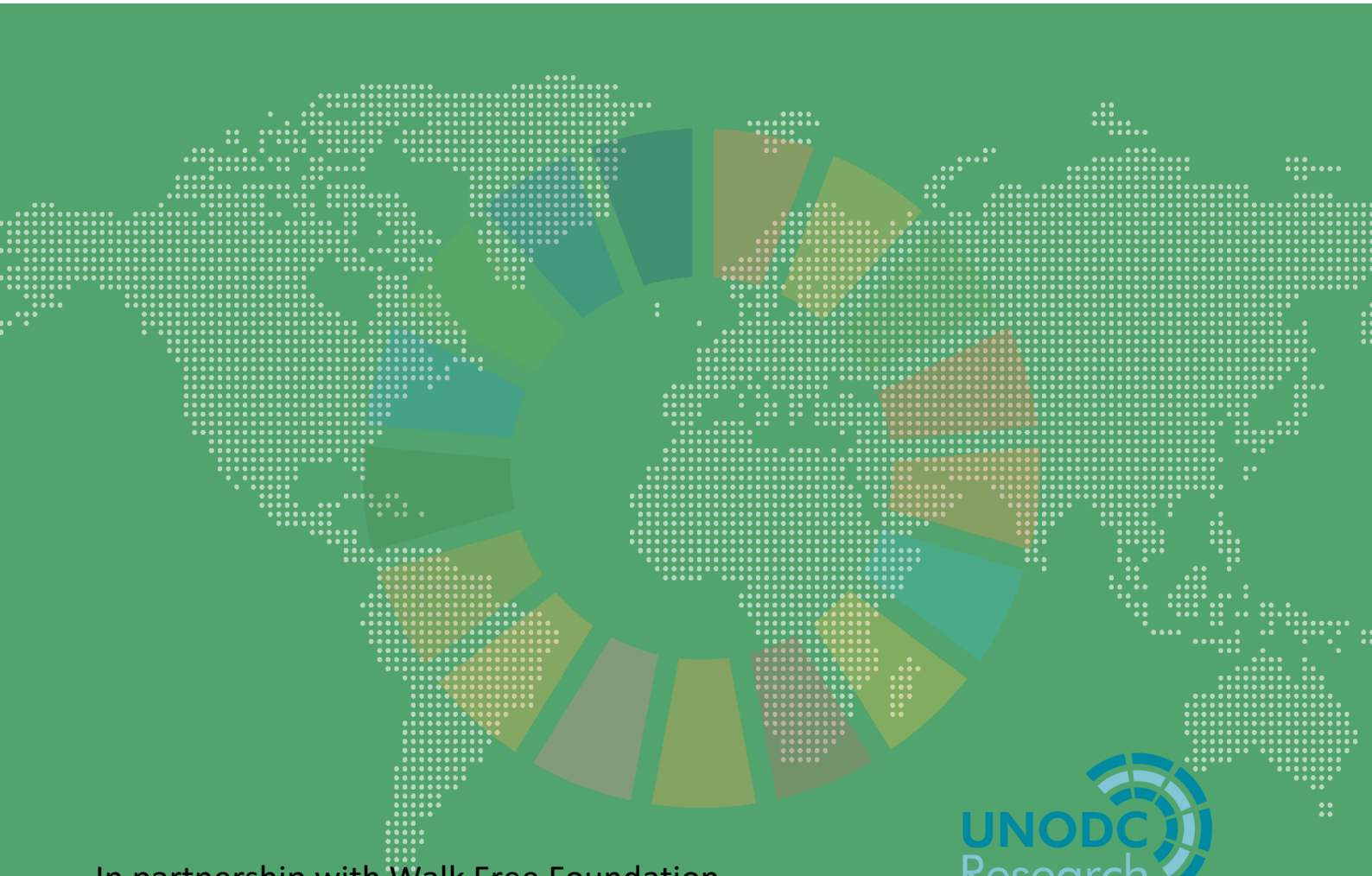
UNODC
United Nations Office on Drugs and Crime

An Roinn Dlí agus Cirt agus Comhionannais
Department of Justice and Equality

RESEARCH BRIEF

Monitoring Target 16.2 of the United Nations Sustainable Development Goals: multiple systems estimation of the numbers of presumed victims of trafficking in persons

Ireland



In partnership with Walk Free Foundation

UNODC Research

Introduction and methodology[1]

The statistical technique to estimate the size of hidden populations, known as capture/recapture analysis, multiple systems analysis or multiple record systems analysis, was originally developed by biologists to estimate animal populations. The quintessential idea to estimate the number of fish in a pond is as follows. One catches a number of fish (say 100), tags them, and then throws them back into the same pond. Sometime later, one takes a new catch (say another 100) from the same pond, and counts how many of the second catch are tagged, as having been part of the returned original first catch. If the overlap between the two catches is zero, or very small, this suggests that the population of fish in the pond is much larger than 100. If the overlap is considerable, say 50, this suggests that the population is smaller. The larger the overlap, the smaller the size of the total fish population. If out of the 100 fish in the second catch, 20 are tagged, it follows that the tagged fish in the pond had a chance of one in five of being caught. Assuming that the non-tagged fish have similar catchment chances, the total number of fish in the pond can be estimated at 500, of which 400 untagged.

