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How impact fees and local planning regulation can influence deployment of telecoms infrastructure

Abstract
This paper examines how local government planning regulations and charges affect the deployment of telecommunications infrastructure. We explore the economic rationale for local government regulation of such infrastructure, which we suggest should be based on managing negative externalities. Using data from Ireland, we find that the observed geographical pattern of impact fees is inconsistent with the economic rationale for them. A simple econometric model of the number of telecoms masts in each county also suggests that the level of impact fees is negatively associated with mast deployment. This paper also examines other regulatory factors that affect the provision of new infrastructure. We find wide regional variation in these regulations but are unable to quantify their impact on infrastructure provision. Such regulatory complexity places extra compliance burdens on private operators, which may in turn distort the level and regional pattern of network investment. We suggest further regional harmonisation of development policy towards telecoms infrastructure to avoid exacerbating regional disparities in rollout of services.

JEL codes: H71, L96, R38, R52

Keywords: Land use regulation; telecommunications infrastructure investment; impact fees

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1 Introduction

Electronic communications services have long been credited with weakening the links between geographic location and economic activity (Negroponte, 1995). However, economic, political and physical geography can still have significant effects on the services themselves, because most telecoms offerings rely on physical network components that must be present in all geographic areas where the service is to be offered. Mobile (cellular) telephone networks and wireless data networks require masts, antennae and base stations, often combined with fibre optic "backhaul" connections to carry bulk traffic around the network. Fixed line and cable networks rely on physical infrastructure elements such as exchanges, trunk lines, street cabinets, ducts or poles and local lines to all connected premises. They may also include some radio-based components such as the ones mentioned above.

Investment in these physical elements and the civil works required to put them in place makes up a significant proportion of the costs of network deployment and hence the costs of the services delivered across them. In this way, the sector is no different from other network utilities such as electricity, gas and water.

However, electronic communications also differs in some important ways from other network sectors, and these characteristics can have a bearing on the deployment of physical infrastructure. In developed countries, including Ireland (from which we draw the examples in this paper) telecoms service are more often provided by private firms than the network services in other utilities sectors, which are commonly provided through state owned organisations. This has two important implications. First, telecoms companies are likely to deploy infrastructure only where it is commercially attractive for them to do so or where they are compelled to do so (e.g. by universal service regulation). Second, in Ireland telecoms firms face different regimes of planning scrutiny and infrastructure-related charges when developing, maintaining and deploying infrastructure than the other utilities. Local authorities are permitted substantial discretion in setting local planning practices and fees, and in practice significant regional variations exist.

This means that the charges, administrative burdens and time delays associated with obtaining planning consents for infrastructure development or maintenance vary by geographical area. To a private telecoms company, these are costs, just like labour, poles or wires. In principle, such firms may respond to these cost variations by favouring network development in some areas more than others.

There are at least two reasons that such effects might concern policymakers. First, if local regulation were applied inefficiently, this could distort or deter markets for electronic communications services. That would make consumers worse off. Indeed, not only consumers in the local authority areas where regulation was applied inefficiently would be affected, but also consumers of two-way services in other areas wishing to communicate with those in affected areas.

Second, such effects could make it more difficult to efficiently implement national and European information society policies. Telecommunications policy has historically tried to maintain some degree of geographical universality in service provision, partly in response to the presence of network externalities and the perceived benefits to social and economic inclusion of maintaining broad connectivity. In Europe, this objective was addressed using universal service measures for fixed line telephony and some other traditional services. It persists as an aspiration in the case of more advanced services. For example, *A Digital*

Agenda for Europe (European Commission, 2010) sets the policy objectives in relation to broadband infrastructure at a European level. The key targets of this agenda are that all European citizens will have access to broadband internet with speeds of at least 30MB/s by 2020 with 50% of users subscribing to broadband with speeds of over 100MB/s. The more short-term policy target is to have universal broadband provision by 2013. This paper focuses on the Republic of Ireland which at present has levels of broadband availability close to 99% (DCENR, 2010). The Irish government has also signalled a commitment to the rollout of a next generation broadband network (Department of the Taoiseach, 2011). Inefficient local regulation could increase the cost of pursuing these policies.

Nevertheless, there may be an economic rationale for maintaining some local planning scrutiny and fees on telecoms infrastructure development. These technologies can create some negative externalities and government may have a role in addressing these. One important principle of policy delivery is the subsidiarity principle, whereby policy is devolved to the most appropriate level. There is a case for assigning some aspects of local planning policy to local authorities, since local conditions and preferences may vary in ways that a centralised mechanism would find it difficult to incorporate. A further option is to allow local discretion within the bounds of a consistent set of national guidelines, so as to create more regulatory certainty and predictability. The objective of policy should then be to ensure that local measures are economically efficient and that local authorities do not face perverse incentives when applying them.

This paper uses data from Ireland to examine the economic appropriateness and practical effects of local government planning regulations on the provision of telecommunications infrastructure. We consider both impact fees, which impose a direct cost on infrastructure developers, and more qualitative aspects of the planning process, which may impose indirect costs in the forms of administrative complexity, delays or unexpected rejections.

The paper is structured as follows. Section 2 discusses previous research of relevance to this topic. Section 3 suggests a possible economic rationale for planning regulation of telecoms infrastructure and considers how optimal impact charges should relate to areas' socio-economic characteristics. In Section 4, we set out empirical findings as to whether current practices in Ireland seem economically appropriate and econometric results on the effects of one sort of impact charge (development contributions). Finally, Section 5 concludes the paper.

2 Previous research on impact fees for telecoms infrastructure

In this paper we are interested both in the institutional arrangements for scrutinising telecoms planning applications and in the fees that are charged by local regulators (sometimes termed "impact fees" or "development fees"). To our knowledge, no studies have directly examined the effects of such planning parameters on the provision of new telecommunications infrastructure.

However, the effects of planning regulations and impact fees on investment patterns have been examined in the context of the housing construction sector, where there is significant spatial regulatory heterogeneity. In particular, researchers have examined their effects on house prices and the supply of new houses. Brueckner (1997) examines the effect of impact fees in terms of a sustainable urban development financing model. He compares the practice of levying an impact fee up front to other long-term cost sharing approaches. Mayer and Somerville (2000) estimate a panel data model on data from US cities. They find that local areas with more intrusive planning regulation (including both monetary and non-monetary elements) can have up to 45% fewer housing starts as well significantly lower housing price elasticities. They also conclude that the presence of impact fees has relatively little impact on new construction, but they find larger and more significant effects from regulations that lead to planning delays or restrict development in other ways. However, it is worth noting that their model controls for the presence of impact fees but not their magnitude. Burge & Ihlanfeldt (2006) find differing effects on housing construction from water and sewerage impact fees compared with fees for other public services, but both types have significant effects. Ihlanfeldt (2007) confirms that the stringency of planning regulation can affect local housing markets, using an instrumental variables approach to take account of the possible endogeneity of the regulation index. Burge and Ihlanfeldt (2009) examine the wider economic impact of different types of impact fees. Using county level panel data from Florida, they find that impact fees affect local employment.

