WISERD
Sefydliad Ymchwil Cymdeithasol ac Economaidd a Data Cymru
Wales Institute of Social and Economic Research and Data

Exploring geographical patterns in the changing landscape of retail banking services in Wales

Mitchel Langford

February 2021

Introduction

The Economy, Infrastructure and Skills Committee of the National Assembly for Wales[1] published a report in October 2019 on "Access to Banking" which observed that, in common with the rest of the UK, the presence of bank branches on high streets in Wales have been in noticeable decline for some time. Ongoing closures of the physical branch network raises concerns regarding the potential impact this may have upon the local businesses and communities it serves.

The Committee were presented with evidence suggesting that diminished access to cash withdrawal facilities due to branch closures and the loss of ATMs was felt to be a concern amongst 50% of all respondents, with 87% of personal banking customers and 78% of business customers reporting they had been impacted by recent closures. Furthermore, although all parts of Wales have been affected, problems appear to be felt most acutely in rural areas, and amongst those elements of society such as elderly and disabled groups who are typically more reliant on cash and on face-to-face services delivered via local branches.

The report recommended the Welsh Government take action to protect and improve access to cash (Recommendation 1), and to strengthen and support the existing free-to-use ATM network to ensure that it remains available where it is most needed (Recommendation 2). Of particular relevance to this study, it also urged the Welsh Government to *"properly map the gaps in banking services overall – access to banks, Post Offices, free-to-use ATMS and connectivity for digital banking"* with the expectation that an improved understanding of the geography of retail banking services in Wales would allow the impacts of recent changes to be addressed, particularly in those rural communities experiencing the greatest loss in provision. The Welsh Government accepted this recommendation in principle, whilst acknowledging that full delivery requires a multi stakeholder approach.

Since the publication of the Committee's report, it has been speculated[2] [3] [4] that one impact of the COVID-19 pandemic will be to accelerate such trends as we move towards a cashless economy in the aftermath of trends driven by the pandemic which has witnessed declining numbers using cash points and increasing use of contactless payments and mobile banking. Attention was drawn to the potential impact on the number of "*underbanked users and unbanked communities*" following the effects of COVID-19 on the transaction levels

[1] National Assembly for Wales: Economy, Infrastructure and Skills Committee. "Access to Banking". October 2019.

[2] Economic Observatory, 5th September 2020 "Will coronavirus accelerate the move towards a cashless economy?

[3] Financial Times, 26th May 2020 "Coronavirus accelerates shift away from cash"

[4] Fool, 26th August 2020 "Covid-19's role in pushing the UK into a cashless society"

experienced in bank branches. If this is the case such trends may further exacerbate inequalities in provision for those most dependent on cash transactions, and suggests that attempts to measure current and projected levels of access to banking services, including for example the impacts on the locations of bank branches and free-to-use ATMs, will become even more relevant in the immediate aftermath of the pandemic.

This study aims to address the need to improve the mapping of banking services in Wales, which to date has been focused on broad-scale static maps of branch provision without enabling a fuller consideration of the wider implications of such changes. By exploiting the capabilities of geographical information systems, spatial databases, and spatial analysis techniques, it seeks to map and model changes in geographical accessibility to retail banking services at highly detailed spatial scales. It is posited this information can assist in identifying inequalities and disparities present within administrative areas of interest, and can be further leveraged to identify communities potentially most vulnerable to future reductions in the physical branch infrastructure.

Specific Aims:
Using advanced spatial analysis and digital mapping techniques, explore:

1. The changes in branch-led retail banking provision in Wales over the past decade.
2. Variations in accessibility to current (summer 2020) financial services infrastructure.
3. Insights into potential future provision, including preliminary attempts to develop a measure of community vulnerability to future losses of service.
4. The role of retail bank branches within the wider picture of financial services accessibility, through an examination of the provision of alternative access routes to financial services, such as Post Offices, ATMs, and digital (broadband) services.

Data Sources and Software

Information on the location of high street bank and building society branches past and present was obtained from PointX, Landmark Information Group. Multiple epochs of data were available, from which those for years 2008, 2018, and 2020 were utilised in this study. Data were provided for December (2008, 2018) and June (2020) of the stated year. Various pre-processing steps isolated the records pertaining to retail high street banks and building society branches. These provided details of the company brand, address, and postcode of each branch. Location was established through a lookup of the postcode, although different epochs variously supplied Easting and Northing UK National Grid coordinates, and Latitude and Longitude geodesic coordinates. A postcode lookup was used as the preferred method of spatial referencing to maintain consistency between data pertaining to alternative dates.

Geographical boundary data were sourced from various online sites, principally the UK Data Service's Census Boundary Data[5] download page. Mid-year population estimates for 2011 Census Output Areas were acquired from the Office for National Statistics[6]. Estimates were taken on 30th June in both 2008 and 2018, matching the epochs of the bank and building society location data. At the time of study, population estimates for 2018 were the most recent release and so are used also in 2020 analyses. A topological street network was constructed from OS Open Roads data supplied by Ordnance Survey[7] with downloaded data dated July 2020.

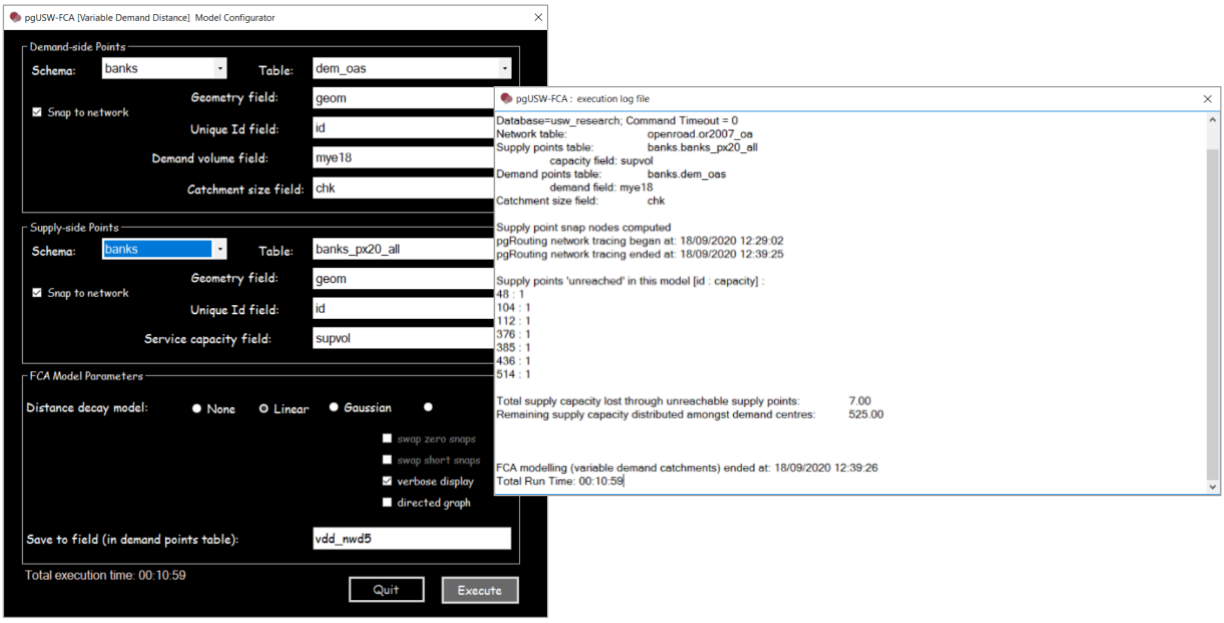
ATM location data was provided by LINK for June 2019. Post Office branch locations data came from Post Office Ltd. This information is based on business records held at the time the list was issued, and data were dated October 2019. Broadband connectivity information relating to 2011 UK Census Output Areas was obtained from Ofcom[8] using its Spring 2019 Coverage Availability supplied under Open Government Licence. It reports coverage and service availability information received from communications providers in January 2019.

Principal software packages used in this study were as follows: All spatial data sources as described above, and most computed outputs, were stored and managed in a PostgreSQL (hereafter Postgres) relational database. This was spatially enabled with the PostGIS extension and provided network route tracing via the pgRouting library.

Most analyses were conducted by issuing spatial queries to Postgres via its pgAdmin management tool. All *enhanced two-step floating catchment area* (E2SFCA) accessibility scores were computed using pgUSW-FCA. This is a suite of bespoke programs written by the

[5] UK Data Service
[6] ONS – Office for National Statistics
[7] Ordnance Survey
[8] Ofcom

author in C# / ADO.NET. By extracting service supply and demand points from the Postgres database and exploiting pgRouting functions to determine shortest network routes, it first constructs an Origin-Destination (OD) matrix in Postgres which is then fed into the E2SFCA computations. The user-interface for model configuration is shown below.



Spatial analyses on access to branches via public transport was undertaken using bespoke software developed by Andrew Price at the University of South Wales. This further develops the concepts and capabilities of pgUSW-FCA to incorporate '*Open Trip Planner',* an open source multi-modal journey planner returning itineraries in response to REST API requests. The server is deployed as a back-end tool to generate comparable OD matrices based on bus timetables as published online in General Transit Feed Specification (GTFS) format. Bus routes and timetables used in these analyses were dated August 2019. General spatial data preparation and management tasks, and the uploading of resources to Postgres, were accomplished in the *QGIS* Geographical Information System, which was also used to create all maps presented in this report.

Concepts and Methodologies

A brief explanation of the geographical accessibility measures used in this report follows. Geographical accessibility (hereafter, accessibility) can be defined as the ease with which a population at a given location (the demand point) can reach the location of a service of interest (the supply point). Within this broad definition many specific methodologies exist for its measurement, with each having arguments both for and against its adoption. Within published research literature two approaches are particularly prominent:

Distance to nearest provider

This is a simple and intuitive measure based on the principle that the nearer a person is to the service they seek, the greater its level of accessibility. Travel is assumed to be onerous

as it takes time and incurs a cost, and so rational individuals seek to minimise travel when all other factors are excluded from consideration. Lower values imply better accessibility.

The straight-line distance between supply and demand points is easily computed and was widely used in the past. By exploiting geographical information systems and route planner algorithms most recent studies adopt network distance instead, this being the actual travel distance along a road or other transport network. Alternatively, a travel time or a monetary cost can replace distance; both often regarded as being of more relevance to the traveller.

Advantages of this method include its simplicity, ease of understanding, and intuitiveness. Its main disadvantage is that no account is taken of the balance of supply and demand. Whilst a service may be located nearby, if it is shared amongst many other users its service quality may nevertheless be poor. Furthermore, reliance on just the single nearest supply point may not reflect well the general availability or choice of services present in a neighbourhood. For example, does a single nearby point, or many additional points located just a little more distant, provide the better access to a service?

Service density (supply-demand ratio)

This is another simple and intuitive metric reporting the number of supply points located within a defined area, normalised by its contained population count. It is commonly called the *container method*. Typically, ratios are computed for well-known administrative zones such as Counties, Constituencies, and Output Areas, with higher values implying better accessibility.

Amongst its advantages are that it is easily understood, and it explicitly accounts for supply capacity and demand volume. Furthermore, it presents scores for areas that may be familiar and widely used in other contexts, and so for some types of policy application this may be the most appropriate metric. For example, Counties and Constituencies are familiar to the public, whilst LSOAs and OAs are well understood within government departments. When available, supply-side capacity measures, for example the number of services offered at a site or total opening hours per week, are easily incorporated into the calculation.

A key disadvantage is the assumption that the population of an area only uses those services contained inside the area of analysis (hence the term *container*). For small areas it is increasingly likely residents will traverse these arbitrary boundaries. Furthermore, whilst smaller areas yield finer geographical detail, they are increasingly likely to return *null* scores when containing no supply points at all. Finally, the accessibility score takes no account of actual distances between the demand point and supply points within the area of analysis.

In addition to these two common approaches, *cumulative opportunity* is also a widely used metric. In its simplest form it records the number of supply points found within a given

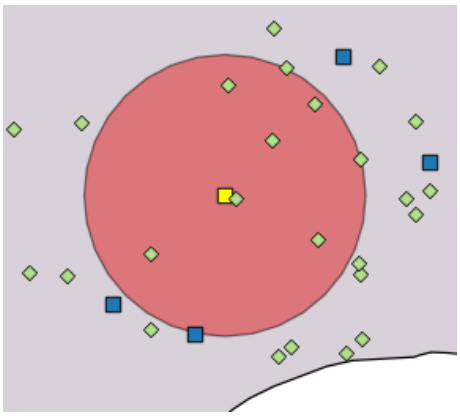
travel distance of each demand point. It can be extended by swapping straight-line distance with network distance, substituting time for distance, and recording the total supply-side capacity of sites rather than a simple point count. Only those supply points within the threshold distance are counted, but their actual proximity to the demand point is not evaluated. This metric is the closest of those so far described to the *enhanced two-step floating catchment area* scores (E2SFCA) which feature strongly in this report and are explained further below.

Enhanced two-step floating catchment area

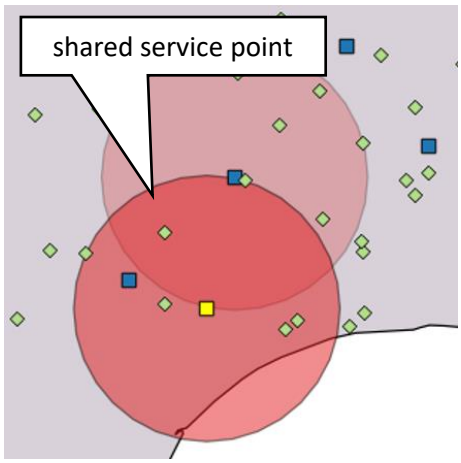
Like the container method, E2SFCA computes a supply-demand ratio for each demand point or area of interest. However, it circumvents many problems associated with the simpler service density measure. Output scores combine elements of service density, service proximity, cumulative opportunity, and local competition. The method requires two distinct sets of calculation, hence its "two-step" nomenclature, while "enhanced" refers to the incorporation of a distance-decay function as described below. E2SFCA is founded upon these tenets:

1. rational individuals seek access to services in close geographical proximity,
2. the closer a service, the more likely it will be used, and
3. a limit exists to the distance individuals are prepared to travel to obtain a service.

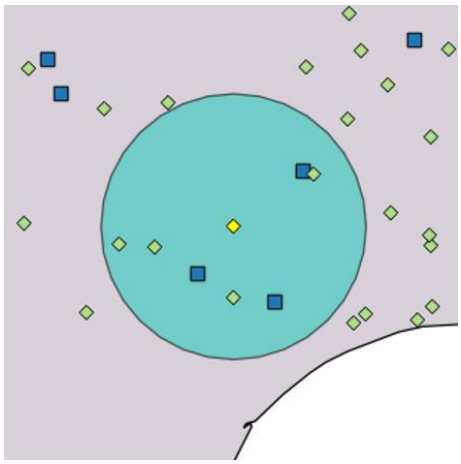
In brief, the algorithm is as follows: Like cumulative opportunity, a travel catchment is computed around each demand point to define a *reachable area* according to the configuration of the transport network and travel tolerance of the service seeker. The travel tolerance is thus a key control parameter in these models. In each catchment (which 'floats' from one demand point to the next) all supply points are identified and weighted according to proximity. A supply point adjacent to a demand point is weighted 1.0, with weights declining over distance to reach 0.0 at the travel tolerance (i.e. boundary of the catchment). These floating catchments are independent of any administrative zones. The residents of a demand point are expected to seek access to services from inside this locally defined area, which may traverse local administrative boundaries. All weighted supply points are summed to provide a final accessibility score. If a supply-side capacity, for example weekly opening hours, is available it can be easily used in place of a simple point count.



To summarise: A floating catchment (shown here schematically as a circular distance buffer) is constructed around each population demand centre (squares). Inside each catchment all supply points (diamonds) are identified, weighted according to their network distance, and summed to yield an accessibility score.



Moving the floating catchment to a new demand centre, as illustrated, typically leads to different supply points falling inside the catchment. Catchments are uniquely defined for each demand point, but nevertheless often overlap, and supply points often fall inside more than one catchment. This implies that the capacity of a supply point may be shared by more than one demand point, which necessitates step two of the algorithm.



To account for supply points being shared between multiple demand points, floating catchments are first constructed around each supply point. In this example, the catchment is drawn for the previously identified shared supply point. Its supply capacity is divided by the total demand population placed upon it. This is the total value of all demand points falling inside it, again weighted by the network distance between each supply and demand point pair.

