The Cost of Food Crime Phase 2

Area of research interest: Food crime
Planned completion: 2 January 2023
Project status: Completed
Project code: FS430643
Authors: Adam Cox, David Shepherd, Lisa Jack, Gerald Miller, Edward Smart, Mark Button, Ansgar Wohlschlegel and Karen Everstine (University of Portsmouth; University of Swansea; FoodChainID)
Conducted by: Food Standards Agency
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Food Standards Agency
food.gov.uk

The Cost of Food Crime Phase 2 - Project Brief and Deliverables

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PDF
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1. This research – Phase 2 – will draw on findings and outputs from Phase 1, Cox et al. (2020) (footnote 1). The aim for phase 2 will be to build on Phase 1 using its outputs and methods to produce monetised estimates pertaining to the cost of food crime
2. The overarching aim of this research is to produce robust estimates of the cost of food crime on UK society that uses a bottom-up approach; identifying costs to individuals, businesses and government. The research in itself can be considered ground-breaking in that current estimates of the cost of food crime are based on high level estimates and proxy numbers.

3. The exact outputs will depend on the methodology decided upon by the contractor of the work, however the deliverables expected are as follows:

i) A bespoke, self-contained database containing all data that is used in the case studies. This should be easily updatable and accessible to all users.

ii) Extrapolated estimates of the total economic cost of food crime, along with sensitivity tests.

iii) Manuals for both the database and model.

iv) A report including the results, as well as the assumptions made and where improvements may be possible as more data and data sourcing techniques become available in the future.

v) PowerPoint presentation summarising the results of the project, as well as how they have been constructed.

vi) As part of the conceptual framework developed in phase 1, the total cost was broken down into individual cost areas and methods of calculating these costs were suggested.

vii) Both the database and model will need to be updateable, such that pending improvements in data collection or changes in economic conditions can be reflected in the framework accordingly.

1. The Cost of Food Crime Report (PDF): Food crime intelligence reporting: barriers and enablers

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The Cost of Food Crime Phase 2 - Executive Summary

As a result of the project, the following have been delivered to the Food Standards Agency (FSA):

- excel spreadsheet database containing extensive data capable of providing averages for each cost group over food types, food crime types, geographic areas, cost bearers and case type (minor/major crimes).
- initial set of multipliers to enable ‘hidden food fraud’ to be included in the calculation.
- initial estimate of the single figure ‘prevention costs’ included in the final cost of food crime.
- power BI Interface that allows final calculation and filtered calculations to be handled easily.
- Weibull curve graphics indicating the contribution to cost from each case; these are useful to indicate if a high proportion of cost is driven by particular types of cases.

Creating a novel and robust approach to data collection and analysis

The Cost of Food Crime (CoFC) model identifies and measures the economic and social cost of food crime. This includes the direct impact on victims of food fraud(footnote) and the criminal justice system, as well as the indirect impact on the economy from lost productivity, lost profits for competing firms, and non-financial impacts of pain, grief, and suffering (discussed in Section 2). The outputs from the model provide an estimate of the total annual cost to the UK of food fraud alongside average per case estimation that offers direct usefulness for policy analysis.

Overall, we found that the combination of the very high degree of awareness of food safety, quality and fraud among large UK businesses, local authorities and enforcement agencies, and the extensive use of objective diagnostic testing means that the sector has built resilience to fraud. However, small and medium sized businesses in the UK are more vulnerable, and there is a real impact on the economy from frauds that occur.

Building on the outputs from Phase 1, Cox et al. (2020), the CoFC model provides a 'bottom up' approach that aggregates individual cost category elements, following the framework outlined in Table 1 and illustrated in Figure 1.

Table 1 Cost of Food Crime elements

Type of cost	Description of included costs
Victim costs	The losses suffered by crime victims, including the cost of illness and loss of property.
Justice System costs	The cost of investigation, legal and adjudication services, and corrections programs including incarceration.
Crime career costs	The opportunity costs associated with the criminal's choice to engage in illegal rather than legal and productive activities.
Market costs	The loss of profits for genuine firms that arise from criminal food entering the supply chain.
Prevention costs	Costs of anti-food crime activities

The burden of these costs falls between individuals, business, and government. The model elements that fall on each affected group are illustrated in Figure 2. This approach is consistent with reporting of cost burden by affected group in the Cost of Illness model for Foodborne Disease (Daniel et al., 2020).

Whilst fraud and counterfeiting crimes have been investigated in existing research (see for example, McCollister et al., 2010 and Heeks et al., 2018), the CoFC model is the first using a bottom up approach to focus specifically on food fraud. Furthermore, in a novel development from existing crime cost estimations, this model incorporates the losses of profits for genuine firms that arise from facing criminal competition. This is further discussed in the Introduction and Methodology sections.

Three approaches were used to generate frequency and cost data for the CoFC: a review of relevant reports published in the public domain, interviews with regulatory enforcement agencies, and a victimisation survey:

1. A web scraping programme identified reported cases from 1990 to 2021 in the UK by generating search terms and collecting Google search engine results. The outputs were reviewed manually for usable information within the CoFC model framework.
2. A total of 24 participants were interviewed: 14 from regulatory / law enforcement agencies and 10 from the private sector. The interviews provided a rich insight into the prevalence of food fraud, the challenges in measuring the problem, and the costs of bringing offenders to justice. The data was fed into the CoFC model.
3. The Food Business Organisation (FBO) Tracker survey of 700 small companies - a wide-ranging survey commissioned annually by the FSA, was co-opted to capture some victim experience data in food businesses with fewer than 50 employees. 'Theft of food' crimes

were excluded from the analysis of survey results, finding that 3% of small businesses were victims of food fraud in the previous year.

Having determined from these sources that the observable food fraud rate is low, the attrition ratio based on the FSA's officially recorded number of food fraud intelligence reports (610) and the number of reported prosecutions (16) in 2021 is as follows:

- Fraud reports / prosecution ratio: 610/16 = 38

Although the 610 recorded schemes provides a lower threshold estimate of the annual number of cases, An indicative upper threshold estimate was derived from the FBO Tracker survey, which found that just 1 in 5 business victims report incidents to the authorities:

- experience / reporting ratio = 5
- indicative upper threshold: 610x5 = 3,050 cases per year

This shows that the actual number of cases could be five times bigger than those that are reported.

The Headline Figures for the Cost of Food Crime to the UK

The total cost of food crime on the UK is estimated to be between £410 million and £1.96 billion per year. This is equivalent to between 0.07% and 0.33% of the UK food industry turnover each year (BEIS, 2021). The estimated value of fraudulent food and drink in the UK is between £296 million and £1.48 billion per year (discussed in Section 2.4 CoFC). The range in the estimated total cost of food crime represents the sensitivity to the volume of criminal activity, from crimes reported to estimates of total crimes (including unreported activity). Further research is required to develop the quality of data in order to narrow the range with confidence.

Notably, the prevention costs to businesses is excluded from the results presented in this report because it has not been possible to differentiate between quality control costs and crime prevention costs. Preventions costs to government are included in the total cost results but excluded from the average costs results as there is insufficient information for case-level estimation.

Once a food fraud has been committed (excludes prevention costs), each case is estimated to cost between £16 thousand and £151 thousand for small cases and between £423 thousand and £7.2 million for larger cases, depending on crime and food type (discussed in Section 2.2). In larger cases (approximately 13% of cases), the burden falls more sharply on business through the loss of property from purchasing criminalised goods. A larger share of the burden falls on government in smaller cases through justice costs.