In the Republic of Ireland, impact fees are called "development contributions". Clinch and O'Neill (2010) discuss the use of development contributions in Ireland, again focusing mainly on housing construction. The Planning and Development Act of 2000 provided the legislative basis for the imposition of impact fees by local government in Ireland. Section 48 of the Act specifies that planning authorities may "require the payment of a contribution in respect of public infrastructure and facilities benefitting development in the area of the planning authority...." Contributions may vary for "different classes or descriptions of development", and the "...planning authority shall have regard to the actual estimated cost of providing the classes of public infrastructure and facilities..." when determining the level of contributions. In this context, "public infrastructure and facilities" means

> (a) the acquisition of land,
>
> (b) the provision of open spaces, recreational and community facilities and amenities and landscaping works,
>
> (c) the provision of roads, car parks, car parking places, sewers, waste water and water treatment facilities, drains and watermains,
>
> (d) the provision of bus corridors and lanes, bus interchange facilities (including car parks for those facilities), infrastructure to facilitate public transport, cycle and pedestrian facilities, and traffic calming measures,
>
> (e) the refurbishment, upgrading, enlargement or replacement of roads, car parks, car parking places, sewers, waste water and water treatment facilities, drains or watermains, and
>
> (f) any matters ancillary to paragraphs (a) to (e);[1]

Section 48 has subsequently been amended by the Planning and Development (Amendment) Act 2010, with the definition of "public infrastructure and facilities" extended to include "the provision of high-capacity telecommunications infrastructure, such as broadband."[2]

We also note that recent European (and Irish) legislation allows for regulation of the co-location and sharing of network elements and associated facilities.[3] Depending upon how they are implemented, such measures may affect both the incentives for those rolling out infrastructure and the external costs of doing so in the future.

In sum, development contributions for telecommunications infrastructure (or any other class of development) in Ireland are set by local authorities, who are supposed to set them with reference to the actual costs of providing public infrastructure. The way the legislation has

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[1] Planning and Development Act, 2000, Section 48(17).

[2] Planning and Development (Amendment) Act 2010, Section 30(b)(ii).

[3] E.g. for Ireland, Regulation 21 of the European Communities (Electronic Communications Networks and Services) (Framework) Regulations 2011, S.I. No. 333 of 2011.

been applied, "actual costs" refers to the general expenditure by the local authority rather than specific costs associated with a given development.[4]

The initial aim of introducing development charges in Ireland was to take account of certain external costs that rapid construction development was causing. These fees subsequently became a large fraction of local government financing (Department of Environment, 2008). Indeed, in 2006 they raised €671m (Burke, 2007). Clinch and O'Neill (2010) discuss the rationale for development contributions with reference to the Irish situation. They advocate Pigouvian taxes on new construction and infrastructure development. Pigouvian taxes are applied to goods or services that generate negative externalities and are set at a rate that aims to increase the private cost of the goods to match the full social cost. In this way, such taxes aim to correct for the effect of externalities on market outcomes. In the next section we take up this theme in the context of telecoms infrastructure.

3 Economic rationale for local government planning regulation and impact fees for telecoms infrastructure

The economic rationale for planning regulation and impact fees on mast and duct infrastructure stems from the negative local externalities that can arise from these investments. Impact fees can be used as Pigouvian taxes to ensure that infrastructure developers face the full social costs of their networks. Other instruments of planning regulation such as application, objection and appeals provisions serve their usual purpose of allowing local conditions and preferences to be taken account of within the framework of national policy guidance.

Telecommunications masts can give rise to visual disamenity, reducing the welfare of those who live and work near them due to their appearance. Some people are also concerned about putative health effects from telecommunications masts, which can give rise to opposition to their installation. Using impact fees on installation of masts is an economically efficient option for ensuring that the network operator compensates society for generating these externalities and takes them into account when making investment decisions. There are other approaches to addressing visual disamenity effects, such as choosing mast locations that minimise such effects. Some attention is giving to such regulatory measures in the guidance given to Irish local authorities by central government, e.g. DELG (1996).

Ducts used to carry fibre optic and copper cables can also give rise to negative externalities, mainly during the period they are being put in place. Often these technologies are deployed in trenches under public roads and paths, and while they are being installed they normally restrict the use of these thoroughfares. This temporarily reduces the public good services provided by the affected roads, reducing the welfare of users. If the construction is not done properly, it may also damage the affected roads and paths, leading to longer term loss of welfare. Here too, impact fees can help ensure the developer bears the wider societal costs. Regulatory provisions can also help control the quality of remediation works.

The optimal impact fees and regulatory provisions for both masts and ducts are likely to vary by area, because local conditions affect the scale and nature of the externalities generated. Local preferences and the backdrop against which visual disamenities are judged vary by locality. Similarly, the intensity with which different roads are used and the cost involved in

[4] The legal justification setting development contributions in this way was challenged in Construction Industry Federation v. Dublin City Council [2004] IEHC 37. However, the High Court concluded that Dublin City Council was acting in accordance with the legislation in its setting of these fees.

repairing their surfaces will affect the externalities that arise when they are blocked or dug up.

The value of these externalities, and hence the optimal level of impact fees, is an empirical question. The only valuation study of which we are aware for telecoms masts in Europe is Brandt and Maennig (2010). In a study of Hamburg house purchases, they find no significant disamenity value for individual mobile base stations, but find that groups of base stations decrease property values by about 5.2% for properties within 100m. There is somewhat more evidence from elsewhere in the world. Higher disamenity values are found for new Zealand by Bond and Wang (2007), but Filippova and Rehm (2011), also for New Zealand (Auckland), find evidence of residential disamenities only for large "armed monopole" masts. Bond (2005) finds statistically significant but "minimal" effects for a sample of property transactions in Orange County, Florida.

