315	219.0	2344	422	387.2	5052
Unemployment decrease[b]	803	−0.006	0.012	1057	−0.008	0.012	415	−0.009	0.010
Long-term unemployment decrease[b]	803	−0.005	0.007	1057	−0.006	0.007	415	−0.007	0.006
Youth unemployment decrease[b]	803	−0.015	0.030	1057	−0.016	0.027	415	−0.019	0.028
Log population	803	7.877	0.549	1057	−0.016	0.027	415	−0.018	0.028
Highly-educated (NVQ4+)[a]	803	0.124	0.052	1057	8.105	0.633	415	7.983	0.551
Unemployment[b]	803	0.034	0.012	1057	0.129	0.057	415	0.121	0.054
Long-term unemployment[b]	803	0.011	0.005	1057	0.032	0.013	415	0.033	0.011
Youth unemployment[b]	803	0.070	0.031	1057	0.010	0.005	415	0.010	0.005
18-24 yo population[a]	803	0.102	0.050	1057	0.064	0.031	415	0.072	0.029
Non-white population	803	0.016	0.019	1057	0.101	0.049	415	0.098	0.029
Agricultural employment[b]	803	0.024	0.035	1057	0.020	0.026	415	0.016	0.023
Manufacturing employment[b]	803	0.098	0.045	1057	0.021	0.032	415	0.018	0.031
Employment in construction[b]	803	0.044	0.011	1057	0.102	0.042	415	0.117	0.041
Employment in mining[b]	803	0.002	0.003	1057	0.043	0.011	415	0.043	0.010
Employment in public admin[b]	803	0.037	0.015	1057	0.002	0.003	415	0.002	0.003
Employment in wholesale & retail[b]	803	0.093	0.019	1057	0.037	0.016	415	0.036	0.015
Employment in finance[b]	803	0.015	0.009	1057	0.098	0.021	415	0.089	0.017
Employment in real estate[b]	803	0.046	0.014	1057	0.019	0.012	415	0.017	0.010
Employment in health services[b]	803	0.074	0.020	1057	0.055	0.021	415	0.048	0.015
Employment in transport services[b]	803	0.030	0.010	1057	0.074	0.019	415	0.076	0.021

Note: a/ calculated as share of ward residents; b/ calculated as share of 16–74 year old residents. Labour market and demographic variables measured in 2001 (source: UK Census).

Table A3
EU funds, unemployment reduction, and Brexit (Cardiff wards included).

Dep. var.: Share of Remain votes	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	−0.00051	−0.0220	−0.0173	−0.0264	−0.0174	−0.0112
	(0.0275)	(0.0243)	(0.0237)	(0.0257)	(0.0298)	(0.0208)
U decrease	−0.377	−0.814	−0.671	−0.397	−0.819	−0.596
	(0.720)	(0.611)	(1.043)	(0.715)	(0.621)	(0.893)
West Wales x U decrease	1.912*	1.799**	2.331*	1.399*	1.812**	2.255**
	(1.045)	(0.761)	(1.226)	(0.840)	(0.800)	(1.096)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	831	1086	444	831	1.086	444
Mean of dep. Variable	0.470	0.470	0.457	0.470	0.470	0.457
R-squared	0.129	0.165	0.131	0.282	0.178	0.147
Best polynomial degree				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. U decrease: ward-level unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

Table A4
EU funds, unemployment reduction, and Brexit (varying bandwidths).

Dep. var.: Share of Remain votes	<5 km	<15 km	<30 km	<40 km
	(1)	(2)	(3)	(4)
West Wales	0.00192	−0.00249	0.00773	0.00453
	(0.0161)	(0.0163)	(0.0176)	(0.0179)
U decrease	0.343	0.559***	−0.381	−0.859
	(0.392)	(0.184)	(0.430)	(0.549)
West Wales x U decrease	1.499*	1.066*	1.389**	1.869**
	(0.811)	(0.629)	(0.663)	(0.769)
Polynomial	3–3	3–3	3–3	3–3
Observations	261	517	740	897
Mean of dep. Variable	0.446	0.450	0.459	0.462
R-squared	0.235	0.183	0.184	0.150
Best polynomial degree (AIC)	✓	✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. U decrease: ward-level unemployment rate difference between 2011 and 2001. Samples: all wards located 5 km or less from the treatment border (column (1)), all wards located 15 km or less from the treatment border (column (2)), all wards located 30 km or less from the treatment border (column (3)), all wards located 40 km or less from the treatment border (column (4)). Cardiff wards excluded. Models estimated with polynomials of order three interacted with forcing variable and treatment variable.