When implemented, the first step computes the availability of each supply site, as just described, while the second step computes the accumulative total of these scores inside the travel catchment of each demand point. Notwithstanding its computational complexity, the output of E2SFCA is the same supply-demand ratio as yielded by the simple container method. However, rather than relating to an arbitrary administrative zone, E2SFCA scores report supply-to-demand inside the *probable activity space* of individuals who reside at each demand point and account for the relative proximities of these service points.

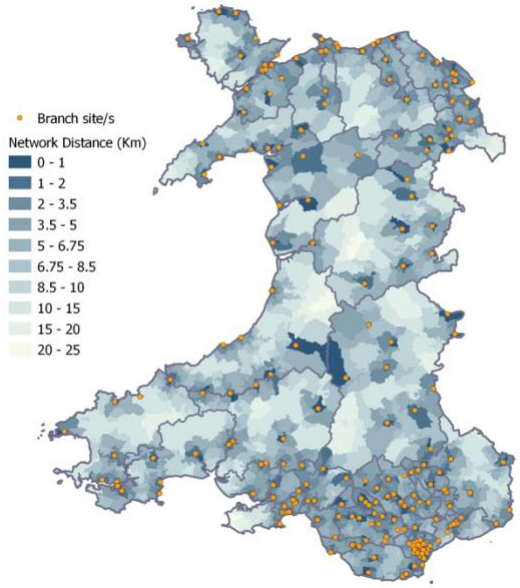
Analyses I – Recent Trends

A broad range of analyses based on the spatial analytical techniques described above have been undertaken in this study. The aim is to provide a comprehensive picture of patterns in the geographical provision of retail banking services across Wales, both in the recent past and the present. They are also used to explore future scenarios, identifying areas potentially most vulnerable to any further reductions in branch-led service provision.

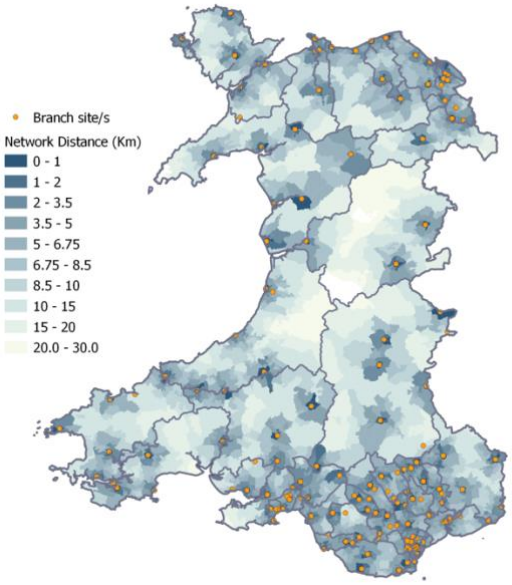
This section focusses on examining the changes that have occurred in branch-led retail banking services over the decade 2008 – 2018. In doing so it also explores and illustrates the relative merits of the alternative methodologies that were described above.

Nearest Provider

Map 1: Branch proximity 2008: Parliamentary constituencies

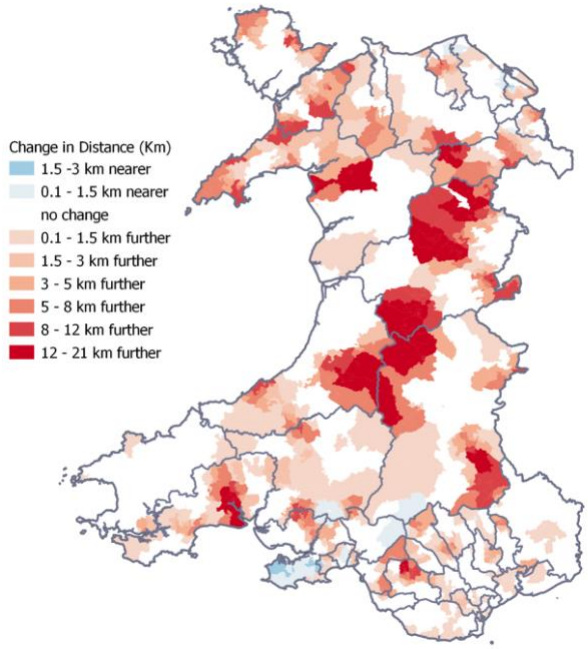


Map 2: Branch proximity 2018: Parliamentary constituencies



Map 1 and Map 2 illustrate computed network distance to nearest branch (bank or building society) for each Output Area population-weighted centroid, in both 2008 and 2018. It is to be expected that residents in urban areas have branches in closer proximity than those in rural areas. Thus, this metric strongly reflects the rural/urban landscape of Wales. Rural towns and villages containing branches stand out as local hotspots amongst their hinterland, while in urban areas the scores are generally more uniform. The inevitable increase in travel distance caused by the closing of branches is evident in a visual comparison of the two maps. The countrywide average travel distance was 2.8 km in 2008, increasing to 3.8 km in 2018. However, change is most clearly expressed by explicitly mapping the difference in these two sets of scores.

Map 3: Change in proximity 2008-18: Parliamentary constituencies



Map 3 highlights those areas in Carmarthenshire, southern Pembrokeshire, southern Ceredigion, Powys and Gwynedd that have experienced notable increases in travel distance to their nearest branch over the decade. Occasional decreased distances. as seen in the Gower and around Neath Port Talbot, arise due to the opening of new building society branches here.

The average network distance to the nearest branch for all OA centroids contained by each Welsh Constituency are presented in Table 1. In 2008, Ceredigion had the highest constituency average at 5.34 km, followed by Montgomeryshire, Carmarthen East and Dinefwr, Preseli Pembrokeshire and Ynys Mon, all with average distances over 4 km. In 2018, Montgomeryshire recorded the highest average travel distance (9.39 km), with Clwyd South, Ceredigion, Dwyfor Meirionnydd, and Brecon and Radnorshire recording averages of more than 6 km. The greatest increases across the time frame were recorded by Montgomeryshire (+4.47 km), Clwyd South (+3.43 km), and Arfon, Dwyfor Meirionnydd, and Brecon and Radnorshire, with branch closures adding around 2.5 km of extra travel. In contrast, the populous southeast report much smaller distances and generally experienced much smaller changes. Cardiff North, Cardiff Central, Rhonda, Swansea West, and Cardiff South and Penarth constituencies recorded the highest proximities in 2008, and this list was largely unchanged in 2018.

As discussed before, nearest distance to provider takes no account of the balance of supply to demand, with the inevitable outcome that it generally records poorer accessibility in rural areas as compared to urban areas. This bias may mask pockets of relatively poor provision present in urban areas where relatively few branches are shared by a large local population.

Table 1: Average travel distance (km) to nearest branch by parliamentary constituency.

Name	2008	2018	Change
Aberavon	2.70	3.55	0.85
Aberconwy	2.31	3.45	1.14
Alyn and Deeside	2.11	3.21	1.10
Arfon	2.46	5.02	2.57
Blaenau Gwent	1.89	2.04	0.15
Brecon and Radnorshire	3.79	6.28	2.49
Bridgend	1.91	2.76	0.85
Caerphilly	2.50	2.50	0.01
Cardiff Central	1.15	1.29	0.14
Cardiff North	1.42	1.72	0.29
Cardiff South and Penarth	1.60	1.81	0.20
Cardiff West	2.08	2.51	0.43
Carmarthen East and Dinefwr	4.88	6.03	1.15
Carmarthen West and South Pembrokeshire	3.48	5.54	2.05
Ceredigion	5.34	6.56	1.23
Clwyd South	3.49	6.91	3.42
Clwyd West	2.95	3.59	0.64
Cynon Valley	2.32	4.04	1.72
Delyn	3.03	3.05	0.02
Dwyfor Meirionnydd	3.83	6.34	2.50
Gower	3.09	3.49	0.40
Islwyn	2.14	2.86	0.72
Llanelli	3.69	4.85	1.16
Merthyr Tydfil and Rhymney	2.83	3.45	0.62
Monmouth	3.42	3.51	0.10
Montgomeryshire	4.92	9.39	4.47
Neath	2.63	3.11	0.47
Newport East	2.49	2.71	0.22
Newport West	2.67	3.33	0.66
Ogmore	2.78	4.87	2.09
Pontypridd	2.63	3.12	0.49
Preseli Pembrokeshire	4.64	5.03	0.39
Rhondda	1.43	1.86	0.43
Swansea East	2.15	3.25	1.10
Swansea West	1.49	1.84	0.35
Torfaen	2.42	2.99	0.57
Vale of Clwyd	2.04	2.58	0.54
Vale of Glamorgan	2.44	2.68	0.24
Wrexham	2.36	2.88	0.52
Ynys Mon	4.33	5.80	1.47

Service Density

The same data were also used to compute supply density measures. A total of 791 branch outlets (both high street banks and building societies) existed in Wales in 2008, serving an estimated population (aged 16 or more) of 2,466,956. This equates to a national supply-demand ratio of 3.206 branches per 10,000 residents. Separate figures for high street banks and building societies are presented in Table 2, along with corresponding statistics for 2018 and 2020. Once again, they illustrate the well documented decline in bank branch numbers and suggest that this trend continued largely unabated into 2020. In contrast, building society branch numbers remained quite stable over this period.

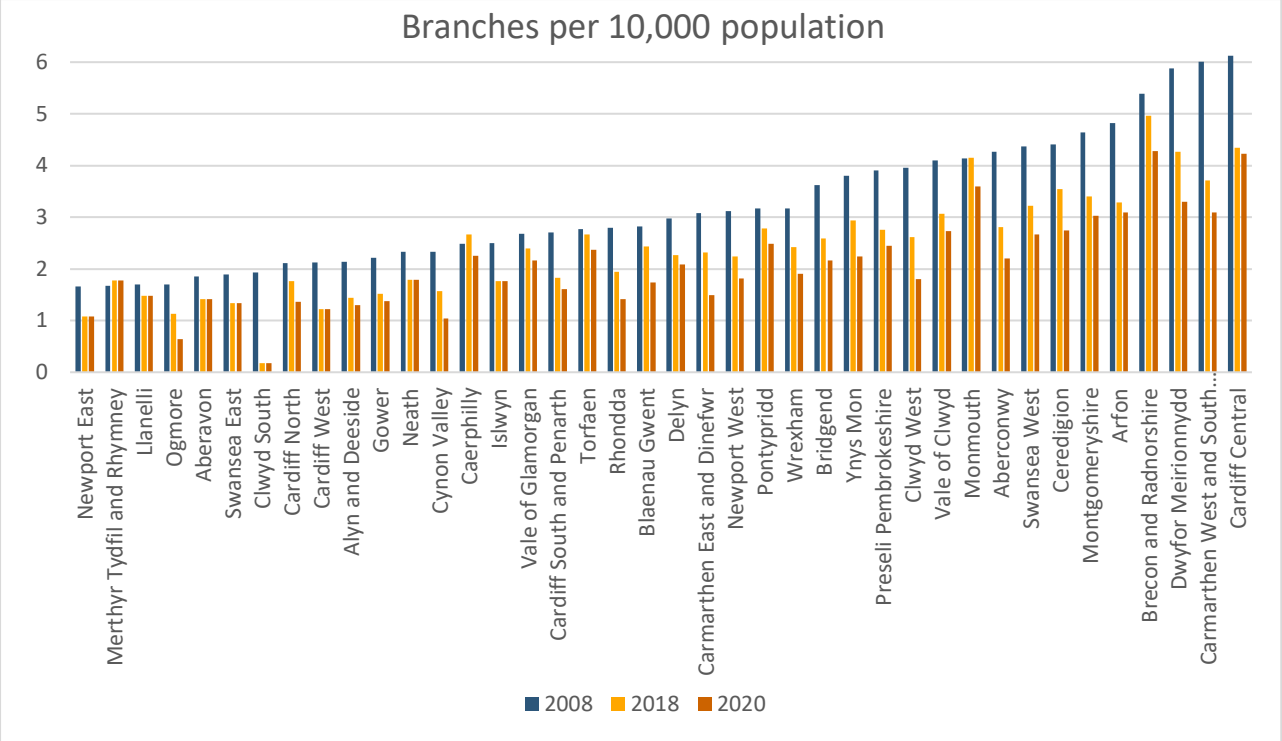
Table 2: National supply-demand ratios of banks and building societies in Wales.

Year	Population base (aged 16+)	All outlets	Banks	Building Societies
2008	2,466,956	791	586	205
		3.206	2.375	0.831
2018	2,575,922	622	422	200
		2.414	1.638	0.776
2020	2,575,922 (2018)	532	332	200
		2.065	1.289	0.776

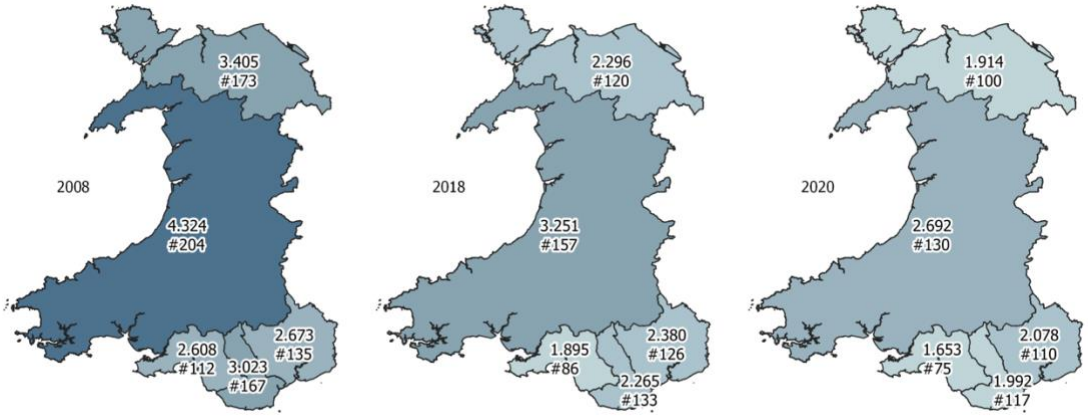
National levels of service provision give no insight into local inequalities that can arise due to the fact that both branches and population are unevenly distributed and connected to each other via a complex transport network. Local patterns can be explored by computing supply-demand ratios for smaller geographical regions. Because the total number of branches and customers remain constant, higher than average scores detected in local areas are always counteracted by lower scores elsewhere. Local scores fluctuate above and below the national ratio but return the same nationwide average.

Local scores are useful in offering insight into areas of relative advantage or disadvantage. If a minimum acceptable level of provision can be defined, they can identify areas where this requirement is unfulfilled. They provide evidence on the extent of inequality, perhaps aiding the future targeting of support or investment, and can assist in exploring whether areas of poor accessibility to services coincide with other environmental and socio-economic indicators, such as deprivation, ethnicity, and rurality.

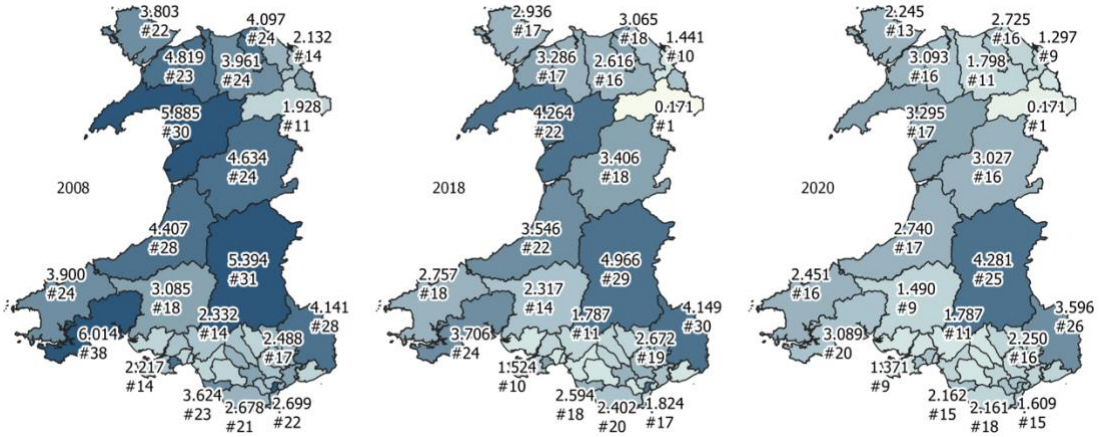
Variations in supply-demand ratios for 2008, 2018, and 2020 as recorded across the Welsh Regions are presented in Map 4. Greater geographical discrimination is revealed by using smaller administrative zones. Map 5 shows outputs for parliamentary constituencies. These data are also summarised in the chart below, ranked in order of the 2008 score.