Anas and Lindsey (2011) review the literature on the use of road charges to manage such congestion externalities. They also discuss how such measures have been implemented in various cities across the world. There is a very limited literature on the direct cost of road closures attributable solely to infrastructure provision. However, Goodwin (2005) examines the role of utility providers in contributing to congestion in London. He finds that up to 25% of congestion is as a direct result of utility works and reports estimates that these utility works generate externalities between £1 billion and £4.3 billion per year. This is in line with a more recent study (Buchanan, 2010). However, both reports conclude that the exact figure is highly sensitive to the methodology used. Goodwin (2005) notes that much more congestion is caused by excessive traffic than by street works. This study also notes that there is a non-linear relationship between speed and traffic volumes. When the system is near capacity, small increases in traffic volumes or reduction in road capacity (e.g. utility works) have a much larger impact on the average speed of traffic. Thus, road closures should ideally be confined to times where the road network is not near capacity.

For both types of infrastructure we conclude that the literature gives little guidance on the precise levels of externalities that should be expected in a given area. However, there are useful lessons about likely relative levels of externalities across different types of areas.

Setting impact fees on a Pigouvian basis involves estimating the value of externalities for all those affected by a given development and then charging this cost to the developer. The nature of externalities generated by these investments provides guidance on how impact fees should vary across geographical areas with different characteristics. In the case of masts, disamenities will tend to have the highest aggregate value in areas that are densely populated (lots of people live close to the mast), high property values (the discount due to the disamenity that is capitalised in house prices will be high), and perhaps high incomes (these are also correlated with house prices).

Aggregate externalities from duct installation probably have more to do with the cost of remediating road surfaces damaged due to installation of ducts, the intensity of road usage and the extent of congestion prior to the development. The timing and duration of the construction period will also have important effects on the total scale of the externality. Roads that bear traffic that places a high value on time would also have correspondingly high externality values.

So far, we have focused in this section on the benefits of appropriate local regulation and fees. It is also important to recognise that there may be substantial costs if these provisions are not set optimally. The previous research discussed in the last section shows that planning regulation can have significant effects on housing investment. We postulate that for similar reasons, such regulation may affect the scale, location and timing of new telecommunications infrastructure investments. To the extent that impact fees increase the cost of putting each mast or metre of underground duct in place, they will thereby reduce the expected lifetime profits arising from commercial use of the infrastructure. The expectation of lower profits in areas with high charges should deter network operators from deploying infrastructure there, relative to areas with low charges. Thus the regional pattern of infrastructure deployment may be distorted, with likely consequences for the regional pattern of service availability or quality. Furthermore, local taxes impose the same static welfare costs (deadweight loss) as national taxes do, so we would not wish impact fee rates to be any higher than necessary. Indeed, impact fees applied to innovative infrastructure are likely to have additional negative effects on societal welfare, as potential consumer surplus from future adopters of the relevant services are deterred or prevented from using them (Goolsbee, 2006). This has obvious relevance to next generation broadband services.

Moreover, non-monetary features of the planning system may affect the attractiveness of deploying infrastructure in a given area. Longer expected delays in obtaining planning permission or greater uncertainty about the likelihood of a successful application should have effects similar in kind to impact fees, and they too may vary by local authority.

In the remainder of this paper we use data from Ireland to examine whether the planning rules and impact fees seem to be set in an economically efficient manner and whether fees seem to have a material effect on infrastructure development.

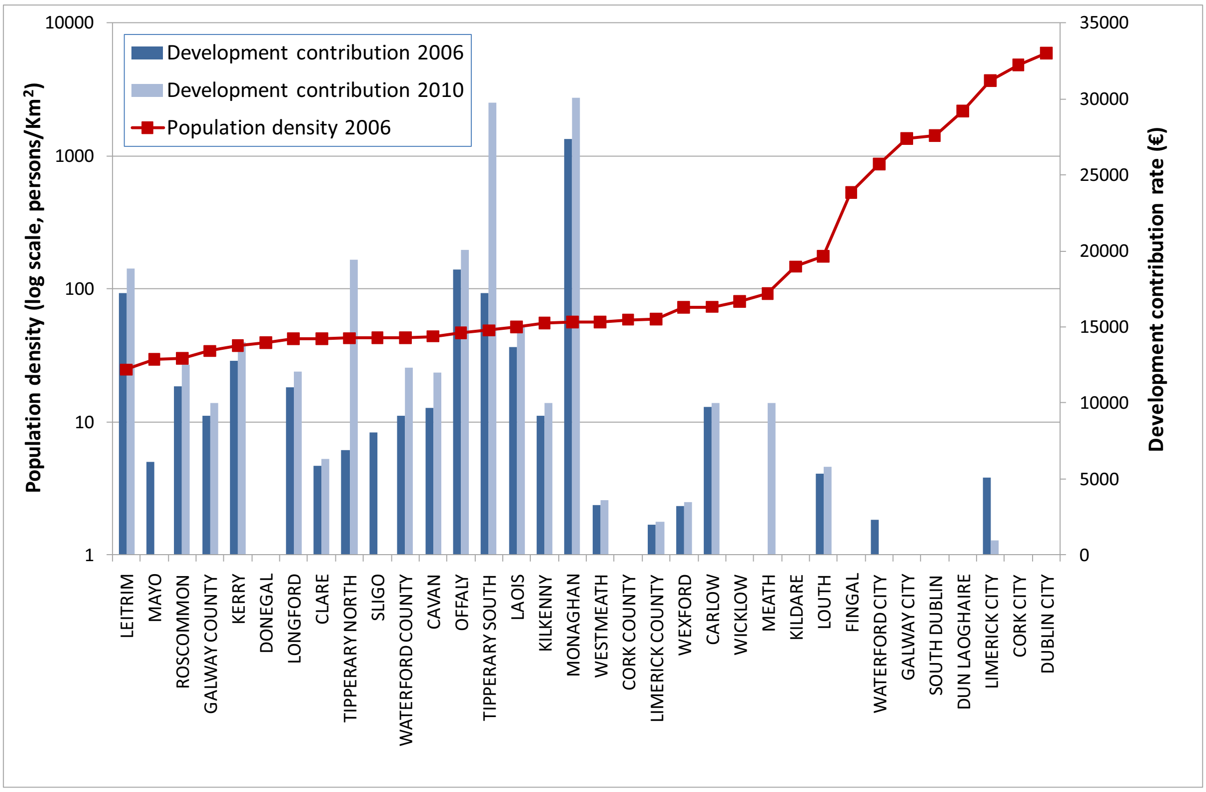
4 Empirical analysis

In this section we consider the evidence on whether the pattern of impact fees and planning regulation practices applied by Irish local authorities to telecommunications infrastructure developments is consistent with the economic principles set out above. In the first two sub-sections we focus on development contributions and road opening charges. The final part of the section discusses other, more qualitative, characteristics of planning regulation and how these may affect investment in telecommunications infrastructure.