Table A5
EU funds, long-term unemployment reduction, and Brexit.

Dep. var.: Share of Remain votes	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	0.0244	−0.00056	0.000501	−0.00041	0.0134	−0.00058
	(0.0211)	(0.0188)	(0.0165)	(0.0163)	(0.0188)	(0.0175)
LTU decrease	1.172**	−0.367	1.682***	1.134**	−0.294	1.640***
	(0.521)	(1.078)	(0.563)	(0.430)	(1.080)	(0.565)
West Wales x LTU decrease	2.201*	2.552**	0.818	1.211	2.454*	0.812
	(1.300)	(1.262)	(1.201)	(0.814)	(1.312)	(1.195)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	802	1.057	415	802	1.057	415
Mean of dep. Variable	0.465	0.466	0.447	0.465	0.466	0.447
R-squared	0.220	0.192	0.152	0.398	0.209	0.161
Best polynomial degree (AIC)				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. LTU decrease: ward-level long-term unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

Table A6
EU funds, youth unemployment reduction, and Brexit.

Dep. var.: Share of Remain votes	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	0.0154	−0.0148	−0.00174	−0.00735	0.00315	−0.00167
	(0.0223)	(0.0189)	(0.0169)	(0.0174)	(0.0191)	(0.0178)
Youth U decrease	0.164	0.188	0.0460	0.306	0.172	−0.0366
	(0.602)	(1.287)	(0.535)	(0.473)	(1.208)	(0.483)
West Wales x Youth U decrease	2.214*	1.320	1.818*	1.279*	1.384	1.922*
	(1.115)	(1.417)	(1.060)	(0.733)	(1.385)	(1.007)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	802	1057	415	802	1057	415
Mean of dep. variable	0.465	0.466	0.447	0.465	0.466	0.447
R-squared	0.120	0.170	0.040	0.351	0.190	0.060
Best polynomial degree (AIC)				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Youth U decrease: ward-level 16–24 yo unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

Table A7
Test for spillover effects.

Dep. var.: Share of Remain votes	Wales	<50 km (West Wales) 10–50 km (East Wales)	<10 km (West Wales) 10–20 km (East Wales)	Wales	<50 km (West Wales) 10–50 km (East Wales)	<10 km (West Wales) 10–20 km (East Wales)
	Control wards < 10 km from border excluded					
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	−0.00190	0.0265	−0.0104	−0.000430	0.0275	−0.00177
	(0.0222)	(0.0190)	(0.0140)	(0.0219)	(0.0184)	(0.0134)
U reduction				0.272	−0.0356	−0.553
				(0.437)	(0.479)	(0.433)
West Wales x U decrease				1.382***	0.832**	1.147**
				(0.372)	(0.390)	(0.492)
Controls	✓	✓	✓	✓	✓	✓
Observation	403	893	207	388	642	168
Mean of dep. variable	0.484	0.477	0.472	0.485	0.479	0.470
R-squared	0.262	0.459	0.404	0.315	0.427	0.604

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Samples: all wards of Wales excluding East Wales wards less than 10 km from border (columns (1), (4)), all West Wales wards located 50 km or less from the treatment border and East Wales wards between 10 and 50 km from treatment border (columns (2), (5)), all West Wales wards located 10 km or less from the treatment border and East Wales wards between 10 and 20 km from border (columns (3), (6)). Controls refer to labour market and demographic ward characteristics taken from the Census.

Table A8
EU funds beneficiaries, unemployment reduction, and Brexit.

Dep. var.: Share of Remain votes	Cardiff excluded		Cardiff excluded	
	(1)	(2)	(3)	(4)
EU funds beneficiaries	1.80e-07	1.28e-07	6.84e-07*	5.56e-07
	(3.85e-07)	(5.28e-07)	(2.90e-07)	(4.26e-07)
U decrease			0.692	1.120
			(0.847)	(0.708)
EU funds beneficiaries x U decrease			0.000147**	0.000131*
			(5.90e-05)	(6.60e-05)
Controls	✓	✓	✓	✓
Observations	852	823	831	802
Mean of dep. variable	0.470	0.465	0.470	0.465
R-squared	0.423	0.383	0.445	0.415

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Samples: all Wales wards (columns (1), (3)), all Wales wards excluding wards from Cardiff (columns (2), (4)). Controls refer to labour market and demographic ward characteristics taken from the Census.