Map 4: Supply-demand ratios (and branch counts): Welsh regions

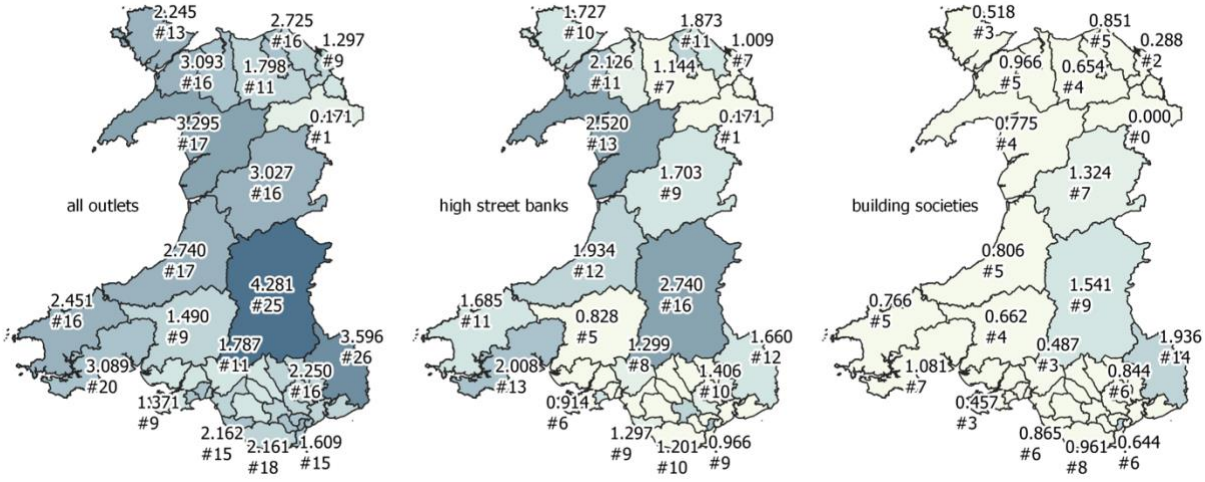


Map 5: Supply-demand ratios (and branch counts): Parliamentary constituencies



Supply-demand ratios are generally easy to understand and work with. For example, scores obtained separately for banks and building societies can simply be added to derive that for all outlets, as illustrated in Map 6.

Map 6: Supply-demand ratios (2020): all outlets, high street banks, building societies



Service Provision Change, 2008 to 2018

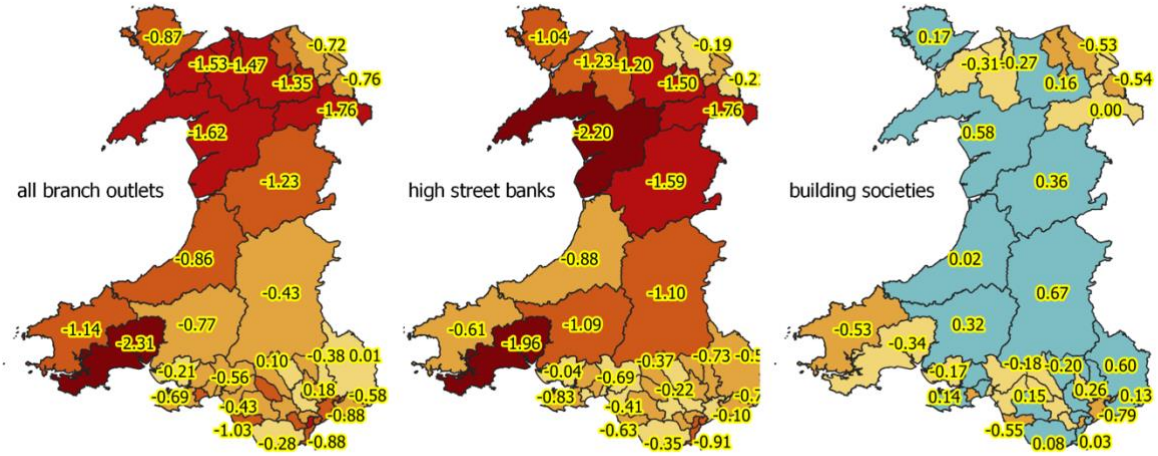
Explicitly mapping the change in score between two dates is again helpful in drawing attention to areas experiencing the most significant decline in service levels. The total number of branch closures in an area, or percentage increase/decrease in branch numbers compared to a base date are two ways to achieve this. However, the difference in the supply-demand ratio over two dates is a better metric because it accounts for both branch closures and any changes in demand population size, and so is a more standardised measure of change.

Evidence of change based on supply-demand densities is displayed for parliamentary constituencies in Map 7. This indicates considerable regional variation exists in the levels of decline experienced over the decade. Considering all branches (banks and building societies) the *Carmarthen West and South Pembrokeshire* constituency reported the biggest decrease of more than 2.3 per 10,000 population. The northern constituencies of *Clwyd South*, *Arfon* and *Dwyfor Meirionnydd* all lost more than 1.5 branches per 10,000 population, as too did *Cardiff Central* in the south. Relatively high rates of decline were experienced in *Aberconwy, Clwyd West*, *Montgomeryshire*, *Swansea West* and *Preseli Pembrokeshire*, all losing more than one branch per 10,000 population. Details for each constituency are recorded in Table 3. Map 7 highlights disparities between bank and building society branches. Almost all losses are associated with banks, and overall scores are ameliorated somewhat by small increases in the provision of building societies.

Table 3: Change in service density, branches-per-10,000 population (2008 – 2018)

Name	All outlets	Banks	Bld. Socs
Aberavon	0.43	0.41	0.02
Aberconwy	1.47	1.20	0.27
Alyn and Deeside	0.69	0.67	0.02
Arfon	1.53	1.23	0.31
Blaenau Gwent	0.38	0.73	-0.35
Brecon and Radnorshire	0.43	1.10	-0.67
Bridgend	1.03	0.63	0.55
Caerphilly	-0.18	0.22	-0.26
Cardiff Central	1.77	1.13	0.78
Cardiff North	0.35	0.60	-0.26
Cardiff South and Penarth	0.88	0.91	-0.03
Cardiff West	0.91	0.90	0.01
Carmarthen East and Dinefwr	0.77	1.09	-0.32
Carmarthen West and South Pembrokeshire	2.31	1.96	0.34
Ceredigion	0.86	0.88	-0.02
Clwyd South	1.76	1.76	0.00
Clwyd West	1.35	1.50	-0.16
Cynon Valley	0.77	0.76	0.20
Delyn	0.72	0.19	0.53
Dwyfor Meirionnydd	1.62	2.20	-0.58
Gower	0.69	0.83	-0.14
Islwyn	0.74	0.71	0.03
Llanelli	0.21	0.04	0.17
Merthyr Tydfil and Rhymney	-0.10	0.37	-0.47
Monmouth	-0.01	0.59	-0.60
Montgomeryshire	1.23	1.59	-0.36
Neath	0.55	0.37	0.18
Newport East	0.58	0.71	-0.13
Newport West	0.88	0.10	0.79
Ogmore	0.57	0.71	-0.15
Pontypridd	0.39	0.22	0.17
Preseli Pembrokeshire	1.14	0.61	0.53
Rhondda	0.86	0.69	0.17
Swansea East	0.56	0.69	-0.13
Swansea West	1.14	0.47	0.83
Torfaen	0.10	0.67	-0.27
Vale of Clwyd	1.03	0.18	0.86
Vale of Glamorgan	0.28	0.35	-0.08
Wrexham	0.76	0.21	0.54
Ynys Mon	0.87	1.04	-0.17

Map 7: Change in supply-demand ratios 2008 to 2018: Parliamentary constituencies



Summary

The report by the Economy, Infrastructure and Skills Committee documented how Wales has witnessed a reduction in retail financial services provision since at least 2008, and probably earlier. It noted that decline appears to be on-going and is likely to impact upon the ability of local businesses and the community to access cash and perform everyday financial transactions.

Using traditional approaches to measure and map the geographical distribution of financial service delivery points over time, evidence presented here suggests changes in accessibility were not uniformly distributed across Wales. Such variation implies relative advantage / disadvantage for the inhabitants of the served areas. Both *nearest provider* and *supply-density* scores visibly demonstrate that rural Wales has often been most impacted. Furthermore, most decline can be apportioned to the closure of high street bank branches, with building society branch numbers remaining stable in most areas, and occasionally increasing particularly in the south-east.

Results from analyses conducted so far are consolidated in Table 4. It lists average distance (km) to nearest branch in 2018, and average increase in distance between 2008 and 2018 in each Welsh parliamentary consistency, along with rankings. Similarly, the number of branches (bank and building society) per head of population, changes in this score, and rankings for each constituency are listed. Finally, the sum of all individual rankings is used to order the list. Clearly, different methodologies produce different outcomes, and whilst some rankings are consistent (such as *Clywd South* and *Caerphilly* at either end of the listing) more often they are not. This reflects both the nature and limitations of each metric; *Brecon and Radnorshire* for example has a low rank for distance but a high rank for supply-demand ratio, whist *Cardiff South and Penarth* exhibits the opposite pattern. Clearly, these largely reflect upon their rural/urban status.

Table 4 Scores and rankings for historical trends based on standard methodologies

Name	np2018	Rnp2018	np0818	Rnp0818	sd2018	Rsd2018	sd0818	Rsd0818	Rtotal
Clwyd South	6.91	39	3.42	39	0.17	40	1.76	38	156
Montgomeryshire	9.39	40	4.47	40	3.41	7	1.23	33	120
Ogmore	4.87	30	2.09	35	1.13	38	0.57	14	117
Cynon Valley	4.04	28	1.72	33	1.56	31	0.77	22	114
Dwyfor Meirionnydd	6.34	37	2.50	37	4.26	3	1.62	37	114
Arfon	5.02	31	2.57	38	3.29	8	1.53	36	113
Carmarth. W. & S. Pembrokeshire	5.54	33	2.05	34	3.71	5	2.31	40	112
Carmarth. East and Dinefwr	6.03	35	1.15	29	2.32	22	0.77	21	107
Ynys Mon	5.80	34	1.47	32	2.94	11	0.87	25	102
Ceredigion	6.56	38	1.23	31	3.55	6	0.86	24	99
Clwyd West	3.59	27	0.64	21	2.62	17	1.35	34	99
Aberconwy	3.45	23	1.14	28	2.81	12	1.47	35	98
Aberavon	3.55	26	0.85	25	1.42	35	0.43	11	97
Llanelli	4.85	29	1.16	30	1.48	33	0.21	5	97
Swansea East	3.25	20	1.10	27	1.33	36	0.56	13	96
Alyn and Deeside	3.21	19	1.10	26	1.44	34	0.69	16	95
Newport West	3.33	21	0.66	22	2.24	24	0.88	27	94
Preseli Pembrokeshire	5.03	32	0.39	11	2.76	14	1.14	32	89
Cardiff West	2.51	8	0.43	14	1.22	37	0.91	28	87
Gower	3.49	24	0.40	12	1.52	32	0.69	17	85
Islwyn	2.86	13	0.72	23	1.76	30	0.74	19	85
Brecon and Radnorshire	6.28	36	2.49	36	4.97	1	0.43	10	83
Bridgend	2.76	12	0.85	24	2.59	18	1.03	29	83
Merthyr Tydfil and Rhymney	3.45	22	0.62	20	1.78	28	-0.10	2	72
Newport East	2.71	11	0.22	7	1.07	39	0.58	15	72
Neath	3.11	17	0.47	15	1.79	27	0.55	12	71
Wrexham	2.88	14	0.52	17	2.42	20	0.76	20	71
Vale of Clwyd	2.58	9	0.54	18	3.07	10	1.03	30	67
Rhondda	1.86	5	0.43	13	1.94	25	0.86	23	66
Cardiff South and Penarth	1.81	3	0.20	6	1.82	26	0.88	26	61
Delyn	3.05	16	0.02	2	2.26	23	0.72	18	59
Pontypridd	3.12	18	0.49	16	2.78	13	0.39	9	56
Swansea West	1.84	4	0.35	10	3.23	9	1.14	31	54
Torfaen	2.99	15	0.57	19	2.67	16	0.10	4	54
Cardiff North	1.72	2	0.29	9	1.76	29	0.35	7	47
Cardiff Central	1.29	1	0.14	4	4.35	2	1.77	39	46
Vale of Glamorgan	2.68	10	0.24	8	2.40	21	0.28	6	45
Blaenau Gwent	2.04	6	0.15	5	2.43	19	0.38	8	38
Monmouth	3.51	25	0.10	3	4.15	4	-0.01	3	35
Caerphilly	2.50	7	0.01	1	2.67	15	-0.18	1	24

****Key:**

np2018/Rnp2018:	average nearest-provider distance (km) 2018, and rank
np0818/Rnp0818:	change in average nearest-provider distance 2008-2018, and rank
sd2018/Rsd2018:	service density (branches-per-10,000 population) 2018, and rank
sd0818/Rsd0818:	change in service density 2008-2018, and rank
Rtotal:	the sum of all rankings

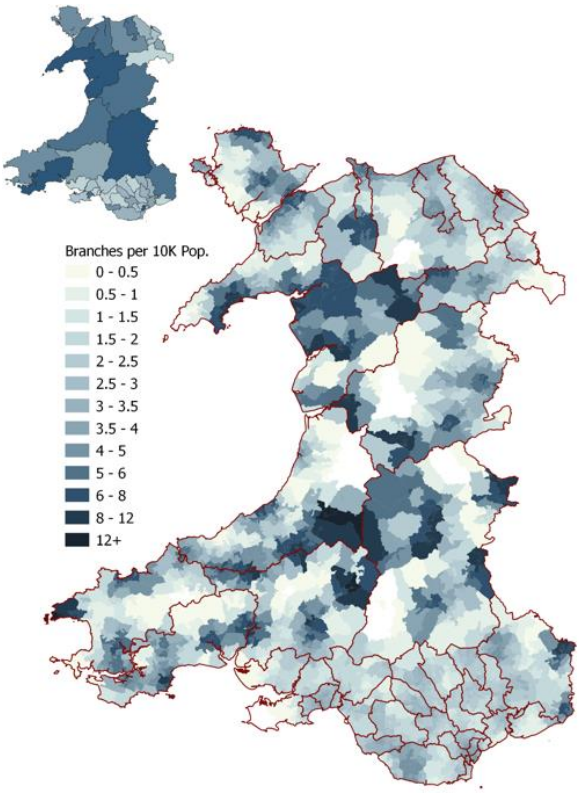
Although the maps and tables presented thus far are useful they use relatively simplistic methodologies. Spatial analysis has developed considerably in the last few decades, as too have the capabilities of geographical information systems and spatially enabled databases. This means that more sophisticated analytical approaches, like E2SFCA, are now available to explore changes in access to banking services in Wales, and provide a better understanding of those areas most affected by such changes.

Analysis using E2SFCA

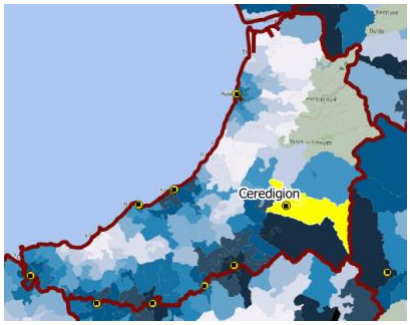
E2SFCA is able map access to services at much finer spatial scales than is achievable using traditional techniques. This fact is illustrated by Map 8 which presents the outcome of an E2SFCA analysis using OA population-weighted centroids and a 10-mile travel tolerance. For

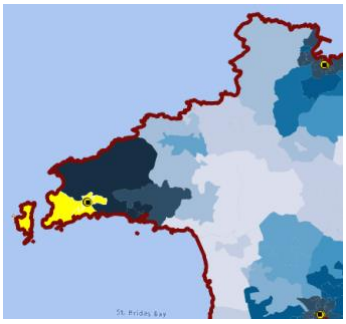
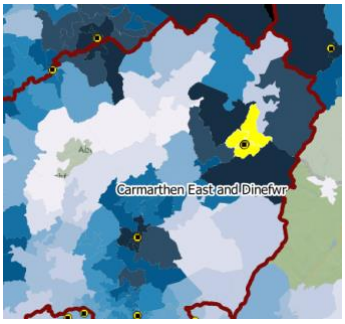
comparison, the equivalent 'container' map using Welsh parliamentary constituencies is shown as an inset. Both maps present supply-demand ratios of the number of branches per 10,000 population. In the container map a single score is generated for each constituency and is based on the assumption that all branches within it are used exclusively by its own residents. E2SFCA scores are generated for each Output Area and assume that all residents are free to travel anywhere within their respective 10-mile catchment. E2SFCA scores recognise the fact that branches are often shared amongst residents from multiple Output Areas, and also account for their proximities to the OA demand centroid.