4.1.1 Regional pattern of development contributions for telecommunications masts

Figure 1 illustrates the relationship between population density (on the left axis, with a log scale) and development contributions for telecommunications masts (on the right axis). We had hypothesised that this relationship should be positive, because the external costs imposed by masts are likely to be positively correlated with population density.

Figure 1: Population density in 2006 and development contribution rates in 2006 and 2010



Sources: TIF and local authority websites for development contribution rates and CSO (2011a) for other data.

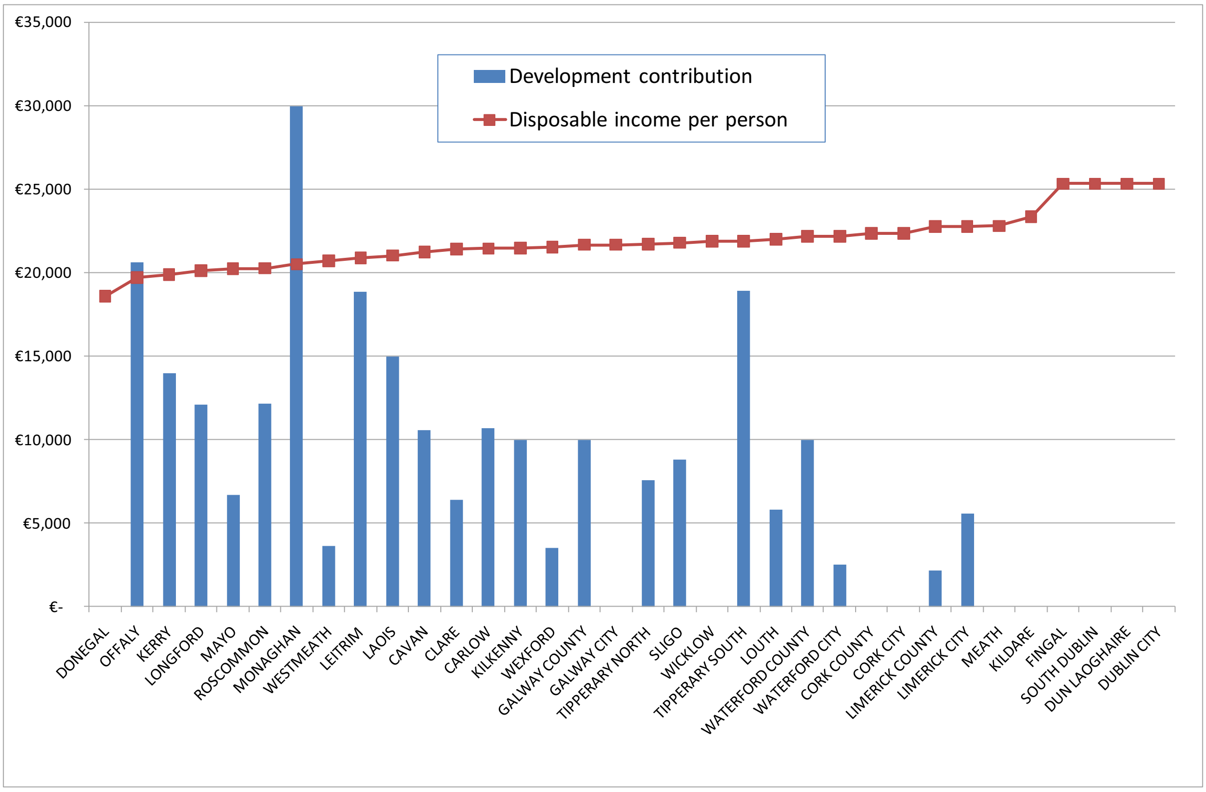
The actual relationship appears to be negative, with the highest density local authorities setting low or zero charges and the high charges being applied by some local authorities that have quite low population densities. Also, if anything this pattern seems to have strengthened over time. Many of these charges are updated according to the building component of the Consumer Price Index. Thus, they increased over the 2006-2008 period. However, they do not seem to have fallen in line with recent deflationary pressures.

Why might this pattern have arisen? Modelling the political economy of local authority fees is outside the scope of this paper, but we can suggest some possible reasons for the observed pattern. The development contribution for this type of infrastructure is only one among many sources of income over which local authorities have more or less discretion. There are presently no domestic property taxes in Ireland, but other development charges, business rates, fees for a variety of services and block grants from central government combine to generate the total income of each local authority. It may be that urban authorities tend to choose a different mix of charges from rural ones because they have a broader tax and fee base to work with. Alternatively, rural local authorities may have different preferences as to the desirability of certain types of infrastructure than urban ones.

However, neither of these explanations sits easily with another feature evident in this figure: there is substantial variation in the charges applied by local authorities with similar demographic characteristics. For example, Kilkenny, Monaghan and Westmeath have similar population density, but Monaghan applies development contributions several times higher than the others. Indeed, the 2011 rates for Monaghan and Carrickmacross Town Councils were over €50,000 per mast and €20,000 per antenna (Monaghan Local Authorities, 2011).

We can carry out the same exercise using per capita income, with similar results. Figure 2 shows the relationship between average per capita disposable income by local authority and levels of development contributions for telecommunications masts. The most recent regional income data available is for 2008, so the comparison is for that year, and we have sorted local authorities in order of increasing income.

Figure 2: Development contribution rates and average disposable income per capita in 2008



Sources: TIF and local authority websites for development contribution rates and CSO (2011b) for county average disposable incomes. Note: where there are more than one local authority in a county (Dublin, Waterford, Cork, Limerick and Galway), we have attributed the county average income to all component areas.

Average income varies much less across counties than population density does, but the overall relationship with development contributions is similar. The local authorities with the highest income residents tend to apply low or zero contributions, while most authorities with high contribution levels tend to be in the lower half of areas by income.

This is the opposite of the pattern we expected to see, since higher household incomes are likely to be correlated with greater demand for telecommunications services and higher external costs (e.g. via property prices). This comparison also exhibits the substantial variation mentioned earlier in the levels of charges applied by areas that seem otherwise similar (indeed, Monaghan and Westmeath are again similar when compared by income level but have very dissimilar charges).