Including prevention costs, the total burden of food crime on businesses is £268 million per year, larger than the burden to government (£84 million per year) and individuals (£58 million per year).

Key Limitations

The key limitations identified in the report are:

- The lower threshold estimate is based on the 610 food fraud intelligence reports recorded by the NFCU in 2021. It excludes unreported and undetected fraud as well as cases which are incorrectly labelled by businesses and the regulators as non-compliant when they are actually fraud.
- The upper threshold estimate addresses the dark figure based on the unreported level of victimisation of small food businesses. However, this figure may overestimate the number

of fraud cases because the cases involve multiple victims.
- The cost of preventing fraud in the private sector is excluded due to the challenges in discriminating between quality/regulatory compliance costs and fraud prevention costs.

Figure 1: Cost of Food Crime model framework (text version)

(Embedded cost of illness model)

Victim costs:

- medical costs: GP, Helpline, Hospital
- individual expenses: Transport, Medication, Funeral
- lost earnings: Lost earnings due to sick absence
- absence from school: School absenteeism due to sickness
- disturbance costs: Administration cost to business for production disturbances
- illness or death: Willingness to pay to avoid illness or premature death
- loss of property: Market value of property lost due to purchase of fraudulent goods.

Justice costs:

- hours cost: Hours cost of authorities and Police working on cases.
- contractor costs: Storage and disposal of fraudulent goods.
- legal costs: Legal costs associated with prosecution.
- prison costs: Holding prisoners convicted of food crime.
- less fines paid: Less fines and costs paid by those prosecuted of food crime.
-
- crime career costs: Lost productivity: Due to being imprisoned rather than contributing to economy.
- market costs: Loss of profits: Genuine firms' losses competing against fraudulent firms
- prevention costs: Anti-fraud activities: Cost to organisations attempting to prevent food crime

Figure 2: Cost components by affected group (text version)

Individuals

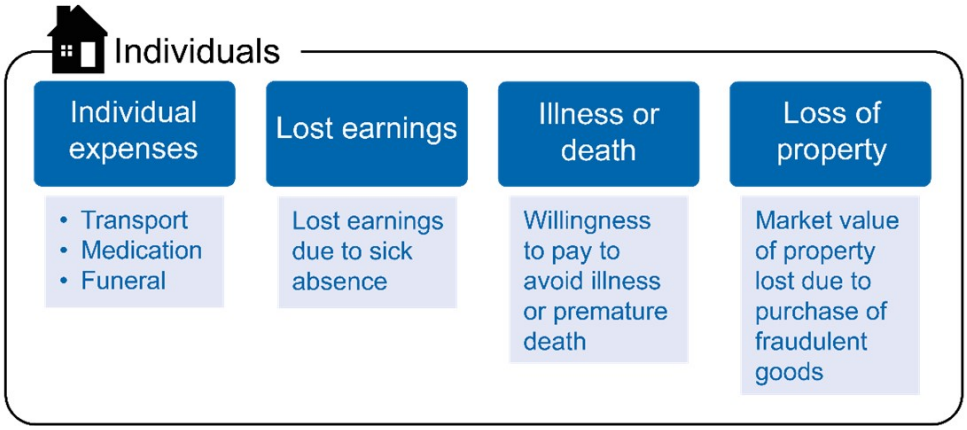
- individual expenses: Transport, Medical and Funeral
- lost earnings: Lost earnings due to sick absence.
- illness or death: Willingness to pay to avoid illness or premature death.
- loss of property: Market value of property lost due to purchase of fraudulent goods.

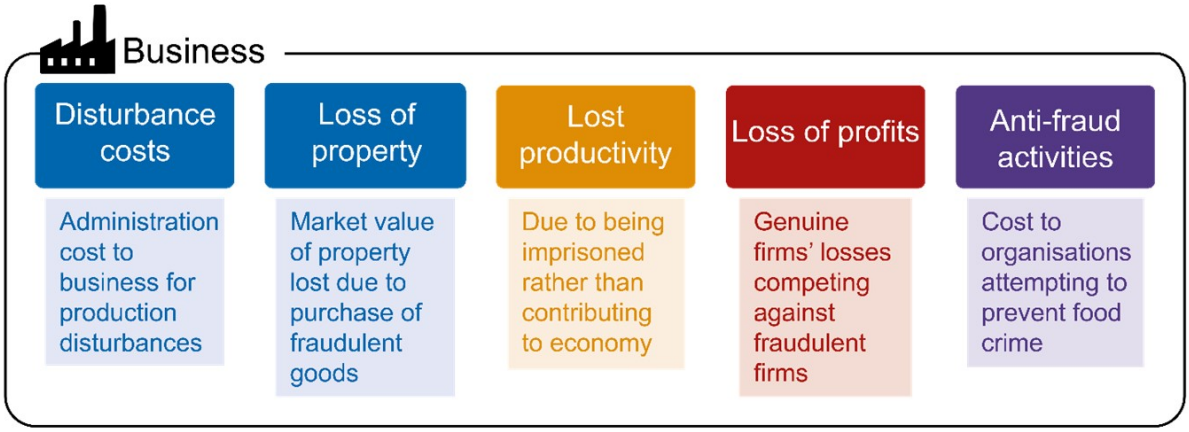
Business

- disturbance costs: Administration costs to business for production disturbances
- loss of property: Market value of property lost due to purchase of fraudulent goods.
- lost productivity: Due to being imprisoned rather than contributing to economy.
- loss of profits: Genuine firms' losses competing against fraudulent firms.
- anti-fraud activities: Cost to organisations attempting to prevent food crime.

Government

- medical costs: GP, Helpline, Hospital
- absence from school: School absenteeism due to sickness.
- hours cost: Hours cost of authorities and Police working on cases.
- contractor costs: Storage and disposal of fraudulent goods.
- legal costs: Legal costs associated with prosecution.
- prison costs: Holding prisoners convicted of food crime.
- less fines paid: Less fines and costs paid by those prosecuted of food crime.
- anti-fraud activities: Cost to organisations attempting to prevent food crime.


Individuals
Individual expenses
• Transport
• Medication
• Funeral
Lost earnings
Lost earnings due to sick absence
Illness or death
Willingness to pay to avoid illness or premature death
Loss of property
Market value of property lost due to purchase of fraudulent goods