Map 8: E2SFCA scores (branches per 10,000 population) 2008



In Map 5 the highest score of 6.121 branches-per-head was reported by *Cardiff Central* closely followed by *Carmarthen West and South Pembrokeshire* (6.014). At the other end of the scale, several constituencies had similar low scores: Newport East (1.654), Merthyr Tydfil and Rhymney (1.679), Llanelli (1.694), and Ogmore (1.697). Ratios returned by E2SFCA exhibit a much wide range: the highest and lowest scores were around 15.6 and 0.2 branches per 10,000 population, respectively. Furthermore, the highest scores occurred not in central Cardiff, as might be expected, but in Tregaron in *Ceredigion*, St Davids in *Preseli Pembrokeshire*, and Llandovery in *Carmarthen East and Dinfwr.*

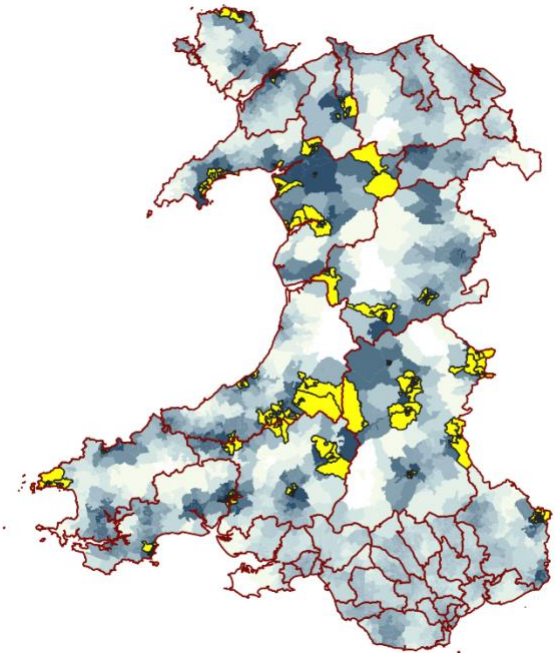


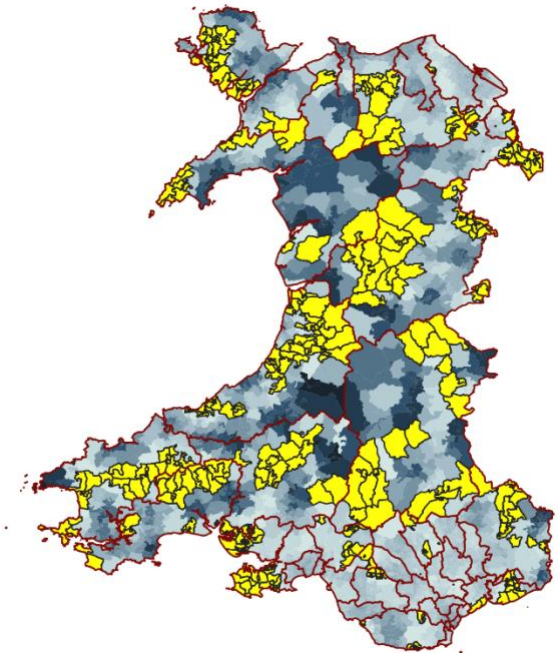
This reflects the nature of E2SFCA in that several closely clustered branches existed at each of these sites in 2008, leading to a large local 'supply'. However, being remote these towns and villages could be reached by only a relatively small population within the 10-mile travel limit and so experience a small 'demand'. The outcome is that residents close to these sites have excellent accessibility; there is in effect a lot of bank service supply being shared amongst relatively few people.

Looking more broadly, the areas reporting high levels of accessibility in 2008 were mostly rural according to E2SFCA (although the instances near the English border should be treated with caution because cross-border interactions are unaccounted for). It is not the case, however, that E2SFCA always favours rural areas in its assessment of accessibility. This is illustrated by also considering the location of OAs that reported the lowest scores. As shown below, these too arise predominantly in rural areas.

These apparent contradictions illustrate how the issue of accessibility in rural areas is often complex. In places where branches remain, some of the highest potential service levels may be offered to those residents in their immediate vicinity. However, this effect is often very localised, with large elements of the dispersed rural population experiencing poor access to services. Furthermore, if market town branches are closed, large swathes of rural OAs may then face substantial increases in travel distance to reach an alternative service, as is examined later in this report. A close inspection of Map 8 supports the assertion that rural constituencies generally exhibit a much wider range of accessibility to branches than is typical in urban areas.



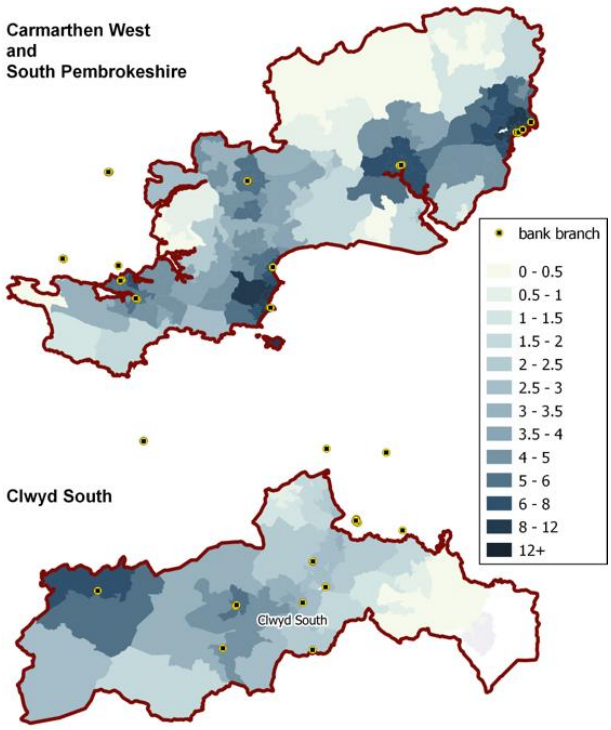
top 5 percent, most accessible (E2SFCA)



bottom 5 percent, least accessible (E2SFCA)

The constituency of *Carmarthen West and South Pembrokeshire* which records the highest accessibility score using the container method (6.014, see Map 5) deserves further consideration. E2SFCA scores reveal how this single figure conceals considerable internal differentiation (Map 9).

Map 9: Accessibility within constituencies revealed by E2SFCA



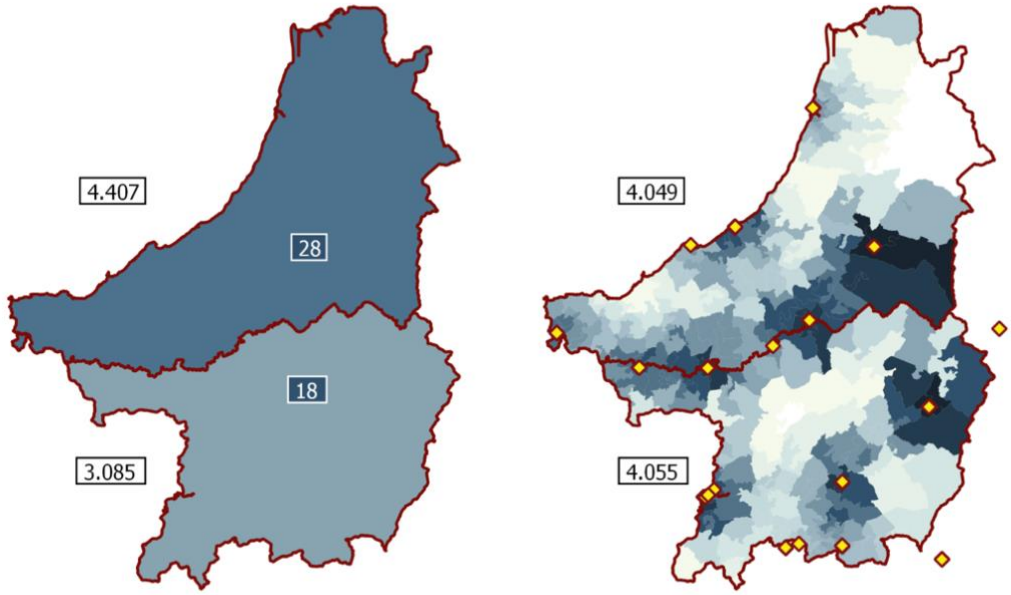
Local highs arise around the towns of Carmarthen, Tenby, and Pembroke Dock, where scores of 8.0 - 9.0 are common, whilst in other parts of the constituency, most notably near its northern border, much lower values around 0.35 are returned. The lowest internal score was in the vicinity of Lawrenny adjacent to the Celddau Ddu estuary with only 0.26 branches per 10,000 population. Meanwhile, the constituency of *Clwyd South* reported one of the lowest scores (1.928) in Map 5. Again E2SFCA exposes how this single figure masks a wide range of internal accessibility; highs of 6.0-7.0 occur around the town of Corwen in the west, with a cluster of slightly lower scores (5.2) near the town of Llangollen further east, and then scores decline to zero at its eastern margin. These examples suggest accessibility is best studied at a range of spatial scales. Comparisons made between constituency wide scores may be useful but ignore the fact that significant variations and overlaps often exist when these data are viewed at a finer geographical scale.

When there is a requirement to compare access at constituency level (or other large zones such as local authority districts) the computation of E2SFCA scores at OA level followed by their aggregation to the target geography offers significant benefits. To illustrate, OA-level scores for *Carmarthen West and South Pembrokeshire* and *Clwyd South* return aggregated values of 5.188 and 2.527, respectively, compared to simple container-based values of 6.014 and 1.928. The difference in these estimates can be explained by the fact that E2SFCA does not model constituency boundaries as an impermeable barrier. As explained in the methodology, population demand centres close to a border can '*steal'* access to nearby services in adjacent constituencies, thereby raising their constituency level score. This seems to have occurred in *Clwyd South,* where several external branches lie just beyond its border. However, population centres close to the border in adjacent constituencies can likewise '*steal'* services from within the constituency in question. This process appears to have prevailed in *Carmarthen West and South Pembrokeshire* resulting in a lower E2SFCA estimate at constituency level. In both cases, E2SFCA derived scores are likely to be much the better estimate.

This may appear to be a technical intricacy, but it is important. In essence it means that a supply-demand ratio derived for a constituency or other administrative area from OA-level E2SFCA scores offer a more realistic evaluation of the accessibility experienced by residents within the area because it better reflects the actual behaviour of local populations seeking access to services.

A further example illustrates the advantages of E2SFCA and reinforces the assertion that it represents a fundamentally better model of underlying human behaviour. Consider the accessibility levels depicted for two adjacent constituencies, *Ceredigion* and *Carmarthen East and Dinefwr,* in Map 10.

Map 10: Traditional and E2SFCA mapping: “Ceredigion” and “Carmarthen East and Dinefwr”



Using 2008 data, the traditional container approach returns supply-demand ratios of 4.407 and 3.085, respectively, based on 28 and 18 branches falling in the two areas. The E2SFCA map also plots the positions of these branches, many of which (specifically, 12) fall either side of the shared border. Although very close to the border in all cases, more fall on the Ceredigion side (8) than the Carmarthen side (4) which contributes to the difference in scores reported by the container method (4.407 versus 3.085). However, these branches serve customers living close by regardless of which side of the border they reside. E2SFCA reflects this reality, displaying high OA scores in both constituencies close to these sites, with lower scores elsewhere where branches are absent. The E2SFCA aggregate scores in *Ceredigion* and *Carmarthen East and Dinefwr* are 4.049 and 4.055 respectively. In other words, when account is taken of the likely sharing of resources across the border, the previous disparity between the two constituencies is shown to be misleading; and in fact *Carmarthen East and Dinefwr* returns the slightly higher estimate of overall accessibility.

Summary

E2SFCA is demonstrated to be capable of mapping accessibility to services at much finer geographical scales than can be achieved with traditional methods. This allows a more nuanced and realistic appraisal of likely accessibility levels experienced at local community levels.

Whilst such *potential* measures may not necessarily reflect *actual* service utilisation patterns (data on which is rarely available), they are based on an underlying model that better reflects the behaviour of people seeking access to services. Arbitrary administrative

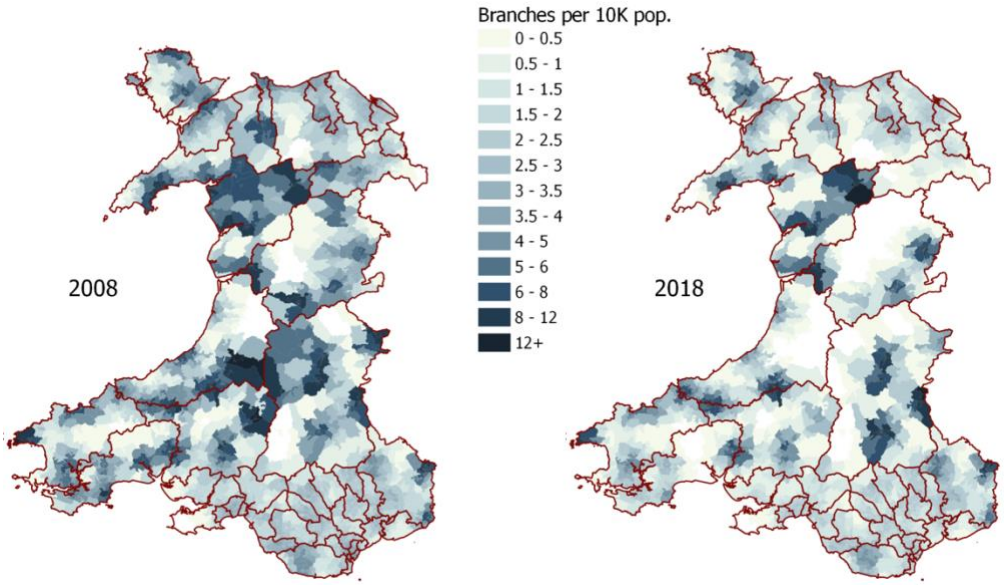
boundaries are not treated as impermeable barriers, leaving populations free to seek out and use service points lying anywhere within their local neighbourhood.

E2SFCA scores computed at fine spatial scale, for example Output Area level, may at times be too complex and convey too much detail for studies concerned with policy development and administration across larger geographical regions. Larger administrative areas often play an important role in respect to local decision-making processes and accountability, so evaluating accessibility scores at this level can be attractive. In this situation, aggregating OA level E2SFCA estimates to the preferred unit of analysis is recommended. This is because scores derived from fine-scale E2SFCA analyses help to minimise fallacies that can otherwise arise due to the influence of arbitrary administrative boundaries, as was shown in the example given above. This relates to a well-known and longstanding issue of potential statistical bias, called the *modifiable areal unit problem,* which is known to significantly impact the results of statistical hypothesis tests performed on data aggregated to geographical districts. Aggregating fine-scale E2SFCA scores provides a way to limit the risks of the modified area unit problem impeding such studies.

