Anthropometric history: revisiting what's in it for Ireland*

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Abstract

This research note updates Cormac Ó Gráda's (1996) critical review of research on the connection between the stature of the Irish, on the one hand, and their health and living standards, on the other. We find most of the datasets used pertain to Irish emigrants rather than those who stayed behind. We therefore argue prison registers are a more appropriate source of anthropometric information. But results derived from these registers need to be handled with caution as prisoners are a selected population. We uncover the various observable selection biases inherent in prison data, and track how they change across the second half of the nineteenth century. We find any changes in selection into crime across time are more likely to have been due to institutional rather than economic factors.

Keywords: anthropometrics, prison registers, sample selection, post-Famine Ireland.

JEL Codes: B81, N33, I15.

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1 Introduction

Prison registers were used to identify and track prisoners in an era before birth registration and identity documentation. Held in National Archives of Ireland and Public Record Office Northern Ireland, they are now a rich source in micro-level data for historical researchers, providing information on crimes committed, dates sentenced and released, recidivism, religion, literacy, marital status, occupation, age, height and weight. They are one of the main sources of anthropometric data – measurements and proportions of the human body – for the Irish population that remained in Ireland (Ó Gráda 1996).

Previous anthropometric studies using prisons (e.g., Ó Gráda 1991, 1994) refer to samples of prisoners in two specific prisons, Clonmel Gaol in County Tipperary, and Kilmainham Gaol in County Dublin. However, there are extant records available for 38 local county prisons, 96 bridewells and four convict prisons over the entire nineteenth century (O'Sullivan and O'Donnell 2003). As few other individual-level sources of information remain, these registers are essential to answer questions about changing health and human capital of Ireland's resident non-migrant population.

But while prison registers are an important source, they are not a panacea. Bodenhorn et al. (2017) have recently found that various selection biases plague the anthropometrics literature. Some of these are observed biases, others are unobserved and even unobservable. They have put well-known published findings into doubt, including work which argues there was a decline in living standards during the Industrial Revolution.

The purpose of our research note is to investigate these selection biases for the Irish case. We argue that identifying and describing the various possible biases will permit future scholars to take them into account in their own anthropometric, or otherwise, research. We aim to reduce the quantity of unobserved biases by making as many as possible observed, and showing how scholars can control for these in their anthropometric research. Our understanding of the history of the health and human capital of the Irish people will consequently be much more robust.[1]

Ó Gráda's (1991) study of Clonmel prisoners' heights argues 'prisoners are representative of the population at large' (p. 26). He draws this conclusion from the fact that most prisoners were first-time offenders. However, in our view this is insufficient evidence of their representativeness. What is currently missing from his, and other, anthropometric studies is the necessary context with which to interpret cliometric analyses of prisoners' heights. By context,

[1] Accounting for the remaining unobservable characteristics has been the subject of wider discussion in econometrics (e.g., Heckman 1976), and very recently also in economic history (Zimran 2019a,b).

we mean the circumstances which form the setting under which the data were recorded. In particular, there is insufficient understanding of the relevant *economic* and *institutional* context among the users of institutional records. If we are to take the economics of crime literature seriously (see review in Friedman 1999), then it is possible that the selection into prisons can change over time according to the socioeconomic circumstances of the population from which the prisoners are drawn, in addition to changes in the institutions of the criminal justice system that affect the level of incarceration. These changes must be better understood and related to institutional records before we can draw any inferences on prisoners' human and health capital. In short, the questions we need to address to fully understand the necessary context are as follows: (1) who ends up in jail and how; and (2) how does this change, if at all, over time.

This research note discusses the institutional structure of Irish law enforcement and punishment. We first survey existing literature on anthropometric studies of Ireland and of Irish people both at home and abroad. We then study the main source material for Irish people remaining in Ireland to assess the institutional nature of these sources (i.e., how people entered the prison system) and whether crime was responsive to economic factors (i.e., selection into crime). We show all areas of the island were overpoliced (relative to the rest of the UK), policing was efficient, custodial sentences were used for both serious and petty criminal offences, and the majority of prisoners were convicted for being drunk and disorderly. We find any changes in selection into crime across time were more likely due to institutional than economic factors.

2 Review of anthropometric studies

Modern growth models implicitly assume Thomas Malthus's 'positive check to population' to mean premature death (e.g., Galor 2005, 2011). But Malthus (1798) himself took a more nuanced perspective: a generational lowering of living standards that manifests itself in bad health, where mortality is just an extreme case of bad health. While the generation directly affected by a positive check may eventually die prematurely, they also suffer health and social consequences in their own, shortened, lifetime. And one manifestation of such a check, which Malthus highlights explicitly in his work, is stunted body growth. Anthropometrics, the scientific study of the measurements and proportions of the human body, can therefore be dated to at least the work of Malthus.

Today, stature is widely used as an anthropometric indicator of the health status of a population in both the economic history and development economics literatures (e.g., Fogel 2004; Deaton 2013). Analysis of height data is at the core of the Cliometric Revolution, led to at least one Nobel Memorial Prize in Economics (for Robert Fogel), and even helped to spawn an academic journal (*Economics and Human Biology*). Heights reflect health and living standards

from an outcome-oriented viewpoint. The mean stature of a population is a function of both official and unofficial income, such as subsistence farming, public goods, and illicit trading (Steckel 1995). Heights also have been found to be sensitive to the level of income inequality (Deaton 2008). The height of a generation is determined around the time of its birth, with health standards of mothers as well as nutritional and health standards of infants playing a crucial role (Eveleth and Tanner 1976; Steckel 1995). Evidence from modern-day Africa suggests genetic explanations for height differences are not convincing (Deaton 2007); differences across one society are much more likely due to ecological factors.

Malthus (1798: p. 44) viewed the incidence of famine as 'the last and most dreadful mode by which nature represses a redundant population'. The work of this Anglican cleric and demographer has cast a long shadow over Irish economic history, with pre-Famine rural Ireland often viewed as having had unsustainable population levels, and the Great Irish Famine interpreted as a Malthusian catastrophe.[2] A number of studies have already used anthropometric indicators, and especially average societal height, as a way of analysing Malthusian pressures. Below we update the review of such studies presented in Ó Gráda (1996), the article which our research note is built on.

Most anthropometric studies have collected data recorded during the period 1800-1850, such as Australian transportation records, East India Company registers, Royal Marine and Army records and prison registers (Nicholas and Steckel 1997; Mokyr and Ó Gráda 1996; Floud et al. 1990). However, these studies do not contain much, if any, information regarding the cohorts born *during* the Famine itself. One notable exception is the data compiled by Fogel et al. (1990) and used, among others, in A'Hearn (1998). This contains the height of soldiers serving in the Union Army during the American Civil War, and includes Irish-born immigrants to the US from cohorts born both before and during the Famine period.

But even where data are available on Famine-born individuals, these do not refer to samples derived from the population resident *in* Ireland, but rather to the Irish-born found elsewhere. None explicitly take account of the various selection biases that may occur, most notable due to migration. A consistent finding of these studies is that the pre-Famine Irish enjoyed a considerable height advantage over the peoples of Great Britain, despite their relative poverty – a result many attribute to the superior nutritional diet composed primarily of potatoes and butter milk. A key facet overlooked in these studies, however, is how the changing diet in the Famine and post-Famine periods might have influenced these observed trends.[3]

[2] See Connell (1950), Mokyr (1984), McGregor (1989) and Kelly and Ó Gráda (2015) for discussion of the Malthusian debate.

[3] Clarkson and Crawford (2001) note that potato consumption declined as tillage land dropped by 50% between the 1860s and 1910.