In the case of telecommunications masts, the pattern of local authority development contributions does not seem consistent with economic principles. In particular, charges vary much more than economic and demographic conditions can explain and levels of charges show the opposite association to what economic reasoning indicated should be efficient.

4.1.2 Association between development contributions and telecommunications mast deployment

A question remains as to whether these regional variations in policy are sufficiently large to have measurable effects on the behaviour of network operators. In the case of masts it is possible to test whether this is so. In the remainder of this sub-section we estimate a simple model of the number of telecommunications masts in each Irish local authority area in 2011, taking into account factors that should affect deployment of masts, including the development contribution in each area. Our interest is in discovering whether the development contribution has a significant effect on the number of masts deployed after controlling for other influences on mast deployment.

We assume that an operator's decision about how many masts to deploy in a given county depends upon the population, the geographical size of the county, the per capita income of those in the county and the cost of deployment. All other things equal, a higher population should require more masts because there are limits to the number of subscribers a mast can serve at one time,[5] geographical extent should be positively associated with the number of masts because cellular technology imposes limits on the physical zone that may be covered from one point, and higher disposable income should require more masts because income is positively associated with the intensity of use of mobile telephony and broadband services. Higher costs of deploying masts should be negatively associated with the number of masts deployed, since we assume that mobile telephony network operators have the objective of maximising profits.

The model is summarised in Equation 1, which describes the number of masts M in the area covered by local authority i:

$$M_i = f\left(\alpha + \beta_1 D_i + \beta_2 P_i + \beta_3 A_i + \beta_4 Y_i + \varepsilon\right) \qquad (1)$$

where α is a constant, D is the development contribution per mast in Euro, P is the population, A is the size of the geographical area in Km^2, Y is disposable income per capita and ε is a random error term.

We use a negative binomial count regression estimator, which is useful for applications in which the dependent variable has a lower bound of zero and is often used to model processes involving numbers of items or events.[6] The commonly used ordinary least squares estimator is not appropriate for limited dependent variables such as this. We also test whether the more restricted Poisson estimator would be an adequate alternative, but the data reject this restriction.

Table 1 below summarises the data we use for this model, and the data are set out in Annex 1. Since local regulatory policy and impact charges are set at the local authority level, we focus on the 34 counties and urban boroughs in Ireland. Information on the number of telecommunications masts in each authority is available for 2011 only. These data were obtained from Siteviewer, a website maintained by the regulator that displays digital maps of current mast locations.[7] The data relate to the number of masts on May 5th 2011. GIS analysis (using ArcGIS10) was carried out to map the data on mast location to specific local authority areas.

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[5] The number of antennae on the mast and the nature of the services it is used to deliver also affect the number of subscribers it can serve, but these characteristics are not included in the available data.

[6] Wooldridge (2002).

[7] http://www.askcomreg.ie/mobile/siteviewer.273.LE.asp

Table 1: Summary statistics (34 observations of counties/urban boroughs)

Variable description	Variable name	Mean	Std Dev	Min.	Max.
Telecoms masts in 2011	*Number of masts*	191	156	50	870
Development contribution rate per mast in 2008 (€)	*Development contribution*	7,220	7,440	0	30,000
Population in 2008	*Population*	137,000	109,000	32,101	594,000
Geographical area of country/urban borough (Km^2)	*County area*	2,050	1,810	20.4	7,430
Average disposable income in 2008 (€)	*Disposable income per capita*	21,900	1,620	18,600	25,300

Data on development contributions in each local authority was provided by the Irish Telecommunications and Internet Federation (TIF), with some additions made by the authors based on local authority publications. Data on population and geographical area were obtained from the Irish Central Statistics Office (CSO, 2011a) and data on average disposable income per capita in each local authority area comes from CSO (2011b).

All variables apart from the number of masts relate to the year 2008, so there is about a three year lag between the explanatory variables and the dependent variable. This is in part unavoidable, because the most recent published data on average disposable income at county level is for 2008. However, it does seem appropriate to impose some form of lag in this model. Masts tend to be relatively persistent, since the networks that use them wish to maintain coverage in the areas they serve. This suggests that the stock of masts should change slowly in response to changes in socioeconomic or cost conditions. To see if the model is sensitive to the length of lag employed, we tested a lag of five years (using 2006 data). This made very little difference to the results.

Marginal effects from the regression are set out in Table 2 below, and the regression coefficients are detailed in Annex 2. All the explanatory variables are significant at the 5% level or better. The development contribution variable has the expected negative sign, suggesting that mast deployment is deterred by higher levels of this charge. The marginal effect shown here implies that an increase in the development contribution of €10,000 is associated with about 23 fewer masts in a county than would be expected if it had average characteristics in other respects (or each increase of €442 is associated with one fewer mast). To put this in perspective, the average development contribution in the sample (from Table 1) was €7,220 and the highest value in the sample was €30,000.

Table 2: Telecommunications masts per county, negative binomial regression model, marginal effects evaluated at sample means		
Dependent variable:	*Number of masts*	
Explanatory variables and statistics	**Marginal effect**	**Standard error**
Development contribution	-0.00226	0.00088**
Population	0.000583	0.00008***
County area	0.0149	0.00393***
Disposable income per capita	0.0124	0.00559**
Observations	34	
Pseudo R^2	0.200	
Log likelihood	-164	
LR test of restriction to Poisson model	$\bar{\chi}^2(1)$=89.7 [0.000]	
*Note: *, ** and *** denote significant at the 10%, 5% and 1% level respectively. Numbers in brackets are p-values. We check for heteroscedasticity using the Breusch–Pagan-Cook–Weisberg test.*		

Population, geographical area and disposable income all had positive effects as expected. *Ceteris paribus*, an extra mast is associated with about 1,700 additional population, 67 Km^2 greater geographical area or €81 higher disposable income per capita.

These results suggest that there is a significant negative association between development contribution levels and mast deployment by network operators. The estimated intensity of the effect should be treated with caution, because this analysis is based on limited data. Variables that we do not observe, such as county topography, may affect the number of masts deployed. If such omitted variables were strongly correlated with development contributions this could distort our results. Another issue is that the results depend strongly upon the assumed functional form of the model. We tested the model with OLS and a log transformed dependent variable, which yielded the same signs on coefficients as the count model shown above, and OLS in levels, in which only the population coefficient was significant. Nevertheless, the direction and broad scale of the effect seems consistent with the theoretical expectation that imposing higher development contributions could be a significant deterrent to investment in local network infrastructure.

