

The interaction of structural factors and diffusion
in social unrest: evidence from the Swing riots

Online appendix

November 18, 2020.

A Online appendix

This appendix provides definitions of all the variables used in the analysis and lists the sources used to construct them. It also presents summary stats, the additional robustness checks referred to in the main text, and a number of maps.

A.1 GIS datasets

The following GIS datasets have been used to construct the dataset used in the estimations:

1. Wrigley, E.A., Shaw-Taylor, L., and Newton, G., (2010). 1831 Census Report of England: County Parish Occupations. This dataset was produced with funding from the ESRC, The Occupational Structure of Nineteenth Century Britain, RES 000-23-1579. For details of the dataset Wrigley, E.A., *The Early English Censuses*, British Academy, Records of Economic and Social History (Oxford, 2011)
2. Satchell, A.E.M., Boothman, L., Shaw-Taylor, L., and Bogart, D., (2016). Parliamentary Enclosure Dataset. This dataset was produced with funding from the Leverhulme Trust, Transport, Urbanization and Occupational Structure 1670-1911, RPG-2013-093.
3. Shaw-Taylor, Broad, J., and Newton, G., (2016). The 1815 Return of Real Property for England and Wales. This dataset was produced with funding from the Leverhulme Trust, Transport, Urbanization and Occupational Structure 1670-1911, RPG-2013-093.
4. Shaw-Taylor, L., Satchell, A.E.M., and Newton, G., (2016). The Cambridge Group England and Wales Towns Database. This dataset was produced with funding from the Leverhulme Trust, Transport, Urbanization and Occupational Structure 1670-1911, RPG-2013-093.
5. Satchell, A.E.M., Shaw-Taylor, L., and Potter, E., (2016). The Cambridge Group England and Wales Town Points Dataset. This dataset was produced with funding from the Leverhulme Trust, Transport, Urbanization and Occupational Structure 1670-1911, RPG-2013-093.

6. Satchell, A.E.M, Newton, G., Bogart, D., and Shaw-Taylor, L., (2014). Bates, Directory of stage coach services 1836. This dataset and associated shapefile were created from Bates, A., Directory of stage coach services 1836 (1969). This dataset was produced with funding from the Leverhulme Trust, Transport, Urbanization and Occupational Structure 1670-1911, RPG-2013-093, with funding from the Leverhulme Trust.
7. Satchell, A.E.M., Kitson, P.M.K., Newton, G.H., Shaw-Taylor, L., and Wrigley E.A., (2016). 1851 England and Wales census parishes, townships and places (2016). This dataset was created with funding from the ESRC (RES-000-23-1579), the Leverhulme Trust and the British Academy. A description of the dataset can be found in Satchell, A.E.M., England and Wales census parishes, townships and places: documentation (2016, 2006) available at: <http://www.geog.cam.ac.uk/research/projects/occupations/datasets/documentation.html>.
8. Satchell, A.E.M, Shaw-Taylor, L., and Wrigley E.A., (2016). 1831 England and Wales ancient counties GIS. This dataset was created with funding from the ESRC (RES-000-23-1579), the Leverhulme Trust and the British Academy. A description of the dataset can be found in Satchell, A.E.M., England and Wales ancient counties 1831 documentation (2016, 2006) available at: <http://www.geog.cam.ac.uk/research/projects/occupations/datasets/documentation.html>

A.2 Definition of variables and sources

We use the following notation in the definitions of the variables below: (i) $i = 1, 2, \dots, n$ is the index for parishes where n is the total number of parishes; (ii) N at the end of a variable name refers to the “neighborhood” of a parish defined as parishes within a radius of 10km from its centroid. We use the following variables:

- **riots** is an $n \times 1$ vector where element i is the total number of riots in parish i between Monday, 28th June 1830 and Sunday, 3rd April 1831. Source: Hobsbawm and Rudé (1973, Appendix II) and Holland (2005). Geo-referenced using Satchell, Kitson, Newton, Shaw-Taylor, and Wrigley (2016).
- $\mathbf{W} \times \mathbf{riots}$ is an $n \times 1$ vector and \mathbf{W} is a $n \times n$ row-normalized weight matrix with non-zero elements corresponding to parishes with centroids within 10km of each other, and all other elements set to 0. Parish i is not considered to be its own neighbor. The variable captures the average number of riots in a 10km neighborhood of a parish. Source: constructed from Hobsbawm Rudé (1973) and Holland (2005). Geo-referenced using Satchell, Kitson, Newton, Shaw-Taylor, and Wrigley (2016).
- Log **population** is an $n \times 1$ vector where element i is the natural logarithm of the total number of inhabitants in parish i in 1831 (in 1000s). Source: Census of Great Britain, 1831. Wrigley, Shaw-Taylor and Newton (2010).
- **cereal** is an $n \times 1$ vector where element i equals one if parish i is located in the cereal growing regions of England, i.e. the east of England. Source: Caird (1852).
- Log **families in agriculture** is an $n \times 1$ vector where element i is the natural logarithm of the number of families chiefly employed in agriculture in parish i . Source: Census of Great Britain, 1831; Wrigley, Shaw-Taylor and Newton (2010).
- Log **traders and craftsmen** is an $n \times 1$ vector where element i is the natural logarithm of the number of males aged 20 or over employed in trade or in handicraft as masters or workmen in parish i . Source: Census of Great Britain, 1831; Wrigley, Shaw-Taylor and Newton (2010).

- Log **professionals** is an $n \times 1$ vector where element i is the natural logarithm of the number of males aged 20 or over classified as capitalists, bankers, professionals and other educated men in parish i . Source: Census of Great Britain, 1831; Wrigley, Shaw-Taylor and Newton (2010).
- Log **males** is an $n \times 1$ vector where element i is the natural logarithm of the number of males aged 20 or over in parish i . Source: Census of Great Britain, 1831; Wrigley, Shaw-Taylor and Newton (2010).
- **enclosure** is an $n \times 1$ vector where element i is equal to one if parish i was affected by any enclosure acts dated 1830 or earlier, and 0 otherwise. Source: Tate (1978); Satchell, Boothman, Shaw-Taylor, and Bogart (2016).
- Log **wealth** is an $n \times 1$ vector where element i is the natural logarithm of the annual value of real property in parish i (as assessed in April 1815). Source: Census of Great Britain 1831. (1831 (348) Population. Comparative account of the population of Great Britain in the years 1801, 1811, 1821, and 1831) and Shaw-Taylor, Broad, and Newton (2016).
- Log **petitions** is an $n \times 1$ vector where element i is the natural logarithm of the number of petitions originating from parish i and submitted to the House of Commons between 1828 and 1831. The petitions were related to abolition of slavery, parliamentary reform, and rights for Catholics (Catholic relief). The House of Commons (1831) reports a list of petitions with information on content and on who had written each of them. We geo-referenced the locations from which the petitions originated and matched this to the parish GIS using Satchell, Kitson, Newton, Shaw-Taylor, and Wrigley (2016).
- **newspaperN** is an $n \times 1$ vector where element i is equal to one if parish i is located within a 10km radius of a town with a local or regional newspaper, and zero otherwise. House of Commons from (1833) reports the stamp duties paid by the 130 newspaper published in England, and the names of the newspapers allow us to establish where they were published. Source: House of Commons from (1833).

- Log **distance to garrison** is an $n \times 1$ vector where element i is the natural logarithm of the “as the crow flies” distance in kilometers from a parish’s centroid to the nearest army or navy garrison. Source: War Office (1830).
- **policeN** is an $n \times 1$ vector where element i is equal to one if parish i is located within a 10km radius of a town with a police force. Source: Clark (2014).

A.3 Descriptive statistics and additional results

Table A1 shows the different types of Swing riot incidents in our dataset.

One concern is that riots near newspapers may have been more likely to be reported. In this case we would expect that proximity to newspapers would predict riots. House of Commons (1833) enables us to deduce the location of local and national newspapers. This return to the House of Commons from 1833 records the stamp duties paid by each of the 130 newspapers in England, and from the name of each newspaper we can establish its location.

In order to assess whether the newspapers systematically under-reported riots in distant rural areas, in Figure A1 we plot two distributions: the first is a distribution of distances to the nearest newspaper for all parishes that experienced at least one riot, and the second is of distances to nearest newspaper for parishes that experienced no riots. Under a null hypothesis of under-reporting, we would expect the first distribution to be much closer to the vertical axis, as this would show that the riots are indeed from an unrepresentative sample of parishes (unrepresentative in terms of distance to nearest newspaper). The fact that both distributions are so similar leads us to reject this null hypothesis.¹

Table A2 shows the correlations between variables, while A3 shows the summary statistics for the main variables used in our estimation. Table A4 shows the results for column 3 of table 1 in the main text, showing explicitly the coefficients for the structural factors of neighbors.