Business
Disturbance costs
Administration cost to business for production disturbances
Loss of property
Market value of property lost due to purchase of fraudulent goods
Lost productivity
Due to being imprisoned rather than contributing to economy
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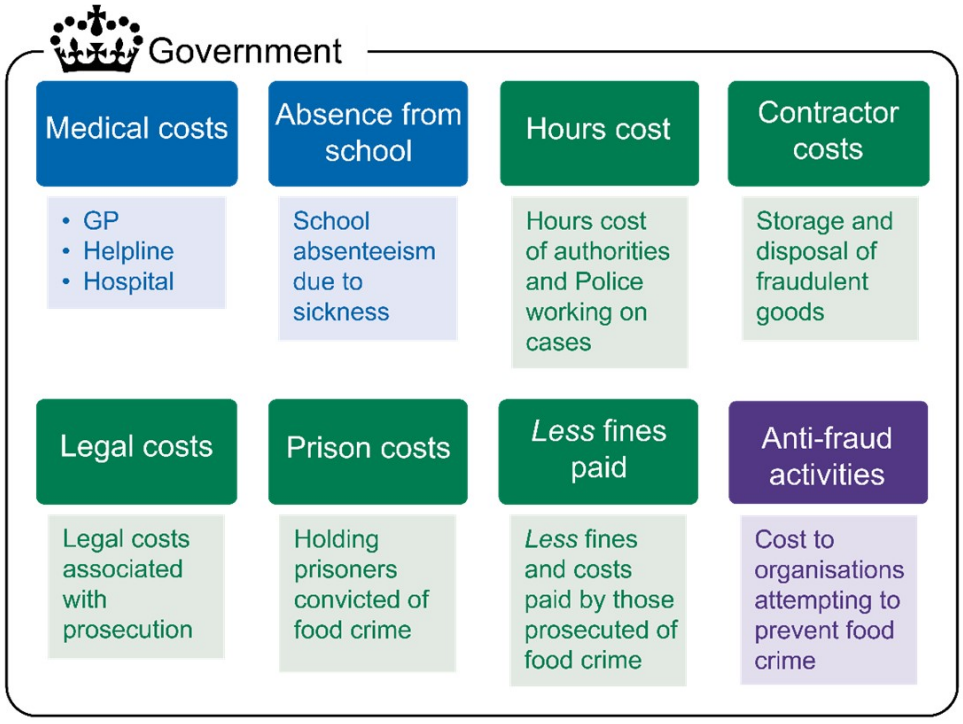
Genuine firms' losses competing against fraudulent firms
Anti-fraud activities
Cost to organisations attempting to prevent food crime


Government
Medical costs
• GP
• Helpline
• Hospital
Absence from school
School absenteeism due to sickness
Hours cost
Hours cost of authorities and Police working on cases
Contractor costs
Storage and disposal of fraudulent goods
Legal costs
Legal costs associated with prosecution
Prison costs
Holding prisoners convicted of food crime
Less fines paid
Less fines and costs paid by those prosecuted of food crime
Anti-fraud activities
Cost to organisations attempting to prevent food crime

The Cost of Food Crime Phase 2 - Introduction

This model aims to capture the full range of impacts that food crime has on the UK economy, and is explicit in the areas where data availability prevents estimation. The most significant problem in assessing the cost of food crime is the lack of statistics and other evidence, and the consistency of the data that does exist. Therefore, we identify the data sources available and offer indicators for further developments to improve future estimates.

Only two academic papers (Spinks and Fejes, 2012; Lord et al, 2017) assess the cost-benefits of food crime, at the micro-level of an individual item or incident, in order to illustrate that there is an economic motivation for individual entities to engage in food crime. From media, professional and industry sources, there are only three figures proposed and the same three figures are used regularly to indicate the likely costs involved in Food Fraud (the term also used is 'economically motivated adulteration' or EMA). The rationale and evidence behind these figures are critically evaluated in the Literature Review section. In brief, the generally accepted figures are:

a. The Grocery Manufacturers Association (GMA, 2010) suggested that the total cost of food fraud to the global food and drink industry is US$10-15million a year. This is based on surveys of food industry companies who estimated their losses per event and then estimated the number of events.

b. Attributed to PwC, around 2013, the figure of US$30-40billion for global losses to food fraud is used. This is based on the level of counterfeit products occurring globally at an estimated 5-7% of World trade, and applied to the value of food trade globally.

c. The Centre for Counter Fraud Studies at University of Portsmouth gives £34.6 billion for the possible fraud losses to the UK, based on loss estimate exercises across organisations in all sectors that show an average fraud loss of 5.92% of turnover per year. However, this estimate covers all types of fraud perpetrated against organisations including, for example, payroll fraud and all types of purchasing fraud.

Each of these three figures is a projection rather than being derived from a detailed economic or accounting methodology and hold a number of weaknesses. The most significant issue in current estimates of the impact of food crime is confusion between the terms in use. One of the aims of this report is to bring clarity to the issues involved by providing a framework based on the FSA/Elliot (2014) definition of food crime and to isolate the elements that should and should not be included in the calculation of the cost of food crime.

We use the definition of food crime given by the Food Standards Agency (FSA) in the brief for this project, which is stated as:
Food crime is serious fraud and related criminality within food supply chains that impacts the safety or the authenticity of food, drink or animal feed. It can be seriously harmful to consumers, food businesses and the wider food industry. (footnote 1)

The FSA (Ibid.) categorises activities observed within food crime as (Ibid.):

- theft – the dishonest appropriation of food, drink or feed products from their lawful owner with an intention to benefit economically from their subsequent use or sale

- unlawful Processing – the slaughter or preparation of meat and products of animal origin in unapproved premises or using unauthorised techniques
- waste Diversion – the unauthorised diversion of food, drink or feed intended for disposal back into relevant supply chains
- adulteration – reducing the quality of a food product through the inclusion of a foreign substance, with the intention either to make production costs lower, or apparent quality
- substitution and Counterfeiting – replacing a food product or ingredient with another substance of a similar but inferior kind
- misrepresentation – the marketing or labelling of a product so as to inaccurately portray its quality, safety, origin or freshness
- document Fraud – the use of false or misappropriated documents to sell, market or otherwise vouch for a fraudulent or substandard product

These definitions are a refinement of those given in Elliot (2014) following the 2013 Horsemeat Scandal in Europe (the NFCU was set up following recommendations in this report). They clearly articulate the FSA's fundamental mission to ensure that consumers have confidence that their food is safe and what it says it is.

Whilst cases of theft can be included in the CoFC model, the theft category was deliberately excluded in order to focus on the six categories associated with fraudulent processing and delivery activities within the supply chain. Furthermore, theft was excluded from the analysis of victimisation survey responses to avoid overestimation of food fraud activity. Therefore, throughout this report the term food fraud is used to explicitly include all food crimes with the exception of theft.

There is a large literature that assesses the costs of various types of crime by splitting costs into several categories and collecting data for these categories from various sources. To the best of our knowledge, however, there is no study that applies this method to the quantification of the cost of food crime. For instance, McCollister et al. (2010) calculate costs of crime for a range of specific crimes, using a combination of cost-of-illness and jury compensation methods known from previous studies. We make use of McCollister et al. (2010) to provide the basic framework for estimating the economic cost of crime. This is a 'bottom-up' accounting method that requires calculating individual cost elements and a summation of all elements to arrive at the total cost. However, we depart from this work in two major areas:

1. Firstly, we define each model element for use within the food fraud context. The McCollister et al. (2010) approach is a 'bottom up' cost method that aggregates the individual cost category elements. These elements need to be carefully defined for the specific context of the crime(s) being examined. Whilst 'fraud' and 'counterfeiting' are crimes investigated by McCollister et al. (2010), some cost elements are not applicable to food fraud (such as, damage to property) and other obvious issues are not considered (such as, loss of profits of genuine firms). As such, the model does not directly translate for use with estimating the cost of food fraud.
2. Secondly, we include an approach to estimate the loss of profits for genuine (non-criminal) firms in the market. A distinctive feature of food fraud is that it can occur alongside legal economic activities, which means that legal and illegal activities will impact on each other. If businesses involved in food fraud are better able to reduce product prices, this can result in the loss of profits for the genuine competing firms.