4.2 Road opening charges

Much local telecommunications infrastructure is installed below ground and thus construction of new and maintenance of existing infrastructure requires permission to dig up roads. This requires a road opening licence, which is obtained though an application to the appropriate local authority. Permission to open national roads now lies with the National Roads Authority (NRA). If permission is granted, a road opening charge is then levied.

We expect to see some geographical differences in the levels of fees charged, with higher fees in dense urban areas than in rural areas. This does seem to happen in at least some cases. However, the structure of charges applied by individual councils also varies widely and not always with an obvious economic rationale. For example, some local authorities apply a minimum fee and others do not. Variables like the required maintenance period, the requirement to post a refundable bond and different charges by type of road surface are applied very differently across the country. For a network operator wishing to deploy infrastructure nationwide, this diversity increases the costs of compliance.

A further source of variation in investment costs across local authorities arises from planning processes governing roadworks. For example, we understand that there are differences in the "taking in charge" processes across authority areas, and different methods are employed for funding "diversionary works", i.e. moving and modifying external plant for road upgrades, widening etc.

While there seems to be a reasonable economic case for variations in the level of charges applied in different areas and to different sorts of road surfaces, it is less clear that the costs of applying widely varying structures of charges are justified by offsetting benefits.

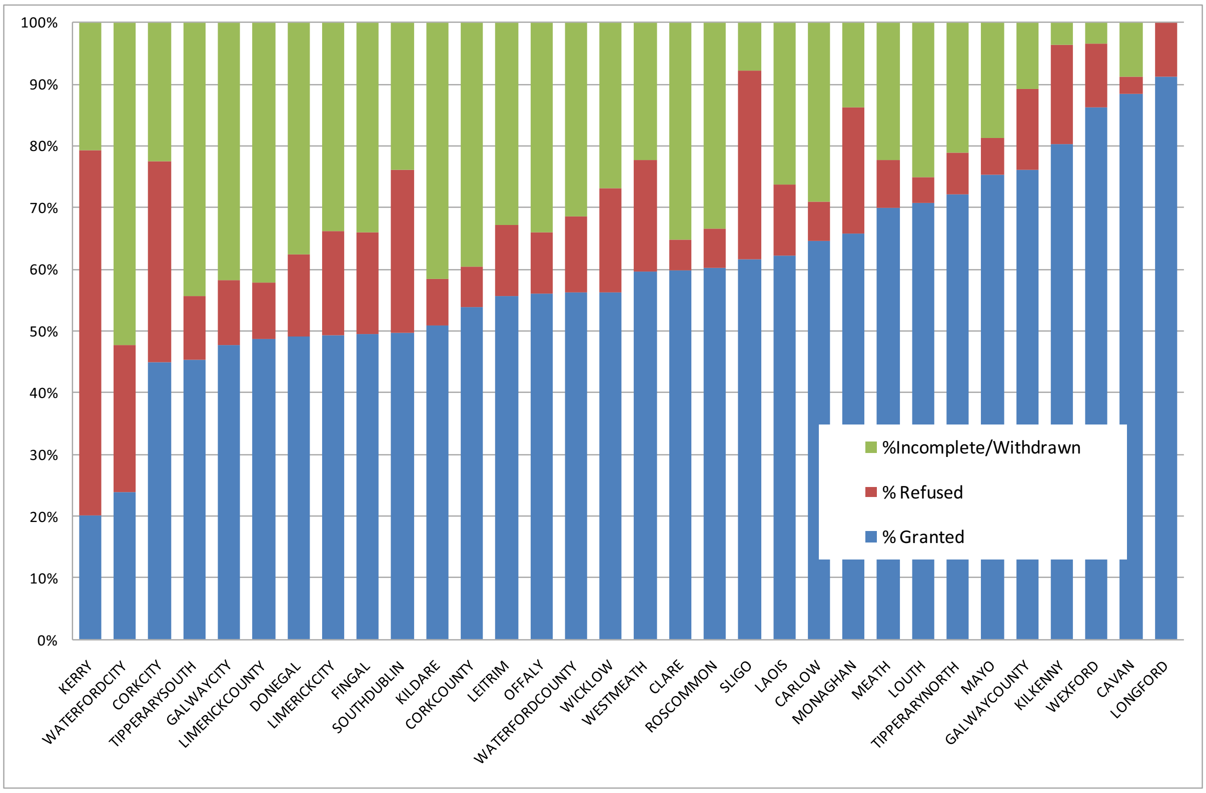
We also note that road opening charges in Ireland take the form of up-front fees. This charging mechanism has the benefit of simplicity, but it provides no incentive for timely completion of the roadworks. Since the externalities associated with road opening are likely to be at least partly proportional to the duration that the road is unavailable for use, such an incentive would be desirable. One option for doing this would be to apply lane rental charges rather than one-off fees (see e.g. Buchanan, 2010).

4.3 Other characteristics of local planning regimes

One curious aspect of planning regulations for telecommunications masts in Ireland is that the permissions given are time limited. Every five years network operators must reapply for planning permission (and in some cases pay a development contribution, albeit often at a lower rate than for *de novo* applications). This provision adds to the administrative costs and uncertainty involved developing mast infrastructure. The economic rationale for such a time limitation is not clear. Telecommunications infrastructure probably has a higher economic depreciation rate than many other types of physical infrastructure (because of rapid technical progress), and thus particular facilities are likely to be replaced or removed sooner. However, this is no reason to require network operators to resubmit applications at a fixed interval. Such a constraint may increase the likelihood of removal for some economically marginal masts, but it increases the cost of maintaining the entire stock of masts.

In Ireland, the planning system is a two-stage process. First, each applicant sends their proposal to the relevant local authority. This local authority then makes a decision regarding the application. Figure 3 illustrates the distribution of planning application outcomes for all planning decisions regarding telecommunications masts in Ireland during the period 2002-2010. There is some variation across counties apparent in the data. However, there is a certain degree of planning consistency when the main outliers (Kerry and Waterford City) are removed. It must also be noted that the number of planning applications in each local authority varies significantly. This is of course partly reflective of population.

Figure 3: Shares of planning decisions for telecommunications masts by type (2002-2010)



Sources: Various Local Authority websites

There may be some justification across local regulators for heterogeneity in the pattern of planning application outcomes. Local factors like topography or preserved land areas may help explain this. There may also be aesthetic or attitudinal differences across areas that affect the frequency of objections or the likelihood of a successful application.