Table A5 shows the results when we only consider large and small incidents, respectively. Horn and Tilly (1988), as part of a larger dataset on “Contentious Gatherings in Britain, 1758-1834”, record 285 Swing Riot-related incidents (which are included in our dataset). These are coded from seven London-based newspapers, and a contentious gathering is defined as “an occasion on which a number of people (a minimum of 10) outside of government gathered in a publicly accessible place and made claims on at least one person outside their own number, claims which if realized would affect the interests of their object” (Tilly 1995; p.393). For 120 of these events, the underlying sources allowed Horn

¹Naturally, it is possible that in the absence of under-reporting we would find the first distribution to the right of the second, and that the under-reporting simply causes them to become closer than they would be otherwise. This seems unlikely, especially given that the distributions end up being very similar.

and Tilly (1988) to estimate the approximate number of individuals involved. Therefore this information is missing for most incidents, but we are still able to calculate the average number of individuals involved for the different types of events, which we record in table A1. Horn and Tilly (1988) do not record any arson or attempted arson, Swing letters or damage to crops and animal maiming; these events typically involved fewer than the 10 individuals required to qualify as a contentious gathering. Based on this information, we can divide the incidents into two groups:

- **Small incidents:** arson, attempted arson, damage to crops, fences and other property, animal maiming, Swing letters.
- **Large incidents:** machine breaking, robbery, wage and tithe riots, rescue of prisoners.

Table A6 shows robustness tests where the radius of the neighborhood is increased to 20km, when it is increased to 30km, when Kent is dropped, and when London is dropped.

A.4 References

Caird, J. (1852). *English agriculture in 1850-51*. London, England: Longman, Brown, Green and Longmans.

Clark, P. (2014). *Police and constabulary of England and Wales (eighteenth century until 2014)*. London, UK: Peter Clark; Kindle Edition.

Hobsbawm, E. and G. Rudé (1973). *Captain Swing*. Harmondsworth: Penguin University Books.

Holland, M. (2005). *Swing unmasked. The agricultural riots of 1830 to 1832 and their wider implications*. Milton Keynes, England: FACHRS Publications.

Horn, N. and C. Tilly (1988). Contentious gatherings in Britain, 1758-1834. *Inter-university Consortium for Political and Social Research ICPSR working paper 8872*.

House of Commons (1831). Index to 83-86th volume. *Journal of the House of Commons* 83-86.

House of Commons (1833). Newspaper stamps, England. Return to an order of the honourable House of Commons, dated 24 May 1833; for, an account of the number of stamps issued to each of the provincial newspapers in England, in the year ending on 1st April 1833. *Parliamentary Papers, Accounts and Papers* 569.

Tate, W. (1978). *A Domesday of English enclosure acts and awards*. Reading, UK: The Library, University of Reading.

Tilly, C. (1995). *Popular contention in Great Britain, 1758-1834*. Cambridge, MA: Harvard University Press.

War Office (1830). *A List of the Officers of the Army and of the Corps of Royal Marines, Full, Retired and half-pay*. London, UK: His Majesty's Stationary Office.

Table A1: The Swing riots, by type

Incident type	Number of incidents	Participants
Arson	1306	< 10
Attempted arson	54	< 10
Machine breaking (Threshing machines)	538	202
Machine breaking (other agricultural machinery)	47	n.a.
Machine breaking (Industrial machines)	35	n.a.
Sending anonymous threatening letters	270	< 10
Robbery	254	122
Wage riot	289	292
Tithe riot	67	496
Rescue of prisoners and police attacks	102	655
Damage to crops, fences, etc.	32	< 10
Animal maiming	74	< 10

Note: “Number of incidents” refers to the total number of Swing Riot incidents recorded by Holland (2005) for each type. “Participants” is an estimate of the average number of individuals involved in each type of incident, based on the 120 incidents recorded by Horn and Tilly (1988) for which this information is available. Sources: Holland (2005), Horn and Tilly (1988)