1. Food Crime food.gov original quote extended following advice from the NFCU.

The Cost of Food Crime Phase 2 - Methodology

The CoFC uses a theoretical framework and a variety of data sources to return bottom-up estimates of the social cost of food crime. This builds on the methodological approach presented in Phase 1, Cox et al. (2020) which is in line with the HM Treasury Green Book guidance (HM Treasury, 2022) and Heeks et al. (2018). The CoFC model includes the direct impact on victims of food fraud and the criminal justice system as well as the indirect impact on the economy from lost productivity, lost profits for competing firms, and non-financial impacts of pain, grief, and suffering. The outputs from the model provide an estimate of the total annual cost to the UK of food fraud in 2021 alongside average per case estimation that offers direct use for policy analysis. The CoFC cost category elements follow the framework outlined in Table 2.

Table 2 Cost of Food Crime elements

Element	Description of included costs
Victim costs	The losses suffered by crime victims, including the cost of illness and loss of property.
Justice system costs	The cost of investigation, legal and adjudication services, and corrections programs including incarceration.
Crime career costs	The opportunity costs associated with the criminal's choice to engage in illegal rather than legal and productive activities.
Market costs	The loss of profits for genuine firms that arise from criminal food entering the supply chain.
Prevention costs	Costs of anti-food crime activities.

Three approaches were used to generate frequency and cost data for the cost of food crime model: a review of relevant reports published in the public domain, interviews of regulatory enforcement agencies, and a victimisation survey. Useful information from these sources were added to a database so that the average cost of each CoFC model component can be calculated. The average is used so that any missing values do not critically alter the reliability of the estimate. The result is therefore an estimate of the average cost per case, one value for major cases and one for "non-major" cases. The total cost is calculated as a weighted sum based on the estimated number of real cases that take place. Financial estimates are presented in 2021 values.

Estimates for the total cost can vary with the assumed total number of food crimes and the definition of major cases. The average cost per minor and major cases are sensitive to the collected information for each case. Sensitivity analysis for two key assumptions is presented in section 4.

2.1 Data collection

In the absence of a systematic database recording instances of food fraud in the UK, three approaches were used to generate frequency and cost data. A web scraping program was developed to identify reported cases in the UK within the public domain. The program generated Google search engine results for food crimes in the UK. The outputs were reviewed manually for usable information within the CoFC model framework. This approach offers a breadth of information on food fraud activity but lacks completeness, such that few cases offer complete information. Therefore, richer details were garnered via interviews and a survey.
A total of 24 participants from the organisations listed in Table 3 were interviewed. The interviews provided a rich insight into the prevalence of food fraud, the challenges in measuring the problem, and the costs of bringing offenders to justice. The data provided the researchers with a firm basis

for understanding the nature of food crimes; the issues around the completeness of data; perceptions of when incidents might be treated as fraud and then investigated, and the costs involved. These shaped the model in that certain cost elements were added that were not in the Phase 1 theoretical framework (see Section 2) and enabled the team to identify what data was available to feed into the multiplier used in the study and how major cases could be defined (see below and Section 3).

Table 3 Participant schedule

Organisation	No. of participants
FSA	5
Local Authorities	8
Police	1
Manufacturers	2
Retailers	3
Insurance / compliance	5
Total	**24**

The FBO Tracker survey of 700 small companies was co-opted to capture some victim experience data in food businesses with fewer than 50 employees. This sector constitutes 97.5% of the 250,000 companies in the food sector and 24% of the £585 billion total turnover (BEIS, 2021). Theft of food crimes were excluded from the analysis of survey results, finding that 3% of small businesses were victims of food fraud in the previous year.

2.2 Definition of major cases

It is observed that within this food fraud dataset, a minority of cases appear far larger in cost values such that 88% of the total cost is derived from 10% of cases. Thus, estimates are presented as major and non-major cases. Major cases are defined as at least one of the following:

- the value of confiscated fraudulent goods is over £100k in market value
- there was at least one fatality
- prosecution secured collective (of all accused) jail sentences of over 2 years
- prosecution secured a fine paid of over £100k

2.3 The total Cost of Food Crime

The average cost of a food crime is generated by summation of average costs of each element in the CoFC model (discussed in the next Section, 2.4). The total cost is then calculated as a weighted sum of this average based on the estimated number of real cases that take place (discussed in Section 3.1). Cases are split between major and non-major. This part of the cost estimation is highly sensitive to changes in estimated number of real cases in a given year. As such, a sensitivity analysis is presented in Section 4 which indicates how the total cost estimate changes with variation in estimated case numbers. From this analysis, the report presents headline total cost estimates as a lower and upper bound.

2.4 Cost of Food Crime categories

The estimation approach for each model element and key assumptions are discussed in turn:

2.4.1 Victim costs

Building on the model presented in Cox et al. (2020) and in line with HM Treasury Green Book guidance (HM Treasury, 2022), additional categories used for estimating the Cost of Illness from Daniel et al. (2020) are embedded. These additions include: personal expenses such as transportation to receive medical care, medication cost, funeral cost; costs associated with school absenteeism due to sickness and administration costs to business disruption due to employee being sick. Furthermore, non-market costs of pain, grief and suffering are relocated within the Cost of Illness for consistency with Daniel et al. (2020). Without existing research available for food crime specific cost of illness estimates, it is assumed that an illness caused by food crime is equivalent to the cost of illness from the pathogen Shigella. This pathogen is specifically chosen due to its association with no fatalities and low impact of quality of life, reflecting the illnesses observed in the food crime data collected in this study. This integration of Cost of Illness into the cost model provides good opportunities for future development and the authors note the need for further research to support the cost estimation specific to food crime activities.

It is assumed that fraudulently produced food is of no value to the end user as when provided with the knowledge, a consumer is more likely to prefer the genuine food over the fraudulent at the same price level. Fraudulently produced food is therefore considered in this model as lost property. The quantities of fraudulently produced food purchased and consumed remains unavailable. Without information on the volume of fraudulent product sold, this report approximates the scale of criminalised activity for each case using the quantity of criminalised food uncovered at the perpetrator's premises following authority intervention. This quantity of criminalised food encountered (reported) along with the market prices (derived from Family Food Survey 2019/20 DEFRA, 2022), offers the best estimate of market value of criminalised food available and can be replaced if accurate data is available. By definition, this measure provides the quantity not consumed but gives a good indicator to the scale of criminal production. This approach also assumes the goods could have been sold at market prices. The cost of criminalised food entering the supply chain upstream is allocated to business and downstream allocated to individuals.

If fraudulently produced food remains undetected and sold on, then the firm, once victim, becomes the criminal (unknowingly) and faces reputation costs and legal consequences for not detecting the crime if later detected by stakeholders. There is a wealth of research concerned with the impact of corporate reputation on financial performance (Gatzert, 2015) and it may be possible to observe such performance changes by fluctuations in share price or Gross Value Added. However, there will exist an economic cost only if the factors of production are not reemployed, the corresponding output is not replaced by competing firms, or if there are transaction costs for the redistribution of resources. As such, the cost to the economy of reputational damage due to food crime remains an empirical issue and an under researched area. As research in this area develops, this element can be included within victim costs.

Table 4 provides the assumptions and derivation of victim costs for an example case.

