DISEI - Università degli Studi di Firenze

Working Papers - Economics

An Assessment of Agro-food Frauds in the Italian Economy: A SAM-based Approach

B. Rocchi, D. Romano, A. Sadiddin, G. Stefani

Working Paper N. 23/2018

DISEI, Università degli Studi di Firenze
Via delle Pandette 9, 50127 Firenze, Italia
www.disei.unifi.it

Benedetto Rocchi[a], Donato Romano[a], Ahmad Sadiddin[a], Gianluca Stefani[a],

An Assessment of Agro-food Frauds in the Italian Economy: A SAM-based Approach

[a] Dipartimento di Scienze per l'Economia e l'Impresa (DISEI), Università degli Studi di Firenze (UNIFI)

September, 2018

This report is the results of the research activities under the research project: Analysis of Fraud Risks in the Agro-Food Sector.

Abstract

Building on the Italian input-output table, and using structural information on agro-food production sub-sectors from several sources, a Social Accounting Matrix (SAM) model for the Italian economy has been developed, disaggregating the agro-food sector into agricultural production activities and ten different agro-food value chains (VCs). Then, using primary data by the Central Inspectorate for Quality Protection and Fraud Repression in Agro-Food Products (Ispettorato Centrale per la Qualità e la Repressioni delle Frodi, ICQRF) of the Italian Ministry of Agriculture, we assessed the economic size of fraudulent agro-food output, estimated the size of the economy depending on fraudulent production, and simulated the impacts of agro-food frauds on the national economy in terms of GDP, employment and income distribution.

The analysis shows that the wine value chain is the sub-sector most exposed to frauds accounting for 88% of the total value of seized agro-food outputs. Second ranks olive oil value chain (6% of total seizures), while the other VCs accounts for only the remaining 6% of total seizures. The shares change slightly when the values of irregular products were expanded to the population levels.

The results of the SAM simulations shows that the share of economy directly and indirectly linked to supply of irregular food products accounts for 0.5% of total value of output, while in terms of value added the share of irregular food products ranges between 0.1% and 0.4% of total value added. This corresponds to a value of 1.9 billion euro (considering only seizures) to 13.9 billion euro (including all irregularities) and is able to activate a up to 156 thousand labour units in the worst-case scenario. In terms of the share relative to the agro-food sector, the total output "driven" by irregular products is much higher accounting for 3.2% of output and 5.8% of employment.

Results from the counterfactual analysis shows that agro-food frauds caused a losses of 1.8 billion euro in terms of total output, corresponding to about 20 thousands of full time labour units. The net impact on GDP is positive though very small since the earnings feed rent-seeking activities instead of strengthening linkages with the rest of the economy. Household incomes are reduced by only 0.01%. However, considering that consumers build their own perceptions on the basis of a mix of quality and health considerations, the potential losses in cases of food scandals would be much more tangible.

These results show that fighting agro-food frauds is justified on efficiency as well as equity ground.

Acknowledgements

This working paper is the second of a series of four stemming out from a joint research project between the Department of Economics and Management (DISEI) of the University of Florence (UNIFI) and the Council for Agricultural Research and Analysis of Agricultural Economics (CREA) on “Risk Analysis and Evaluation of Frauds in the Agrofood System”.

The overall objective of the project is to analyse the agro-food fraud evolution over the last decade and to assess its role in the Italian economy. In addition to this paper, readers are referred to the following working papers produced under the same project: Sadiddin *et al*. (2018a), Rocchi *et al*. (2018), and Sadiddin *et al*. (2018b).

The authors would like to thank the staff and management of the Central Inspectorate for Quality Protection and Fraud Repression in Agro-Food Products (Ispettorato Centrale per la Qualità e la Repressioni delle Frodi, ICQRF), namely Dr. Stefano Vaccari (ICQRF Director), Dr. Luca Veglia (Head of Risk Analysis Office), and Dr. Placido Iudicello (Data Manager), for providing primary data on seizures and irregularities as well as providing feedbacks on preliminary results.

Important contributions were also provided by Dr. Amedeo De Franceschi, Head of the Agro-food Unit of the Italian Forest Service (Nucleo Agroalimentare e Forestale del Corpo Forestale dello Stato), providing data and discussing the most important fraud modalities in the wine, olive oil and dairy value chains.

The authors would like to thank also Dr. Pietro Sandali, Director of the Italian Consortium of Olive Producers (Consorzio Olivicolo Italiano, UNAPROL) for fruitful discussions on the frauds in the olive oil value chain, and Dr. Francesco De Filippis and Dr. Dario Parenti for providing the technical coefficients of the wine value chain.

Special thanks also to the Institute of International Education/Scholar Rescue Fund (IIE-SRF) for its financial support to Dr. Ahmad Sadiddin, a Syrian refugee scholar: without the IIE-SRF support the Project would never materialize.

Acronyms

COICOP	Classification of individual consumption by purpose (Classificazione dei consume individuali per finalità)
CPA	Statistical Classification of Products by Activity (Classificazione dei prodotti per attività)
CREA	Council for Agricultural Research and Agricultural Economics Analysis (Consiglio per la ricerca in agricoltura e analisi dell'economia agraria)
DISEI	Department of Economics and Management (Dipartimento di Scienze per l'Economia e l'Impresa)
FADN	Farm Accountancy Data Network
ICQRF	Central Inspectorate for Quality Protection and Fraud Repression in Agro-Food Products (Ispettorato centrale della tutela della qualità e della repressione frodi dei prodotti agroalimentari)
IRVAM	Institute for Research and Information for the Evaluation of Agricultural Production (Istituto per le Ricerche e le Informazioni di Mercato e per la Valorizzazione della Produzione Agricola)
ISMEA	Institute of Services for Agricultural Food Market (Istituto di Servizi per il Mercato Agricolo Alimentare)
ISTAT	Central Institute of Statistics (Istituto Centrale di Statistica)
MIPAAF	Italian Ministry of Agriculture (Ministero delle politiche agricole, alimentari e forestali)
NACE	Nomenclature générale des Activités économiques dans les Communautés Européennes
SAM	Social Accounting Matrix
VC	Value chain
UNIFI	University of Florence (Università degli Studi di Firenze)

Table of contents

1. Introduction

Food fraud has been conducted since the old ages, and evidence has been found in the past literature of most civilizations. However, the scale of food frauds has been rapidly growing mainly due to the rise of modern and complicated food supply chains that have expanding the scale of the phenomenon making its impacts on the economy and society so important to measure. Food fraudsters do not comply with the rules regarding many aspects of production and marketing. This makes them a source of unfair competition to the regular producers. For example, they do not pay taxes, they may use informal labour, they may not comply with product safety regulations and they may violate intellectual property rights, thus feeding a long chain of illegal activities.

Of course, not all food fraudsters go through the whole chain of illegal activities; rather, they are involved at different degrees in such activities. But organised crime benefits from this chain by making use of commerce channels opened up by trafficking, so they can take advantage of equally profitable but far less risky activities such as trade of counterfeit goods. The flourishing of this trade is made possible due to a significant demand created by self-interested consumers who think they are getting a deal in buying counterfeit products that are much cheaper than genuine products. When it comes to agro-food products, the complexity and the high levels of sophistication of many agro-food production processes that make more difficult the chance to spot counterfeiting activities exacerbate the problem. For example, Censis (2012) estimates that the agro-food sector ranks as third among sectors most affected by counterfeiting in Italy.

Considerable attention has been recently given to this phenomenon at the national as well as EU levels. In Italy, there are indeed many bodies and agencies involved in these activities and each one has built its own data management system. Among those bodies, the Ispettorato Centrale per la Tutela della Qualità e Repressione Frodi (ICQRF) is the only Italian inspection body that is specialized in the repression of agro-food frauds and in monitoring of relevant regulatory interventions. The ICQRF has a systematic control system spanning across the whole country, with inspection activities performed in all value chains of the agro-food sector from agricultural production through processing and distribution to retailing.

The data of ICQRF monitoring activities with all relevant information represents the base of information that has been used to present an exploratory analysis of frauds and counterfeiting in the agro-food sector, describing how it developed over time across major agro-food subsectors (cf. Sadiddin *et al*., 2018a). The same database is used in this paper to assess the economic size of agro-food frauds and simulate the impacts of agro-food frauds on the national economy in terms of GDP, employment and income distribution using a SAM model approach.

Given the above, the report is organized as follows. After reviewing the scanty existing literature on the impacts of fraud in section 2, in section 3 we provide an estimation of the value of irregular agro-food products. Then, section 4 summarizes the SAM model used in the assessment of agro-food frauds impacts, while section 5 is devoted to the discussion of simulation results. The report ends with a concluding section summarising the major findings and their implications for policy makers and public managers.

2. Literature Review

Censis (2012) is the only source available that measured the impact of counterfeiting on the Italian economy[1]. It provides analysis of the legal context and the impacts in economic and fiscal terms on GDP, employment, and government finances as a result of lost direct and indirect tax revenues. Besides the aggregate impact of the phenomenon, the study focuses on a number of industries particularly affected by counterfeiting such as leather goods, cosmetics, and design, as well as an explorative analysis of demand factors in some of the most important cities.

The study starts with a chapter on the legal and institutional contexts by providing a list of the public bodies and agencies involved in the fight against counterfeiting with summary of their duties and responsibilities. The chapter also includes a review of national legislations against counterfeiting and the recent changes introduced by Law no. 99/2009 (known as the Development Law). Then the report presents the definitions of several critical concepts, namely: intellectual property rights, patents for industrial inventions, utility models, trademarks, designs, geographical indications, counterfeiting, copyright, and piracy.

When it comes to counterfeiting, Censis (2012) adopts the definition of the EC Regulation no. 1383 of 22 July 2003 that identifies as counterfeiting:

- goods, including packaging, bearing without authorisation a trademark identical to the trademark validly registered in respect of the same type of goods, or which cannot be distinguished in its essential aspects from such a trademark, and which thereby infringes the trademark-holder's rights;
- any trademark symbol (including a logo, label, brochure, etc.), even if presented separately, if it is found in the same situation as described above;
- packaging materials bearing the trademarks of counterfeit goods, even if presented separately, found in the same situation as described above.

Two sections of the chapter are then devoted to the innovations introduced by the Development Law on counterfeiting. The first explains the changes the Law made regarding the sanctions and penalties for broad categories of counterfeiting. The second explains the contribution of Directorate-General for the Fight Against Counterfeiting, which has inherited the functions formerly performed by the Italian Patent and Trademark Office and the High Commission to Combat Counterfeiting.

The last section of the chapter presents an explorative analysis of some data on seizures available from different sources, namely: Tax Police (*Guardia di Finanza*), Customs Agency (*Agenzia delle Dogane*), National Police (*Polizia di Stato*), Local Polices (*Polizie Municipali*), and activities of *Carabinieri*. Here it is stated that data on seizures, although provide a proxy measurement of the phenomenon, should be carefully analysed as they could help learn and monitor qualitative and quantitative trends on counterfeit goods, their origin and the routes they follow and their final destination. For this purpose, Italy through its Ministry of Economic Development is making efforts to harmonise the data coming from various sources on seizures through setting up the IPERICO (Intellectual Property-Elaborated Report of the Investigation and Counterfeiting) database.