Findings from several studies that have used British military data suggest that there is a noticeable scarring effect from the Famine. Floud et al. (1990: p. 205), who use data from volunteer army and navy recruits, find a significant decline in the average height of Irishmen born in the 1840s.[4] In the subsequent decades they find that heights rebound among Irish families that 'survived and stayed'. Using the same data, but different methods, Komlos (1993: pp. 133-136) finds that the downturn in average heights had already began in the 1830s, which he attributes to Malthusian pressures foreshadowing the Famine.[5] However, neither Floud et al. (1990) nor Komlos (1993) dealt with the selection biases inherent in the volunteer army sample, such as changes to the supply and demand for soldiers over time and the place of origin of recruits in Ireland.[6] This point is addressed by Mokyr and Ó Gráda (1988, 1994, 1996), who use comparable volunteer army recruits, this time from the East India Company over the period 1800 to 1860.

Studies using anthropometric data from the penal system find declining height trends before the Famine. Nicholas and Steckel (1997) use a sample of Irish-born men and women transported to New South Wales between 1817 and 1840. They find a modestly declining height trend for male cohorts born in the 1770s through to the 1820s. Riggs (1994) uses decadal samples from prisons in Glasgow over the period 1840 to 1880, which includes Irish-born migrants. He finds that trends in mean heights were declining for those born in the 1810s to the 1830s, but that these rebounded for those born in the 1840s. Riggs interprets his results to indicate that the nutritional status of the Irish-born in Scotland was already under pressure *before* the Famine.

New life was given to the debate by a series of studies exploiting data from the 1930 *Harvard Anthropological Survey of Ireland*.[7] Relethford (1995) and Young et al. (2008) use these data to answer whether there was an observable increase in stature in post-Famine Ireland. Both studies find evidence to support scarring, which Young et al. (2008) attribute to relief of Malthusian pressures. However, as Relethford (1995) notes, to fully address the potential impact of the Famine, data on heights before, during and after the Famine are needed, which the Harvard survey does not contain. Using a small dataset collected by Beddoe (1870) from the voluntary measurement of men and women in the 1860s, they suggest that pre-Famine height trends were not too dissimilar from post-Famine trends and tentatively concluded that 'the Famine did not have a dramatic effect on adult stature' (Relethford 1995: p. 252).

[4] This famine effect was noticeable when estimating long-run trends, so much so that Floud et al. (1990: pp. 211-212) decreed that those born in famine years should be omitted as outliers.

[5] Komlos is critical of the underlying methods used by Floud et al. (1990) to address the truncated height distribution resulting from minimum height requirements

[6] The sampling strategy of 5,000 observations-per-decade may influence this trend; a larger share of Irish-born were recruited in the 1860s than in the 1870s (Floud et al. 1990: p. 90). Furthermore, they fail to distinguish between urban and rural-born in among Irish recruits; most Irish-born recruits were from urban centres (McLaughlin 2017).

[7] See Hooton and Dupertuis (1955) for description of these data.

Blum and McLaughlin (2019) use a re-discovered dataset from an experiment measuring the height of university of Edinburgh students in the 1830s. It shows little evidence of Malthusian pressures foreshadowing the Famine. A study by Forbes (1838) was later cited by Kane (1848) as evidence that 'when at all well fed, there is no race more perfectly developed, as to physical conformation, than the inhabitants of Ireland'. Kane in turn is cited in Mokyr and Ó Gráda (1988, p. 227). The rediscovered data shows that Irish students enrolled in Edinburgh were incredibly tall by the standards of the day (20 year olds were 179cm) and were not far off modern-day standards. Of course, the dataset used is rather small, and constitutes an already elite Irish-born class which left the island in pursuit of elite higher education.

Blum et al. (2017b) is the most expansive contribution to the study of Irish heights. It enjoys a key advantage over other recent contributions: the data used pertain to non-migrants. The paper aims to measure the long-run health impact of the Great Irish Famine on Ireland's residual population, those who did not die or emigrate. It does so by isolating 21,000 individuals from two prison registers who were born immediately before, during or immediately after the Famine. Alongside information on eye colour, hair colour and skin complexion, height was consistently recorded in these prison registers. This was because it was used as a means of identifying prisoners in a time where identity cards were non-existent, and fingerprinting was not yet in wide use. With the introduction of a uniform prison administration for the island, a standard set of rules on prisoner admission was also introduced.[8] This makes the data collected across prisons on entry consistent and comparable.

3. Institutional biases in prison data

Prison registers are one of the most widely available and accessible sources of information for Irish people who remained in Ireland, however to fully utilise this data requires understanding two separate selection issues: (1) selection from the general population into crime; and (2) selection from crime into our prisons. Bodenhorn et al. (2017), applying a Becker (1968) style approach, see individuals as being influenced by the net present value of the benefits and costs of committing crime. This benefit-cost matrix can vary temporally depending on, for example, institutional change, or fluctuations in the business cycle. Different individuals may select into crime at different times, depending on the prevailing benefit-cost matrix. In order to fully address this selection issue, we must understand whether this type of benefit-cost matrix is evident in our underlying population. We describe Ireland's criminal justice system, catalogue the types of

[8] Rule number 10 of the general prison rules of 1888 states that 'the name, age, religious denomination, height, weight, features, particular marks, and general appearance of a prisoner shall, upon his admission, be noted in a nominal record of prisoners to be kept by the Governor' (BPP 1888).

crime individuals committed and were imprisoned for, and discuss whether and how this changed over the period under investigation.

Ireland's criminal justice system was highly sophisticated; Kilcommins et al. (2004) note it was 'incongruous with its level of industrialisation'. Figure 1 outlines our schema of this system. Crimes were either reported or observed by police. How they were subsequently dealt with depended on how they were classified. Essentially, there were two types of offence, and the demarcation depended on the crime's severity: indictable offences (trial-by-jury) and summary offences (non-jury cases). Indictable offences related to more serious offences, such as murder, manslaughter, rape and grand larceny.[9] Summary offences were often petty crimes, such as drunkenness, common assault, vagrancy, petty theft, and transgressions of acts of parliament, such as infringements against the poor law acts, revenue laws and food adulteration. Toward the end of the century, summary offences were regarded as 'civil transgressions' or 'quasi-criminal offences' (BPP 1892: p. 17; BPP 1902: p. 11). Nevertheless, summary offences comprised the majority of crimes prosecuted in Ireland over the entire nineteenth century.[10]

The police were the central point of any criminal investigation and they acted as prosecutors. County constabularies were established in 1822. Paramilitary forces modelled on the French *gendarmerie*, these were centralised into an Irish constabulary in 1836. Dublin City maintained its own police force, the Dublin Metropolitan Police. Ireland was heavily policed, with three times as many police per capita as England and Wales (Kilcommins et al. 2004: p. 13).[11] This disparity of policing levels persisted over time.[12] Constabulary returns from census occupations and other sources suggest rural areas of the island were similarly highly policed.[13] The high police manifestation suggests a strong law enforcement presence throughout the period of our study.

Apprehension rates were high (75 per cent), consistently higher than contemporary apprehension rates in England and Wales (50 per cent) (BPP 1874: p. 28). The higher police presence led contemporaries to argue that the Irish police force had better knowledge of the character of those apprehended for crimes committed. The majority of those apprehended were previously known to police and, of those known, the majority were of previous good character,

[9] Although some indictable offences were dealt with summarily, these constitute a very small share.

[10] Prison inspectors in 1824 noted that most prisoners had committed minor offences (BPP 1826). Later prison reports emphasised that 'drunkenness is the main source and cause of crime' (BPP 1874: p. 13; BPP 1875: p. 13).

[11] E.g., in the 1860s, the number of police in Ireland were approximately half the number of those in England and Wales (13,812 versus 22,622) but the population of Ireland was only a quarter (BPP 1864).

[12] E.g., in the 1880s, the Dublin Metropolitan Police had more police per capita (336 per 100,000 capita) than the London Metropolitan Police (230 per 100,000 capita), and much higher police per capita compared with similarly-sized cities, such as Manchester and Leeds (230 and 120 per 100,000 capita) (BPP 1888).

