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.
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.

Justice costs	Cost information	Assumptions and derivation
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.