Up to now, however, harmonisation has been completed only for data coming from the Tax Police and the Customs Agency, while a number of inconsistencies within the data coming from *Carabinieri*, National Police, and Local Polices prevented their integration into the other forces' databases yet. These inconsistencies mainly concern the lack of distinction between seizures carried out for counterfeiting offenses and those carried out for copyright violation offenses, which are aggregated at the relevant source. But they also concern the lack of data on the number of seizures in relation to the number of items seized (Riccio *et al*., 2014).

[1] Censis (2012) is an extension of a previous study published in 2009, which provided only an aggregate estimate of counterfeiting, based on a methodology different from the one used in Censis (2012).

The second chapter is devoted to the measurement of economic and fiscal impact of counterfeiting on some Italian economic and fiscal indicators. The scope of the analysis is limited to the total amount spent by Italian consumers on purchasing counterfeit goods and so it excludes the Italian counterfeit goods sold abroad while it includes products manufactured abroad but sold in Italy. The study estimates the economic impact of counterfeiting using an Input-Output Table for the Italian economy while relying on secondary data to estimate the market value of counterfeit products. The latter makes use of some sophisticated statistical techniques that exploits the relationships between the value of counterfeiting and some economic indicators (GDP and consumption) at the level of OECD countries and then apply it to the Italian context, specifically focusing on the sectors assumed to be mostly affected by counterfeiting.

Censis (2012) estimates total revenue from counterfeit goods to be equal to 7.1 billion euros in 2008. This estimate fell to about 6.9 billion euros in year 2010 due to the recession. This last figure when carried to the official market, meaning that if legitimate products of the equivalent value had been sold over the same period, 13.7 billion euros of additional output would have been produced, 5.5 billion euros of value added would have been generated and 110,000 full-time jobs would have been guaranteed. In fiscal terms, this would have brought additional revenue to the government through direct and indirect taxes equal to 4.62 billion euros, which is about 1.74% of all government tax revenue[2]. Referring to the food and drinks sector, the results show that it is the third top sector in terms of impact of counterfeiting after the audio-visual, CDs, and DVDs sector and the clothing and accessories sector.

The third chapter of the study is devoted to the analysis of three main sectors, which are leather goods, cosmetics, and design. In order to perform the analysis, a mix of methodologies was employed including both office and fieldwork. The analysis made use of available data on trends in the sector and the seizures made by various bodies as well as secondary data/information from previous studies on counterfeiting by organizations in the field or consumer associations. The analysis also relied, for the fieldwork, on semi-structured open-ended interviews with experts in the relevant sectors. The last chapter focuses on demand analysis by use of focus group of specialists through discussions.

[2] The fiscal impact is based first on calculating a tax base for each individual income category using the data from I-O Table and from other source (Censis, 2012, p. 74, Table 1, p. 76. Table 2). The study demonstrates that the total expenditure on counterfeit goods generated almost 1.7 billion euros of lost revenue to the government 37.3% of which derived from direct taxation and the remainder from indirect taxes. In addition, if induced production in other sectors of the economy is considered, almost 3 additional billion euros are lost reaching a total of almost 4.62 billion euros of lost government revenue. Concerning food and drink sector, it is placed third in importance as the case for the economic impact.

3. Irregular food products: estimation of their values by VC

3.1. The Role of various agencies in the repression of agro-food frauds

Other than the ICQRF, the following bodies are involved in the repression of agro-food frauds and counterfeiting: Custom Agency (*Agenzia delle dogane*), Tax Police (*Guardia di Finanzia*), Anti-Sophistication and Health Units *Carabinieri* (NAS), Command of Agricultural and Food Policies *Carabinieri* (NAC), State Forestry Body (CFS), in addition to regular *Carabinieri*, national and local police bodies. In this section, we describe the available data, by source and sector, and explain how we used them to estimate the values of irregular products at the national level in the agro-food VCs.

To the best of our knowledge, only the ICQRF performs systematic inspections based on representative samples, while the inspection activities of the other institutions are mostly *ad hoc* and mainly based on information on potential violations that reach the relevant institutions. Unfortunately, we could not have access to the detailed datasets of agencies other than that of the ICQRF. Therefore, we ought to rely exclusively on what is published in the IPERICO[3] report on agro-food frauds (Riccio *et al*., 2014), which provides an overview of their inspection activities with summary tables of their inspection outcomes of all involved bodies. One limitation of IPERICO's data is that, differently from ICQRF (2016), they are focus only on seizures with no details on inspections samples and other types of irregularities that do not lead to seizures, which according to ICQRF (2016) represent the vast majority of irregularities.

There is no clear-cutting allocation of responsibilities among the inspection agencies/bodies including ICQRF, except for the Custom Agency, which is the only one having the mandate to act at the borders. The other bodies can inspect to fight frauds on the whole national territory according to their capacities. To the best of our knowledge, there is no strict coordination in terms of inspection planning and sampling, which leaves room for overlapping of inspection domains. Moreover, examining the published data on seizures reveals that not all of them have conducted seizures in all agro-food sub-sectors. For example, the *Carabinieri*, National and Local Police bodies did not seize olive oil or wine over the period of 2010-2012 despite the high importance of these two VCs.

As shown in Table 3.1, the ICQRF's dataset includes all details on inspections, reports and their results and consequences, which are well explained in Sadiddin *et al*. (2018a). Various units of measurements are used in this dataset according to the type of data. For example, inspections and irregularities are provided as numbers for products and establishments. However, seizures, which form a sub-set of irregularities, are in addition expressed in terms of quantities and values, while quantities are measured by various units as weight (e.g. kg) or as size (e.g. litre).

Table 3.1. Available data by source, year, type, detail, method and unit of measurement and level of disaggregation

Years	ICQRF	Custom Agency	Tax Police	NAS	NAC, Carabinieri, National & Local Police	CFS
2007	X					
2008	X	X				
2009	X	X	X			X
2010	X	X	X	X	X	X
2011	X	X	X	X	X	X
2012	X	X	X	X	X	X

[3] IPERICO stands for Intellectual Property-Elaborated Report of the Investigation on Counterfeiting and is a database that collect and harmonize data on frauds from all agencies/bodies involved in frauds repression.

2013	X					
2014	X					
2015	X					
Level of details	Full database	Seizures	Seizures	Seizures	Seizures	Fines
Method of measurement	Q & V	Q	Q	Q & V	Q	V
Unit of measurement	Litre & Euro	kg	kg	kg & euro	kg	number
Disaggregation by VC	Yes	Yes	Yes	Yes	Yes	No

Source: Authors' elaboration on ICQRF (2016) and Riccio *et al*. (2014).

Data from other sources/bodies of inspections are all summaries (Table 3.1), but they also differ in other details from the ICQRF's data, and among each other. For example, data from Custom Agency, Tax Police, NAS, NAC, *Carabinieri*, National Police and Local Police are principally seizures that are disaggregated by VC, from which, however, only those of NAS include quantities and values while the seizures of the others are expressed only in terms of quantities. In addition, Table 3.1 shows that the temporal coverage of the available data differ from source to source. While we could obtain data from the ICQRF to cover nine years (2007-2015), the available data from Custom Agency, Tax Police and NAC covers 5, 4 and 3 years respectively. In addition, the ICQRF system of records register in addition to seizures (in terms of both quantities and values) the irregularities that do not lead to seizures, but are, however, frauds and their imputed values must be accounted for when estimating the overall values of irregular products.

Moreover, the ICQRF (2016) includes information on the number of inspected establishments, which is necessary to expand the values of any sample to the population level when joined with the total number of active establishments. Given the above, and accepting that the ICQRG inspections are based on representative samples covering the entire national domain, we can ignore the data on seizures conducted by the other agencies since they can be considered as potentially covered by the ICQRF inspections. This is a valid proposition because we are interested not only in estimating the actual values of seizures/irregular products that are actually detected, but also in assessing their values at the population level. The latter can be performed on results of the ICQRF data using a proper measure of expansion to the population level, while accepting that the ICQRF data are based on representative samples.

Since agro-food VCs differ in their technical and economic characteristics including those of their major products, and given the time and resources available to this project, we follow an *ad hoc* plan for the estimation of the values of irregular products. The plan is based on concentrating the efforts on olive and wine VCs to achieve a reasonable level of precision in the calculations taking into account the transformations of values along each of the two VCs. The choice of these two chains is dictated by the fact that they make the bulk of agro-food irregularities (Sadiddin *et al*., 2018a) in addition to being relatively simpler than the other VCs as each of the two includes only a limited number of similar products. The way we deal with the other VCs implies some simplifications that are driven by their high complexities compared to the cases of wine and olive oil, while they are noticeably less important.

3.2. Assessment of the value of seized and irregular products: sample vs. population

In order to estimate the value of seized and irregular products, several data manipulations have been undertaken on ICQRF's dataset, but complemented by secondary data from literature and experts in some cases. In this section, we describe the operations conducted in order to estimate the values of seized products evaluated at the consumer level. The latter means that quantities of seized products used in the evaluation reflect quantities of final products, implying that all seized intermediary products should be transformed into their final products equivalents. In the same token, prices should be those prevailing at the consumer level for each final product.

3.2.1. Olive oil VC

To obtain the technical coefficients of transformation of olive oil VC, we rely on ISMEA (2014), which provides a detailed description of the olive oil VC, from which we adopt the numbers on supply and use shown in Table 3.2. The table reveals that along all phases of the VC, the technical coefficients are all 1:1 because the sum of supplies at the early stages of the VC is equal to the sum of uses at the end of the VC, and therefore, there are no losses of olive oil along the chain.

Table 3.2. Brief supply-use table of the olive oil VC (unit: 000 litres; reference year: 2011)

Item	Supply	Use
Imports	625	
National production of pressure oil	542	
National production of pomace oil	31	
Exports		402
Domestic consumption		611
HO.RE.CA		108
Canning Industry		77
Total	1,198	1,198

Source: ISMEA (2014).

It is worth mentioning here that we ignored the technical coefficient of transforming olives into olive oil for the following reasons. First of all, as the data of ICQRF reveal, there are no seizures of olives carried out by the ICQRF, neither by any other inspection body. Second, the ICQRF report, over the period of nine years (2007-2015), only two cases of irregularities on olives, which can be neglected given that the number of irregularities over the same period approaches six thousands. These findings imply that no manipulations are necessary on the quantities of seized olive oil regardless of the VC level in which the seizure was conducted, and the only necessary manipulation is to find a reasonable way of calculating an average seized quantity. Table 3.2 provides a summary of all available data on seizures of the ICQRF.

Table 3.2. Olive oil seizures by inspection body over time (000 litre)

Year	ICQRF
2007	2,678.91
2008	322.74
2009	179.05
2010	79.68
2011	141.45
2012	678.35
2013	1,337.80
2014	1,709.30
2015	101.81
Average	803.23

Source: Authors' elaboration on ICQRF (2016).