Table 4 Example derivation of victim costs

Victim costs	Cost information	Assumptions and derivation
Health care costs (Gov)	£149 illness £1,217 fatality	1 illness and 1 fatality reported throughout this example. NHS costs of providing health care. FSA Cost of Illness of Shigella, 2018 in the case of illness. Department for Transport TAG data costs per fatal accident in the case of fatality, 2021.
Individual expenses (Individual)	£14 illness £3,837 fatality	Personal expenses such as transportation to receive medical care, medication cost, funeral cost. Assumptions and derivation as above.
Lost earnings (Individual)	£941 illness £141,851 fatality	Loss of earnings due to being sick. Assumptions and derivation as above.
Costs associated with absence from school (Gov)	£36 illness £0 fatality	School absenteeism due to sickness. Assumptions and derivation as above.

Victim costs	Cost information	Assumptions and derivation
Disturbance cost (Business)	£80 illness £0 fatality	Administration costs to business disruption due to employee being sick. Assumptions and derivation as above.
Human cost of pain, grief & suffering (Individual)	£6,881 illness £2,063,940 fatality	Willingness to pay to avoid illness or premature death (death also includes loss of consumption). Assumptions and derivation as above.
Loss of property (Business)	£22,467	1000 litres of vodka sold to retail from wholesale level. Market value of fraudulent product upstream. Volume identified in reports. Market price taken from Food Fraud Survey. Loss of property (Individual)
Loss of property (Individual)	£1,132	72 bottles of vodka sold at retail premises. Market value of fraudulent product downstream. Volume identified in reports. Market price taken from Food Fraud Survey.

Source: Authors' calculations, Cost of Food Crime model 2022. All financial figures presented in £ at 2021 prices.

2.4.2 Criminal justice system costs

We conducted interviews with authorities who have led in the gathering of evidence, provided intervening actions (such as raiding premises), and preparation of cases for prosecution. From these interviews, the costs of hours for all authorities involved, contractor services, and prosecutions are obtained from specific case studies, forming the basis of information used for cost estimation.

The sentence length of the jail term given at the time of prosecution is combined with the Ministry of Justice estimate of the average costs per prison place (in 2019-20 this was £42,670 per year) (Ministry of Justice, 2020). This provides an estimate of the total cost to the Ministry of Justice of imprisoning a convicted criminal assuming they serve the full jail term as sentenced.

Fines and costs paid by criminals as a consequence of successful prosecution are returned to the government and are therefore taken from the economic cost of crime calculation. The model does allow for additional assets to be included if data becomes readily available, for example, it is possible here to include criminal proceeds or assets purchased with them that are subsequently confiscated.

Table 5 provides the assumptions and derivation of justice costs for an example case.

Table 5 Example derivation of criminal justice costs

Justice costs	Cost information	Assumptions and derivation
Hours cost (Gov)	£58,099	2115 hours on case reported by authorities involved (often LA, FSA, CPS, police). Average salary cost of £50k FTE is assumed. Information taken from FSA case studies, interviews.
Contractor costs (Gov)	£5,000	Costs for refrigerated vehicles and storage, a locksmith, and disposal if required. Information taken from FSA case studies.
Legal costs of prosecution (Gov)	£12,500	From interviews, legal costs are typically £10,000 to £15,000 for a prosecution. Mid-point used.
Prison Costs (Gov)	£37,538	Prosecution led to 10 months sentence. Ministry of Justice 2019-2020 cost per prisoner per year of £42,670 is assumed.
Less fines paid (Gov)	£4,023	Less fines / costs paid as a consequence of prosecution. From case studies and case reports.
Total justice costs	£109,113	Summation of costs

Source: Authors' calculations, Cost of Food Crime model 2022. All financial figures presented in £ at 2021 prices.

2.4.3 Crime career costs

Crime career costs are the opportunity costs associated with the criminal's choice to engage in illegal rather than legal and productive activities. If an individual enters the labour force then they are a productive factor that contributes to the growth of the economy. Following the existing research literature, the crime career cost is derived as the cost to the economy caused by an individual choosing to be employed in activities that don't contribute to the economy. More precisely, this is the loss of productivity associated with those choosing to spend time engaging in illegal activities that do not contribute to Gross Domestic Product (GDP).

Productivity losses are approximated by combining the sentenced jail term with the median annual gross salary for the local area the convicted criminal resided. As with the estimation of prison costs, this calculation will overestimate the loss of productivity if the jail term served is reduced from that handed down at sentencing.

Table 6 provides the assumptions and derivation of crime career costs for an example case.

Table 6 Example derivation of crime career costs

Crime career costs	Cost information	Assumptions and derivation
Crime career costs (Business)	£19,921	Product of length of prison sentence (years) and median annual gross pay). 0.83 years jail time sentenced. Median annual gross salary of local area is £23,905. Earnings and hours worked, place of residence by local authority: ASHE Table 8, 2021

Source: Authors' calculations, Cost of Food Crime model 2022.

All financial figures presented in £ at 2021 prices.

2.4.4 Market costs

Market costs are the losses of profits for genuine firms that arise from criminal food entering the supply chain. This is the losses incurred by genuine firms due to competing against fraudulent firms, assuming that fraudulent goods can be sold at a lower price or lower cost. Therefore, this cost represents an additional cost to the economy, over and above the value of fraudulent goods in the market. The mark-up calculation is based on the price elasticity of demand of the food product in question, the market price, and the level of competition (of genuine firms) in the market.

One unit of the genuine good generates a social surplus equal to the difference between consumers' marginal willingness to pay, Pd(X+K), and the social cost of producing this final output, C. Hence, if we assume that the social surplus generated by a unit of counterfeit is zero, the social cost of one unit of the genuine good crowded out by the counterfeit can be approximated by equation (1).

$$p_d(X) - C = \frac{p_d(X)}{|\varepsilon_d|}\frac{d+u+1}{du}$$

(1)

Where Pd(X) denotes the final (downstream) demand, X is the total quantity supplied by all firms. u and d denote the number of upstream and downstream firms. The price elasticity of demand estimates are taken from Marioni et al. (2022) where available and Tiffin et al. (2011) otherwise. Market prices are taken from expenditure and consumption information in the Family Food Survey 2019/20 (DEFRA, 2022). The level of competition in the market is taken from the number of firms

producing similar food product by SIC and geographical region, UK Business Counts (ONS, 2022).

Table 7 provides the assumptions and derivation of market costs for an example case.

Table 7 Example derivation of market costs

Market Cost	Cost information	Assumptions and derivation
Offender entry point in the supply chain	Manufacturing / production	Supply chain point at which the case is identified
Offender firm / franchise size (No. of Employees)	<10 people	Number of employees in offending organisation. Often revealed, otherwise Companies House accounts
Victim point in supply chain	Unknown	Supply chain point at which the case identifies the victim
Victim firm size (No. of Employees)	Unknown	Number of employees in offending organisation. Often revealed, otherwise Companies House accounts
Upstream competition level	UK	NUTS level at which competition is assumed
Upstream firms by 5 digit SIC	3,470 firms	Number of firms producing similar food product by SIC, NOMIS UK Business Counts 2022.
Upstream SIC group	Wholesale of meat and meat products; Processing and preserving of poultry meat; Production of meat and poultry meat products	SIC group of competition for product category
Downstream competition level	NUTS 3	NUTS level at which competition is assumed
Downstream firms by 5 digit SIC	935	Number of local area firms retailing similar food product
Downstream SIC group	All food retail	SIC group of competition for product category
Elasticity	-0.568	Own price elasticity of demand. NIESR Food and drink demand elasticities 2022 or DEFRA Food and drink elasticities, 2011
exp per week (p)	80	Household weekly expenditure on food product. Family Food Survey 2019/20
q per week	97	Household weekly consumption on food product. Family Food Survey 2019/20
Unit measurement	g	Uni of measurement used in the Family Food Survey 2019/20
£ per unit	0.0087	Per unit price calculated from expenditure and quantity, unless price revealed by case information
Quantity of fraudulent good	5100000 (g) of beef and lamb	Volume of fraudulent good in unit used by Family Food Survey
Market cost (business)	**£34.20**	**Calculation of the cost to genuine firms caused by fraudulent product in the market upstream.**

Source: Authors' calculations, Cost of Food Crime model 2022.
All financial figures presented in £ at 2021 prices.