Of course, network operators are not unaware of how past applications performed in the planning system. One would expect that counties where many applications were rejected in one period might have fewer applications and lower rejection rates in subsequent periods, as operators reduce or adjust their patterns of applications to avoid likely rejections. There is indeed some evidence that this might have happened in Ireland. For example, after only 10% of mast applications were granted permission in Kerry in the 2001-6 period, 34% were accepted in 2007-10 (see Annex 3). Of course, other areas saw reductions in acceptance rates over time, so other mechanisms may also be at work.

At the second stage of the planning process, if the initial application is refused or an objection is lodged against it, the applicant has the option of appealing the decision to An Bord Pleanála, which is a state planning body that can confirm, modify or overturn the decision made at local level. When a planning application is granted at local authority level, there is a waiting period of four weeks. This allows any person to lodge an objection to the development. This, in turn, may lead the planning application to be reviewed by An Bord Pleanála. This process can create significant delays as summarised in Table 3.

Table 3: Effect of appeals on planning process duration for telecoms mast applications (in days, 2002-2010)	
Average planning case duration	91
Average Planning case duration with appeal	217

Sources: Various Local Authority websites and An Bord Pleanála

Table 4 summarises outcome shares for An Bord Pleanála decisions regarding telecommunications masts. As shown in Table 3, there is a significant time delay associated with an appeal process. 61 percent of appeals that were initially refused at local authority level were subsequently overturned by An Bord Pleanála. Almost 90 percent of appeals for applications that were initially granted at local authority level are upheld by An Bord Pleanála. These types of appeals arise when a third party objects to the infrastructure development or when a private operator appeals against the number of conditions associated with the initial grant of permission.

Table 4: Refusal rates on planning appeal decisions for telecommunications mast applications (2002-2010)		
Local Authority Decision	An Bord Pleanála Decision	
	Grant	Refuse
Grant	89%	11%
Refuse	61%	39%
Total number of appeals: 533		

Source: An Bord Pleanála

In sum, we see little reason that planning permissions for mobile masts should be time limited, and although we could not quantify the costs arising from planning delays or unexpected refusals, the wide variation in outcomes across the country suggest that there may be scope for reducing the costs of infrastructure development by further harmonisation of development practices.

5 Conclusions

In this paper, we have discussed the rationale for local government regulation. We conclude that there are valid reasons for having such regulation and that there are likely to be local differences in the appropriate level of regulation. The cost of disruption will not be uniform across the country and thus different levels of road opening charges are likely to be justified. Disruption costs should tend to increase with population density and urbanisation, as well as the value of time for those affected, which in turn may be correlated with incomes, local sector of employment, employment status and other socio-economic characteristics. Telecommunications masts may have some disamenity value. Again, this may vary by area so variations in regulation, and in particular development contributions, may be appropriate. Disamenity value is likely to be correlated with population density, property values and income levels, but may also be associated with topology, attitudinal factors and the presence of other local amenities (e.g. nice views) or the prevailing types of structures in the area.

Comparing the pattern of development contributions applied by different local authorities, we find that areas with lower population density and lower average disposable income tend to apply higher development charges for telecommunications masts. This pattern does not seem consistent with the economic rationale for these charges. The variations in contribution levels overall and particularly between otherwise similar local authority areas seems excessive. It is also notable that the high levels of charges applied by many local authorities seem hard to justify given that most international evidence on mast externalities indicates that these costs are small or even undetectable. As yet, there has been no published research on the scale of these effects in Ireland.

We developed a simple econometric model of the number of masts at local authority level to see whether there is evidence that development contribution rates have a material impact on mast deployment in Ireland. It seems they do. Although our model is based on a small number of cross-sectional observations, the development contributions variable is significant both statistically and in economic terms. A hypothetical increase in the development contribution of €10,000 is associated with about 23 fewer masts in a county than would be expected if it had average characteristics in other respects (or each increase of €442 is associated with one fewer mast). This suggests that setting appropriate rates of development contributions could help avoid significant distortions in the deployment of future mast infrastructure.

We briefly discussed the structure of road opening charges, and we noted significant variation in the amount and the structure of the charges applied. These charges should reflect variations in costs of road remediation and levels of congestion that exist across the country. However, there may be scope for improvement in their application. Additional transparency on the criteria that road authorities should apply, a central source for information on fees and other conditions, and perhaps some degree of harmonisation of the charging structure that is applied would be desirable improvements. For example, we understand that a more unified approach is employed in the United Kingdom, governed by the New Roads and Streets Work Act, 1991. In addition, the incentive properties of road opening charges could be improved by taking into account the time dimension of development, for example by switching from fixed up-front charges to lane rental charges. There may be scope for future empirical research in this area, as data exist on both determinants and outcomes of local fixed line infrastructure deployment.

We also discussed the planning process for telecommunication masts. Again, this process is largely undertaken at local authority level. Although, we found evidence of variation across jurisdictions, we were unable to quantify the direct impact of this on the costs of developing telecommunication masts. However, it is evident that planning delays and uncertainty about outcomes imposes significant non-monetary costs on private operators. Some of this is unavoidable, because it would be impractical to have a system entirely without delays or uncertainty. However, the level of variation in the distribution of outcomes across local authorities is surprisingly high, so there may be some benefit in further harmonisation of practices through central guidance.

Previous research shows that most telecommunications networks are subject to economies of density. This effect is more important for fixed than for mobile networks, and particularly so for fibre and coaxial cable networks. If local regulatory measures were to amplify this effect by unnecessarily inflating the cost for developments in rural areas relative to dense urban areas, that should be a concern for policymakers. Absent reform, such distortions would either reinforce the tendency towards an urban/rural digital divide or make it more costly for the government to prevent such a divide.

Ireland's current economic difficulties may add an extra dimension to this potential problem. In 2008, the Telecommunications and Internet Federation (TIF) estimated that €700m was being invested in telecoms infrastructure (DCENR, 2009). The fiscal crisis and credit crunch have tended to depress investment in many sectors of the economy. For this reason, the elasticity of investment with respect to regulatory costs may have increased since the data for our study was collected. Costs of all kinds may loom larger at times when expected demand growth is low and investment constraints are tight.

Most households in Ireland now have access to basic broadband, and mobile coverage is extensive. However, in the medium term, continued technological progress is likely to offer new opportunities for telecoms infrastructure deployment and enhancement. For example, if Long Term Evolution (LTE) mobile technology is deployed in low population density areas, upgrading of the mast infrastructure will be required. Similarly, the rollout of fibre-based next generation broadband network in urban areas would require a lot of construction under roads and paths.