Given the above, and in order to calculate the values of the seizures, it is enough to multiply the quantities by an average representative price at the consumer level. To reach this price, we use the data of the ICQRF, which include detailed information on quantities and values at various levels of the VC. The price is calculated as a weighted average of the quantities seized from production units that sell directly to consumers. However, since seizures have been enforced in different years, we deflate their values using the Consumer Price Index (CPI) with two different base years: 2009 and 2011. The latter is used only for comparison between the average price of the seized quantities with the price calculated from ISMEA (2014) for 2011, while the former base year, i.e. 2009, is the reference year of our SAM. The calculated prices are reported in Table 3.3, which shows that the calculated average prices are similar regardless of source and base year. This is because, from one hand, inflation has been low in the last few years; on the other hand, the price calculated by ISMEA (2014) in 2011 is noticeably close to the price calculated from the ICQRF database, with the latter being higher, especially after deflation. This difference, that is tangible in proportional terms, might be explained, at least in part, by the reasonable assumption that frauds are usually committed on more expensive products.

Table 3.3. Average prices of olive oil at consumer level by year, source, and deflation basis

Item	Price (Euro/litre)	Difference with respect to average price of ISMEA (2011)
Average price without deflation (ICQRF)	3.52	9.6%
Average price deflated to 2009 (ICQRF)	3.42	6.6%
Average price deflated to 2011 (ICQRF)	3.57	11.3%
Average price in 2011 (ISMEA)	3.20	0.0%

Source: Authors' elaboration on ICQRF (2016), ISMEA (2014) and ISTAT (2016).

Having estimated a reliable average price for the seizures, it is enough to multiply it with the seized quantities to reach the values of seized products. Table XIV illustrates the results of this multiplication in the first column by inspection body. However, in order to estimate the values of all irregular products, including those that have not been seized, we need a parameter of expansion. The only way was to use the ratio of the number of seized products to irregular ones calculated from the ICQRF database, and averaged at 15.61% over the entire period of 2007-2015. Assuming that the same ratio applies to other inspection bodies, the second column in Table 3.4 includes what would be the values of products detected irregular, including but not confined to the seized ones.

Table 3.4. Values of seized and irregular olive oil: a sample based estimation (000 euros)

Agency	Seized olive oil	Irregular olive oil	Expansions ratio
ICQRF	2,748	17,306	15.61%

Source: Authors' elaboration on ICQRF (2016).

3.2.2. Wine VC

Differently seizures in the olive oil VC, seizures enforced in the wine VC include products other than final wine; therefore, it is necessary to use technical coefficients of transformation in order to express all the seized quantities in terms of final wine ready for consumers. Data from ICQRF shows there three types of seized products: wines, musts, and grapes. Table 3.5.

Table 3.5.Quantities of seizures in the wine VC by product

Year	Wine (litre)	Must (litre)	Grapes (Kg)
2007	6,727,855	1,698,909	0
2008	19,687,960	9,736,393	150,270
2009	5,951,702	1,893,024	0
2010	2,541,994	2,574,272	330
2011	2,376,464	465,438	0
2012	4,986,305	14,434,455	0
2013	7,048,523	45,930,126	0

2014	1,875,047	3,287,634	24,260
2015	34,397,280	20,761,140	333
Total	85,593,130	100,781,390	175,193

Source: Authors' elaboration on ICQRF (2016).

The first step in data manipulation is to transform the seized quantities of intermediary products into final product equivalents, therefore, transform the quantities of musts and grapes reported in Table 3.5 into wine equivalents. To do this, we need technical coefficients of processing (transformation) which are reported in Table 3.6 based on the judgements of two experts in the wine sub-sector.

Table 3.6. Technical coefficient of transformation in the wine VC

Source	Grapes to must	Must to wine	Grapes to Wine (Kg to litre)
Expert 1	0.80	0.90	0.72
Expert 2	0.60	0.85	0.51
Average	0.70	0.88	0.61

Source: personal communication (Parenti & De Filippis).

Table 3.7. Seizures in the wine VC by inspection body: all transformed into wine equivalents

Year	Wine	Must	Grapes	Total
2007	6,727,855	1,486,545	0	8,214,400
2008	19,687,960	8,519,344	92,040	28,299,344
2009	5,951,702	1,656,396	0	7,608,098
2010	2,541,994	2,252,488	202	4,794,684
2011	2,376,464	407,258	0	2,783,723
2012	4,986,305	12,630,148	0	17,616,453
2013	7,048,523	40,188,860	0	47,237,384
2014	1,875,047	2,876,679	14,859	4,766,585
2015	34,397,280	18,165,997	204	52,563,481
Average	9,510,348	9,798,191	11,923	19,320,461

Source: Authors' elaboration on ICQRF (2016).

Table 3.7 includes the quantities of seizures in the wine VC as if they were all final product (i.e. wine). The numbers are obtained by multiplying the quantities of musts and grapes in Table 3.5 by their corresponding transformation coefficients into wine including the conversion of measurement unit from kg to litre for grapes, while those of wine remained unchanged.

In order to calculate the values of these seizures, we need multiply the average quantities by an average representative price at the consumer level. To reach this price, we use the data of the ICQRF, which include detailed information on quantities and values at various levels of the VC. The price is calculated as a weighted average of the quantities seized from production units that sell directly to consumers. However, since seizures have been enforced in different years, we deflate their values using the Consumer Price Index (CPI) with the base years 2009: the reference year of our SAM. The resulting average price is 2.02 euro per litre of final wine.

Table 3.8. Values of seized and irregular products in the wine VC (000 euro)

Agency	Seized wine	Irregular wine	Expansion ratio
ICQRF	39,030.5	219,292	17.8%

Source: Authors' elaboration on ICQRF (2016).

Having estimated a reliable average price for the seizures, it is enough to multiply it with the average seized quantity reported in Table 3.7 by this price to reach the values of seized products, which is shown in Table 3.8. Moreover, in order to estimate the values of all irregular products, including those that have not been seized, we need a parameter of expansion. As the case of olive oil, we use the ratio of the number of seized products to irregular ones calculated from the ICQRF database for wine VC, and averaged at 17.8% over the entire period of 2007-2015.

3.2.3. Other VCs

In order to estimate the value of seized and irregular products for all the other VCs, we optimally could follow steps similar to those taken for wine and olive oil as explained above. However, the high level of complication in all the other VCs entailing high number of final products and intermediary transformations have prevented us from doing so given the time span of the project. Therefore, we resort to other simpler mechanisms. That is to say we just deflated the values of the ICQRF seizures for the other VCs before taking the averages over the entire period of 2007-2015, with 2009 as a base year since it is the reference year of our SAM. Our choice is dictated by lack of time since repeating the same operations performed over wine and olive oil require plenty of time to be invested for VCs whose importance in terms of fraud weight is relatively small (a part of olive oil and wine, all the other 8 VCs include less than 40% of the values of seizures). In addition, the possibility to rely on prices of final products in the other VCs would have caused the loss of some important data since many products were exclusively seized at early stages of the VCs. The results are reported in Table 3.9.

Table 3.9. Values of seized and irregular products: sample-based estimation (000 euro)

Sector	Values of Seizures (000 euro)	Expansions ratios	Values of Irregularities (000 euro)
Meat	40	3%	1,675
Fish	21	18%	161
Other Food	203	10%	2,890
Horticultural	701	8%	11,462
Dairy Products	313	8%	5,233
Cereals and Starch	447	6%	10,921
Animal Feed	77	7%	1,561
Other Drinks	154	19%	1,126

Source: Authors' elaboration on ICQRF (2016).

However, values reported in Table 3.9 do not reflect the value of final products. This implies that they should be higher should we accommodate them to the consumer level. One way to do that could be by using a ratio that can be drawn from olive oil and wine VCs, which is the ratio of value of seized products accommodated to the consumer level to its counterpart without this accommodation. If we assume that this ratio applies to all the other VCs, multiplying the values in Table 3.9 by this ratio (1.37) gives us the values of each VC at the consumer level. The results (including those of wine and olive oil VCs) are reported in Table 3.10 so that they can be considered as if all seized products are valued with prices of final products prevailing at retailers' level.

Table 3.10. Values of seizures and irregular products: sample-based estimation after transforming the values of the other VCs to the consumer level (000 euro)

Sector	Values of Seizures (000 euro)	Values of Irregularities ICQRF (000 euro)
Meat	55	1,675
Fish	29	161
Olive Oil	2,748	17,306
Other Food	278	2,890
Horticultural	964	11,462
Dairy Products	430	5,233
Cereals and Starch	614	10,921
Animal Feed	106	1,561
Wine	39,030	219,292
Other Drinks	212	1,126

Source: Authors' elaboration on ICQRF (2016).

It is worth adding here a comment on the reliability of the estimation. We are highly confident about the reliability of the values of seized products since this figure has been calculated based completely on the observed. However, this confidence goes down with the estimates of the irregular products values. For expanding the values of seizures to all irregular products, we assume that if all irregularities had led to seizures, the amount of seized quantity would have increased in proportion to the relationship between the number of irregular products and the number of seizures, which has no strong evidence. However, as this is the only parameter that can be drawn from the data, we have no other option to perform this expansion.

3.3. From sample-based estimations to the population

Results in Tables 3.9 and 3.10 still refer only to sample-based estimates since these data and calculations are confined to the sample of establishments that have been subject to inspection. However, we need to expand these numbers to the population level in order to reach an estimate of agro-food fraud economy. Therefore, we need a parameter of expanding the sample-based calculations to the population level. The only available way of doing so is by using the ratio of the inspected establishments (sample) to the number of active ones (population). On the population level, the most recent figures on total number of establishments involved in the agro-food VCs refer to 2011 and could be calculated from the last census on industry and services (ISTAT, 2014).

Using the ICQRF database, we see can calculate the (sample) number of inspected establishments per year in all phases of the olive oil VC. We preferred to use the average of the period 2010-2012 instead of only data on 2011 to alleviate any bias caused by annual variability. By dividing the values of Tables 3.9 and 3.10 over these ratios, we obtain Tables 3.11 and 3.12 that would reflect the values of seized and irregular products if all establishments were inspected and if our assumptions were valid. We emphasize that the reliability of this expansion depends on how representative the sampling of the ICQRF is.

Table 3.11. Values of seized and irregular products: population level estimation (000 euro)

Sector	Expansion parameter (Inspected/Active)	Values of Seizures (000 euro)	Values of Irregular products (000 euro)	VC industrial turn-over (million euro)	Proportions of irregular products value/turnover
Meat	2.0%	2,039	85,121	18,821	0.45%
Fish	0.2%	13,961	107,049	1,387	7.72%
Olive Oil	6.3%	43,577	274,433	3,000	9.15%
Other Food	2.2%	9,135	130,298	43,456	0.30%
Horticultural	3.8%	18,618	304,352	8,087	3.76%
Dairy Products	4.8%	6,590	110,179	14,425	0.76%
Cereals and Starch	3.7%	12,135	296,530	8,110	3.66%
Animal Feed	61.4%	125	2,544	5,700	0.04%
Wine	8.3%	470,740	2,644,843	10,600	24.95%
Other Drinks	1.0%	15,894	115,818	8,800	1.32%

Source: Authors' elaboration on ICQRF (2016).