2.4.5 Prevention costs

Prevention costs are those to all organisations, private, public, and NGOs, in attempting to prevent food crime from taking place. From annual accounts, the operational cost of the National Food Crime Unit is £5.8 million in 2021 (Food Standards Agency internal information). In 2019-20 Local Authorities allocated 345 full time equivalent posts, professional and administrative staff, on food hygiene and/or food standard issues (Food Standards Agency, 2020). This approach is limited to staff costs associated with food regulation, however, aspects of the work conducted are wider than the remit of food crime. At an approximate wage cost of £50,000 assumed, this costs Local Authorities £17.25 million per year. Combined, the cost to the government for food crime prevention is £23,040,141 per year. This approach can be refined by surveying Local Authority costs of food crime activities, with the caveat that authority time spent on food hygiene and standards activities likely prevents some crime from taking place.

Food companies, particularly large firms, spend substantial resources on quality controls to ensure products and processes comply with specifications and with the regulations. For example, survey based research estimates the cost to UK food business for complying with FSA regulation

and food law (KPMG, 2018). The researchers considered a plausible set of assumptions to apportion this cost according to food fraud prevention activity. However, the extent to which food companies unknowingly label products as non-compliant rather than being unsafe or inauthentic as a result of fraud is unknown. Such instances could contribute to the dark figure of undetected food fraud because firms would deal with them as commercial business-to-business issues rather than as crimes. Therefore, in combination with the conducted surveys, it has been recognised that currently there are no consistent methods, to our knowledge, for discriminating between the resources used for quality, safety and regulatory compliance purposes and those applied to the prevention of food fraud. Surveillance is focussed on the symptoms and may not lead to a conclusion about the cause. Consequently, at this stage, the model does not include an estimate of the business resources used to help prevent food crime. In the absence of this information, the analysis uses a minimum threshold cost based on the regulatory cost to the government (the approximate cost to the government for food crime prevention of £23 million per year). Further work is required to clearly discriminate and estimate the cost of food fraud prevention in the private sector.

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The Cost of Food Crime Phase 2 - Results

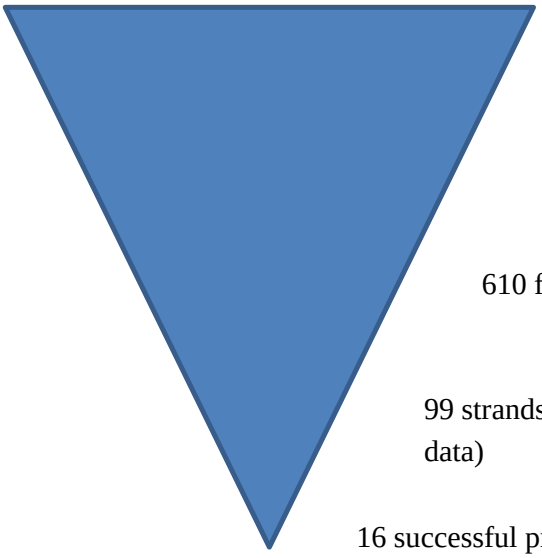
3.1 Food Fraud Attrition 2021

The research did not find any examples of food fraud in the large business sector. That is not to say such activities do not exist, for example, there may be food fraud masked by issues categorised as non-compliance. Just 0.5% of food firms employ over 250 people, yet they constitute 64% (£375 billion) of the £585 billion industry turnover (BEIS, 2021). The findings suggest that the bulk of the food industry has built resilience to fraud because it invests heavily in quality and regulatory compliance controls, including diagnostic testing that objectively identifies non-compliance. On the other hand, the interviews, victimisation rates in the FBO Tracker survey, the enforcement data and the web scraping exercise all indicate that the small business sector is vulnerable to food fraud, though the incidence rates are low. Having determined from these primary and secondary sources that the observable food crime rate is low, the most reliable data is mapped out in Figure 3 to illustrate the attrition from the unknown extent of the problem down to the proven extent of the problem. The data provides a snapshot of the incident rates at the measurable stages of enforcement. The present research developed the estimates for possible food crimes (3,050) and prosecutions (16) prosecutions. It is important to note that the attrition diagram does not represent the outcome of a coherent cohort of crimes because the estimates are derived from different sources. Consequently, the figures at each stage of the attrition diagram are not sub-sets of the higher figures. Nevertheless, the data provides a snapshot of the incident rates at the measurable stages of enforcement in 2021.

Figure 3 Food Fraud Attrition 2021 (accessible version)

- Unknown level of food crime
- 3,050 possible food crimes (present)
- 610 food crime intelligence reports (FSA data)
- 99 strands of food crime operational activity in 2021 (FSA data)
- 16 successful prosecutions (present research)

Figure 3 Food Fraud Attrition 2021



One measure of the food crime rate in the UK is the number of prosecutions identified by the scraping exercise (16), but this does not reflect reality at all as it represents only those cases which are proven at court. A more reasonable figure is the 610 food crime intelligence reports recorded by the FSA. This figure is an estimate of suspected food fraud: it excludes reports related to hygiene and regulatory issues, theft and other criminality. It is the closest equivalent to police recorded fraud crime, and, just like the police recorded crime statistics, it may include cases that subsequent investigations deem are not crimes. However, as with all crime statistics, the 610 figure is undoubtedly an underestimate that should be regarded as a lower threshold figure because it only includes detected cases that have caught the attention of the authorities and have been identified as carrying the hallmarks of fraud. The estimate therefore excludes the dark figure of undetected and unreported food fraud, including fraud cases which are incorrectly labelled by the authorities as non-compliant with the regulations due to negligence or mistake. It is a key figure used in the cost of food crime model. The estimate provides a key ratio for benchmarking purposes:

- Suspected / prosecution ratio: 610/16 = 38

Findings from the 2021 FBO Tracker survey are used to estimate the dark figure of food fraud and thereby provide an upper threshold limit for the number of crimes. The survey found that just 1 in 5 business victims report food fraud to the authorities, so that 80% remain hidden. Therefore an indicative upper threshold can be calculated by multiplying the number of suspected cases by a factor of 5:

- Experience / reporting ratio = 5
- Indicative upper threshold: 610x5 = 3,050 cases per year

The necessary, key caveat for this upper estimate is that the unit of measure for the survey is victims, whereas the unit of measure for the recorded and prosecuted crimes is cases. Consequently, as many crime cases have multiple victims, using victimisation rates for cases overestimates the number of cases. Nevertheless, the 3,050 cases per year upper estimate provides an indicative ceiling for the sensitivity analysis and an upper boundary for the CoFC model.