[13] Tipperary, the county in which Clonmel Gaol was situated, had a large police presence relatively to the population (442 per 100,000 capita according to the 1891 census).

primarily because many had committed only minor offences.[14] If we assume that law enforcement officers were equally efficient throughout Ireland, this implies that the likelihood of being detected, and penalised, for committing a crime was uniformly distributed through the island.

Tracing levels of criminality over time is made difficult by the fact that what was deemed a criminal offence varied over time. For example, a person who selects into a criminal activity in 1841 may repeat the same activity in 1891, but no longer be deemed to be a criminal for doing so. Also, the social tolerance for types of behaviour can change, and some minor offences can be punished with greater or less vigour depending on prevailing social norms. Perhaps the case in point was drunkenness, which was prosecuted with greater intensity following the 1872 Licencing Act (BPP 1872: pp. 31-32; BPP 1874: p. 13).

Criminal justice statistics, published annually from 1864, were intended to be used to make comparisons between Ireland and England, but their function evolved to provide comparison of prevailing crime trends. These data show that over the period 1864 to 1910, summary offences vastly outnumbered indictable offences by a ratio of 28-to-1. Figure 2 shows trends in indictable offences for this period.[15] There is significant variation in the data, with clear peaks (1864, 1881, 1882, 1898, 1908) and troughs (1888-1894).[16] Figure 3 shows the distribution of indictable offences, the overwhelming majority of which were classified as 'offences against property without violence'.

While non-violent larceny was the main crime in this period, during the spike in crime in 1881 and 1882 the majority of these were for offences such as writing threatening letters, the most common form of 'agrarian outrage' during the Land War (McLaughlin 2015). Summary offences, shown in Figure 4, do not display such extreme variability.[17] Of the 206,193 summary offences proceeded against in 1881, 78,573 were for 'drunkenness and drunk and disorderly'. The second-most common offence was common assault, with 30,088 cases proceeded against, and it was observed that both were 'closely connected with one another' (BPP 1892: p. 17).[18] Data from parliamentary returns of the number of people arrested for drunkenness show that it was a common offence throughout the island (BPP 1877; BPP 1883).[19]

[14] The English police forces had less knowledge of the character of those proceeded (30% versus 15% in Ireland), a factor that was attributed to 'the greater number of foreigners and the greater aggregation of the people in cities and towns in England than in Ireland' (BPP 1872: p. 30).

[15] The number of offences averaged 8,146 per year and 168 per 100,000 capita.

[16] The coefficient of variation for both the number of offences and offences per capita was 21% and 24%.

[17] The number of summary offences averaged 220,092 and the number of offences per capita averaged 4,490 per 100,000. The coefficient of variation for the number of summary offences and the number of summary offences per 100,000 capita was 11% and 8%.

[18] Drunkenness and common assault together accounted for 53% of all summary offences.

[19] In the 1877 and 1883 the mean arrests per 100,000 capita was 1,902 and 1,745, with standard deviation of 694 and 623. Arrests per 100,000 capita in 1883 there were 3,604 in Dublin versus 2,162 in Tipperary.

Contemporaries were aware that summary offences dominated the criminal justice system, and argued that other indicators of crime were more appropriate to gauge the level of criminal activity. Their view was that summary offences were primarily of a 'civil nature', and so should be excluded from the statistics.[20] Another approach was to assess "fresh crime" in a year: 'the statistics of commitments of persons not previously committed to any prison afford the best goal test of the amount of fresh crime in the year' (BPP 1873: p. 45).[21] An approach used by criminologists to measure crime more consistently across time is to use homicides (see, e.g., O'Donnell 2005; McMahon 2013). Homicide has the attraction of having a consistent definition (i.e., a body count), is less subject to under-reporting, and is correlated with other forms of crime (Fajnzylber et al. 2002). Homicide rates in nineteenth-century Ireland were low by modern standards.[22]

The final issue to understand is how crime was tried and punished. Both indictable and summary offences were punished with a mixture of custodial and non-custodial sentences. Custodial sentences were the predominant punishment for indictable offences; fines had a similar function for summary offences. Legislation stipulated specific fines for breaches for many summary offences (BPP 1872: p. 39). There was a much greater reliance on fines in Ireland than in England for comparable offences.[23] This, contemporaries suggested, was because Petty Sessions, the court that heard such cases, had a financial interest in the fines imposed (BPP 1882: p. 18).

The most severe punishment, execution, was rare, with only 0.01 per cent of indictable offences receiving the death penalty in 1881. Shorter sentences (under six months) were more widely allocated as a punishment for indictable offences. However, most of the prison population consisted of summary offenders. With respect to these more minor offences, fines were the most common punishment, even in the case of drunkenness and common assault. However, ten per cent of drunkenness and common assault offences received custodial sentences.[24] The custodial sentences given for drunkenness in particular put enormous strain on the prison system and accounted for 50 per cent of all prisoners in Ireland in 1900 (BPP 1900: p. 9).

The average daily imprisonment rate from 1839 to 1909 is shown in Figure 5. The average daily rate was 62 per 100,000 capita, with a noticeable peak during the Famine. The reports

[20] The 'number of "indictable offences" may be taken as the more correct standard by which to measure the prevalence of crime in relation to the population' (BPP 1902: p. 10).

[21] First-time offenders were 68% of total offenders imprisoned in 1873, 77% in 1881 and 44% in 1891. However, the data do not provide details of those deemed to have committed "fresh crime" who received non-custodial sentences.

[22] For Ireland as a whole, the rate ranged between 1.44 to 1.85 per 100,000 capita. In the early period of our study, Tipperary was the more violent of the two locations, with homicide rates of 5.92 and 3.60 in the 1840s and 50s, but this fell to 2.51 by the end of the century. Dublin increased from 1.44 in the 1840s to 4.13 in the 1890s.

[23] In England the ratio of fines to imprisonment was 1-to-3.5; in Ireland this was 1-to-8 (BPP 1882: p. 30).

[24] We are likely, therefore, to be observing poorer individuals, who could not afford these fines.

from the inspector generals of prisons outline three reasons why the prison population increased: distress from the Famine, the sudden cessation of transportation to Australia as a form of punishment, and the Vagrancy Act, which criminalised vagrancy and prescribed a custodial sentence (BPP 1847-48). The effect of the Famine was said to have 'quadrupled the evils occasioned by the two last'.[25] All these factors led to overcrowding of the prison system, with 12,883 prisoners held in prisons designed to hold 5,655 prisoners. The Famine period withstanding, the data indicate that custodial sentences were quite common. For the purpose of our study, it is important that we exclude those incarcerated during the Famine because this period saw individuals selected into prison in ways that are difficult to quantify. Any results that include such individuals would be rendered difficult to interpret.[26]

The spike in the prison population during the Famine illustrates an important point about crime and institutions: changes in institutional structures affected the prison population at the same time as a severe economic shock. However, without knowledge of this changing institutional context it might be appealing to attribute all of the increase in incarceration solely to the changing economic circumstances. Any analysis of prison populations needs to be aware of these changing institutional contexts. Prisons may cater to different segments of criminal classification depending on the time period. If possible, various measures need to be considered which re-weight prison samples to mitigate the impact of these institutional changes.[27]

What is evident from the historical record is that there were effectively three "prison regimes" over the nineteenth century. The first, from 1791 to 1853, saw the removal of a segment of criminals from the UK as a punishment for what were deemed the most severe crimes: over this period, 26,500 convicts were transported to Australia (Kilcommins et al. 2004: p. 17).[28] Transportation was replaced with penal servitude and this was accompanied by the opening of the first "state prison", Mountjoy, in 1850.