Table 3.12. Values of seizures and irregular products after transforming the values of the other VCs to the consumer level: population level estimation (000 euro)

Sector	Expansion parameter (Inspected/Active)	Values of Seizures (000 euro)	Values of Irregularities ICQRF (000 euro)	VC industrial turn-over (million euro)	Proportions of irregular products value/turnover
Meat	2.0%	2,803	85,121	18,821	0.45%
Fish	0.2%	19,188	107,049	1,387	7.72%
Olive Oil	6.3%	43,577	274,433	3,000	9.15%
Other Food	2.2%	12,555	130,298	43,456	0.30%
Horticultural	3.8%	25,588	304,352	8,087	3.76%
Dairy Products	4.8%	9,056	110,179	14,425	0.76%
Cereals and Starch	3.7%	16,678	296,530	8,110	3.66%
Animal Feed	61.4%	172	2,544	5,700	0.04%
Wine	8.3%	470,740	2,644,843	10,600	24.95%
Other Drinks	1.0%	21,844	115,818	8,800	1.32%

Source: Authors' elaboration on ICQRF (2016).

4. The model used to assess the impact of agro-food frauds

4.1. An Introduction to Social Accounting Matrix (SAM)

Social accounting matrix (SAM) is a representation model of the circular flow within an exchange economy in a matrix form. Different from input-output tables, where only interdependencies between industries in a disaggregated production account are represented, the SAM accounts for the interrelationships among production activities, primary and secondary income distribution among factors and institutions, final consumptions and capital formation.

Each row of the SAM shows the receipts for a specific sector while the corresponding column lists the sector expenditures. There are several types of accounts in the rows of the matrix: a) production activities, b) factors of production, c) institutions' current accounts, such as households (possibly further disaggregated by type), firms, government, d) capital formation account, and e) the account for exchanges of the economy with the rest of the world. The same structure holds for the columns of the matrix.

As in a double entry accountancy system, the sums of corresponding rows and column totals must balance. The economic meaning of this balancing condition is that: a) costs must be equal to revenues in each production sector; b) expenditures of each institution must be equal to its income; c) total savings must be equal to total investments plus financial capital accumulation.

SAMs have been first proposed as an accountancy framework to integrate input–output tables with a complete representation of the distributive flows in the economy. The first area of application of the SAM approach was the representation of developing economies for planning. Afterwards, the construction of SAMs became a widespread practice both for statistical and analytical purposes. In 1993, the SAM concept was integrated in the System of National Accounts as a compact and consistent representation of flows recorded in the full system of accounts.

An interesting feature of the SAM is its flexibility as an accounting system. Different blocks of the matrix can be disaggregated according with the purpose of the analysis and data availability. This allows highlighting peculiar features of the economy that are relevant for the purpose of the analysis, within a coherent macroeconomic framework. This is the reason why SAM-based models are particularly interesting in the study of specific *sectors* of the economy within an economy-wide perspective. The availability of a SAM properly disaggregated allows to carry out detailed structural analyses of interdependencies among the components of the economy as well as calibrating models to simulate the impacts caused by exogenous shocks (policy driven or due to external factors).

With reference to the Italian agro-food sector in Italy, the input-output table and the SAM approach have been already used to generate a longstanding stream of studies. Input-output tables with highly disaggregated agriculture and food sectors have been produced by ISMEA at regular intervals (IRVAM, 1987; ISMEA 1997; ISMEA, 2009). Also ISTAT produced a version of the input-output table of the Italian economy for 1992 with the agro-food sector disaggregated into 10 industries (ISTAT, 2002).

This study follows this approach extending it to obtain a complete SAM representation of the Italian agro-food system. The ISTAT input-output table of the economy for 2009 was disaggregated to include 8 groups of farms with different productive specialisation and 10 different groups of food manufacturing activities. All these activities produce a set of 11 different commodities. Furthermore, the disaggregated table was merged into a SAM of the Italian economy previously estimated by IRPET for the same year. Finally, the disaggregated SAM was used to solve a linear model of the Italian economy with the aim of assessing the economic impact of agro-food frauds. In the following section, a short description of the modelling approach is provided.

4.2. Simulation within a SAM framework

The first step in SAM modelling is the identification of endogenous and exogenous accounts. Usually, for small economies, the government and the rest of the world are considered as exogenous, so the model does not explain the behaviour of those accounts. The process of capital formation can be also considered as exogenous when the research question does not focus on dynamic impacts, as is the case in our study. Therefore these three accounts were considered as exogenous.

Let *B* be the matrix of expenditure coefficients for endogenous accounts, that is the matrix of coefficients obtained dividing each single entry of the matrix by the corresponding column/row total. Given the matrix *B*, the model can be represented in a compact form as a set of equations representing the balance of the accounts for the endogenous components (production activities, factors of production, households and firms):

$$Y = By + x \qquad (1)$$

where *x* is the vector of nominal income of endogenous accounts (output of production activities, factor earnings and gross income for institutions), and *y* is the vector of exogenous inflows towards endogenous accounts (foreign exchange, savings and capital formation, transactions between institutions and the government).

The solution of the system (1) maps the vector *x* of exogenous component of the system to the vector *y* of totals through the matrix *M* of SAM multipliers:

$$y = (I - B)^{-1}x = Mx \qquad (2)$$

where *I* is the identity matrix.

Equation (2) can be used as a basis for simulations as follows:

$$dy = Mdx \qquad (3)$$

where *dx* is a vector of changes in exogenous injections, representing different scenarios to be assessed.

A first step in the analysis aims at estimating the impact of final demand that in the current configuration of the Italian agro-food system is supplied by irregular food productions (including both seized and irregular products). In order to do this, equation (3) was used with *dx* being a vector including estimates of the total of seized and irregular food production extended to the whole population (see section 3.3 for details). This exercise is quite straightforward and allows assessing the share of total economy directly and indirectly relying (via the circular flow) on irregular food productions. We interpret the total impact of demand met by irregular production as a measure of fragility of the agro-food production system. Indeed, irregular food production brings about an inherent risk of trust loss by food consumers should a food scandal and scare happen: in this event, the larger the share of final demand supplied by irregular products the higher the risk of a disruption in the usual activity of the system.

The adoption of the SAM framework makes possible to estimate the impacts in terms of output, value added and households' gross income. An assessment of the impact in terms of employment is possible as well, simply post-multiplying the vector of impacts on output by a vector of labour requirement coefficients per euro of output value.

A further analysis was carried out adopting a "counterfactual" framework. The SAM represents the *actual* flows in the economy, including both regular and irregular food production activities. The direct expenditure coefficients in the matrix *B* depict the *average* structure of intermediate consumption for different subsectors of food industry, reflecting their composition in terms of regular and irregular activities. However, it is reasonable to assume that the structure of costs in a production activity not complying with regulations and standards is different from that of a complying production unit.

Overall, we expect that an irregular and/or counterfeit production would be obtained increasing the ratio between value added and intermediate costs, and increasing the share of profits in the primary distribution of value added to factors. Such a different configuration of costs decreases the backward linkages of the irregular production activity, reducing also its ability to activate the economic system through industrial interdependencies. Furthermore, the increased share of distributed profits is likely to change the impacts on the economy via the income distribution – final consumption expenditure path.

A counterfactual analysis of the impact of irregular activities should compare the total activity of the actual economy represented in the SAM, with that of a hypothetical economy where all firms comply with all regulations. Suppose a matrix B^* of direct coefficient representing a "fully-compliant" economy is available. The corresponding matrix M^* of SAM multipliers could be calculated. Using equation (2) the total impact of irregular production activities can be calculated as follows:

$$cf = (M - M^*)x = y - y^* \tag{4}$$

where, x is the vector of *actual* exogenous inflows towards the endogenous accounts, y^* is the vector of totals of endogenous accounts that would be observed should the productive system be “fully-compliant”, and *cf* estimates the impacts of irregular activities expressed as changes in the totals of endogenous accounts.

Such a counterfactual analysis requires additional data on the way non-compliance with regulations and standards affects the vector of costs of production activities in different food subsectors. Let A_f be the matrix of irregular expenditure coefficients and f the vector of total values of irregular productions. The *use matrix* Z_f of total costs for irregular productions can be calculated as follows:

$$Z_f = A_f \hat{f} \tag{5}$$

where the hat superscript indicates the diagonalization of vector f. The *use matrix* for "fully-compliant" production activities can be obtained by the difference:

$$Z_r = Z - Z_f \tag{6}$$

where, Z is the *use matrix* in the original SAM.

Finally, matrix A^* can be obtained from Z_r by dividing elements by column totals given by the total value of regular products:

$$A^* = Z_r(\widehat{y - f})^{-1}. \tag{7}$$

Matrix B^* representing the "fully-compliant" (i.e. counterfactual) economy is obtained substituting the "modified" matrix A^* for the matrix of direct expenditure coefficients of production activities in matrix B.

Information on frauds is by definition difficult to obtain and, considering the high variety of production processes in the food industry, getting the relevant information/data would require an extensive survey. However, this solution was prevented due to time and resource limitations. Therefore, we asked food sector experts and key informants working in organizations in charge of inspections in the agro-food sector to provide their best guess on the expenditure coefficients that may be calculated from a hypothetical use matrix of only irregular production activities. After a qualitative description of each typology of fraud, they were asked to modify the coefficients in the B matrix (based on actual SAM flows) to better represent the cost vector of each irregular activity. The exercise was actually developed only with reference to production of olive oil and wine that represent the largest part of seized and irregular productions.

4.3. The SAM of the Italian economy for the analysis of the agro-food system

4.3.1. Introduction

ISTAT provides both supply and use table for the Italian economy, which are consistent with National accounts. Current price tables are available from 1995 onwards and are based on the NACE rev 1 classification for industries and CPA[4] classification of products. We disaggregated the 2009 table, which shows details for 59 industries and corresponding products. The table presents the agro-food component of the productive system in an aggregated way. In fact, both agriculture and food industry are represented by a single production account. Furthermore, the commodity classification adopted in the ISTAT table includes only two products, namely "agricultural products" and "food products".

In order to get a representation of the agro-food system that is most detailed as possible and in the meanwhile compatible with available statistical information, we proceeded according to the following steps:

- disaggregate the agro-food industry into 11 subsectors;
- disaggregate food commodity into 11 products, with a classification correspondent with the food industry disaggregation;
- disaggregate agriculture into 8 subsectors producing both the single "agricultural commodity" and the food products according to the new disaggregation.

Finally, the disaggregated supply and use tables were included within the SAM of the Italian economy that was constructed by IRPET for the same reference year.