Further work is required to develop these estimates. Whilst the FBO Tracker survey provided estimates of victimisation in the small business sector, it did not estimate the level of offending by small businesses as this would require them to self-report their criminality. One way forward for this sector is to leverage an asset of the current regulatory regime to more reliably discriminate between food fraud and other incidents. The regime is unique in that the regulated industry is subject to thousands of inspections each year, including product sampling and testing: in 2017-18

English local authorities tested 30,744 samples (NAO, 2019) and members of the Food Industry Intelligence Network (FIIN) pool over 50,000 authenticity tests for intelligence purposes. (footnote 1) These are potentially rare and powerful sources of data for crime research based on very large samples. It would require investment to create a coherent data source based on common data standards, and it would require the inspectors tuning into the 'red flags' or hallmarks of food fraud. Until then, an interim solution would be to survey local authorities and other enforcement agencies.

A similar approach to differentiation could be used to estimate the extent that large food companies incorrectly label a product as merely non-compliant when it actually bears the hallmarks of food fraud. Such a research project would further expose the dark figure of food fraud, but it would necessarily require the close collaboration of the private sector.

3.2 Cost of Food Crime in the UK

The total impact of food crime on the UK is estimated to be between £409 million and £1.96 billion per year, presented in Table 8. The scale of food crime is equivalent to between 0.07% and 0.33% of the UK food industry turnover each year (BEIS, 2021). The range in estimates of the total costs reflects the further research required to develop the quality of data in order to improve the estimate and narrow the range with confidence. Notably, the prevention costs to businesses is missing from the results presented in this report because it has not been possible to discriminate between quality control costs and fraud prevention costs.

Table 8 Average and total costs of food crime by affected agent

Affected agent	Average cost Non-major case	Average cost Major case	Total cost (includes prevention costs)
All agents (610 cases per year)	87,099	4,299,691	408,965,136
All agents (3,050 cases per year)	As above	As above	1,961,177,398
Individual (610 cases per year)	2,282	719,657	58,280,014
Business (610 cases per year)	22,313	3,235,904	268,448,872
Government (610 cases per year)	62,503	344,129	83,500,028

Source: Authors' calculations, Cost of Food Crime model 2022.
All figures presented in £ at 2021 prices.

Once a food fraud has been committed (excludes prevention costs), the average cost is estimated at £87 thousand for small cases and £4.3 million for major cases. In major cases (approximately 13% of cases), the burden falls more sharply on businesses through the loss of property from purchasing criminalised goods. Conversely, a larger share of the burden falls on government in smaller cases through justice costs. The total burden of food fraud on businesses is £268 million per year, larger than the burden to government of £84 million (including prevention costs) and to individuals £58 million per year.

Tables 9 and 10 show the average cost per case by food and crime type. Each case is estimated to cost between £16 thousand and £151 thousand for small cases and between £423 thousand and £7.2 million for larger cases, depending on food and crime type. Cases involving meat or alcoholic beverages tend to cost more per case. Some of the costliest large cases involved waste diversion of meat and fish that is unfit for consumption, this is due to the large volume of food involved.

Table 9 Average costs of food crime by crime type

Crime type	Average cost (£) Non-major case	Average cost (£) Major case
Adulteration	86,901	538,611

Crime type	Average cost (£) Non-major case	Average cost (£) Major case
Document fraud	-	2,533,043
Illegal processing	151,627	508,754
Misrepresentation	35,858	2,527,187
Substitution	24,575	2,527,187
Waste diversion	82,608	3,758,152

Source: Authors' calculations, Cost of Food Crime model 2022.
All figures presented in £ at 2021 prices.

Table 10 Average costs of food crime by food type

Food category	Average cost (£) Non-major case	Average cost (£) Major case
01 - Meat And Meat Preparations	111,541	2,655,364
02 - Dairy Products And Birds' Eggs	16,232	423,114
03 - Fish Crustaceans, Molluscs; Prep.Thereof	28,597	2,296,878
04 - Cereals And Cereal Preparations	-	-
05 - Vegetables And Fruit	18,034	2,210,845
06 - Sugars, Sugar Preparations And Honey	22,434	-
07 - Coffee, Tea, Cocoa, Spices;Manuf.Thereof	-	-
08 - Feeding Stuff For Animals,Excl.Unmil.Cer	-	-
09 - Miscellaneous Edible Products And Prep.	14,557	-
11 - Beverages	27,401	7,233,097
12 - Tobacco And Tobacco Manufactures	-	-
22 - Oil Seeds And Oleaginous Fruit	-	-
41 - Animal Oils And Fats	-	-
42 - Fixed Vegetable Fats And Oils	-	-
43 - Process.Anim.And Veg.Fats And Oils;Waxes	64,737	-

Source: Authors' calculations, Cost of Food Crime model 2022. Food categories are Standard International Trade Classifications. All figures presented in £ at 2021 prices.

The cases collected do not cover all food and crime types. This highlights an important feature of the model presented in this report: that whilst this dataset and estimate provides a significant contribution to understanding the cost of food crime in the UK, further data is needed in order to provide completeness and accuracy. When considering estimates at a granulated level such as by food or crime type, it should be noted that the estimates rely on subsection of the data, reducing the estimate confidence.

Approximating the scale of criminalised activity using the quantity of criminalised food uncovered at the perpetrator's premises following authority intervention, provides an estimate of the value of fraudulent goods in the UK is between £296 million and £1.48 billion per year. This is the quantity of criminalised goods reported at market prices.

3.3 Case study of food crime costs

To provide a working context to the methodology employed in estimating the cost of food crime in the UK, Table 11 provides a breakdown of costs and information regarding a single case.

The inclusion of market costs within an estimate of the impact of crime is unique to this model. The market costs are the losses of profits for genuine firms that arise from criminal food entering the supply chain. Therefore, these costs are in addition to estimates of the market value of fraudulent products. Results show that the size of the market cost is on average 0.6% of the

market value of the fraudulent product and up to 3% in some cases. In the example case shown in Table 11, the market cost is £34.20 (or 0.07% of the market value), reflecting the strong volume of competition at the point of entry into the supply chain and geographic area for the corresponding food category.

Table 11 Detailed cost breakdown of single case study

Details	Cost information	Notes
Case type	Major case, case study	From interviews and media reports
Product	Beef and lamb	-
Crime type	Illegal processing	-
Origin location	Swindon, UK	-
Start / end year	2020	-

Justice costs

Cost type	Cost information	Notes
Organisation	LA, FSA, CPS, police	Reported organisations handling the case
Regulatory sanction/intervention	Prosecution	Prosecution, warning, etc.
Authority hours	2075 hours	Hours spent working case
Police hours	40 hours	Hours spent working case, if not included above
Hours cost (at £27.47/hr) (Gov)	**£58,099**	Average salary of £50k FTE assumed
Contractor costs (Gov)	**£5,000**	Costs for refrigerated vehicles and storage, a locksmith, and disposal
Criminal sanction (fine, suspended prison, prison)	10 months sentence, £4024 costs paid	Reported sentencing
Legal costs of prosecution (Gov)	**£12,500 approximately**	From interviews, legal costs are typically £10,000 to £15,000 for a prosecution. Mid-point used
Prison Costs (Gov)	**£37,538**	Ministry of Justice 2019-2020 cost per prisoner £42,670. 2020
Less fines paid (Gov)	**£4,023.58**	Less fines / costs paid as a consequence of prosecution