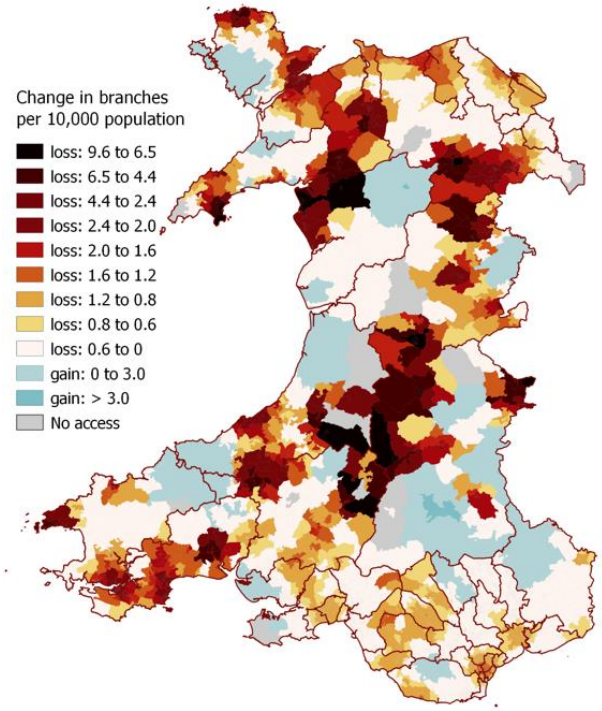
Assessing recent change using E2SFCA

As with previous metrics, computing E2SFCA scores for separate epochs allows any changes in service provision over time to be evaluated. OA-level scores for 2008 and 2018 are shown in Map 11, and the changes between the two dates are presented in Map 12.

Map 11: E2SFCA scores (branches per 10000 population) 2008 and 2018



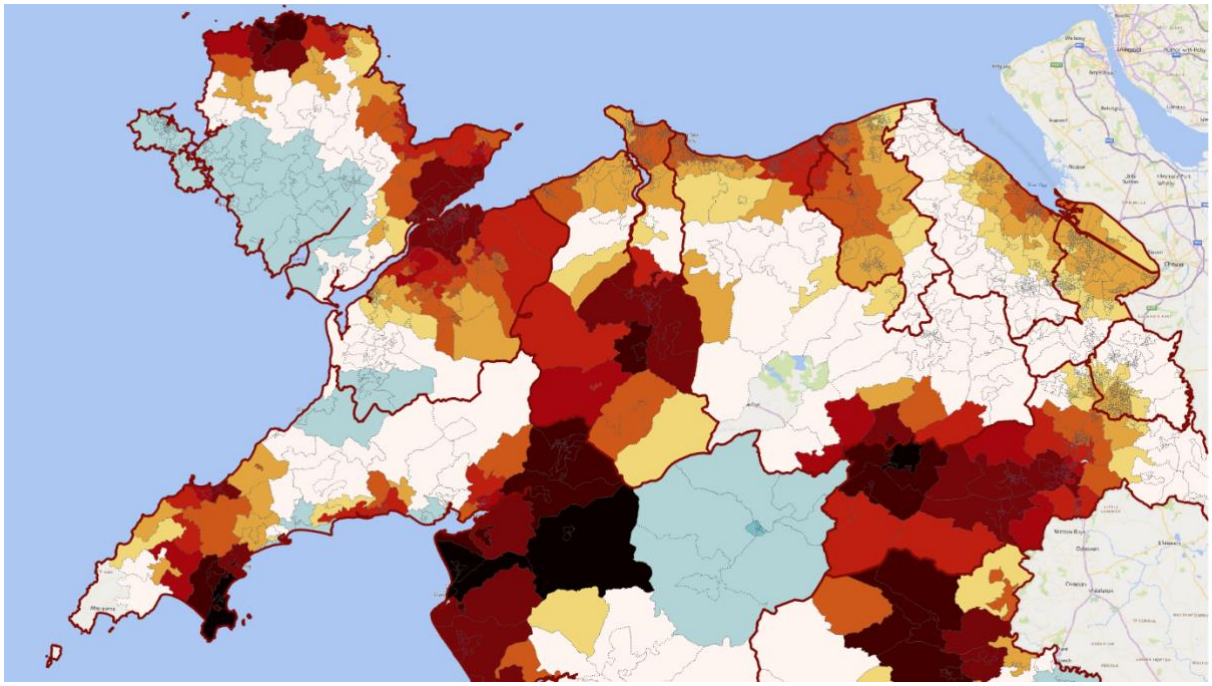
Map 12: Change in E2SFCA accessibility ratios, 2008 to 2018



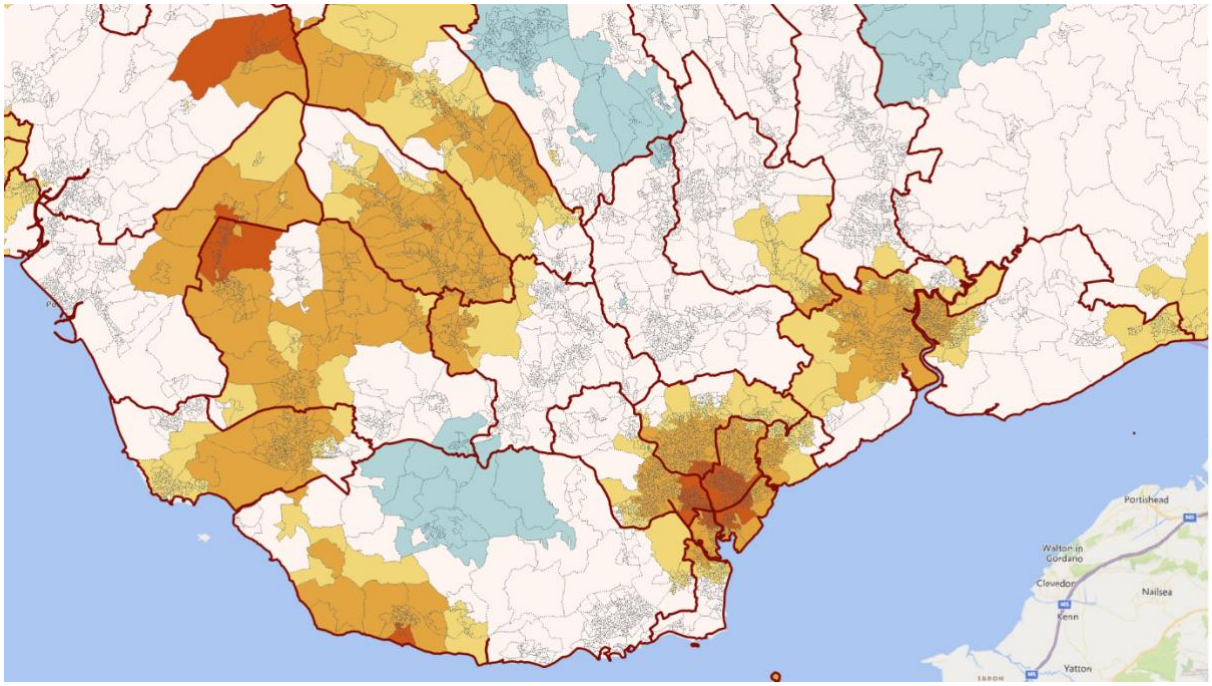
The somewhat complex Map 12 benefits from further guidance on its interpretation. OAs shaded from yellow, to orange, to umber, indicate an increasing decline in accessibility, using a classification comparable to Map 7. However, because E2SFCA computes a greater range of access scores, declines of larger magnitude can arise and these are represented by shades of deep brown through to black. Most of these occur due to a complete loss of service caused by branch closures, and are often peripheral to, and thus extend, grey areas which represent OAs deemed unable to reach a branch within a 10-mile distance according to 2008 data. OAs showing a rise in accessibility are mapped in shades of blue.

Areas of substantial decline appear to be concentrated in rural communities and in central and west Wales, such as Rhayader and Llanwrtyd Wells in *Brecon and Radnorshire*, Llanidloes and Llanfair Caereinion in *Montgomeryshire,* Tregaron *in Ceredigion,* and Llanbydder in *Carmarthen East and Dienfwr.* In most of these cases, and similar examples elsewhere (Cemaes Bay, *Ynys Mon;* Abersoch, *Dwyfor Meirionnydd*, Saint Clears and Saundersfoot, *Carmathen West and South Permbrokshire*) communities experienced the complete loss of all bank branches within a 10-mile travel distance over this time period.

In contrast, impacts in urbanised areas in south east Wales appear muted. Although branch closures occurred here too, they seldom led to a complete loss of service, but typically eliminated duplication of services between rival bank brands. As the examples below demonstrate, the primary benefit of E2SFCA is its enhanced precision and level of spatial detail compared to that provided by traditional methodologies, allowing community level scrutiny.

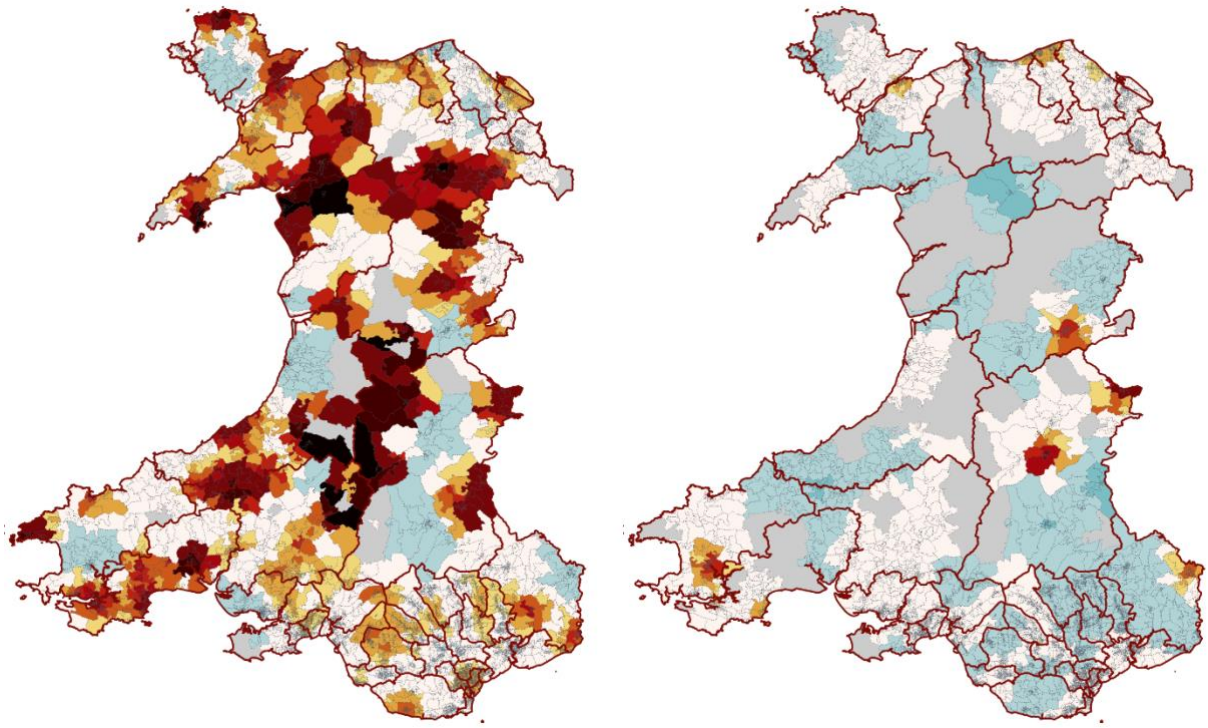


Accessibility changes in North Wales revealed by E2SFCA



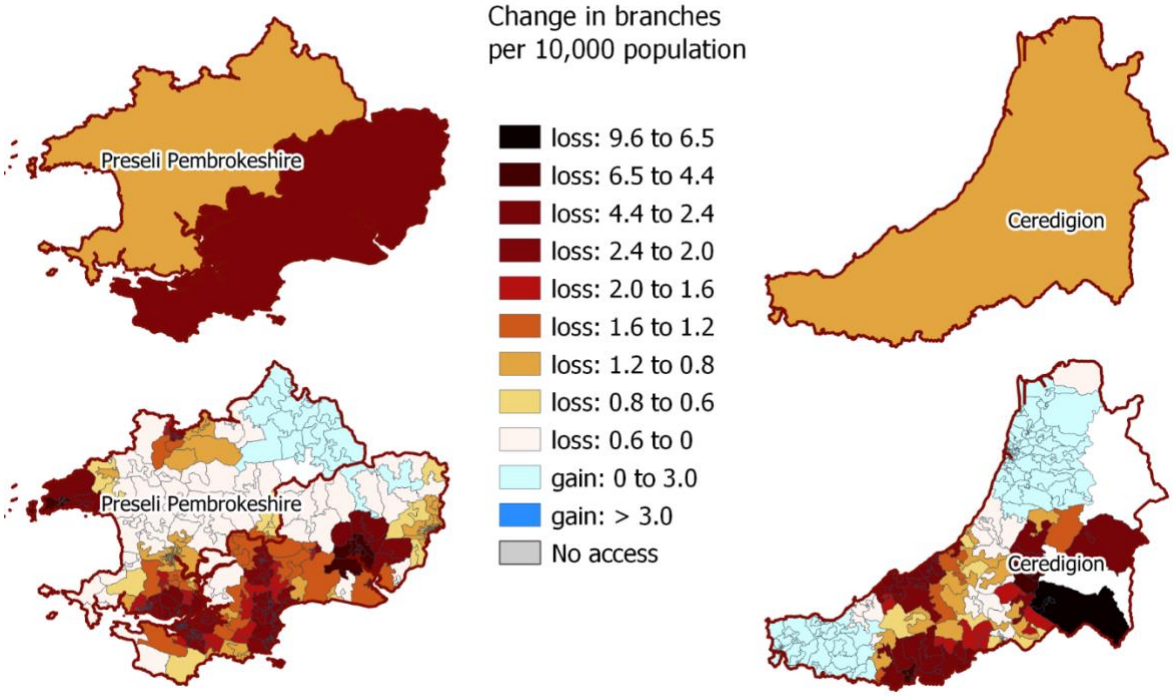
Accessibility changes in South Wales revealed by E2SFCA

Illustrations below show it is possible to disassemble change relating specifically to high street banks and building societies. The message from an E2SFCA analysis remains much the same, however; that service decline is mostly associated with high street bank closures and has transpired predominantly in north, mid, and west Wales.



The ability of E2SFCA to reveal insight into community level provision is illustrated by Map 13.

Map 13: Traditional 'container' and E2SFCA views of accessibility change



In *Preseli Pembrokeshire* a decline reported for this constituency as a whole is revealed to arise from a complex internal pattern. There is little change in many areas, steep declines near St Davids and Aberporth, and small gains in accessibility in the east around New Quay.

In *Carmarthen West and South Pembrokeshire* its constituency wide decline is revealed as being more uniformly distributed at local level. In *Ceredigion* mapping at OA level reveals a complex mix of small gains, little change, and steep declines, all of which contribute towards its constituency wide decline.

Analyses II – Current Accessibility

This section directly addresses the Economy, Infrastructure and Skills Committee request to *"properly map the gaps in banking services overall – access to banks, Post Offices, free-to-use ATMS and connectivity for digital banking".* Using the most recent branch data (summer 2020) it aims to document current accessibility to these facilities. Furthermore, consideration of "*banking services"* is extended to cover other facilities and services; specifically Post Offices, ATMs, and Broadband Connectivity. These may compliment or substitute for traditional branches, and in the case of the latter may be instrumental in the promotion of digital banking alternatives. Methods by which E2SFCA can be adapted to provide greater detail in urban areas are also explored, as too are the latest enhancements to this technique which can better accommodate the diversity of settlement types that exist in Wales.

Banks and Building Societies:

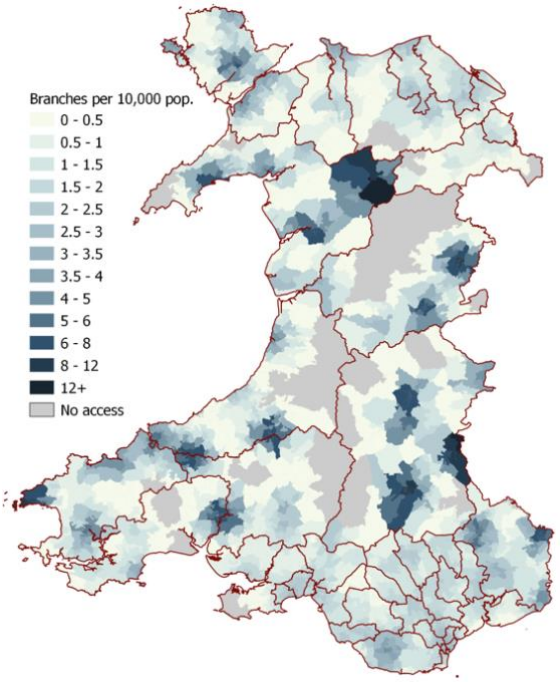
Table 1 shows 532 branch outlets were present in Wales in 2020, comprising 332 high street banks and 200 building society branches. This equates to a national supply density of 2.065 branches per 10,000 head of population. E2SFCA accessibility scores computed at OA level are displayed in Map 14. The same scores aggregated to parliamentary constituencies are shown in Map 15 and listed in Table 5, along with a ranking of each entry.