4.3.2. Disaggregation of the Food Industry in the ISTAT 2009 supply-use table

The aim of the work was to disaggregate the original food industry branch (column) and the corresponding product (row) into 11 more detailed branches/products, namely:

1. Meat and production of meat products
2. Processing and preserving of fish, crustaceans and molluscs
3. Production of olive oil (virgin and refined)
4. Manufacture of other food products (vegetable oils and fats, sugar, bakery and farinaceous products)
5. Manufacture of processed vegetables and fruits products
6. Manufacture of dairy products
7. Manufacture of grain mill products, starches and starch products
8. Manufacture of prepared animal feed
9. Production of wine
10. Manufacture of beverages
11. Manufacture of tobacco products

[4] Statistical Classification of Products by Activity

Within the supply and use framework the "use" (or "make") provides the production account for the whole economy disaggregated by groups of production units classified according to the nature of economic activity (industries). Each column of the use table shows the value at purchasing prices of goods and services employed by each group industry. So the original overall values composing the aggregated food industry column represent a set of row constraints for the estimation of the 69x11 matrix of the disaggregated "use" account for the food industry (58 rows of non-food products plus 11 new rows replacing the original food industry product).

Further information on the cells of the matrix was collected from the following sources:

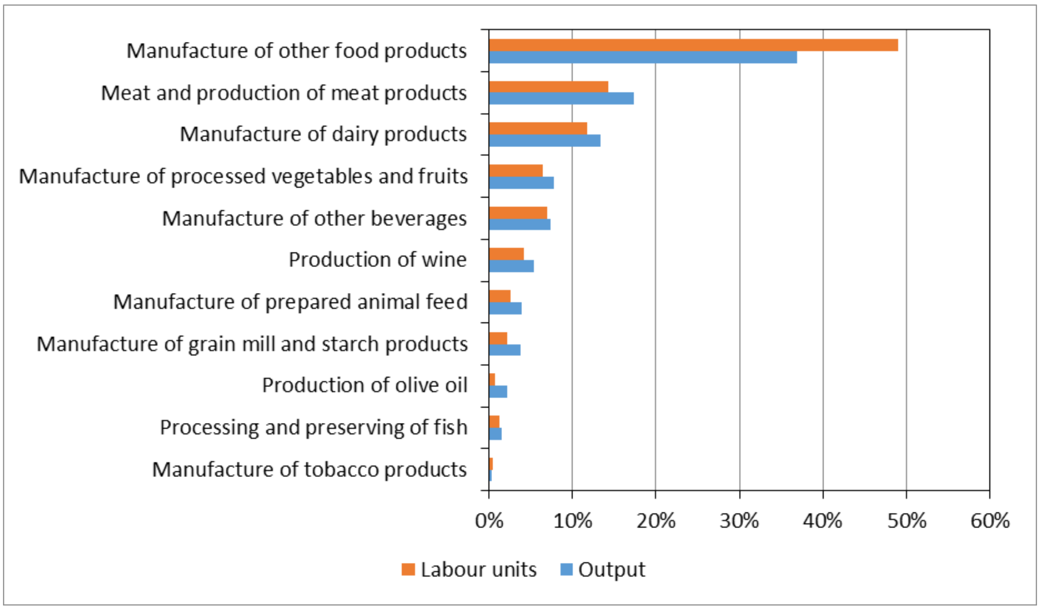
- EUROSTAT structural business statistics database which provides for each year the values for: production, value added, wages and salaries at the proper NACE disaggregation.

- ISTAT surveys on industrial enterprises accounts (which we had available at the elementary data level), a yearly business survey which as well as providing data on aggregated intermediate consumption and labour input, is also a source of information for specific inputs such as energy consumption, transportation and commercial services, legal services and so on.

- ISMEA 2003 use matrix of the Italian food system which provides inter-industry flows for the Food Industry at a disaggregated level although using a classification not completely consistent with the NACE one: for example, while it provides a separate industry for olive oil it aggregates other vegetable and animal oils and fats to the other food product industry.

Building on the above mentioned sources we proceeded by trying a first tentative disaggregation of each cell of the original column into the 11 cells of the row of the 69x11 matrix. Since for aggregated intermediate consumption we got reliable disaggregated estimates by both ISTAT and especially Eurostat sources and also the row totals were known from the original ISTAT table, it was possible to use a RAS procedure (Bacharach, 1965) to get more accurate and consistent estimates for the intermediate consumption use submatrix of the Food Industry. Wages were disaggregated building on Eurostat data. The composition of the food industry in terms different sub-industries is represented in Figure 4.1.

Figure 4.1. Output and labour units in the food industry, Italy, 2009 - % values



Source: This study.

The manufacture of other food products, including some of the most important sectors of Italian food industry, such as bakery, farinaceous products, sugar and vegetable oils and fats (excluding olive oil), represents almost 50% of employment and 37% of the output value. Table A1 in the Appendix provides figures on the percentage composition of intermediate consumptions in the food industry. The structure of costs is quite diversified across different sub-industries, reflecting the nature of different production processes. Some of the components of the food industry show a higher degree of decomposition of the production process, reflected by a higher share of purchases of semi-finished products from production units included in the same industry (fish and dairy products, olive oil, and beverages).

In the disaggregated input-output table, the single row for food industry is replaced by a 11 (commodity) row and by 69 (industry) column matrix with the inclusion of further columns for final uses, namely household consumption, gross investments and exports. The estimates of interindustry flows were mainly based on data from the ISMEA matrix. Household consumption was disaggregated building on estimates from the household budget survey, which was available at the micro level. We used a correspondence table to reallocate consumption based on the COICOP[5] classification to the corresponding voices of the CPA nomenclature. Export by individual food industries were directly obtained by export statistics at FOB prices by CPA from ISTAT, whereas gross investments were disaggregated on the basis of the totals of the other components.

Table A2 in the Appendix provides the most important entries of the supply table for the food industry. The output mix of subsectors is for the largest part concentrated in the characteristic produce of the sector itself, with percentage values almost always beyond 90%. A notable exception is represented by the olive oil industry, where as relevant share of the output is represented by other vegetable oils. Indeed, sub-sector includes refineries where the processing of raw (*lampante*) olive oil is the prevalent activities but usually processing also other vegetable oils.

4.3.3. Disaggregation of Agriculture in the ISTAT 2009 supply-use table

The disaggregation of agriculture was carried out on the supply and use table including the sub-sectors of food industry and the disaggregated classification of food products. Given the focus of the research on processed food, agriculture was disaggregated only as an industry; as a consequence, all 8 sub-sectors composing agriculture in the disaggregated supply and use table, provide only one "agricultural products" commodity.

The disaggregation of agriculture in the use table was based on information from the Farm Business Survey (FBS) carried out by ISTAT on a sample of representative farms of Italian agriculture. The survey is designed to support national accounts estimates for agriculture and includes information on the intermediate consumptions and labour inputs of farms. Data were taken for the research at the micro level. This allowed to reclassify observations and obtain estimates of the composition of intermediate consumption by groups of farms with different specialisation. Farms were classified into 8 subsectors according to the Type of Farming classification adopted at the European level within the Farm Accountancy Data Network[6]:

1. Specialized field crops
2. Specialized horticulture
3. Specialized permanent Crops
4. Specialized grazing livestock
5. Specialized granivores

[5] Classification of individual consumption by purpose.

[6] FADN is a sample of farms surveyed to support decisions on agricultural policy at the European level. The General Type of Farming classification used in the analysis is defined in the 2003/369 EU regulation. The FT classification is one of the stratification variables used in the design of the FBS sample used to disaggregate the production account for agriculture in the original use table.

6. Mixed cropping
7. Mixed livestock
8. Mixed crops-livestock

Coherent with the approach followed for food industry, the 69x8 matrix of estimates of intermediate consumptions for the subsectors of agriculture based on FBS data was used to disaggregate by row the single entries of the Agriculture column of the original use matrix. A similar approach was used to disaggregate entries referred to factors use (wages for employed labour, mixed income of self-employed labour) as well as net indirect taxes on production. Table A3 in the Appendix provides figures on the composition of intermediate consumptions of the 8 farming type subsectors of agriculture, as well as on their relative importance in terms of output value and number of labour units

The disaggregation of agriculture in the supply table was based on additional information of products sold by different Types of Farming provided as Standard Results by the Farm Accounting Data System public database[7]. The inclusion of this information was necessary to integrate FBS information on the composition of agricultural output. Farms are typically multi-product production units. In recent years, a relevant increase in the diversification of farm activity increased also the share of non-agricultural goods and services (e.g. processed food or touristic services) supplied by farms. Furthermore, in the Italian agriculture, a considerable share of wine and olive oil production is produced and traded by farms. In the disaggregated version of the supply and use table, the 8 subsectors corresponding to Types of Farming supply agricultural products as well as other commodities, including processed foods and restaurant and accommodation services. Table A4 provides figures on the most important entries of the supply table for the subsectors of Italian agriculture. Three faming types (permanent crops, mixed cropping and mixed livestock) show a typically lower share of agricultural products in their product mix. As expected, in specialized permanent crops farms, more than 50% of output is represented by olive oil and wine, two products still largely processed at the farm level. The case of wine and olive oil is peculiar within the agro-food system, with an almost balanced role played by agriculture and manufacturing in the domestic supply. Table 4.1 shows the share of different industries represented in the disaggregated SAM in the production of olive oil and wine. Noticeably, in the case of olive oil a substantial share accrues to wholesale trade service units, usually carrying out an activity of blending and packaging of oils for final consumption.

Table 4.1. Share of different industries in the production of olive oil and wine, Italy, 2009 – M€ % values

	Olive oil	Wine
Specialized permanent crops	32.7	42.3
Other agriculture	9.4	3.7
Olive oil industry	16.5	0.0
Wine industry	1.4	48.7
Wholesale trade services	20.5	0.0
Other industries	19.5	5.2

Source: This study.

Also in the case of mixed crops farms, olive oil represents a considerable share of output (12.6%, refer to table A4). In case of farms not featuring a prevalent groups of activities (mixed crops and farm), a substantial share of output is represented by tourist services (restaurant and accommodation, not represented in the table).

[7] Standard Results are estimates of average values by farm type. The Public FADN Database is accessible at the URL http://ec.europa.eu/agriculture/rica/index.cfm

4.3.4. Inclusion of the disaggregated supply and use table in the SAM of Italian economy

The Social Accounting Matrix of the Italian economy provided by IRPET for the reference year included a supply and use table essentially based on the ISTAT's. The industry and commodity classifications are coherent even though represented at a lower level of disaggregation. Furthermore, despite little discrepancies due to the balancing of the matrix after the inclusion of the "social" (i.e. income distribution and final consumption) part of the table, the values of total output of industries and total supply of commodities are very close to those in the original supply and use ISTAT table. As a consequence, the inclusion of the disaggregated supply and use table was quite straightforward, requiring only a few simple adaptations.

Accounts for industries and commodities (except for agriculture and food industry and products) were re-aggregated where necessary to harmonize with the disaggregation adopted in the IRPET matrix. In the final version, the supply and use part of the SAM includes 54 industries producing 64 commodities. In the original IRPET SAM, institutions purchase bundles of goods and services corresponding to 23 final consumption functions. Agriculture and food industry sell their products to consumers throughout the first two functions referred to as purchases of food and beverages. As a consequence, it was not necessary to disaggregate final consumption according to the new classification of commodities in the supply and use table.