A further administrative change occurred in 1877, when prisons throughout Ireland were centralised under the General Prisons Board. This resulted in a change in the classification of prisoners being held county gaols such as Kilmainham and Clonmel: they were to be used for 'untried and prisoners under sentence, males for sentences not exceeding 12 months and females not exceeding 6 months' (BPP 1878-79, p. 37). From 1877 onwards, prisoners serving longer-

[25] Another factor was that people that were receiving indoor poor relief were rioting in an attempt to get transferred from the workhouse to the prison system, where conditions were considered better (BPP 1847-48: p. 8).

[26] Very few such individuals are eligible for inclusion in our sample anyway, as they would have been too young to be eligible for prison, even when adopting our 10-year study window.

[27] For example, prisoners could be assigned a weight according to their relative representativeness in the closest census year, by religion and profession (see Blum et al. 2017a, 2017b).

[28] The cumulative figure for transportation is eye-catching, but it was less dramatic on an annual basis; over the period 1839-44 transportation accounted for 9% of all sentences.

term sentences were sent to specialist convict prisons: Lusk (Dublin), Mountjoy (Dublin), and Spike Island (Cork).

4. Economic biases in prison data

Given our knowledge of the institutional and historical context described above, how did individuals select into crime across the post-Famine era between the 1860s and 1910s? How responsive was crime to year-on-year fluctuations in economic and social conditions, such as to the business cycle? Bodenhorn et al. (2017) describe a mechanism which suggests economic opportunity may alter the composition of prison samples. Contemporaries were also interested in this question. For example, the criminal justice statistics compilers in 1973 remarked how 'notwithstanding the unfavourable character of the harvest last year, producing pressure on the poor and withdrawal of saving' there was a decrease in year-on-year crime; 'the pressure has been attended with a diminution of crime' (BPP 1873: p. 10).[29]

Changing opportunity costs of crime, such as job opportunities and levels of income, may alter the necessity and attractiveness of criminal activity. If such a bias is detected, prison samples may be subject to bias and this bias may change as the opportunity cost of crime changes. Some of these biases may be detected by comparing, and then correcting, prison samples using census reports.[30] However, such a methodology cannot disentangle economic from institutional selection mechanisms, and hence we need to make use of some econometrics. We therefore test whether the prison population was responsive to changing economic conditions using a series of time series analysis of key macroeconomic performance indicators.

We use the annual homicide rate per 100,000 inhabitants and the average daily incarceration rate per 100,000 inhabitants to proxy crime and conviction on the island. The following indicators serve as a proxy of economic opportunity, i.e., the opportunity cost of criminal activity: real GDP per capita (£, 1841 prices); bank deposits per capita (£, real terms); a price index of the Dublin stock market (1964 = 100); and an index of agricultural prices (1856-60 = 100). Indices depicted in Figure 6 illustrate the data we used in our analysis. The data we use here refer to the period 1854-1913 so as to exclude the core Famine years, which we already know to have been very different; analysis which would include those incarcerated during this demographic catastrophe would not yield any of the more nuanced selection biases we are aiming to discover.

[29] During the Land War period, comparisons were made between the crime statistics and falls in bank deposits and use of the poor law as indicators of 'pressure' (BPP 1882: p. 15).

[30] While individual-level census data no longer survive for Ireland, Parliamentary Papers report summary statistics by census district (see Blum et al. 2017b).

As the data are time-series in nature, we test for stationarity; we cannot reject the presence of unit roots and subsequent analysis of the data accounts for this. Basic levels OLS regressions indicate that all variables are co-integrated. We therefore report autoregressive distributive lag models (ARDL (p,q)) with an error correction component.[31] In these regressions, the β represents long-run correlation and α is the error correction.

For incarceration rates all regressions display negative and statistically significant values for α whereas values for β are positive but not statistically significant. For homicide, the autoregressive lag models all regressions display negative and statistically significant values for α, whereas values for β are negative for GDP and the stock exchange indices, but positive for deposits and the price index. However, only deposits are statistically significant. The implication of this exercise is that there is some weak evidence that as Ireland got richer there was a fall in crime (as measured here by incarceration rates and homicide).

Our results do not provide very strong evidence that the economic performance of the Ireland influenced homicide or incarceration rates in any meaningful sense. We therefore cannot conclude that the size and composition of the prison population in Ireland was particularly responsive to changing economic conditions. The alternative hypothesis, that institutions mattered more than economics, is a closer approximation to the historical record of crime trends in Ireland; in fact, we see some evidence of structural breaks in the 1870s coinciding with changes in prison regimes.

This result runs counter to the view held by most contributors to the literature on the economics of crime (see, e.g., Freeman 1999). But it is far less surprising following a broader reading of the criminology literature. Pratt and Cullen's (2005) meta-study of the determinants of violent crime outlines at least seven competing macro theories commonly tested in this literature. They find rational choice theory, classically associated with Becker (1968), receives the weakest support across studies. Social disorganisation theory, which stresses the role of institutions, receives the strongest backing.

5. Conclusion

We argue any differences in selection into crime across time were much more likely the result of institutions. More specifically, we take the view that the various institutional reforms to the criminal justice system are key to understanding any changes to selection into crime. We collapse these institutions into three so-called "prison regimes", and mark with vertical lines in Figure 6.

[31] P lags of the crime indicator and q lags of the economic indicator, with lags chosen by the Akaike information criterion. We also test for structural breaks and where breaks are detected the model is subsequently adjusted. Breaks were detected for incarceration rates and price index, and homicides and real deposits.

Anthropometric studies using Irish prison registers must control for these prison regimes, alongside other political events which potentially saw a change in the attributes of prisoners. Scholars working with prison data pertaining to other times and places must make similar adjustments.

Prison registers can be used to answer questions about developments in Irish living standards. We can also use them to re-visit issues such as what was the long-term effect of the Industrial Revolution and Famine. A recent study by Blum (2012) looks at the effect of famine during the first World War on the German population using military records. The Blum methodology can be used to analyse the effects of ecological distress in Ireland, including the Great Irish Famine of the 1840s, and agricultural crises in the early 1860s and late 1870s. We do exactly this in a companion paper (Blum et al. 2017b).

An additional question to be addressed is the effect of slum conditions on urban populations. Dublin city grew steadily from a population level of 176,610 in 1813 to 290,638 in 1901 (Vaughan and Fitzpatrick 1978), however the city was reputed as being a slum (Prunty 1998). These slum conditions differed from those reported in contemporary British, European and North American cities as the Dublin slums were not a corollary of Irish industrialisation. Therefore, it would be interesting to see how conditions in the Dublin city differed from those elsewhere, in particular in comparison to Belfast. Such an exercise would likely require the use of spatial data and methods from the digital humanities.

References

Archival sources

National Archives of Ireland (1798-present). Prison Registers, pris1 and mrgs51. [Closed for 70 years from last date of entry on the register.]

Official publications

British Parliamentary Papers (BPP) (1823). Report of inspectors general on the general state of the prisons of Ireland, (342).
_____ (1826). Fourth report of the inspectors general on the general state of the prisons of Ireland. (173).
_____ (1840). Eighteenth report of the inspectors general on the general state of the prisons of Ireland, 1839. [240].
_____ (1843). Twenty-first report of the inspectors-general on the general state of the prisons of Ireland, 1842. [462].
_____ (1847-48). Twenty-sixth report of the inspectors-general on the general state of the prisons of Ireland, 1847. [952].
_____ (1849). Twenty-seventh report of the Inspectors-General on the general state of the prisons of Ireland, 1848. [1069].
_____ (1851). Abstract of census of Ireland, 1841 and 1851. (673).
_____ (1865). Judicial statistics, 1864, Ireland. [3563].
_____ (1867). Forty-fifth report of the inspectors-general on the general state of the prisons of Ireland, 1866. [3915].
_____ (1867-68). Judicial statistics, 1867, Ireland. [4071].
_____ (1868-69). First annual report of the registrar-general of marriages, births, and deaths in Ireland. [4137]
_____ (1871). Criminal and Judicial Statistics, 1871. [C.674].