Figure A1: Distribution of distances to newspapers

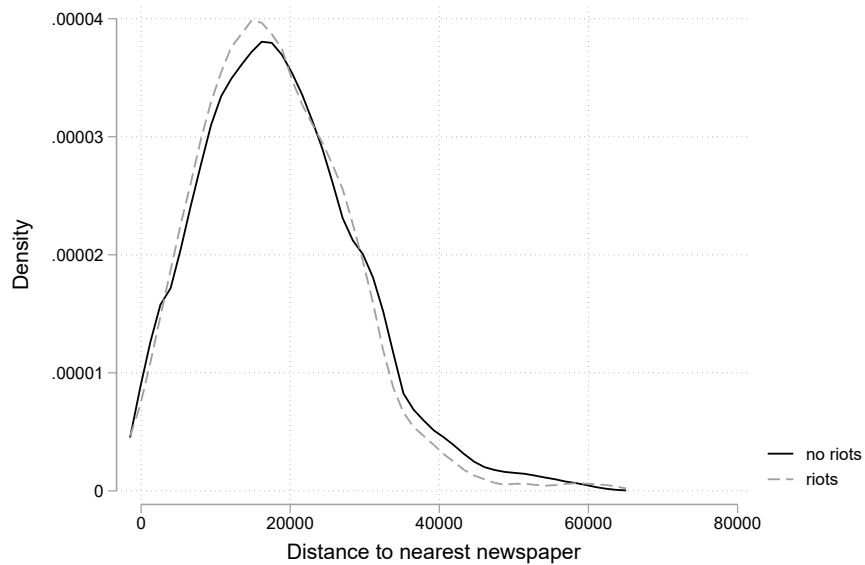


Table A2: Correlations

Variables	cereal	Log families in agriculture	enclosure	Log wealth	Log males	Log population	Log traders and craftsmen	Log professionals	Log petitions	newspapersN	Log distance to garrison	policeN
cereal	1.000											
Log families in agriculture	-0.032	1.000										
enclosure	-0.072	0.254	1.000									
Log wealth	-0.002	-0.293	-0.070	1.000								
Log males	-0.032	0.551	0.146	-0.629	1.000							
Log population	-0.033	0.541	0.144	-0.633	0.998	1.000						
Log traders and craftsmen	-0.056	0.391	0.135	-0.616	0.916	0.916	1.000					
Log professionals	-0.013	0.143	0.030	-0.426	0.764	0.769	0.789	1.000				
Log petitions	-0.037	0.206	0.137	-0.271	0.478	0.477	0.464	0.442	1.000			
newspapersN	-0.080	-0.122	-0.051	-0.089	0.074	0.079	0.105	0.137	0.011	1.000		
Log distance to garrison	-0.403	0.187	0.176	0.070	-0.140	-0.142	-0.160	-0.262	-0.068	-0.018	1.000	
policeN	-0.066	-0.028	-0.023	-0.070	0.057	0.061	0.064	0.080	0.014	0.423	-0.021	1.000

Table A3: Summary statistics

	N	mean	sd	min	max
riots	10,335	0.22	0.91	0	20
cereal	10,335	0.51	0.50	0	1
Log families in agriculture	10,317	3.73	1.14	0	6.77
Log males	10,317	5.42	1.21	0	11.2
enclosure	10,335	0.36	0.48	0	1
Log wealth	9,492	1.99	0.54	0	5.76
Log population	10,317	6.11	1.24	0	12.0
Log traders and craftsmen	10,317	3.02	1.58	0	9.86
Log professionals	10,317	1.37	1.31	0	8.60
Log petitions	10,335	0.25	0.51	0	4.06
newspapersN	10,335	0.22	0.41	0	1
Log distance to garrison	10,335	10.7	0.88	3.51	11.9
policeN	10,335	0.37	0.48	0	1
$W \times$ riots	10,335	0.21	0.36	0	4.72

Notes: The variable names refer to vectors. For each vector, N is the number of elements with non-empty values, mean is the average value of the non-empty elements, the standard deviation is calculated using the value of non-empty elements, and min and max refer to the minimum and maximum values taken by the non-empty elements.