The new accounts for agriculture and food industry sub-sectors were balanced adjusting the value of depreciation in the disaggregation of value added, while the accounts for new food commodities were balanced adjusting variations in stocks. The final SAM includes a total of 183 accounts, which are namely 64 commodities, 54 industries, 12 accounts for primary income distribution, 23 final consumptions functions, 18 accounts for current income use of institutions, 9 accounts to represent capital formation and 3 accounts for flows with the Rest of the World.

5. The economic value of agro-food frauds

5.1. The overall share of non-agro-food frauds

Frauds and irregularity in the production of food estimated in the first part of this study represent a relevant share of sector activity, ranging from 0.5 to 3.3% of turnover depending on estimates (respectively based on the value of only seized production or of the total of irregular products detected by inspection authorities as clarified in section 3, table 3.11 e 3.12). The availability of a SAM-based model of the Italian economy, with a breakdown of production activities suitable to represent in detail the structure of the agro-food sector, allows for a more in-depth analysis of the economic impact of frauds.

In section 4, data and methods for impact analysis have been outlined. A first important result can be obtained looking at the share of economy directly and indirectly linked to supply of irregular food products. Figures in table 3.12 have been used as elements of a vector of exogenous shock to be multiplied by the matrix of SAM multipliers. This vector expresses the final demand for food that on average, in the period 2007-2015, has been supplied by irregular production units (including both frauds that led to seizures of products and/or products subject to other administrative sanctions). As a consequence, the resulting figure computed through equation (3) represents the value of total economy of agro-food fraud, thus the share of economic activity directly and indirectly activated (via the circular flow in the economy) by demand actually met by irregular food products. Table 5.1 provides some results from this first SAM based analysis.

Table 5.1. Share of total economy activated by final demand for irregular food products. Average 2007-2015 – Values expressed in euro 2009

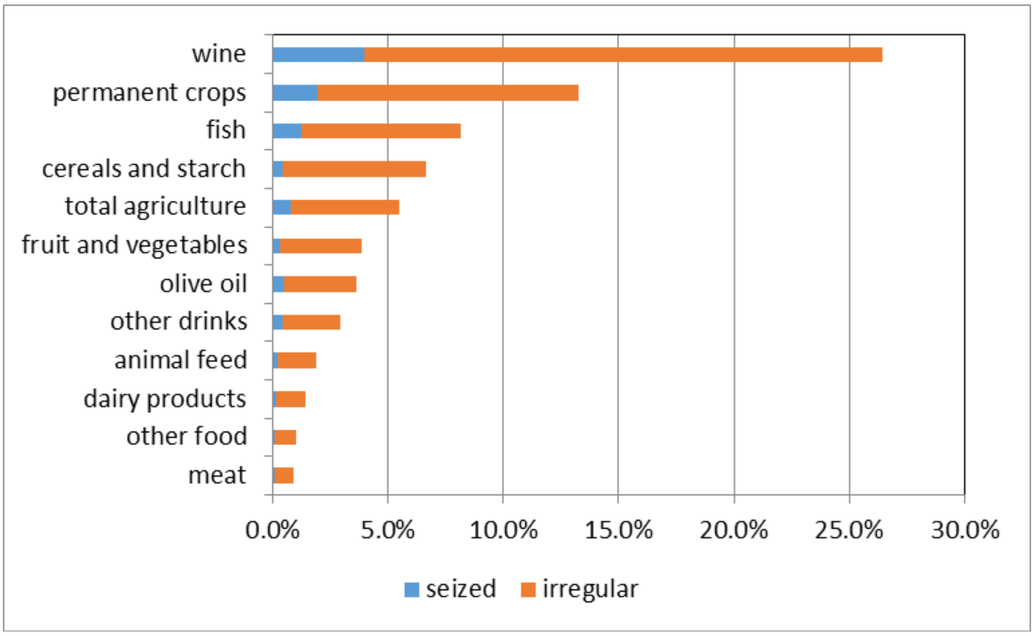
	Only seized products		All irregular products	
Total value of irregular food (M€)	622		4 693	
Share of total output (M€)	1 858	0.1%	13 879	0.5%
Share of total employment (000 UL)	22	0.1%	156	0.6%
Share of value added (M€)	795	0.1%	5 828	0.4%
Share of households' gross income (M€)	715	0.0%	4 754	0.3%

Source: This study.

The resulting values are not trivial: in case of total irregular products 0.5% of total value of output, more than 150,000 LUs. The numbers clearly show the importance of the agro-food frauds in the Italian economy. In the reference period, from 0.1 to 0.4% of value added (a proxy of GDP) was generated by irregular food production activities. The value of production directly and indirectly activated by the demand for irregular food amounted to a value ranging from 1.9 to 13.9 billion Euro, based on the two estimates (conservative/only seizures vs. extended/including other irregularities) of the total value of irregular products. These figures corresponded to a share of total employment accounting up to 156 thousand labour units in the extended scenario i.e. when all irregular products are considered.

The share is even more important when considering the agro-food sectors, where the total output "driven" by irregular products accounts for 3.2% of total output and 5.8% of total employment (data not included in the table). In Figure 5.1, the dependence of food industry on the demand satisfied by irregular production is graphically represented. The "exposure" of different sectors to instability due to irregular production methods is variable among sectors but is particularly important (more than 25% when considering all irregular products) for the wine sector and the connected activity of specialized permanent crops farms (11.3%). More than 5% of Italian agriculture directly and indirectly depends on demand for irregular food products.

Figure 5.1. Share of the output of agro-food sectors activated by final demand for irregular food products



Source: This study.

The results give a measure of the "exposure" of the productive system to possible problems and instability linked to the presence of activities not complying with rules and standards. In food sector, where the trust of consumers in the quality of products is a fundamental factor driving the market, the presence of frauds is a potential source of instability and market disruption, as largely observed in the past years when food scares and scandals caused large losses. Data in table 5.1 and Figure 5.2 show that the impact may be spread in the total economy in a considerable extent and that some sectors are more at risk than others.

An economic measure of the exposure of the food sector to the risks of frauds is a policy relevant result, though not yet a genuine measure of the impact of agro-food frauds on the economy. In fact, even though at risk of instability, the irregular food production activities generate and distribute (illegal) incomes and activate the economy throughout backward and forward linkages. However, the presence of such activities, beside the obvious adverse effect on the vulnerability of the agro-food sector to food scandals/scares, may have a negative *impact* on the economy in a more thorough meaning: in the following section the SAM-based model will be used to quantify it by means of a counterfactual analysis.

5.2. The impact of agro-food frauds: a counterfactual analysis

How much the presence of irregular production activities affects the overall activity level of the economy? In other words, what could be the level of activity of the economic systems if all production activities were carried out complying with all rules and standards? To answer this question, a counterfactual approach to the analysis is needed. The results presented right below are obtained using the methodology outline in section 4.2.

The construction of matrix B* of expenditure coefficients representing a hypothetical food sector composed only by regular production activities followed specific approaches for the wine and the olive oil industries, two sub-sectors that are strategic for Italian food system and largely affected by frauds. In the case of wine and olive oil the vector of direct expenditures was corrected with the help of experts and key informants, taking also into account the different possible configurations of the process in different typologies of production units (for instance farm-based or industrial production activities). Details on the hypotheses made are provided in the report dedicated to the two sub-sectors.

Regarding the other food sub-sectors, in order to carry out a counterfactual analysis of the impact of the total amount of frauds we assumed a homogeneous (and simplified) hypothesis on the impact of frauds on the structure of costs. More precisely, we assumed that the adoption of irregular practices in production and trade was able to triple the value of output at the same cost. Consequently, all coefficients representing the composition of intermediate consumptions were divided by 3. Only the cost of professional and legal services was assumed to maintain the same share on the total value of production of the "averages" activities represented in the SAM.

Such procedure is quite simplistic and implies strong assumptions. Two elements, however, suggest that the analysis could anyway produce a useful look on the economics of agro-food frauds in Italy. First, the value of irregular products other than wine and olive oil represents a small share of the total (27%). Second, the presence of frauds in all sub-sectors of the agro-food system, is likely to multiply the impact of single productions, due to inter-industry interdependency *within* the food system (first of all between agriculture and food production). Even a raw description of the effects of frauds on production costs is likely to better approximate results to the actual value. In any case, a counterfactual analysis of the impact of frauds in the wine and olive oil sector considered is case by case in the sub-sectors' specific reports. In table 5.2, the impact of frauds in the agro-food sector on the whole Italian economy is presented by a few summary figures.

Table 5.2. Impact of irregular production activities, average 2007-2015 – Values expressed in €2009

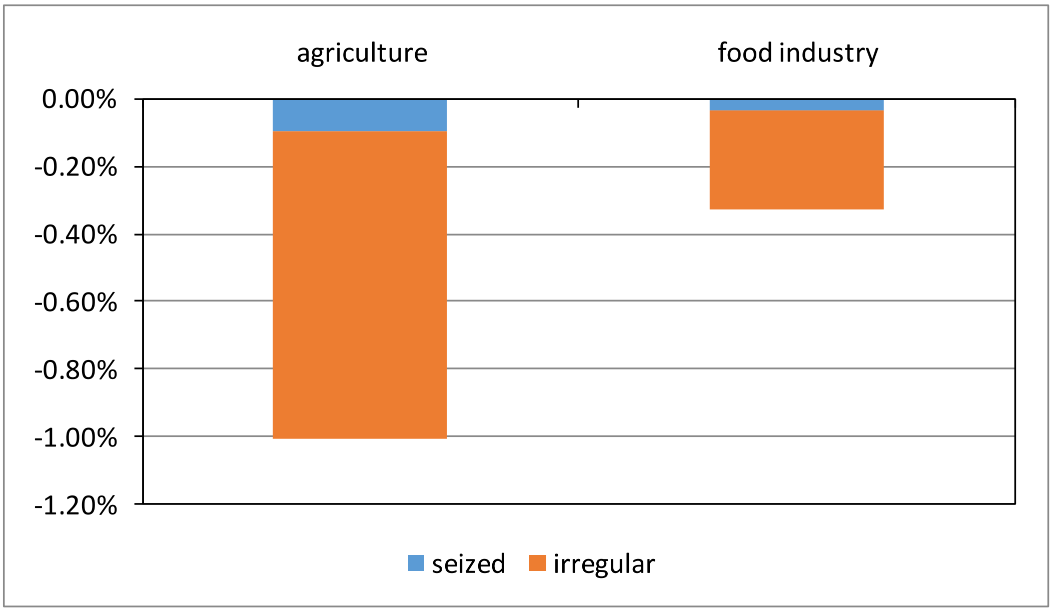
Type of impact	Only seized products		All irregular products	
	Absolute value	% impact	Absolute value	% impact
Impact on total output (M€)	-139	0.00%	-1 827	-0.06%
Impact on total employment (000 LU)	-2	-0.01%	-20	-0.08%
Impact on value added (M€)	6	0.00%	87	0.01%
Impact on households' gross income (M€)	-16	0.00%	-174	-0.01%

Source: This study.