Table 5: Constituency-based estimates of 2020 accessibility using E2SFCA

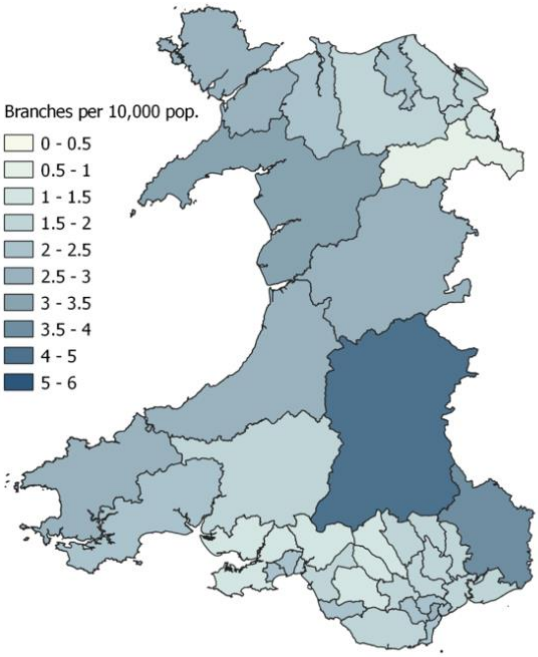
Name	Branch Density	Rank
Aberavon	1.782	24
Aberconwy	2.407	11
Alyn and Deeside	1.640	29
Arfon	2.791	5
Blaenau Gwent	1.656	28
Brecon and Radnorshire	4.092	1
Bridgend	2.028	18
Caerphilly	1.717	26
Cardiff Central	2.675	8
Cardiff North	2.377	12
Cardiff South and Penarth	2.107	17
Cardiff West	2.215	16
Carmarthen East and Dinefwr	1.837	21
Carmarthen West and South Pembrokeshire	2.494	10
Ceredigion	2.690	7

Clwyd South	0.736	40
Clwyd West	1.952	19
Cynon Valley	1.458	34
Delyn	1.693	27
Dwyfor Meirionnydd	3.297	3
Gower	1.138	39
Islwyn	1.626	30
Llanelli	1.438	35
Merthyr Tydfil and Rhymney	1.772	25
Monmouth	3.650	2
Montgomeryshire	2.985	4
Neath	1.486	33
Newport East	1.521	32
Newport West	1.592	31
Ogmore	1.171	38
Pontypridd	1.825	22
Preseli Pembrokeshire	2.730	6
Rhondda	1.363	37
Swansea East	2.223	15
Swansea West	2.283	14
Torfaen	1.933	20
Vale of Clwyd	2.311	13
Vale of Glamorgan	1.795	23
Wrexham	1.409	36
Ynys Mon	2.504	9

Map 14: Current branch accessibility (2020) using E2SFCA



Map 15: E2SFCA-derived 2020 accessibility: constituencies



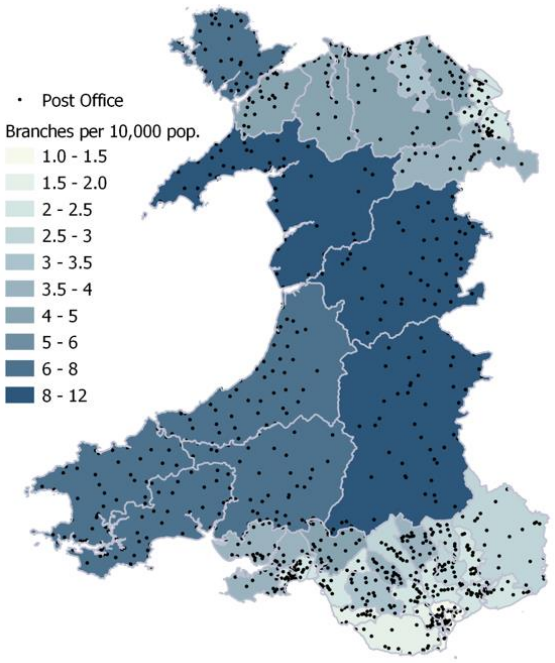
Access to Post Offices:

The Post Office network is often regarded as a potential substitute for banking services in places where high street bank and building society branches have closed. Whilst an evaluation of the types of banking services currently available at such sites is outside the

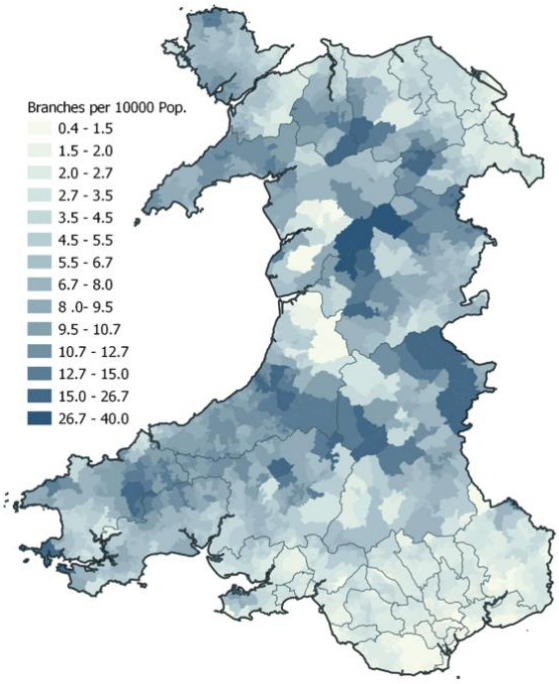
scope of the present study, evidence provided to the Committee suggested the Post Office network currently only provides basic banking services such as the ability to withdraw cash and to deposit cash and cheques. Data available to this study, for October 2019, indicates the presence of 930 Post Office outlets across Wales although information regarding the exact nature of each site was limited. Knowledge of opening hours, range of services offered, or the precise nature of outlet (for instance, whether a standalone site or located inside an existing shop) would have allowed more detailed analysis of their value to local communities, but unfortunately was unavailable. In the absence of any meaningful way to rate or rank services, all sites were treated as simple points of provision of equal value.

The prevalence of Post Office sites across Welsh constituencies is shown in Map 16, and E2SFCA accessibility scores using a 10-mile travel tolerance in Map 17.

Map 16: Post Office branch distribution and densities



Map 17: Post Offices E2SFCA accessibility scores



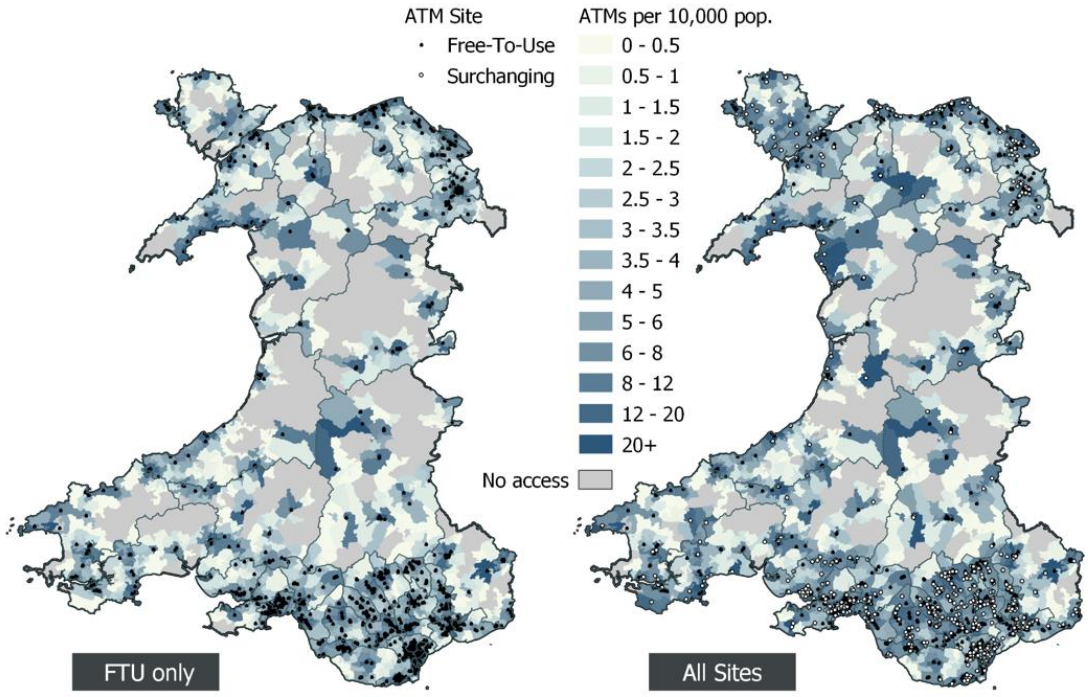
These suggest Post Office branches are widely dispersed throughout the country and often return the highest supply-demand densities in rural areas. As previously, E2SFCA scores reveal considerably more detail than a traditional constituency level '*container*' map and are likely be of interest and benefit to local administrators and inhabitants. Despite intriguing insights into local high and low scoring areas, it broadly conveys the same message, that rural areas are relatively well provisioned on a supply-demand basis compared to metropolitan areas in the North and South East of the country. However, this assumes all sites are of equal value in terms of services offered and hours of opening. A recent study incorporating the opening hours of Post Offices in an assessment of banking provision suggests many rural sites offer very limited temporal availability. The situation may

therefore be less satisfactory than is implied by the purely geographical analysis conducted here.

Access to ATMs:

Despite widely reported concerns on their declining availability, ATMs remain an important resource in respect to providing access to cash. The current distribution of ATM sites in Wales and an E2SFCA analysis of their accessibility is displayed in Map 18. Available data differentiated between free-to-use (FTU) ATMS and those that impose a charge. Map 18 shows information in respect to both. In contrast to previous analyses a travel tolerance of 5 miles was used because it was felt that distance to this cash-only service is more critical than for banks, building societies and post offices.

Map 18: ATMs distribution and E2SFCA accessibility scores: 5-mile travel tolerance



Whilst there have been suggestions that societal trends towards cashless transactions may be accelerated by the COVID-19 pandemic, findings from the Economy, Infrastructure and Skills Committee enquiry highlighted that access to cash is likely to remain vital for the foreseeable future at least. As might be expected, ATMs are concentrated in shopping venues and centres of commercial activity rather than in residential zones, but these maps also highlight a marked absence of FTU sites in deeply rural regions of Wales. Metropolitan areas in the south-east and north-east appear well-catered for, as do many coastal regions where tourism may constitute an important element of the local economy. E2SFCA analysis implies that residents in many rural parts of Wales must travel more than 5 miles to reach

an FTU ATM, whilst elsewhere access is highly variable. With only a single timeframe of data available to this study it was not possible to consider recent closures or declining service levels, but this would merit on-going monitoring and analysis, particularly given the possible impacts of COVID-19 and current trends in the provision of banking services more generally.

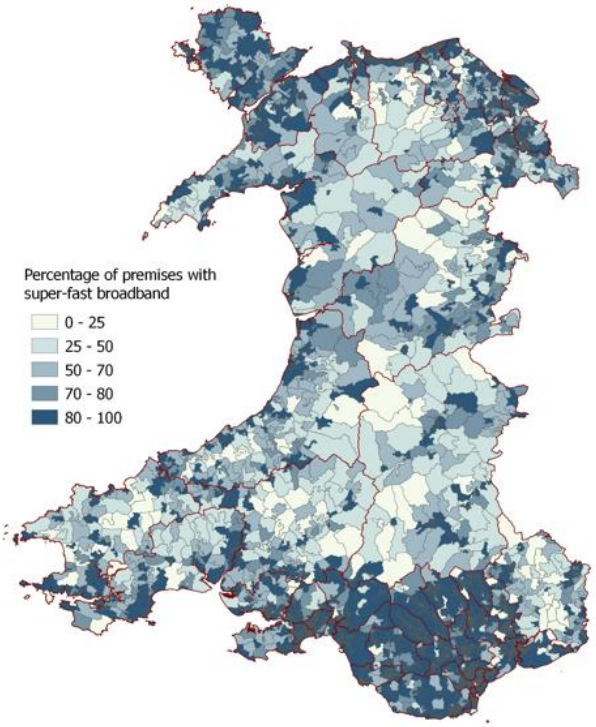
Access to digital services:

Online banking and digital services are widely promoted as the future of retail financial services, with the availability of broadband connectivity seen as a potential substitute for face-to-face interactions via a physical branch network. Although there is undoubtedly an opportunity to offer financial services through this mechanism, concerns persist regarding potential digital exclusion.

The Economy, Infrastructure and Skills Committee report noted that Wales may suffer from higher rates of digital exclusion than that experienced in many other parts of the UK as a consequence of having a population with higher proportions of elderly and disabled residents and low-income households. It was also noted that financial service providers often ignore the possibility of people not having phones or computers, or of them being unwilling or unable to use them. Thus skills, the cost of equipment, and the preparedness of the public to engage with this technology all factor into its overall effectiveness as a substitute for branch networks. It is beyond the remit of this report to evaluate such factors, but the geographical availability of an adequate broadband service is considered. Quite what constitutes an 'adequate broadband service' remains a matter of conjecture and opinion.

The data available to this project was derived from Ofcom under its Fixed Broadband Coverage statistics. It presents more than 22 variables at OA level that report information such as: "*Number of premises with 30<300Mbit/s download speed*"; *"% of premises with 10<30Mbit/s download speed*"; and "*% of premises unable to receive 2Mbit/s*". The variable "*% of premises with super-fast broadband availability"* was used as an indicator of broadband availability, although it is admitted this is an arbitrary choice. The availability of super-fast broadband according to this metric is illustrated in Map 19. Predictably, high rates occur mainly in metropolitan areas, with highly variable coverage in rural areas and the lowest rates mostly concentrated in deeply rural parts of Wales.

Map 19: Super-Fast broadband availability (2019)



Access to branches via Public Transport:

All analyses reported thus far assume the entire population can access banking services by private car. Of course, not all residents have access to a car, nor may they be able or willing to drive, and so will instead rely upon public transport. When restricted to bus routes and timetables it is inevitable that access to branches is further constrained, and a more realistic assessment of accessibility for members of the community reliant on public transport deserves consideration.

Multi-modal accessibility has received increased attention in recent research literature, and a multi-modal E2SFCA algorithm (Langford et al., 2016) allows populations to be subdivided into cohorts using alternative transports modes. This results in a set of accessibility scores for each demand point, one for each mode of transport considered. Time constraints prevented a full multi-modal E2SFCA analysis in this study, but software developed at USW was used to conduct an analysis to illustrate the value in pursuing this line of enquiry, and to provide insights into the potential accessibility of branch-led services amongst Welsh public transport users.

This analysis began by determining every instance where an Output Area centroid fell within a 10-mile straight line distance of a branch. Because a network distance is always longer than a straight-line distance, this creates a first pass estimate of the branches that may be accessible to residents in each OA. Each case was then fed into an analytical engine using *Open Trip Planner* to calculate all possible bus route itineraries, using a database of bus services, stops, routes, and timetables downloaded from on-line repositories. This is the

same information used, for example, by Google Map to display directions and calculate travel times. The output lists the shortest bus travel times and distances between the OA centroid and its candidate branches based on services operating in August 2019.