_____ (1873). Fifty-first report of the Inspectors-General on the general state of the prisons of Ireland, 1872 .[C. 837].
_____ (1873). Criminal and judicial statistics, 1872, Ireland. [C.851].
_____ (1874). Fifty-second report of the Inspectors-General on the general state of the prisons of Ireland, 1873. [C. 966].
_____ (1874). Eighth annual report of the Registrar-General of the marriages, births, and deaths in Ireland. [C.968].
_____ (1874). Criminal and judicial statistics, 1873, Ireland. [C.1034].
_____ (1875). Fifty-third report of the inspectors-general on the general state of the prisons of Ireland, 1874. [C.1256].
_____ (1877). Drunkenness (Ireland). (124).
_____ (1878-79). First report of the General Prisons Board, Ireland, 1879; with appendices. [C.2447]
_____ (1882). Criminal and judicial statistics, 1881, Ireland. [C.3355].
_____ (1884). Summary proceedings for drunkenness in 1883 (Ireland). (1).

Secondary literature

Andersson, F. N. G., and Lennard, J. (2018). Irish GDP between the Famine and the First World War: Estimates based on a dynamic factor model. *European Review of Economic History*, Advance Access, https://doi.org/10.1093/ereh/hey003.

A'Hearn, B. (1998). The antebellum puzzle revisited: A new look at the physical stature of Union Army recruits during the Civil War. In: Komlos, J., and Baten, J. (eds), *The Biological Standard of Living in Comparative Perspective*. Stuttgart: Franz Steiner Verlag, pp. 250-267.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy* 76(2), pp. 169-217.

Beddoe, J. (1870). *On the Stature and Bulk of Man in the British Isles*. London: Asher.

Blum, M. (2011). Government decisions before and during the First World War and the living standards in Germany during a drastic natural experiment. *Explorations in Economic History* 48(4), pp. 556-567.

Blum, M., Colvin, C. L., McAtackney, L., and McLaughlin, E. (2017a). Women of an uncertain age: Quantifying human capital accumulation in rural Ireland in the nineteenth century. *Economic History Review* 70(1), pp. 187-223.

Blum, M., Colvin, C. L., and McLaughlin, E. (2017b). Scarring and selection in the Great Irish Famine. QUCEH Working Paper Series, Queen's University Belfast. Paper No. 17-08.

Blum, M., and McLaughlin, E. (2019). Living standards and inequality in the Industrial Revolution: Evidence from the height of University of Edinburgh students in the 1830s. Mimeo, University College Cork.

Bodenhorn, H., Guinnane, T. W., and Mroz, T. A. (2017). Sample-selection biases and the "industrialization puzzle". *Journal of Economic History* 77(1), pp. 171-207.

Clarkson, L. A., and Crawford, E. M. (2001). *Feast and Famine: Food and Nutrition in Ireland 1500-1920*. Oxford: Oxford University Press.

Deaton, A. (2007). Height, health, and development. *Proceedings of the National Academy of Science* 104(33), pp. 13232-13237.

_____ (2008). Height, health, and inequality: The distribution of adult heights in India. *American Economic Review: Papers & Proceedings* 98(2), pp. 468-474.

_____ (2013). *The Great Escape: Health, Wealth, and the Origins of Inequality*. Princeton: Princeton University Press.

Eveleth, P. B., and Tanner, J. M. (1976). *Worldwide Variation in Human Growth*. Cambridge: CUP.

Fajnzylber, P., Lederman, D., and Loayza, N. (2002). What causes violent crime? *European Economic Review* 46(7), pp. 1323-1357

Floud, R., Wachter, K., and Gregory, A. (1990). *Height, Health and History: Nutritional Status in the United Kingdom 1750-1980*. Cambridge: Cambridge University Press.

Fogel, R. W. (1994). Economic growth, population theory, and physiology: The bearing of long-term processes on the making of economic policy. *American Economic Review* 84(3), pp. 369-395.

_____ (2004). *The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the World*. Cambridge: Cambridge University Press.

Floud, R., Fogel, R. W., Harris, B. & Hong, S. C. (2011). *The Changing Body: Health, Nutrition, and Human Development in the Western World since 1700*. Cambridge: Cambridge University Press.

Fogel, R. W., Engerman, S. E., Pope, C., and Wimmer, L. (1990). Union Army recruits in white regiments in the United States, 1861-1865. [Computer file]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].

Freeman, R. B. (1999). The economics of crime. In: Ashenfelter, O., and Card, D. (eds.), *Handbook of Labor Economics*. Vol. 3, Part C, Amsterdam: North Holland, pp. 3529-3571.

Galor, O. (2005). From stagnation to growth: Unified growth theory. In: Aghion, P., and Durlauf, S. N. (eds.), *Handbook of Economic Growth*. Vol. 1, Part A, Amsterdam: Elsevier, pp. 171-293.

_____ (2011). *Unified Growth Theory*. Princeton University Press.

Hooton, E. A., and Dupertuis, W. C. (1955). *The Physical Anthropology of Ireland*. Cambridge MA: Peabody Museum of American Archaeology and Ethnology.

Kennedy, L., and Solar, P. (2007). *Irish Agriculture: A Price History*. Dublin: Royal Irish Academy.

Kilcommins, S., O'Donnell, I., O'Sullivan, E., and Vaughan, B. (2004). *Crime, Punishment and the Search for Order in Ireland*. Dublin: Institute of Public Administration.

Komlos, J. (1998). Shrinking in a growing economy? The mystery of physical stature during the industrial revolution. *Journal of Economic History* 58(3), pp. 779-802.

Malthus, T. R. (1798). *An Essay on the Principle of Population, as it Affects the Future Improvement of Society*. London: J. Johnson.

McLaughlin, E. (2015). Competing forms of cooperation? Land League, Land War and cooperation in Ireland, 1879-1921. *Agricultural History Review* 63(1), pp. 81-112.

McLaughlin, E. (2017). The Irish Revolution and its aftermath: The economic dimension. In Crowley, J. Drisceoil, D. Ó, and Murphy, M. (eds.), *Atlas of the Irish Revolution*. Cork: Cork University Press, pp. 762-769.

McMahon, R. (2013). *Homicide in Pre-Famine and Famine Ireland*. Liverpool: Liverpool University Press.

_____ (1994). The heights of the British and Irish c. 1800-1815: Evidence from recruits to the East India Company's Army. In: Komlos, J. (ed). *Stature, Living Standards, and Economic Development: Essays in Anthropometric History*. Chicago: University of Chicago Press, pp. 39-59.

_____ (1996). Height and health in the United Kingdom 1815-1860: Evidence from the East India Company Army. *Explorations in Economic History* 33(2), pp. 141-168.

_____ (2002). What do people die of during famines: The Great Irish Famine in comparative perspective. *European Review of Economic History* 6(3), pp. 339-363.

Nicholas, S., and Shergold, P. R. (1988). Unshackling the past. In: S. Nicholas, S. (ed.), *Convict Workers: Reinterpreting Australia's Past*, Sydney: Cambridge University Press.

Nicholas, S., and Steckel, R. H. (1997). Tall but poor: Living standards of men and women in pre-Famine Ireland. *Journal of European Economic History* 26, pp. 105-134.

O'Donnell, I. (2005). Lethal violence in Ireland, 1841 to 2003. *British Journal of Criminology* 45, 671-695.

Ó Gráda, C. (1991). The heights of Clonmel Prisoners 1845-9: Some dietary implications. *Irish Economic and Social History* 18, pp. 24-33.

_____ (1994). *Ireland: A New Economic History 1780-1939*. Oxford, Oxford University Press.

_____ (1996). Anthropometric History. What's in it for Ireland? *Histoire and Mesure* 11, 139-166.

_____ (1999). *Black 47 and Beyond: The Great Irish Famine in History, Economy and Memory*. Princeton, Princeton University Press.