Market costs

Cost type	Cost information	Notes
Offender entry point in the supply chain	Manufacturing / production	Supply chain point at which the case is identified
Offender firm / franchise size (No. of Employees)	<10 people	Number of employees in offending organisation. Often revealed, otherwise Companies House accounts
Victim point in supply chain	Unknown	Supply chain point at which the case identifies the victim
Victim firm size (No. of Employees)	Unknown	Number of employees in offending organisation. Often revealed, otherwise Companies House accounts
Upstream competition level	UK	NUTS level at which competition is assumed
Upstream firms by 5 digit SIC	3,470 firms	Number of firms producing similar food product by SIC, . NOMIS UK Business Counts 2022.
Upstream SIC group	46320 : Wholesale of meat and meat products10120 : Processing and preserving of poultry meat10130 : Production of meat and poultry meat products	SIC group of competition for product category
Downstream competition level	NUTS 3	NUTS level at which competition is assumed
Downstream firms by 5 digit SIC	935	Number of local area firms retailing similar food product
Downstream SIC group	All food retail	SIC group of competition for product category
Elasticity	-0.568	Own price elasticity of demand. NIESR Food and drink demand elasticities 2022 or DEFRA Food and drink elasticities 2011
exp per week (p)	80	Household weekly expenditure on food product. Family Food Survey 2019/20
q per week	97	Household weekly consumption on food product. Family Food Survey 2019/20

Cost type	Cost information	Notes
Unit measurement	g	Uni of measurement used in the Family Food Survey 2019/20
£ per unit	0.0087	Per unit price calculated from expenditure and quantity, unless price revealed by case information
Quantity of fraudulent good	5100000 (g) of beef and lamb	Volume of fraudulent good in unit used by Family Food Survey
Market cost (business)	**£34.20**	**Cost to genuine firms caused by fraudulent product in the market**
Total cost of case (excluding prevention costs)	**£173,471**	Summation of elements in bold

Victim costs

Type of cost	Cost information	Notes
Possible health concern	Lack applicable safety information or regulatory authorization	Potential hazard as classified by Everstine et al (2018).
Reported health concern	No reported health concerns	-
Health care costs (Gov)	**0 as no harm reported**	NHS costs of providing health care, incorporated from FSA COI 2018 or DfT TAG data
Individual expenses (Individual)	**0 as no harm reported**	Personal expenses such as transportation to receive medical care, medication cost, funeral cost.
Lost earnings (Individual)	**0 as no harm reported**	Loss of earnings due to being sick
Costs associated with absence from school (Gov)	**0 as no harm reported**	School absenteeism due to sickness
Disturbance cost (Business)	**0 as no harm reported**	Administration costs to business disruption due to employee being sick
Human cost of pain, grief & suffering (Individual)	**0 as no harm reported**	Willingness to pay to avoid illness or premature death (death also includes loss of consumption)
Loss of property (Business)	**£44,403**	Market value of fraudulent product upstream. Volume identified in reports. Market price taken from Food Fraud Survey.
Loss of property (Individual)	**0 as product entered upstream**	Market value of fraudulent product downstream. Volume identified in reports. Market price taken from Food Fraud Survey.

Crime Career costs

Cost type	Cost information	Notes
Length of prison sentence	0.83 years	Years of jail sentenced
Annual gross pay - median	£23,905	Median annual gross salary. Earnings and hours worked, place of residence by local authority: ASHE Table 8, 2021
Crime career costs (Business)	**£19,921**	**Product (Length of prison sentence (years) Annual gross pay - median)**

Source: Authors' calculations, Cost of Food Crime model 2022.
All financial figures presented in £ at 2021 prices.

1. https://www.fiin.co.uk/

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The Cost of Food Crime Phase 2 - Sensitivity of model estimates

The CoFC model by nature of construction is sensitive to variations in estimated total number of food crimes and the assumed proportion of major cases. This section demonstrates the CoFC model results when alternative assumptions are applied in order to provide a range of results that can be used in the absence of statistical upper and lower bounds. From the application of alternative scenarios, results show that the total annual cost of food crime to the UK is at lowest £33 million and at highest £1.96 billion per year.

4.1 Estimated total number of food crimes

The dataset of 16 food fraud cases for 2021 is used to derive cost estimates with the knowledge that the count of cases understates the number of cases that take place. To estimate the number of cases, this research assumes the 610 food crime intelligence reports processed by the FSA in 2021 as the total number of food crime in the UK each year. However, from the Food Business Organisation Tracking Survey conducted in 2021, it is inferred that five crimes were experienced for every one reported. If this is true, then there could be 3,050 food crime cases per year. Table 12 shows the CoFC model results vary between £33 million and £1.96 billion per year with changes in the estimated total number of food crimes. As such, the headline estimated total cost, based on the 610 suspected food crime incidents, is a conservative estimate.

Table 12 Sensitivity of estimates by varying estimate number of cases

Estimated total food crimes per year	Total annual cost
3,050 (reported x experience ratio)	£1,961,177,398
610 (reported)	£408,965,136
16 (prosecuted)	£32,858,905

Source: Authors' calculations, Cost of Food Crime model 2022

4.2 Major cases

In small datasets, outlying observations can distort analysis based on simplistic representations of a distribution, such as the mean or median values. By constructing a Weibull curve, it is observed that within this food crime dataset, a minority of cases appear far larger in cost values. Such cases have been labelled as major cases and are defined as at least one of the following:

- the value of confiscated fraudulent goods is over £100k in market value
- there was at least one fatality
- prosecution secured collective (of all accused) jail sentences of over 2 years
- prosecution secured a fine paid of over £100k

Across the dataset, 17% of cases are defined as major. The frequency of major cases does not fall evenly each year, there were 13% major cases between 2017 and 2021 and 8% between 2020 and 2021. Adjusting the assumed proportion of major cases projected from multiplying real number of cases provides the range of estimates shown in Table 13. Results vary between £283 million and £514 million in total cost when adjusting the assumed proportion of major cases. As such, the headline estimate takes the assumed proportion as 13% major cases per year, reflecting the activity of food crime cases over the last five years.

Table 13 Sensitivity of estimates by varying expected proportion of major cases

Proportion of major cases	Total annual cost
17% (all data)	£514,279,930
13% (2017-2021)	£408,965,136
8% (2020-2021)	£282,587,383

Source: Authors' calculations, Cost of Food Crime model 2022

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The Cost of Food Crime Phase 2 - Conclusion

To achieve an estimate of the cost of food crime to the UK, the team carried out substantial investigations into sources of data supplemented by 24 qualitative interviews that fed into the refined model for the cost of food crime, or more accurately, the cost of food fraud as theft is not currently included in the model. The main issue that we encountered was the absence of detailed crime records for food fraud, which led to us creating our own database of cases using web scraping.

The qualitative data collection through interviews and the FBO Tracker survey gave a picture of food fraud in the UK that shows that, unless prosecuted, most occurrences likely go unreported and not classified as fraud, being dealt with as food safety, quality compliance, or business-to-business incidents.

The combination of the very high degree of awareness of food safety, quality and fraud among large UK businesses, local authorities and enforcement agencies, and the extensive use of objective diagnostic testing means that the sector has built resilience to fraud. Small and medium sized businesses in the UK are more vulnerable, as our findings show. It is also likely that the occurrence of food fraud in the UK is higher than that given in the study, especially in the small business sector.

To provide a fuller picture of the extent of food fraud in the UK, and its cost to the UK, a standard system of reporting and recording such occurrences would need to be developed. In the meantime, the model developed here and the range of costs identified, show that the cost of food fraud in the UK is significant and takes many forms, and that continued government action to protect consumers is much needed.

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