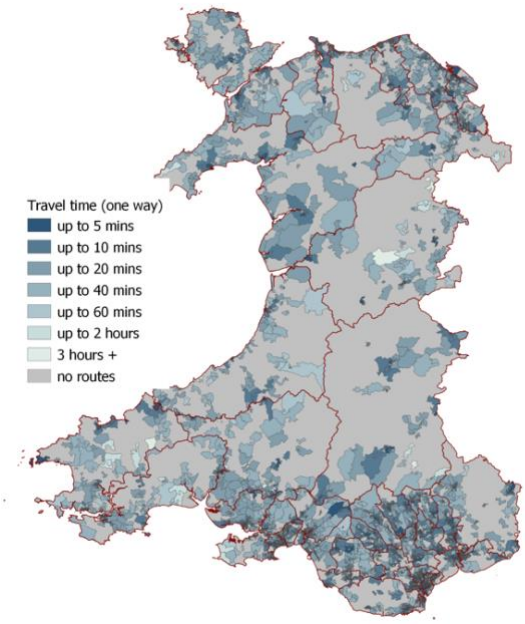
Many branches were found to be unreachable by bus, even though no constraint was imposed on total travel time (indeed the longest returned trip was a somewhat impractical 18 hours). Each trip will typically consist of a walking leg from OA centroid to bus stop, traversing of the bus network, and a walking leg from the final bus stop to the branch. Itineraries allow transfers between bus routes, which may necessitate additional walking legs between stops. No single walking leg, whether at the start, end, or middle of a journey, can exceed 400m in length. A trip could, however, consist entirely of walking if the 400m limit is not exceeded. The result, for each OA centroid, is the number of branches reachable by bus from those candidates selected for consideration, and both the duration and distance of each trip.

A number of limitations are recognised in this analysis:

1. no account was taken of the time of day of the proposed journey, or if the arrival time coincides with typical branch opening hours,
2. no account is taken of how frequently a service is available, either daily or weekly, and
3. it is not determined whether a return journey is possible on the same day. All of these are, of course, important considerations in the real world. Modelling also assumes access to a bus is possible only via a bus stop, but in some parts of Wales services may operate as '*hail and ride'*, effectively stopping anywhere upon request. Arguably, potential need for public transport should also be considered alongside availability. In other words, areas with poor access to bus services are of greater significance if their occupants also exhibit low levels of car ownership and/or are areas with a high proportion of individuals without driving licences, suggesting a higher likelihood of need for public transport.

Results are shown in Maps 20 and 21 and summarised in Tables 6 and 7. The maps suggest substantial parts of Wales have no realistic access by bus, but because rural OAs are much larger in size than their urban counterparts this is somewhat visually deceptive.

Map 20: Accessibility by bus/walking: one-way travel time



Map 21: Banking opportunities by bus/walking

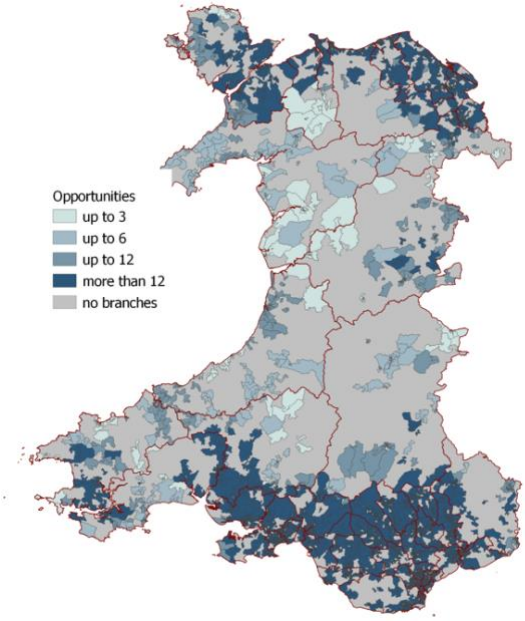


Table 3 shows that only 16% of OAs were modelled as having no bus routes, and that 60% could reach a branch within a 20-minute journey. Around 10% of the Welsh population live within walking distance (400m) of a branch, although this may of course not be the brand they use.

Table 6: Accessibility by bus

Criteria	Number of OAs	% of OAs
< 6 minutes (walking)	1058	10.5%
6 minutes – 3 hours	7367	73.5%
up to 10 mins	2642	26.3%
up to 20 mins	6073	60.5%
more than 20 minutes	1300	12.9%
No route found	1612	16.0%

Predictably, opportunities to reach branches by bus are much greater in metropolitan areas although 'gaps' still remain where no service is available. In rural Wales the opportunities diminish substantially, suggesting little choice for customers, little competition amongst the branches present, and greater vulnerability of communities in the event of branch closures.

Table 7: Banking opportunities by bus

Criteria	Number of OAs	% of OAs
Access to 1 branch	86	0.9%
…up to 2 branches	187	1.8%
…up to 3 branches	240	2.3%
…up to 4 branches	364	3.6%
…up to 6 branches	580	5.8%
…up to 12 branches	1150	11.5%
more than 12 branches	7281	72.6%

Exploring latest enhancements to E2SFCA:

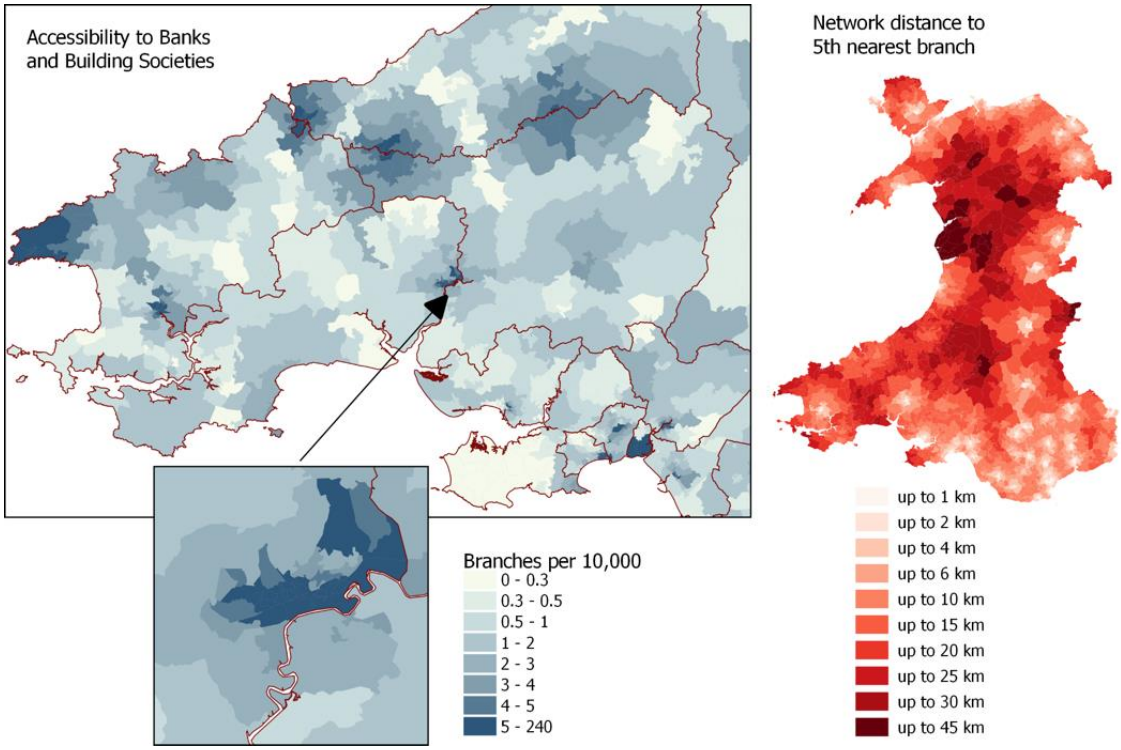
Except for access to ATMs all E2SFCA analyses reported have, in the absence of data on actual bank usage and distances travelled to access financial services, assumed a travel tolerance of 10 miles. This parameter determines the area in which residents seek access to services. If no supply points are found, an accessibility score of zero is returned implying no access to service. Larger travel tolerances provide greater scope for residents to reach branches, but also mean supply sites will be shared amongst a larger population base. The net effect is that larger tolerances induce a greater degree of smoothing to the output scores (local variation is suppressed) whilst raising the potential for a more inclusive coverage. These traits are reversed when a smaller tolerance is specified; local variation is accentuated, but coverage is typically less complete.

Setting a travel tolerance can be problematic in E2SFCA studies. Ideally, empirical evidence of travel behaviour should be used but is often unavailable, leaving the analyst to make a subjective judgement. The problem is exacerbated in environments exhibiting a wide range of settlement densities, such as Wales, because the travel tolerance of populations varies. For example, while urban residents may consider a travel distance of 10 miles to reach a bank as unreasonable, in remote settings this may be quite acceptable, and in the most rural areas it may need to be larger still to secure any access to a service.

The latest enhancements to E2SFCA methodology seek to accommodate variable-size catchments. Each demand centre has a travel tolerance set in accordance with the specific expectations or needs of its residents. Langford et. al. (2020) published a study on the use of variable catchment E2SFCA to retail banking provision in Wales. It assumed residents would, at the very least, be willing to travel as far as their nearest branch. Thus, the distance to nearest branch can be used as the travel tolerance of each OA. However, because it is unlikely all residents use the nearest branch, this rule was further relaxed to adopt the network distance to the 5^{th} nearest branch.

To show the potential of this cutting-edge approach, Map 22 illustrates a variable catchment E2SFCA analysis of the 2020 data. Network distances shown here are analogous to those in Maps 1 and 2, except they report distance to the 5th nearest branch which is then used to set a unique travel tolerance for each OA. This means travel catchments are naturally smaller in urban areas, or wherever branches are closely clustered, and become larger as rurality and remoteness increase. Variable catchment E2SFCA provides complete coverage because each OA always has a travel tolerance set large enough to reach service delivery points. It is also believed to be capable of providing highly nuanced analysis of accessibility in both rural and urban environments.

Map 22: Variable-catchment E2SFCA analysis



Analyses III – Exploring future scenarios

These analyses are exploratory in nature, seeking to obtain information that helps to paint a picture of what the future may hold with regards to access to banking services in Wales.

Potential impacts of future branch closures on travel distance:

In the computation of E2SFCA scores an Origin-Destination matrix is created that identifies the distance of all nearby branches to each OA centroid. This table presents opportunities for further analyses. For example, although not undertaken here, it is possible to query these tables to examine the implications of branch closures for customers of a specific bank or building society brand. A scenario where a particular bank branch is earmarked for closure can be analysed to establish the increased travel distances needed for local

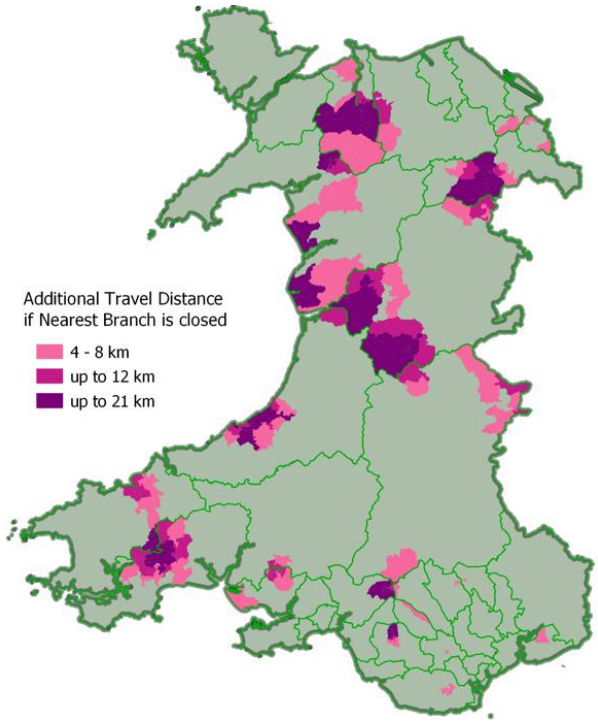
customers to reach the next nearest branch of the same brand. Similarly, there is the potential to examine implications if a particular brand were to implement a large-scale branch closure program.

The difference between the nearest and next nearest branch of each OA, regardless of brand, is also a useful indicator of a potential impact felt by residents if their current nearest branch closes. However, banks and building societies have a well-known tendency to cluster, particularly in urban areas and to a lesser extent in market towns and villages. For many OAs this means that the closure of its nearest branch may have little impact in terms of extra travel distance because most likely an alternative branch exists nearby. However, as branches are repeatedly lost this 'protection' is progressively eroded, and in rural towns and villages the point is soon reached where a branch becomes '*the last bank in town'.* Its subsequent closure can then cause substantial impacts on travel distances for the occupants of all its nearby communities.

Map 23 shows the outcome of an analysis conducted to illustrate this issue. For each OA centroid the potential impact of closing its current nearest branch (in 2020) was investigated. OAs whose travel distance would increase by less than 1 km were disregarded, leaving those that remain to highlight pockets of potential high vulnerability across Wales. In the worst cases additional travel (each way) would be well in excess of 10 km. Communities in and around the towns of Glynneath in Neath Port Talbot, Narberth in Pembrokeshire, Aberaeron in Ceredigion, Llandiloes and Machynlleth in Powys, Tywyn, Barmouth, and Blaenau Ffestiniog in Gwynedd, Llangollen in Denbighshire and Llanrwst in Conwy, are highlighted as being particularly vulnerable to the impacts closure. Worryingly, most of these sites (Aberaeron, Barmouth, Llandiloes, Llanrwst, Narberth, and Tywyn) have already succumbed to the ongoing process of branch closures since the data being used for this analysis was assembled!

Although not conducted here, similar scenario testing to that just demonstrated could be applied in respect to the public transport infrastructure: examining the potential impacts of withdrawing or introducing new bus routes, for example, on the ability of communities to reach the branches that remain.

Map 23: Travel impact of nearest-branch closure



Exploring the concept of a multi-factor vulnerability index:

The idea that increased travel caused by branch closures can identify potentially vulnerable communities can be developed further to consider a range of factors that may influence accessibility to banking services in a broader sense.

This is an idea that has been explored previously, both in relation to banking facilities and other services. For example, Bowles (2000) considered potential impacts on rural communities caused by bank mergers in Canada. He proposed a simple *Branch Closure Vulnerability Index (BCVI)* based on two key factors: the likelihood than a merger will result in a closure, and the impact it may have on financial competition within the community. Green et al. (2017) explore a more complex methodology to create an index of local health hazards and assets, and identify that there is a long-standing interest within the social sciences into understanding complex interactions amongst multiple influences.

Bowles recognised that "*…the construction of any index is fraught with methodological difficulties concerning issues such as which indicators to include, how to measure them, and how to weight and aggregate them*". These concerns apply equally to the current study, with the choice of variables and method of aggregation a contentious issue. This exploratory study adopts a similar methodological approach to the BCVI, defining factors thought to be relevant, and mapping each onto a simple scale using subjective break points. These are aggregated to yield a final estimate of local community vulnerability. It is acknowledged that the factors adopted, their scaling and their weightings, are all contentious and would benefit greatly from further statistical analysis and scientific justification in the future.

Nevertheless, the exercise is useful, even if purely illustrative in nature, to show proof of concept and to act as a catalyst for further debate on the nature of contributory factors. The map of aggregate scores is presented here in the same spirit, being intended to act as a catalyst for further debate and not to be used for serious judgment or decision making given the exploratory methodology adopted.