Table A4: The effect of the structural factors of neighbors

VARIABLES	riots
cereal	0.057 (0.035) ⁺
Log families in agriculture	0.065 (0.020)**
enclosure	0.006 (0.015)
Log wealth	0.058 (0.023)*
Log males	0.018 (0.048)
Log population	0.001 (0.039)
Log traders and craftsmen	0.044 (0.015)**
Log professionals	0.036 (0.009)***
Log petitions	0.116 (0.028)***
newspapersN	-0.038 (0.032)
Log distance to garrison	-0.078 (0.078)
policeN	0.073 (0.022)***
W × cereal	0.005 (0.027)
W × Log families in agriculture	-0.022 (0.014)
W × enclosure	-0.188 (0.108) ⁺
W × Log wealth	-0.105 (0.074)
W × Log males	-0.302 (0.197)
W × Log population	0.260 (0.199)
W × Log traders and craftsmen	-0.017 (0.015)
W × Log professionals	-0.017 (0.024)
W × Log petitions	-0.178 (0.058)**
W × newspapersN	-0.022 (0.048)
W × Log distance to garrison	0.080 (0.085)
W × policeN	-0.090 (0.030)***
W × riots	0.935 (0.033)***
Observations	9,484
Dummies	County
Standard errors	Spatial
Estimation	SHAC

Notes: Standard errors in parentheses, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + < 0.1 . Constants not reported. The weight matrix **W** is row-normalized so that the sum of elements in any row j adds to 1, and **W** × **factor_k** is the average value of factor k among neighbors. This means that we use the average of each of the twelve factors in the 10km neighborhood of a parish.

Table A5: Results for large and small riots

VARIABLES	(1) large riots	(2) small riots
<i>Motivation</i>		
cereal	0.059 (0.026)*	0.027 (0.004)***
Log families in agriculture	0.046 (0.011)***	0.023 (0.006)***
enclosure	0.007 (0.015)	-0.003 (0.006)
Log wealth	0.037 (0.016)*	0.012 (0.006)*
Log males	0.020 (0.041)	-0.036 (0.023)
Log population	-0.029 (0.031)	0.038 (0.024)
<i>Organizational capacity</i>		
Log traders and craftsmen	0.036 (0.014)**	0.019 (0.004)***
Log professionals	0.011 (0.006)*	0.024 (0.006)***
Log petitions	0.057 (0.019)**	0.048 (0.011)***
newspapersN	-0.012 (0.014)	-0.012 (0.007) ⁺
<i>Repression</i>		
Log distance to garrison	0.005 (0.005)	-0.003 (0.005)
policeN	0.013 (0.008)	0.011 (0.006) ⁺
<i>Diffusion</i>		
W × large riots	0.905 (0.036)***	
W × small riots		0.576 (0.085)***
Observations	9,484	9,484
Dummies	County	County
Standard errors	Spatial	Spatial
Estimation	SHAC	SHAC

Notes: Standard errors in parentheses, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + < 0.1 . Constants not reported. The unit of observation is the parish, and element i in the vector **large riots** equals the total number of large riots in parish i during the Swing riots. For a parish i , **W** × **large riots** refers to the average number of large riots across parishes within 10km of its centroid (excluding riots that happened in i itself). Large riots refers to machine breaking, robbery, wage and tithe riots, rescue of prisoners. Element i in the vector **small riots** equals the total number of small riots in parish i during the Swing riots. For a parish i , **W** × **small riots** refers to the average number of small riots across parishes within 10km of its centroid (excluding riots that happened in i itself). Small riots refers to arson, attempted arson, damage to crops, fences and other property, animal maiming, threatening letters.