Changes in the value of output are negative. The presence of frauds in food production decreases the total level of activity in the economy. The table provides two different estimates obtained considering (1) only production subject (when detected) to seizures; (2) all irregular production. The overall estimated impacts on total output are tangible: up to 1.8 billion € of total output in all sectors of Italian economy are potentially lost, corresponding to about 20 thousands of full time labour units. In times of underemployment, this is a striking figure. The income distributed to households is decreased too (up to -0.01%). Interestingly, the net impact on value added is positive though small. The extra-profits produced by fraudulent activities counterbalance the reduction due to the loss of productive activities, but forward linkages in their use are not able to activate the economy (throughout final demand) and generate employment and income. The largest parts of these profits are likely to be saved in non-productive assets and/or transferred outside the economic systems. Overall results provide a fairly clear evidence of the existence of *rents from frauds* negatively affecting the viability of the economic system.

Looking at the agro-food system, the figures expressed in relative terms are higher as expected. The percentage impact on output is far more important in agriculture than in the food industry (Figure 5.2). The loss of qualification in irregular food production reduces the value of agricultural input used per unit of processed food. Looking at Figure 5.2, we can see that the presence of frauds negatively affects the output of agriculture up to 1%. The impact on food industry is lower (varying from -0.03% - % - 0.33%) even though higher than the average loss in the economy.

Figure 5.2. Impact on total output in the agro-food sectors, average 2007-2015 - % of total output



Source: This study.

Table 5.3 shows the breakdown by industry of the impacts estimated based on the value of total irregular production. Overall, the agro-food sector loses more than 13,700 labour units, with the largest part concentrated in agriculture, where the productivity of labour is typically lower but also where the losses in terms of output are higher. The impact is differentiated among different production activities, ranging from 0.17% in the "Other food" sector to 1.28% in the "Fish products" industry. Interestingly, the wine sector is one of the most impacted by frauds, (output-1.06%, employment -218 LU). The datum should be read together with that of specialized permanent crops farms, producing a relevant share of wine and olive oil. This component of agriculture loses 1.0% of its potential output and more than 5,300 LU for the presence of frauds in the agro-food system.

Table 5.3. Impact on output and employment in the agro-food sectors, average 2007-2015 - % of total output and total labour units

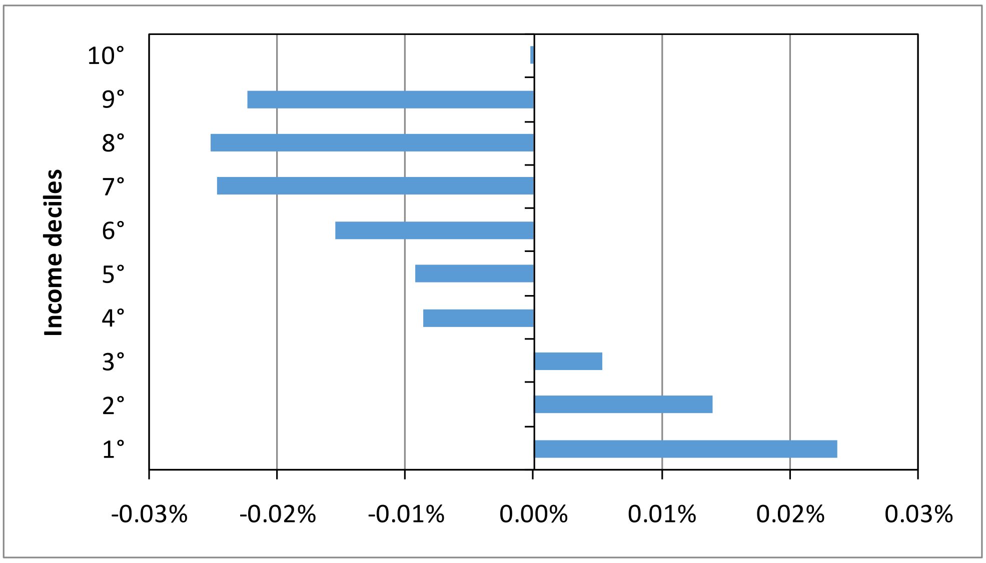
Sub-sector	All irregular products	
	% total output	LU
Meat and production of meat products	-0.16%	-102
Processing and preserving of fish, crustaceans and molluscs	-1.28%	-74
Production of olive oil	-0.47%	-15
Manufacture of other food products	-0.17%	-368
Manufacture of processed vegetables and fruits products	-0.22%	-63
Manufacture of dairy products	-0.37%	-192
Manufacture of grain mill products, starches and starch products	-0.74%	-72
Manufacture of prepared animal feed	-0.78%	-90
Production of wine	-1.06%	-218
Manufacture of other beverages	-0.25%	-77
Specialized fields crop	-1.03%	-2 681
Specialized permanent crops	-1.00%	-5 335
Total agriculture	-1.00%	-12 507
Total food industry	-0.33%	-1 271

Source: This study.

A further interesting result concerns the distributive features of impacts. Table 5.2 shows that frauds in the agro-food sector decreases the gross income earned by households by about 187 M€. In Figure 5.3 the impact is disaggregated among deciles of equivalent per-capita income and expressed in percentage terms. The impact seems to show a slight "progressive" profile, affecting more the income of highest deciles. Considering that the difference in average income between the two odds of income groups is far larger than the differences in impacts, the changes in the relative position of groups in income distribution generated by frauds are likely to be small. Further, as will be shown in the analysis dedicated to wine and olive oil, the distributive impact is fairly differentiated among different food production. Frauds in wine and olive oil sub-sectors show "regressive" distributive impacts, affecting poorest families in a larger extent than richest ones. This is probably due to stronger link of these productions with agricultural activities.

A further interesting result concerns the distributive features of impacts. Data in table 5.2 shows that the presence of frauds in the agro-food sector could decrease the gross income earned by households about 174 M€. In figure 5.3 such an impact is disaggregated among deciles of equivalent per-capita income and expressed in percentage terms. The impact seems to show a slight "progressive" profile, advantaging the lowest deciles and negatively affecting more the income of higher deciles. A relevant exception is represented by the highest decile, whose income is not affected. Consider also that the difference of average income between the two odds of distribution is far larger than the estimated differences in impacts. The changes in the relative position of groups in income distribution generated by frauds are likely to be small.

Figure 5.3. Impact on households' gross income, average 2007-2015 - % values by income deciles



Source: This study.

6. Conclusions

In this paper, we used data from the ICQRF monitoring activities (Sadiddin *et al.*, 2018a) to assess the economic size of fraudulent agro-food output, estimated the size of the economy depending on fraudulent production, and simulated the impacts of agro-food frauds on the national economy in terms of GDP, employment and income distribution within a SAM framework.

The analysis shows that the wine value chain is the sub-sector most exposed to frauds accounting for 88% of the total value of seized agro-food outputs. Second ranks olive oil value chain (6% of total seizures), while the other VCs accounts for only the remaining 6% of total seizures. The shares change slightly when all irregular products (i.e. seizures plus other irregularities) are considered.

The shares of various value chains change a bit more after expanding the sample values to the population level. The wine VC is still ranks first but with a lower share, namely 76% (when only seizures are considered) and 65% (when all irregular products are accounted for). The shares of olive oil VC slightly increased up to 7% in both cases, while a more noticeable increases are observed for the other VCs, especially when all irregular products are considered. For example, fish VC that accounted only for 0.1% at the sample level increased up to 3% at the population level.

A first important result of the analysis is the estimation of the economic size of the agro-food frauds. The results of the SAM simulations[8] shows that the share of economy directly and indirectly linked to supply of irregular food products accounts for 0.5% of total value of output, while in terms of value added the share of irregular food products ranges between 0.1% and 0.4% of total value added. This corresponds to a value of 1.9 billion euro (considering only seizures) to 13.9 billion euro (including all irregularities) and is able to activate up to 156 thousand labour units in the worst-case scenario. In terms of the share relative to the agro-food sector, the total output "driven" by irregular products is much higher accounting for 3.2% of output and 5.8% of employment.

The heavy dependence of some value chains on the demand met by irregular production makes them vulnerable to shocks as the ones deriving from food scandals/scares, especially if they refer to products featuring relatively large price elasticities. Wine seems to be the most fragile value chain considering that roughly 25% of its demand is met by irregular production. This translates, through backward linkages, into a 11% of the demand for products of permanent crops. Overall, for the whole agricultural sector the share of demand met by irregular product is around 5%, a significant lower figure though still not negligible.

Results from the counterfactual analysis shows that agro-food frauds caused a losses of 1.8 billion euro in terms of total output, corresponding to about 20 thousands of full time labour units. The net impact on GDP is positive though very small since the earnings feed rent-seeking activities instead of strengthening linkages with the rest of the economy. The extra-profits produced by fraudulent activities counterbalance the reduction due to the loss of productive activities, but forward linkages in their use are not able to activate the economy (throughout final demand) and generate employment and income. The largest parts of these profits are likely to be saved in non-productive assets and/or transferred outside the economic systems. Overall results provide a fairly clear evidence of the existence of *rents from frauds* negatively affecting the viability of the economic system. Looking at the agro-food system, the figures expressed in relative terms are higher as expected. The percentage impact on output is far more important in agriculture than in the food industry. Frauds negatively affect the output of agriculture up to 1%. The impact on food industry is lower (varying from -0.03% - % - 0.33%) even though higher than the average loss in the economy.

[8] Disaggregated impact evaluation of frauds committed in wine and olive oil sub-sectors is provided in Rocchi et al. (2018) and Sadiddin et al. (2018b) respectively.

Household incomes are reduced by only 0.01%. However, in the food sector, where the trust of consumers in the quality of products and health concerns are fundamental factors driving the market, the presence of frauds is a potential source of instability and market disruption as has been largely observed in the past years when food scares and scandals caused large losses.

In conclusion, agro-food frauds deceive consumers and create unfair competition to compliant producers and agents. The results of this paper show that fighting agro-food frauds is justified both on efficiency and equity grounds.

References

Bacharach, M. (1965). Estimating Non-negative Matrices from Marginal Data. *International Economic Review*, 6 (3): 294–310.

Censis, (2011), *Dimensioni, Caratteristiche e Approfondimenti sulla contraffazione*, Centro Studi Investimenti Sociali (Censis), Ministero delle Sviluppo Economico, Roma. Retrived from: <http://www.uibm.gov.it/attachments/Censis-%20Final%20Report.pdf>.[November 9, 2016].

De Filippis, F. (2016). Technical coefficients for wine production. Personal communication.

ICQRF (2016). Datasets of Central Inspectorate for Quality Protection and Fraud Repression in Agro-Food Products (Ispettorato Centrale per la Qualità e la Repressioni delle Frodi, ICQRF), the data were provided to the authors confidentially and to be used exclusively for this research project.

IRVAM (1987). *Matrice del sistema agro-alimentare 1985*. Roma, mimeo.