_____ (2007). Making famine history. *Journal of Economic Literature* 45(1), pp. 5-38.

_____ (2011). Famines Past, Famine's Future. *Development and Change*. 42(1): 49-69.

O'Sullivan, E., and O'Donnell, I. (2003). Imprisonment and the crime rate in Ireland. *The Economic and Social Review* 34, 33-64.

Pratt, T. C., and Cullen, F. T. (2005). Assessing macro-level predictors and theories of crime: A meta-analysis. *Crime and Justice* 32, pp. 373-450.

Prunty, J. (1998). *Dublin Slums, 1800-1925: A Study in Urban Geography*. Dublin: Irish Academic Press.

Relethford, J. H. (1995). Re-examination of secular change in adult Irish stature. *American Journal of Human Biology* 7(2), pp. 249-253.

Relethford, J. H., and Crawford, M. H. (1995). Anthropometric variation and the population history of Ireland. *American Journal of Physical Anthropology* 96(1), pp. 25-38.

Riggs, P. (1994). The standard of living in Scotland, 1800-1850. In: John Komlos (ed). *Stature, Living Standards, and Economic Development: Essays in Anthropometric History*. Chicago: University of Chicago Press.

_____ (1995). Stature and the standard of living. *Journal of Economic Literature* 33(4), pp. 1903-1940.

Vaughan, W. E., and Fitzpatrick, A. J. (1978). *Irish Historical Statistics: Population 1821-1971*. Dublin: Royal Irish Academy.

Young, K., Relethford, J. H., and Crawford, M. H. (2008). Postfamine stature and socioeconomic status in Ireland. *American Journal of Human Biology* 20(6), pp. 726-731.

Zimran, A. (2019a). Sample-selection bias and height trends in the nineteenth-century United States. *Journal of Economic History* 79(1), pp. 99-138.

_____ (2019b). Recognizing sample-selection bias in historical data. Mimeo, Vanderbilt University, Nashville.

Table 1: Autoregressive distributed lag models of incarceration rates and economic indicators (with error correction)

	(1)	(2)	(4)	(3)
Economic Indicator	Real GDP pc	Real deposits pc	Price index	Stock exchange
Model	ARDL(4,4)	ARDL(4,2)	ARDL(4,0,0)	ARDL(1,2)
Sample	1854 - 1909	1854-1909	1854-1909	1869 - 1909
α	-0.290***	-0.282***	-0.298***	-0.293 ***
	(0.051)	(0.049)	(0.053)	(0.100)
β	0.160	0.060	0.039	0.053
	(0.104)	(0.044)	(0.384)	(0.095)
Observations	56	56	56	41
R-squared	0.744	0.725	0.704	0.302
Adj R-squared	0.694	0.685	0.668	0.225
Log likelihood	-175.386	-181.172	-183.208	-130.769
F	16.090	16.485	10.563	4.857
Structural break	n.a.	n.a.	1873	n.a.
Parameter stability	0.600	0.717	0.712	0.629
I(0)	***	***	***	*
I(1)	***	***	***	n.s.

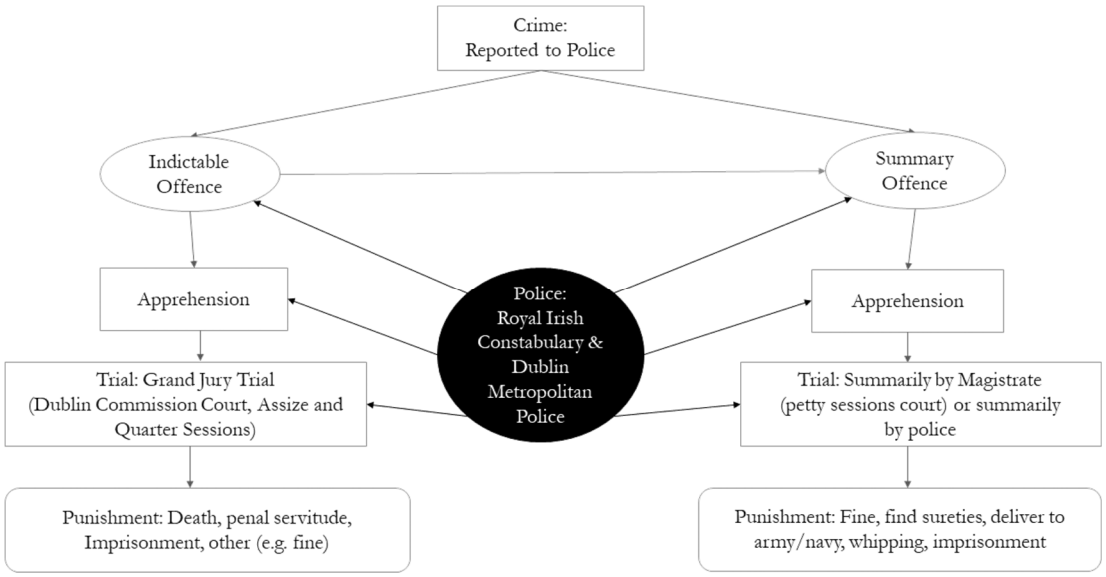
Notes: Authors' calculations, using parliamentary papers cited in text, Kennedy and Solar (2007) for agricultural prices, Grossmann et al. (2014) for stock market data, and Andersson and Lennard (2018) for GDP estimates.

Table 2: Autoregressive distributed lag models of homicide rates and economic indicators (with error correction)

	(1)	(2)	(3)	(4)
Economic indicator	Real GDP pc	Real deposits pc	Price index	Stock exchange
Model	ARDL(2,3)	ARDL(2,0)	ARDL(2,0)	ARDL(2,1)
Sample	1854-1913	1854-1913	1854-1913	1869-1913
α	-0.580	-0.816***	-0.375***	-0.463***
	(0.147)	(0.121)	(0.122)	(0.150)
β	-0.137	0.089**	0.657	-0.199
	(0.107)	(0.041)	(0.586)	(0.144)
Observations	60	60	60	45
R-squared	0.368	0.453	0.307	0.412
Ad R-squared	0.297	0.424	0.270	0.353
Log likelihood	-246.729	-242.403	-249.483	-186.973
F	7.751	15.459	5.305	4.878
Structural break	n.a.	1899*	n.a.	n.a.
Parameter stability	0.787	0.772	0.639	0.994**
I(0)	***	***	**	*
I(1)	**	***	*	n.s.

Notes: Authors' calculations, using parliamentary papers cited in text, Kennedy and Solar (2007) for agricultural prices, Grossmann et al. (2014) for stock market data, and Andersson and Lennard (2018) for GDP estimates.