The following contributory 'factors' were used as component variables in a Banking Services Community Vulnerability Index (BSCVI), with higher scores indicating increasing vulnerability to potential loss of services…

1. Broadband availability. Premise: Low levels of access to superfast broadband suggests higher vulnerability
   - 3 - 0-15% of households with superfast broadband (SFBB)
   - 2 - 15%-30% of households with SFBB
   - 1 - 30%-50% of households with SFBB

2. Closure travel impact. Premise: Extra travel imposed upon a population by the closure of its current nearest branch suggests higher vulnerability
   - 3 - 8 km to 12 km
   - 2 - 4 km to 8 km
   - 1 - up to 4 km

3. Bus transport availability. Premise: Long travel times by bus to reach a bank/building society branch suggests higher vulnerability
   - 3 - no bus service available
   - 2 - > 60 minutes travel time
   - 1 - > 40 minutes travel time

4. FTU ATM accessibility scores using E2SFCA. Premise: Communities with low access to free-to-use ATMs are more impacted by branch closures
   - 3 - < 1.5 branches per 10,000 population
   - 2 - 1.5 to 2.5 branches per 10,000 population
   - 1 - 2.5 to 3.5 branches per 10,000 population

5. Variable catchment E2SFCA branch availability score. Premise: Communities with low current accessibility are more vulnerable to future closures

3 - < 0.5 branches per 10,000 population
2 - 0.5 to 1.0 branches per 10,000 population
1 - 1.0 to 1.5 branches per 10,000 population

6. Car ownership. Premise: Communities with low access to cars have higher public transport usage and are more vulnerable to future closures

   3 - > 35% of households with no car
   2 - 25 – 35% of households with no car
   1 - 20 – 25% of households with no car

7. Proportion of aged population. Premise: Communities with higher proportions of aged residents (60+) have more difficulty in adapting to online services, and have a higher likelihood of relying on cash and face-to-face branch services

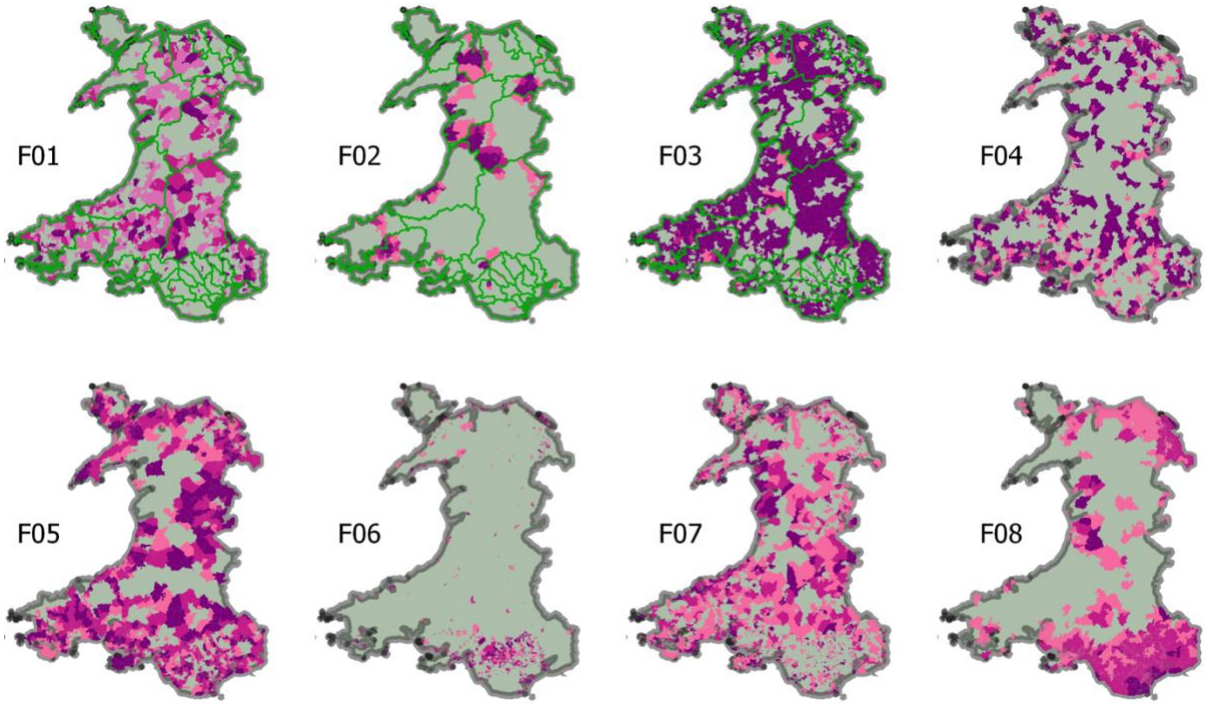
   3 - > 40% aged 60 and above
   2 - 35 to 40% aged 60 and above
   1 - 30 to 35% aged 60 and above

8. E2SFCA score for Post Office accessibility. Premise: Communities with low access to Post Office branches are more vulnerable to bank and building society closures.

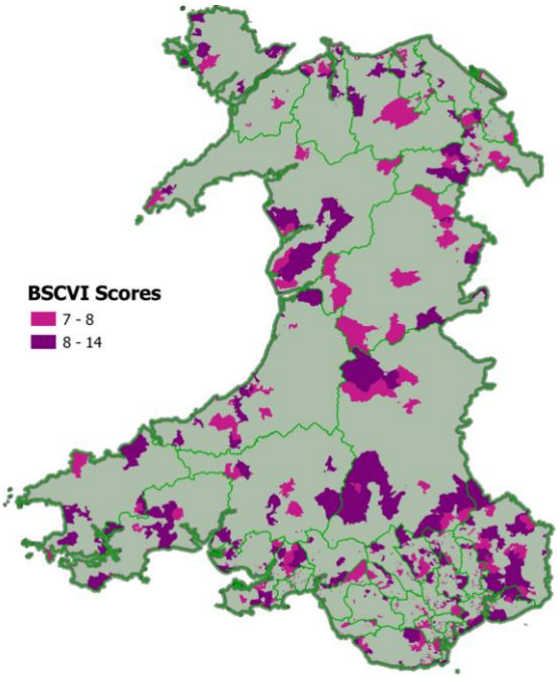
   3 - < 1.5 branches per 10,000 population
   2 - 1.5 to 3.0 branches per 10,000 population
   1 - 2.0 to 5.0 branches per 10,000 population

Scores for each factor, mapped on the 0-3 scale are shown in Map 24, with aggregated scores in Map 25. It must be reiterated that both outputs are highly speculative and are presented as an illustrative example of a potential modelling approach. Given the current lack of scrutiny concerning contributory factors, their relative importance, and the subjectivity of the class boundaries adopted, these should not be interpreted as authoritative indicators of areas most at risk from future branch closures.

Map 24: Factor contributions to a Banking Services Community Vulnerability Index



Map 25: Areas modelled as highly vulnerable to future closures



In addition to mapping these outputs, there is considerable potential to engage in further statistical analyses of these data, as suggested by Table 8. This ranks each parliamentary constituency (1=worst, 40=best) according to alternative criteria. First, the percentage of its total population living in OAs with a BCVI score of 8 or more. Next, the absolute count of residents aged 60 or more living in these areas. Third, the percentage of the population

living in high BCVI scoring areas that are aged 60 or more – in effect, the degree to which areas identified as vulnerable to bank closures exhibit an older population profile. And finally, the percentage of its aged 60+ population that live in high scoring BCVI score – in effect, how concentrated into those areas identified as vulnerable to bank closures are its older aged citizens. Any number of similar calculations could be performed once the basis of the underlying multi-criteria index has been more rigorously considered and agreed upon.

Table 8 Example analysis of BSCVI scores

Name	% BSCVI 7+	Rank	Age60+ BSCVI 7+	Rank	% BSCVI 7+ Aged 60+	Rank	% Aged 60+ BSCVI 7+	Rank
Aberavon	16.2	15	3198	17	21.5	38	5.6	40
Aberconwy	19.2	9	4410	9	32.5	17	14.8	21
Alyn and Deeside	11.2	26	2505	28	27.2	28	17.7	18
Arfon	5.7	39	740	40	30.4	19	9.1	34
Blaenau Gwent	18.7	12	4023	10	13.6	40	22.8	10
Brecon and Radnorshire	12.4	21	3087	19	34.6	11	9.9	32
Bridgend	7.5	33	1824	34	29.9	20	27.1	3
Caerphilly	20.5	8	4789	6	29.8	22	19.5	14
Cardiff Central	23.9	4	2866	22	36.3	7	7.2	38
Cardiff North	13.5	19	3197	18	33.3	16	14.4	25
Cardiff South and Penarth	29.1	2	5736	2	28.3	25	26.9	4
Cardiff West	14.5	16	3302	16	27.6	27	24.4	7
Carmarth. East and Dinefwr	8.7	32	2137	31	40.8	1	24.4	8
Carmarth. W. & S. Pembrokeshire	5.9	38	1654	37	29.0	24	14.8	22
Ceredigion	9.0	31	2508	27	34.9	9	9.9	33
Clwyd South	29.2	1	5498	3	34.2	13	15.2	20
Clwyd West	11.7	24	3442	15	37.7	3	6.5	39
Cynon Valley	12.2	22	2450	30	25.1	36	20.4	13
Delyn	4.6	40	1223	39	28.3	26	10.8	31
Dwyfor Meirionnydd	16.7	14	3821	12	39.7	2	14.8	23
Gower	14.4	17	3905	11	36.1	8	13.8	27
Islwyn	24.0	3	4548	8	29.6	23	14.2	26
Llanelli	11.3	25	3055	21	26.1	34	7.8	37
Merthyr Tydfil and Rhymney	18.9	11	3564	14	26.4	32	22.2	11
Monmouth	19.0	10	5494	4	37.2	4	18.6	15
Montgomeryshire	13.0	20	2832	23	33.4	15	8.4	35
Neath	7.4	34	1897	32	34.5	12	22.0	12
Newport East	17.9	13	3696	13	25.1	35	25.1	5
Newport West	21.0	6	5362	5	27.0	29	13.1	28
Ogmore	6.8	37	1324	38	36.7	6	11.8	30
Pontypridd	10.4	28	2710	24	30.8	18	23.5	9
Preseli Pembrokeshire	7.3	35	1865	33	18.3	39	29.2	2
Rhondda	12.1	23	2501	29	34.8	10	17.8	17
Swansea East	14.1	18	3082	20	36.9	5	12.3	29
Swansea West	11.0	27	2649	25	25.0	37	18.3	16
Torfaen	20.8	7	4663	7	26.8	31	24.7	6
Vale of Clwyd	7.0	36	1666	36	33.6	14	8.3	36

Vale of Glamorgan	23.1	5	6401	1	29.8	21	14.4	24
Wrexham	9.0	30	1809	35	26.3	33	31.7	1
Ynys Mon	10.1	29	2594	26	26.9	30	16.3	19

**Key:

% BCVI 7+:	% of total population living in areas with a high BSCVI score (8 or more)
Age60+ BSCVI 7+	Total number of residents aged 60 or more living in areas with a high BSCVI score
% BSCVI 7+ Aged 60+	% of all residents living in areas with a high BSCVI score that are aged 60 or more
% Aged 60+ BSCVI 7	% of all residents aged 60 or more that are living in areas with a high BSCVI score

Summary Remarks and Conclusions

The primary impetus for this research was to address one of the recommendations of the Economy, Infrastructure and Skills Committee, namely the call for more mapping and analytical insight into potential changes in the branch-led banking network in Wales. This research has extended such analysis to consider a wider range of options for accessing financial services. In so doing it has highlighted spatial inequalities in the provision of such services that are worthy of further study but were outside the scope of this exercise. It has also provided some preliminary ideas on how such factors can be assessed to attempt to model the potential vulnerability of communities to further losses of bank branches.

Recent trends in branch-led retail banking provision over the past decade has been examined using a broad range of spatial analytical tools. First, the traditional techniques of *distance to nearest provider* and *service density*, were used to present evidence of past patterns of branch distribution and reveal disparities in rates of service decline as experienced across Welsh Parliamentary Constituencies. Although useful, these methodologies suffer from several well know limitations. This report has therefore sought to demonstrate how recent developments in spatial analysis presents an opportunity to greatly increase the geographical detail of such analyses, providing insight and scrutiny into service provision experienced at local community level.

The *enhanced two-step floating catchment area* (E2SFCA) methodology is used to reveal the variability in access that may be experienced amongst residents living within a constituency boundary, and to explore detailed spatial patterns and disparities in the rates of service decline across communities in Wales. This revealed that accessibility to services is often complex, and particularly so in rural areas. Although the broad pattern of a significant decline in branch-led banking provision across rural Wales appears indisputable, at local level there are many more nuanced outcomes.

Whilst the capability to investigate banking provision at such detailed scales is useful, it can be overwhelming when information relating to larger geographical regions is needed to assist in policy development and general administration duties. Fortunately, ESFCA scores are easily aggregated to alternative geographies such as parliamentary constituencies or district councils. Furthermore, because they model more realistically the underlying

behaviour of people seeking access to services, these aggregated scores minimise fallacies that can otherwise arise due to the influence of arbitrary administrative boundaries (the so-called *modifiable areal unit problem* that can affect statistical hypothesis tests performed over geographical zones).

As well as a thorough analysis of recent trends in banking provision in Wales, this report presents accessibility scores computed for recent information concerning bank and building society branch sites. This has included applying the very latest E2SFCA methodologies that use variable travel catchments. Analyses were also conducted for other complimentary services (post offices, ATMs, broadband connectivity), thereby addressing the Committee's request to *"properly map the gaps in banking services overall".* Furthermore, the potential ability of those members of society reliant upon public transport to be able to reach banking facilities was also analysed. Using online repositories of bus routes, stops and services, and multi-modal journey planner software, the opportunities for people to walk and catch a bus to a bank or building society branch have been modelled and presented here.

Finally, the report conducts example spatial analyses to explore potential future scenarios regarding banking provision in Wales. The impact that branch closures might have on travel distances to the nearest point of provision was investigated. Many of the sites highlighted as having the greatest potential impacts on travel distances were subsequently targeted in the most recent round of branch closures. Had time allowed, any number of similar analyses might have been undertaken: the impact on travel distances caused by ATM closures; a sensitivity analysis in respect to potential closures amongst specific bank brands; the consequences of reconfigured bus services; and so on. Finally, an illustration was given of how information representing a broader consideration of banking services than branch provision alone might be assembled and utilised. Details regarding which factors to include and how best to integrate them requires greater consideration before this can be used in a meaningful manner, but nevertheless demonstrates the potential power of spatial analysis for better understanding and managing service provision in the future.

Access to banking services and to cash remains a topic of considerable public and governmental interest, as the frequency of news articles [9],[10] and recent online reports[11] testifies. The work reported here was undertaken during the COVID-19 pandemic but has used datasets and information that pre-dates this episode. It may therefore represent a valuable "snap-shot" that can be used as a benchmark against which to judge the eventual long-term impacts that this significant event may have upon transport services, branch network infrastructure, societal shifts in the use of cash and its alternatives, shopping habits, and so on. All of which, at the time of writing, are yet to fully manifest themselves let alone begun to be measured and understood.

Acknowledgements

The advice, guidance, and technical support received from the following people whilst undertaking this study is gratefully acknowledged.

Helen Jones, Senior Researcher, Senedd Research, National Assembly for Wales
Samuel Jones, Arbenigwr GIS, Senedd Cymru (GIS Specialist, Welsh Parliament)
Gary Higgs, Professor, WISERD Co-Director, University of South Wales
Andrew Price, Ph.D. Candidate, University of South Wales

Online Maps

https://ces-web2.southwales.ac.uk/staff/mlangfor/res/banks_show/bankmaps.php

[9] BBC News, 24th March 2020: "Coronavirus: Bank branches close as virus affects access"
BBC News, 29th April 2020: "Coronavirus 'will hasten the decline of cash'"
BBC News, 17th June 2020: "Ampthill: The town with one cash machine for 8,000 people"
BBC News, 23rd September 2020 :"Could churches double up as bank branches in cash-stricken areas?"
BBC News, 30th September 2020: "TSB to close a third of branches and cut 900 jobs'"
BBC News, 15th October 2020: "Will we be getting our cash from shops, not ATMs?"
BBC News, 15th October 2020: "Goodbye ATMs. How local shops offer access to cash"
Economic Observatory, 5th September 2020: "Will coronavirus accelerate the move towards a cashless economy?"
Financial Times, 26th May 2020: "Coronavirus accelerates shift away from cash"
Fool, 26th August 2020:"Covid-19's role in pushing the UK into a cashless society"

[10] S&P Global Market Intelligence, 17th May 2020: "Shuttered for COVID-19, some US banks consider closing branches for good"
The Telegraph, 16th August 2020: "Banks step up plans to close branches and cut jobs"
The Times, 17th July 2020: "Banks may share branches to avoid coronavirus closures"

[11] Access to Cash Review
University of Bristol, "Where to withdraw? Mapping access to cash across the UK"

References

Bowles, P. (2000) Assessing the impact of proposed bank mergers on rural communities: A case study of British Columbia. *Social Indicators Research*; 51; Psychology Database, 17–40

Green, M.A., Daras, K., Davies, A., Barr, B. and Singleton A. (2018) Developing an openly accessible multi-dimensional small area index of 'Access to Healthy Assets and Hazards' for Great Britain, 2016. *Health & Place,* 54, 11–19

Langford, M., Higgs, G., & Fry, R. (2016). Multi-modal two-step floating catchment area analysis of primary health care accessibility. *Health & Place*, 38, 70–81

Langford, M., Higgs, G. and Jones, S. (2020). Understanding spatial variations in accessibility to banks using variable floating catchment area techniques. *Applied Spatial Analysis and Policy*. https://doi.org/10.1007/s12061-020-09347-2