This paper examined current regulations affecting telecommunications infrastructure. The current pattern of development contributions charged by local authorities does not seem consistent with the economic rationale for these charges. It might also be more efficient if road opening charges and some qualitative aspects of local planning regimes as applied to telecoms infrastructure exhibited less variation and complexity across local authorities. These issues may become still more pertinent as network operators seek to deploy high bandwidth data services across an ever larger footprint. The spatial distribution of such investments will obviously be largely driven by population density, but reform of local planning regulations might help avoid an unnecessary amplification of the urban-rural rollout divide.

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Annex 1 – Data used to model the number of telecommunications masts in Ireland

County/urban borough	Masts in 2011	Development contribution per mast in 2008 (€)	Population in 2008	Geographical area (Km2)	Avg. disposable income per capita (€)
Carlow	69	10,658.34	55,820	898	21,450
Cavan	114	10,570.00	70,857	1,898	21,241
Clare	197	6,391.00	121,576	3,387	21,428
Cork City	210	0.00	161,893	40	22,340
Cork County	550	0.00	369,948	7,431	22,340
Donegal	188	0.00	161,913	4,856	18,596
Dublin City	870	0.00	594,263	118	25,337
Dun Laoghaire	262	0.00	233,162	127	25,337
Fingal	349	0.00	205,230	453	25,337
Galway City	139	0.00	76,551	67	21,680
Galway County	263	10,000.00	175,906	6,061	21,680
Kerry	220	14,000.00	151,109	4,735	19,899
Kildare	266	0.00	206,269	1,648	23,342
Kilkenny	150	10,000.00	96,870	2,072	21,462
Laois	109	15,000.00	74,021	1,688	21,030
Leitrim	50	18,835.00	32,101	1,531	20,902
Limerick City	87	5,570.00	63,408	20	22,769
Limerick County	195	2,188.00	138,434	2,740	22,769
Longford	54	12,100.00	38,362	1,069	20,123
Louth	155	5,818.00	123,594	823	22,007
Mayo	176	6,699.00	135,898	5,425	20,223
Meath	264	0.00	180,558	2,305	22,806
Monaghan	97	30,000.00	62,183	1,296	20,506
Offaly	98	20,600.00	78,543	1,990	19,704
Roscommon	105	12,130.00	65,146	2,548	20,263
Sligo	86	8,800.00	66,912	1,837	21,798
South Dublin	297	0.00	268,966	223	25,337
Tipperary North	118	7,580.58	72,105	1,994	21,721
Tipperary South	115	18,899.74	93,445	2,258	21,905
Waterford City	71	2,507.00	53,491	72	22,197
Waterford County	94	10,000.00	65,377	1,787	22,197
Westmeath	135	3,600.00	87,622	1,825	20,718
Wexford	179	3,500.00	146,078	2,365	21,543
Wicklow	193	0.00	139,363	2,033	21,893

Note: Urban boroughs have been assigned the same average income as the county in which they are located.

Annex 2 – Regression coefficients

Table A2.1: Telecommunications masts per county, negative binomial count model, regression coefficients and standard errors		
Dependent variable:	*Number of masts*	
Explanatory variables and statistics	**Coef.**	**Standard error**
Development contribution	-0.0000142	0.00000555***
Population	0.00000366	0.000000468***
County area	0.0000936	0.0000246***
Disposable income per capita	0.0000781	0.0000351**
Constant	2.77	0.778***
*Note: *, ** and *** denote significant at the 10%, 5% and 1% level respectively. Numbers in brackets are p-values. We check for heteroscedasticity using the Breusch–Pagan-Cook–Weisberg test.*		

Annex 3 – Summary of planning data

2001-2006				2007-2010		
% Granted	% Refused	%Incomplete/Withdrawn	County	% Granted	% Refused	%Incomplete/Withdrawn
0.75	0.00	0.25	CARLOW	0.33	0.22	0.44
0.86	0.05	0.10	CAVAN	1.00	0.00	0.00
0.79	0.05	0.15	CLARE	0.47	0.06	0.47
0.44	0.40	0.16	CORK CITY	0.44	0.28	0.28
0.52	0.07	0.40	CORK COUNTY	0.59	0.03	0.38
0.62	0.09	0.29	DONEGAL	0.31	0.43	0.26
0.51	0.14	0.35	FINGAL	0.00	0.00	1.00
0.62	0.10	0.29	GALWAY CITY	0.41	0.10	0.49
0.77	0.15	0.08	GALWAY COUNTY	0.75	0.03	0.23
0.10	0.72	0.18	KERRY	0.34	0.21	0.45
0.51	0.06	0.43	KILDARE	0.43	0.07	0.50
0.74	0.23	0.03	KILKENNY	0.89	0.06	0.06
0.76	0.10	0.14	LAOIS	0.75	0.06	0.19
0.57	0.12	0.31	LEITRIM	0.57	0.10	0.33
0.72	0.04	0.24	LIMERICK CITY	0.23	0.33	0.43
0.58	0.04	0.38	LIMERICK COUNTY	0.44	0.10	0.46
0.95	0.05	0.00	LONGFORD	0.88	0.10	0.02
0.86	0.03	0.11	LOUTH	0.58	0.05	0.37
0.82	0.03	0.15	MAYO	0.70	0.11	0.19
0.70	0.03	0.28	MEATH	0.76	0.13	0.11
0.67	0.18	0.15	MONAGHAN	0.60	0.25	0.15
0.72	0.08	0.20	OFFALY	0.48	0.11	0.41
0.57	0.05	0.38	ROSCOMMON	0.81	0.10	0.10
0.72	0.17	0.11	SLIGO	0.64	0.32	0.05
0.57	0.25	0.18	SOUTH DUBLIN	0.44	0.26	0.30
0.74	0.07	0.20	TIPPERARY NORTH	0.76	0.07	0.17
0.56	0.07	0.37	TIPPERARY SOUTH	0.28	0.12	0.60
0.27	0.27	0.47	WATERFORD CITY	0.25	0.25	0.50
0.64	0.07	0.29	WATERFORD COUNTY	0.57	0.14	0.29
0.70	0.22	0.08	WESTMEATH	0.56	0.11	0.33
0.91	0.05	0.05	WEXFORD	0.89	0.11	0.00
0.56	0.18	0.26	WICKLOW	0.73	0.14	0.14

Note: Often, these numbers are based on small sample sizes. They are only used for illustrative purposes