Table A9
Main results - bootstrapped standard errors.

Dep. var.: Share of Remain votes	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	0.00763	−0.0319	−0.00636	0.0190	−0.00556	0.00223
	(0.369)	(-0.803)	(-0.461)	(0.921)	(-0.302)	(0.142)
U decrease				0.430**	−0.588	0.546*
				(3.266)	(-0.904)	(2.568)
West Wales x U decrease				1.361	1.573*	1.114*
				(1.435)	(1.985)	(1.758)
Polynomial	1–1	1–1	1–1	1–1	1–1	1–1
Observation	823	1315	422	802	1.057	415
Mean of dep. variable	0.465	0.467	0.447	0.465	0.466	0.447
R-squared	0.075	0.102	0.004	0.181	0.191	0.139

Note: wild-bootstrapped (999 replications) clustered t-statistics in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. U decrease: ward-level unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order three interacted with forcing variable and treatment variable.

Table A10
EU funds, human capital, and Brexit.

Dep. var.: Share of Remain votes	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	−0.0167	−0.0148	−0.0145	−0.0177	0.00552	−0.0144
	(0.0204)	(0.0222)	(0.0239)	(0.0179)	(0.0246)	(0.0251)
Tertiary educated	0.223***	0.343***	0.270**	0.223***	0.363***	0.267**
	(0.0541)	(0.104)	(0.0995)	(0.0557)	(0.107)	(0.105)
West Wales x Tertiary educated	0.277*	0.0444	0.136	0.154	0.0380	0.132
	(0.135)	(0.140)	(0.173)	(0.103)	(0.144)	(0.173)
Polynomial	1–1	1–1	1–1	3–3	3–3	3–3
Observations	802	1.057	415	802	1057	415
Mean of dep. variable	0.465	0.466	0.447	0.465	0.466	0.447
R-squared	0.243	0.279	0.239	0.429	0.306	0.243
Best polynomial degree (AIC)				✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. Tertiary educated: 2001 ward population holding NVQ level 4 or above. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

Table A11
EU funds, unemployment reduction, and Brexit – results by level of human capital.

Dep. var.: Share of Remain votes						
	Human capital below median (26% holding tertiary education degree)			Human capital above median (>26% holding tertiary education degree)		
	Wales	<50 km	<10 km	Wales	<50 km	<10 km
	(1)	(2)	(3)	(4)	(5)	(6)
West Wales	0.00062	0.0178	−0.0084	0.0154	0.0244	0.0212
	(0.0193)	(0.0219)	(0.0170)	(0.0153)	(0.0210)	(0.0167)
U decrease	0.298	0.722	0.0912	0.341	1.123	0.326
	(0.244)	(0.645)	(0.269)	(0.239)	(0.931)	(0.305)
West Wales x U decrease	0.346	1.426**	1.010	2.094***	2.541*	2.247*
	(0.418)	(0.689)	(0.587)	(0.453)	(1.381)	(1.301)
Polynomial	3–3	3–3	3–3	3–3	3–3	3–3
Observations	521	650	278	281	407	137
Mean of dep. variable	0.482	0.481	0.467	0.455	0.456	0.436
R-squared	0.282	0.178	0.139	0.374	0.209	0.217
Best polynomial degree (AIC)	✓	✓	✓	✓	✓	✓

Note: clustered standard errors at local authority level in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Forcing variable: distance in km from border between East Wales and West Wales. West Wales: dummy variable taking value 1 for all wards belonging to West Wales and The Valley. U decrease: ward-level unemployment rate difference between 2011 and 2001. Samples: all wards of Wales (columns (1),(4)), all wards located 50 km or less from the treatment border (columns (2),(5)), all wards located 10 km or less from the treatment border (columns (3),(6)). Cardiff wards excluded. Models estimated with polynomials of order one (columns (1)–(3)) or order three (columns (4)–(6)) interacted with forcing variable and treatment variable.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.regsciurbeco.2020.103556.

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