Figure 1: Criminal justice system schema

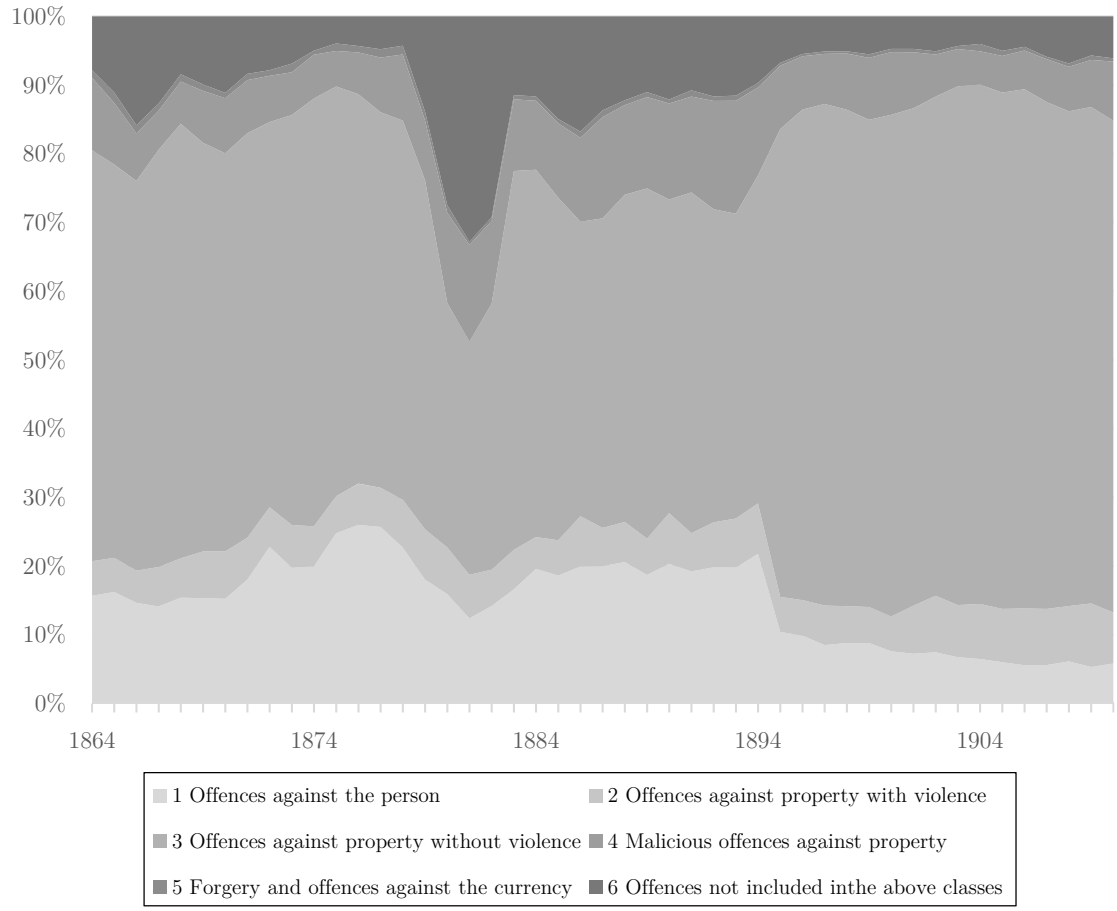


Sources: Authors' summary, using the annual *Criminal and Judicial Statistics* that were published as parliamentary papers cited in text.

Figure 2: Indictable offences, 1864-1910

Sources: Authors' calculations, using the annual *Criminal and Judicial Statistics.*

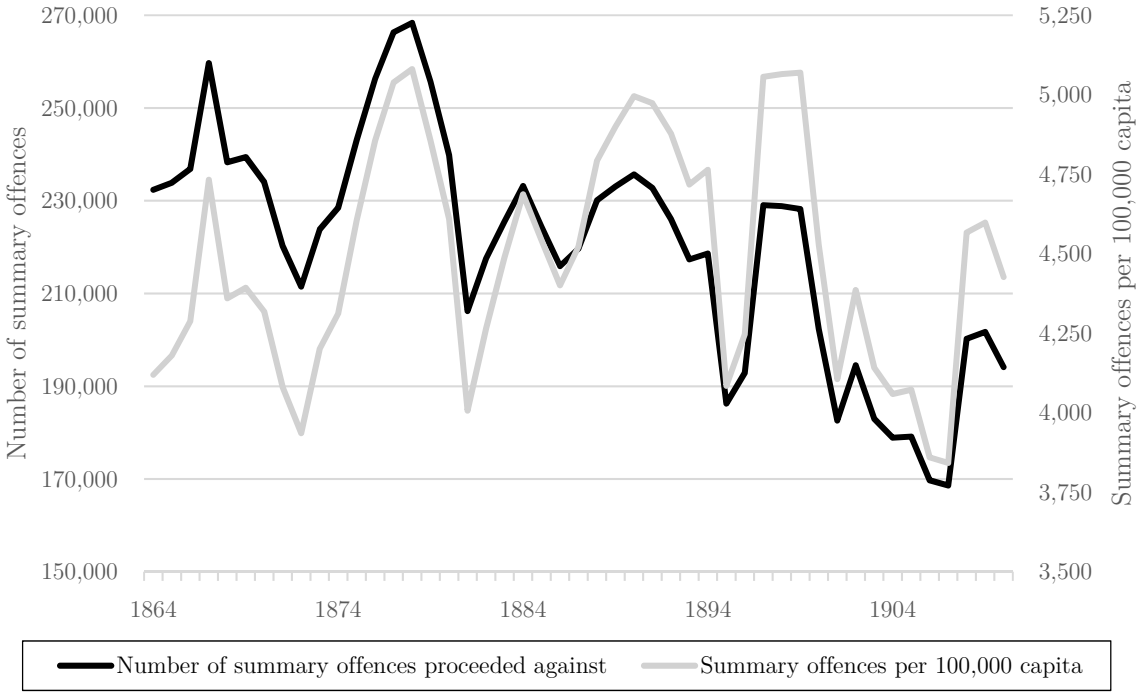
Figure 3: Distribution of indictable offences committed, 1864-1911



Notes: Indictable offences were comprised of 6 categories: (1) Offences against the person: Murder of infants aged one year and under; Other murders; Attempts to murder; Shooting at wounding, Stabbing &c, to do bodily harm; Manslaughter; Attempts to procure miscarriage; Concealing the births of infants; Sodomy and bestiality; Attempts to commit and other unnatural misdemeanours; Rape; Assaults with intent to ravish and abuse; Defilement of girls under 13; Defilement of girls between 13 and 16 years of age; Abduction; Bigamy; Child stealing; Unlawful abandoning of Children under 2 years of age; Endangering the safety of passengers on railways; Assault and indicting bodily harm; Assaults, common; Assaults on Peace officers. (2) Offences against property with violence: Sacrilege; Burglary and housebreaking; Breaking into shops, warehouses &c; Attempts to break into houses, shops, warehouses & c; Robbery on the highway; Attempts to rob on the highway, and demanding money by menaces. (3) Offences against property without violence: Cattle Stealing; Horse Stealing; Sheep Stealing; Larceny to the value of £5 in dwelling houses; Larceny from the Person; Larceny by servants; Larceny, simple; Larceny on rivers, canals, wharfs & c.; Stealing fixtures, shrubs growing, & c.; Attempts to steal; Embezzlement; Larceny by servants in the post office; Receiving Stolen goods; Fraudulently obtaining goods by false pretences and attempts to defraud. (4) Malicious offences against property: Arson and other wilful burning; Felonies riot and demolishing buildings &c.; Destroying goods in process of manufacture; Destroying trees, shrubs & c. growing; Killing and maiming cattle; Malicious Injuries to property exceeding £5 in value; Other wilful and malicious injuries to property. (5) Forgery and offences against the currency: Forging and uttering forged instruments; Having in possession forged bank notes; Coining, and having implements for coining in possession; Uttering, printing off and having in possession counterfeit coin. (6) Offences not included in the above classes: Offences against the Queen as Authority and Person; Intimidation by threatening letters, notices, or otherwise; Having arms or ammunition without licence in a proclaimed district; Offences against game laws; Being at large under sentence of transportation or penal servitude; Perjury and subordination of perjury; Riot, breach of the peace etc; Keeping disorderly houses; Indecently exposing the person; Suicide, attempting to commit; Other felonies not included in the above; Other misdemeanours not included in the above.

Sources: Authors' calculations, using the annual Criminal and Judicial Statistics.