ISMEA (1997). *La tavola delle interdipendenze settoriali del sistema agroalimentare italiano 1995*. Roma, Ismea.

ISMEA (2009). *La tavola delle risorse e degli impieghi del sistema agroalimentare italiano 2003*. Roma, Ismea.

ISMEA (2014). Piano di Settore Olivicolo-oleario: La catena del valore della filiera olivicola-olearia (ISMEA). Rome. Retrieved from: <http://www.pianidisettore.it/flex/cm/pages/ServeAttachment.php/L/IT/D/4%252F9%252F7%252FD.e5f908b3acf5008ae9ba/P/BLOB%3AID%3D697>. [November 9, 2016].

ISTAT (2000). *Tavola intersettoriale dell'economia italiana. Anno 1992*. Collana Informazioni n. 22. Roma, Istat.

ISTAT (2014). Censimento Generale dell'industria e dei servizi del 2011, ISTAT, Roma. Latest access to the website http://dati-censimentoindustriaeservizi.istat.it on 06/08/2014.

ISTAT (2016). Consumer Price Index with reference years 2009 and 2011. ISTAT, Roma. Latest access to the website https://www.istat.it/en/archive/CPI on 16.06.2016.

Parenti, D. (2016). Technical coefficients for wine production. Personal communication.

Riccio, P., Felici, G., Alisi, G. & Caira, E. (2014). *La Lotta alla Contraffazione in Italia nel Settore Agro-alimentare 2009-2012*, Direzione Generale per la Lotta alla Contraffazione – Ufficio Italiano Brevetti e Marchi, Ministero dello Sviluppo Economico, Roma, p. 129. Retrieved from: <http://www.uibm.gov.it/iperico/home/Rapporto%20IPERICO-%20Lotta%20alla%20contraffazione%20nel%20settore%20agroalimentare_definitivo.pdf>. [February 11, 2016].

Rocchi, B., Sadiddin, A., Romano, D., Stefani, G., Zucaro, R., Manganiello, V. (2018). Frauds in the Italian Wine Subsector: A value chain analysis and SAM-based evaluation of economic impacts. Working Paper no … . Dipartimento di Scienze per l'Economia e l'Impresa. Università degli Studi di Firenze.

Sadiddin, A., Romano, D., Zucaro, R., & Manganiello, V., (2018a). Frauds in the Italian Agro-Food Sector: An Introduction. Working Paper no … . Dipartimento di Scienze per l’Economia e l’Impresa. Università degli Studi di Firenze.

Sadiddin, A., Rocchi, B., Romano, D., Stefani, G., Zucaro, R., Manganiello, V. (2018b). Frauds in the Italian Olive Oil: A value chain analysis and an evaluation of economic impacts. Working Paper no … . Dipartimento di Scienze per l’Economia e l’Impresa. Università degli Studi di Firenze.

Annexes

Table A1 - Composition of intermediate consumption, labour units and total output in the food industry, Italy, 2009 – Column % values

Commodities/Industries	Production of meat meat products	Processing and preserving of fish, crustaceans and molluscs	Production of olive oil (virgin and refined)	Manufacture of other food products (vegetable oils and fats, sugar, bakery and farinaceous products)	Manufacture of processed vegetables and fruits products	Manufacture of dairy products	Manufacture of grain mill products, starches and starch products	Manufac ture of prepared animal feed	Production of wine	Manufacture of other beverages	Manufacture of tobacco products
Agricultural products	36.6%	1.4%	35.2%	10.5%	29.2%	26.0%	49.9%	19.7%	21.9%	2.6%	19.2%
Meat and meat products	12.6%	0.3%	0.4%	5.2%	2.0%	1.4%	0.2%	5.1%	0.0%	0.0%	0.0%
Processed fish, crustaceans and molluscs	0.3%	50.4%	0.0%	0.6%	1.3%	0.0%	0.0%	1.9%	0.0%	0.0%	0.0%
Olive oil, virgin and refined	3.8%	4.4%	11.3%	8.3%	6.9%	2.8%	5.1%	1.9%	2.2%	0.4%	0.0%
Other food products	1.4%	6.7%	1.1%	4.7%	12.5%	2.5%	0.8%	12.2%	0.8%	4.5%	0.0%
Processed fruits and vegetables	0.1%	0.3%	0.9%	3.5%	4.4%	1.4%	0.4%	0.5%	0.7%	2.4%	0.0%
Dairy products	0.3%	0.0%	0.3%	2.5%	1.4%	33.4%	0.2%	3.9%	0.0%	0.0%	0.0%
Grain mill products, starches and starch products	0.2%	0.7%	0.7%	11.9%	0.3%	0.2%	3.1%	10.2%	0.1%	0.5%	0.0%
Prepared animal feeds	0.9%	0.8%	0.0%	0.0%	0.0%	0.4%	1.0%	5.9%	0.1%	0.1%	0.0%
Wine	6.8%	0.3%	0.1%	0.0%	5.5%	4.9%	9.3%	3.7%	6.9%	11.1%	0.0%
Other beverages	0.0%	0.3%	0.0%	0.1%	0.3%	0.4%	0.0%	0.1%	0.7%	16.7%	0.0%
Processed tobacco products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.0%
Other goods	8.0%	9.4%	17.1%	11.8%	10.6%	4.8%	6.0%	10.4%	22.6%	13.7%	26.6%
Trade and transportation services	17.8%	12.9%	12.6%	18.5%	17.2%	17.1%	16.6%	19.6%	19.6%	23.9%	13.4%
Financial services	1.6%	1.3%	3.8%	3.0%	1.3%	0.5%	0.7%	0.8%	6.9%	2.1%	1.0%
Other services	9.6%	10.8%	16.7%	19.4%	7.0%	4.1%	6.7%	4.2%	17.5%	21.7%	33.8%
Labour Units (000)	62	5	3	213	28	51	9	11	18	30	2
Output (M€)	20 358	1 844	2 553	43 389	9 126	15 767	4 465	4 661	6 295	8 697	419

Source: This study.

Table A2 - Composition of intermediate consumptions, labour units and total output in agriculture, Italy, 2009 – Column % values

Commodities/Industries	Specialized field crops	Specialized horticulture	Specialized permanent crops	Specialized grazing livestock	Specialized granivores	Mixed cropping	Mixed livestock	Mixed crops-livestock
Agricultural products	31.5%	31.2%	11.6%	17.7%	26.2%	28.2%	26.7%	62.2%
Meat and meat products	0.1%	0.0%	0.5%	0.1%	0.0%	0.5%	0.8%	0.1%
Processed fish, crustaceans and molluscs	0.8%	0.1%	2.5%	0.5%	0.1%	2.6%	4.2%	0.5%
Olive oil, virgin and refined	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other food products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Processed fruits and vegetables	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%
Dairy products	1.5%	0.3%	4.8%	1.0%	0.2%	5.1%	8.0%	0.9%
Grain mill products, starches and starch products	0.3%	0.1%	1.1%	0.2%	0.1%	1.2%	1.9%	0.2%
Prepared animal feeds	1.9%	0.0%	0.3%	37.9%	46.1%	0.6%	21.7%	20.2%
Wine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other beverages	0.1%	0.0%	0.2%	0.0%	0.0%	0.2%	0.3%	0.0%
Processed tobacco products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other goods	40.0%	27.6%	46.5%	26.1%	19.3%	37.3%	23.4%	10.1%
Trade and transportation services	9.9%	34.1%	19.7%	2.4%	2.8%	9.2%	0.5%	2.2%
Financial services	8.5%	2.2%	5.6%	4.4%	2.0%	5.0%	3.8%	1.2%
Other services	5.5%	4.4%	7.3%	9.6%	3.2%	9.9%	8.6%	2.4%
Labour Units (000)	258	94	485	185	21	97	6	48
Output (M€)	9 894	5 419	12 813	9 678	3 837	2 641	189	1 665

Source: this study.

Table A3 - Output composition in the food industry, Italy, 2009 – Row % values

Industries/Commodities	Meat and meat products	Fish, crustaceans and molluscs	Olive oil, virgin and refined	Other food products	Processed fruits and vegetables	Dairy products	Grain mill products, starches and starch products	Prepared animal feeds	Wine	Other beverages	Processed tobacco products
Meat and production of meat products	92.4%	0.0%	0.0%	1.3%	0.0%	0.1%	0.0%	3.8%	0.0%	0.0%	0.0%
Processing and preserving of fish, crustaceans and molluscs	1.1%	91.4%	0.0%	4.8%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Production of olive oil	0.0%	0.0%	50.9%	46.3%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Manufacture of other food products	0.8%	0.2%	1.0%	87.4%	1.9%	2.1%	2.1%	0.7%	0.1%	0.9%	0.0%
Manufacture of processed vegetables and fruits products	0.1%	0.0%	0.8%	7.8%	86.9%	0.0%	0.7%	0.0%	0.3%	0.8%	0.0%
Manufacture of dairy products	2.2%	0.0%	0.0%	3.6%	0.4%	91.3%	0.0%	0.0%	0.0%	0.1%	0.0%
Manufacture of grain mill products, starches and starch products	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	91.1%	4.6%	0.0%	0.0%	0.0%
Manufacture of prepared animal feed	1.2%	0.0%	0.0%	2.0%	4.8%	0.0%	4.2%	84.9%	0.0%	0.0%	0.0%
Production of wine	0.0%	0.0%	1.7%	0.1%	0.7%	0.0%	0.0%	0.0%	89.2%	5.5%	0.0%
Manufacture of other beverages	0.0%	0.0%	0.0%	0.6%	0.4%	0.2%	0.0%	0.0%	2.8%	92.3%	0.0%
Manufacture of tobacco products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.5%

Source: This study.

Table A4 - Output composition in agriculture, Italy, 2009 – Row % values

Industries/Commodities	Agricultural products	Meat and meat products	Fish, crustaceans and molluscs	Olive oil, virgin and refined	Other food products	Processed fruits and vegetables	Dairy products	Grain mill products, starches and starch products	Prepared animal feeds	Wine	Other beverages
Specialized field crops	95.2%	0.0%	0.0%	2.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%
Specialized horticulture	95.5%	0.0%	0.0%	0.5%	1.5%	0.3%	0.0%	0.2%	0.2%	0.6%	0.4%
Specialized permanent crops	37.9%	0.0%	0.0%	20.1%	0.2%	0.0%	0.0%	0.0%	0.0%	38.1%	0.1%
Specialized grazing livestock	92.4%	0.2%	0.1%	0.7%	0.5%	0.1%	0.6%	0.1%	0.1%	0.3%	0.1%
Specialized granivores	98.4%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.7%	0.0%
Mixed cropping	65.6%	0.0%	0.0%	12.6%	0.1%	0.0%	0.1%	0.0%	0.0%	7.7%	0.0%
Mixed livestock	69.3%	0.1%	0.0%	0.7%	0.3%	0.1%	0.2%	0.0%	0.0%	0.3%	0.1%
Mixed crops-livestock	87.0%	0.2%	0.1%	5.0%	0.0%	0.0%	0.7%	0.0%	0.0%	4.8%	0.0%

Source: This study.