Table A6: Robustness

VARIABLES	(1) riots	(2) riots	(3) riots	(4) riots
cereal	0.078 (0.030)***	0.118 (0.037)**	0.101 (0.030)***	0.121 (0.035)***
Log families in agriculture	0.068 (0.016)***	0.076 (0.019)***	0.054 (0.012)***	0.077 (0.021)***
enclosure	0.005 (0.013)	0.006 (0.013)	0.014 (0.012)	-0.001 (0.016)
Log wealth	0.053 (0.021)*	0.042 (0.017)*	0.028 (0.013)*	0.054 (0.025)*
Log males	-0.073 (0.045)	-0.086 (0.043)*	-0.053 (0.039)	-0.058 (0.041)
Log population	0.061 (0.034) ⁺	0.072 (0.036)*	0.030 (0.032)	0.051 (0.035)
Log traders and craftsmen	0.056 (0.015)***	0.052 (0.015)***	0.064 (0.015)***	0.054 (0.015)***
Log professionals	0.039 (0.006)***	0.041 (0.009)***	0.024 (0.006)***	0.040 (0.011)***
Log petitions	0.103 (0.029)***	0.107 (0.031)***	0.111 (0.029)***	0.115 (0.033)***
newspapersN	-0.033 (0.013)**	-0.036 (0.014)**	-0.038 (0.010)***	-0.028 (0.011)**
Log distance to garrison	0.009 (0.006)	0.008 (0.009)	0.003 (0.007)	0.020 (0.010)*
policeN	0.022 (0.011)*	0.014 (0.012)	0.020 (0.010)*	0.027 (0.013)*
W × riots	1.196 (0.042)***	1.487 (0.091)***	0.780 (0.047)***	0.742 (0.049)***
Observations	9,484	9,484	9,085	9,245
County dummies	YES	YES	YES	YES
Standard errors	Spatial	Spatial	Spatial	Spatial
Estimation	SHAC	SHAC	SHAC	SHAC
Note	20km neighborhood	30km neighborhood	No Kent	excl < 20km London

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + < 0.1. Constants not reported. The unit of observation is the parish, and element i in the vector **riots** equals the total number of riots in parish i during the Swing riots. For a parish i , in column (1) **W × riots** refers to the average number of riots across parishes within 20km of its centroid (excluding riots that happened in i itself). In column (2) **W × riots** refers to the average number of riots across parishes within 30km of its centroid (excluding riots that happened in i itself). In columns (3) and (4) it refers to the 10km neighborhood, but excludes Kent and parishes near London, respectively. The SHAC estimator used to estimate the coefficients is implemented with the `sphet` package in R. The standard errors reported in these columns are robust to heteroskedasticity and spatial correlation.

A.5 Maps

Figure M1: The four agricultural regions of England and Wales

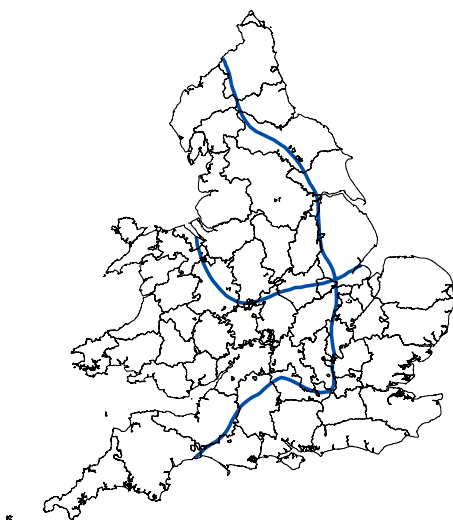


Figure M2: The locations from which petitions were sent

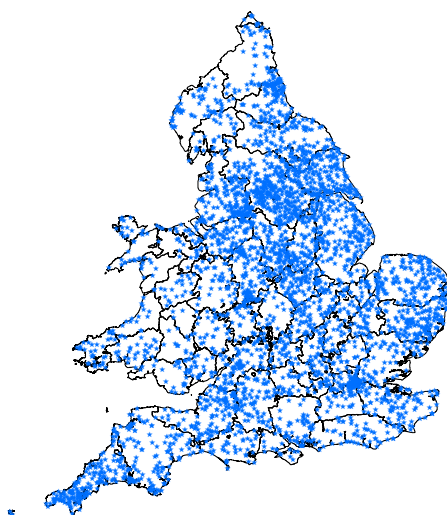


Figure M3: The location of regional newspapers

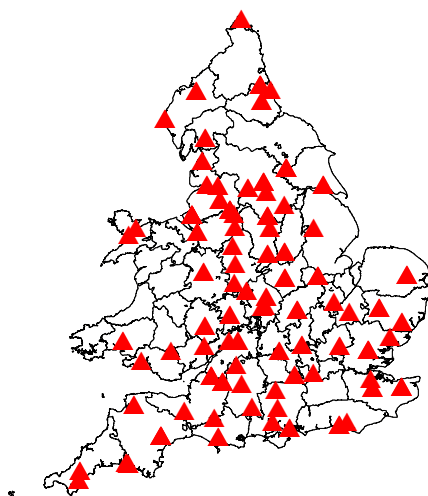


Figure M4: The location of police stations and garrisons. Each diamond represents a garrison and each circle represents a police station.