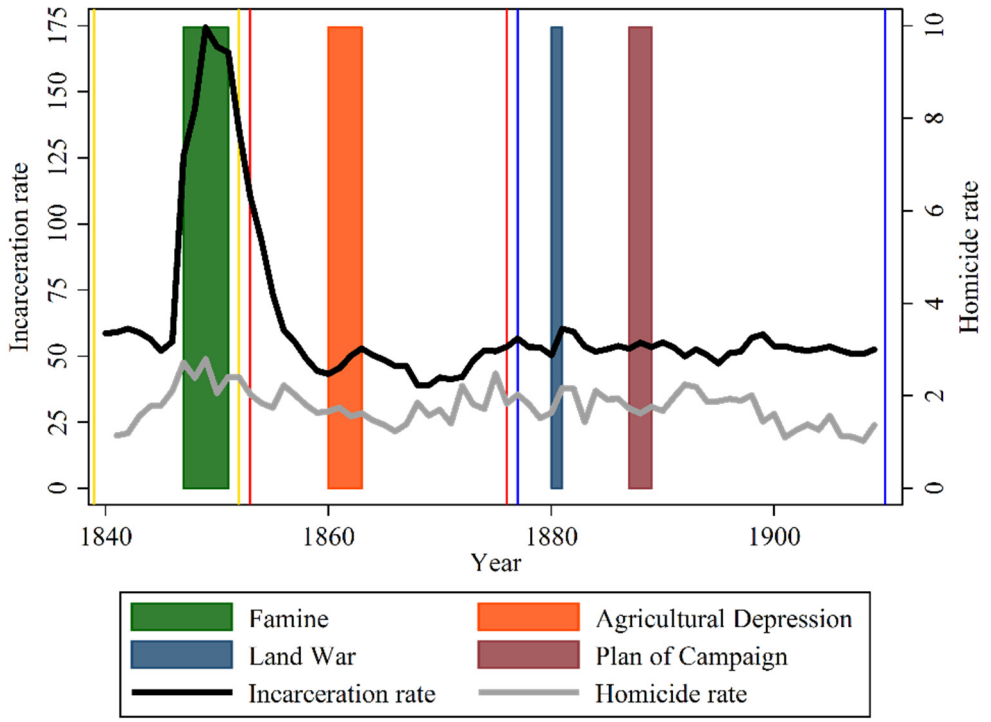
Figure 4: Number of summary offences, 1864-1910



Notes: Summary offences related to petty crime: Adulteration of food, & c, Act; Assaults, aggravated, on women and children; Assaults, on peace officers, resisting, obstructing & c.; Assaults, common; Bastardy orders, disobeying; Breaches of the peace, want of sureties & c.; Cattle plague orders, offences against; Chimney sweepers act, offences against; Cruelty to animals; Embezzlement; Employers and workmen act, 1875; Factory acts, offences against; Fisheries Acts, offences against; Game acts, offences against viz: Trespassing in the day time in pursuit of game, Night poaching and destroying game, Illegally selling or buying game, Poaching act, 1862, Other offences against game acts; Licencing acts, 1872-74 offences against, viz: Drunkenness and drunk and disorderly, Permitting drunkenness and disorderly conduct in licensed houses, Illegally selling intoxicating drinks, Adulteration of intoxicating liquors, Beerhouse Act offences against, Other offences under the licensing acts; Lord's Day Act, offences against; Local acts and borough bye-laws, offences against; Maliciously destroying fences, walls, gates, & c.; Maliciously destroying fruit and vegetable productions; Maliciously destroying trees, shrubs &c.; Other malicious and wilful damage and trespass; Mutiny acts, offences against: Army Act, Navy Act, Militia Act, Mercantile marine acts, offences against; Nuisance and offences against health, viz: Public health acts; Smoke acts; Sewers act; Nuisance, removal act.; Common lodging houses acts; Selling and exposing for sale unsound food; Other sanitary offences; Pawnbrokers act, offences against, viz: By pawnbrokers, By persons unlawfully pledging or disposing, Other offences; Police acts, offences against: Unlawfully possessing goods, Offences punishable as misdemeanours, Constables neglecting their duty, Other offences, not falling under special heads, Prevention of crime act, 1871, sec 7 (special offences by persons twice committed); Poor law acts, offences against: Deserting or neglecting to support family, Disorderly conduct in the workhouse, Damaging workhouse clothing, bedding etc; Refreshment houses and wine licences act; Revenue laws, offences against: Customs acts; Excise acts (including Hawkers and peddlers act); Salmon fisheries act, offences against; Stealing or attempts to steal, viz. -: Larceny, by offenders under 16 years (Juvenile offenders act), Larceny, under value of 5s and on pleading guilty (Criminal Justice Act), Larceny, above value of 5s, on pleading Guilty (criminal justice act), Larceny, or larceny from person, attempting to commit (Criminal Justice Act), Dogs, birds, or beasts (&c), Fruit or vegetable productions, Fences, wood & c., Trees, Shrub, etc.; Vagrancy acts, offences against: Prostitutes, Begging, Having no visible means of subsistence & c., Having implements for homebreaking, etc., Found in enclosed premises for unlawful purposes, Frequenting places of public resort, &c, to commit felony, Incorrigible rogues, Other offences against Vagrant Act; Vaccination Acts, offences against; Ways acts, offences against: Stage and Hackney Carriage Acts, Highway Act (including road nuisances), Watermen's Act, Railway Acts; Weights and Measures Act, offences against; Other offences (not included under the above heads).

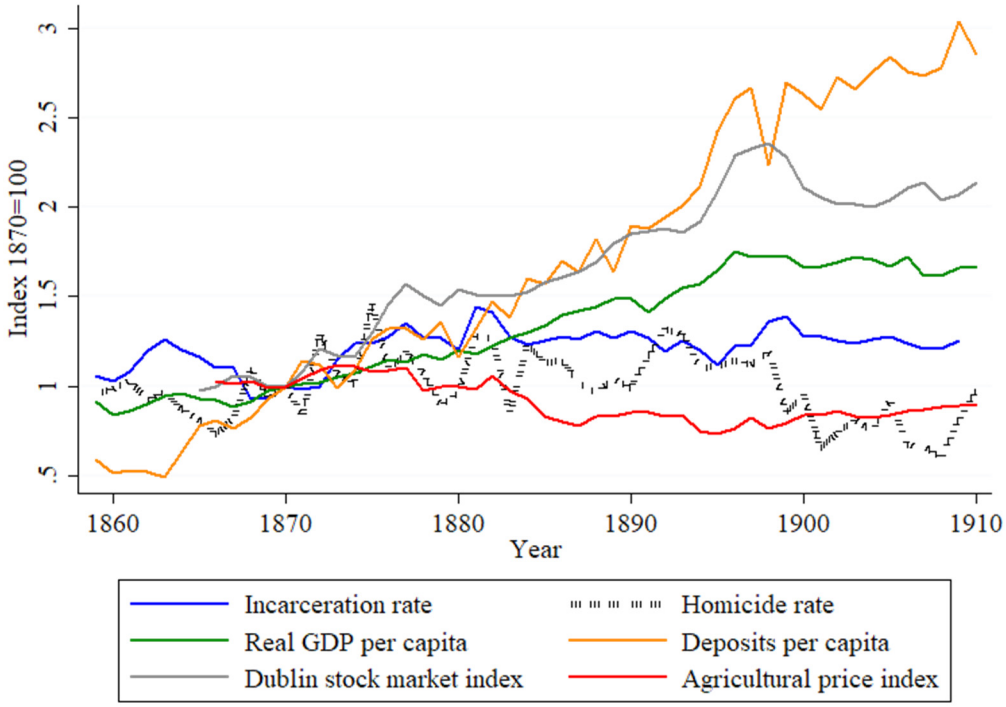
Sources: Authors' calculations, using the annual Criminal and Judicial Statistics.

Figure 5: Prison regimes, incarceration rate and homicide rate, 1840-1920



Sources: Authors' calculations, using the annual *Criminal and Judicial Statistics*.

Figure 6: Crime and macroeconomic indicators, 1860-1910



Sources: Authors' calculations, using parliamentary papers cited in text, Kennedy and Solar (2007) for agricultural prices, Grossmann et al. (2014) for stock market data, and Andersson and Lennard (2018) for GDP estimates.