The capture-recapture approach of biologists has translated into a well-known method for estimating the size of a hidden human population using two independent recording systems (or registers) which partially list its members. Linking the individuals in the two registers allows for the estimation of the number of individuals that are not recorded in any of the registers. For example, with two registers A and B, linkage gives a count of individuals in A but not in B, a count of individuals in B but not in A, and a count of individuals in both A and B. The counts form a contingency table denoted by A x B, with the variable labeled A being short for "inclusion in register A" differentiating between the categories "yes" and "no," and likewise for register B. The statistical problem is to estimate the value in the cell "no, no". An estimate of the total population size is obtained by adding the estimated count of doubly missed individuals to the counts of individuals found in at least one of the registers.

The capture-recapture method has been successfully applied to estimate the size of hidden human populations by determining the overlaps between unique individuals appearing in separate recording systems (or lists). Using such capture-recapture analysis, estimates have, for example, been made of the numbers of casualties of human rights violations in Peru and irregular migrants in the Netherlands (Lum, Price & Banks, 2013; Van der Heijden, et al, 2015).

Capture-recapture analysis depends on certain assumptions about the lists and the population from which they are drawn. Arguably the most problematic condition to fulfill when using recording systems of human individuals is the condition that recording systems are independent of each other. In the case of records of persons, this assumption of independence of lists is usually not met. For example, persons identified by law enforcement authorities as possible victims of human trafficking are likely to be referred to social assistance programs, and they consequently have a higher probability of being included in the recording systems of the involved NGOs. In this case the inclusion in the list of a service provider is far from independent from registration by the police. This is an example of positive dependence. Since such positive dependence increases the overlap between the two lists, the number of the unobserved population is consequently underestimated. In practice, negative dependence may

[1] UNODC research based on contributions by Jan J. M. van Dijk (University of Tilburg, Netherlands), Maarten Cruyff and Peter G. M. van der Heijden (University of Utrecht, Department of Psychology, Netherlands).

also occur, for example, when inclusion in one register lowers the chance of being registered in another register, which leads to an overestimation.

A promising approach to relax the condition of independence is to include a third register, or multiple additional registers, and to analyse the three-way, or multiple-way contingency tables. With three (or more) lists the independence assumption in the two-list case is replaced by the less severe assumption that three (or more) factor interaction is absent. In official statistics, this extension of the two-list capture-recapture method is known as multiple systems estimation (MSE).[2]

In collaboration with the three countries concerned, and in partnership with the Walk Free Foundation, UNODC carried out MSE studies to estimate the total number of victims of trafficking in persons in Ireland, Romania and Serbia. This Research Brief presents the findings from Ireland.

[2] See also Van Dijk, J.J.M. and P.G.M. van der Heijden (2016).

Ireland

Introduction

Ireland is primarily a country of destination for trafficked persons. A particularity of the Irish statistics on trafficking in persons at the time of data collection for this study was that they included cases of sexual abuse of minors, often not amounting to trafficking in persons as defined in the United Nations Trafficking in Persons Protocol. While the study was carried out on the complete dataset, subsequent repression of those cases yielded very similar results (for further details, please see Annex I D). Recently, the statistical classifications of trafficking in persons cases in Ireland were realigned, and cases of sexual abuse of minors are no longer included in Irish trafficking in persons statistics.

The numbers of presumed victims reported to or detected by An Garda Síochána (the Irish police) were 48 in 2012, 44 in 2013, 46 in 2014, 78 in 2015 and 95 in 2016. The 15% increase in the number of presumed victims of trafficking in 2016 can be attributed to one case in which 23 Romanian men were exploited in a waste recycling plant. The majority of the presumed victims in the period 2012-2016 were female (197, or 63%). There were 94 children among the presumed victims. In terms of forms of exploitation, during the reporting period, the majority of the presumed victims were trafficked for sexual exploitation (200), which concerned primarily women and girls, followed by forced labour (82).

The Department of Justice and Equality's Anti-Human Trafficking Unit (AHTU) continues to have the lead on all policy issues on human trafficking in Ireland. Since 2009, in order to provide reliable and useful data on the nature and extent of trafficking on an on-going basis, the AHTU has implemented a data strategy based on systems developed at the EU level. The goal of this data strategy is to collect information on cases of suspected/presumed trafficking by means of a standardized template from a variety of different sources, including NGOs, government agencies, and law enforcement. Reports summarizing the statistical data are issued annually by AHTU. These reports provide data on the number of presumed victims of trafficking, which are disaggregated by sex, age, form of trafficking, region/country of origin of the victims, immigration status of the victims, and the agencies and organizations which reported the victims.

Results

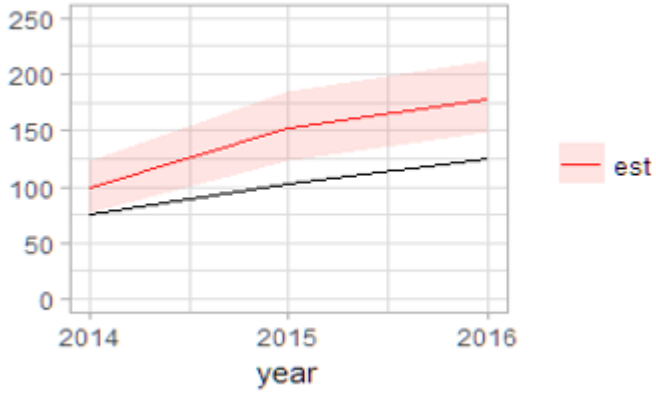
The estimated numbers of trafficking victims in Ireland were 98 in 2014, 153 in 2015 and 179 in 2016, suggesting an upward trend. The victimization rate per 100,000 population was 3.3 in 2015 (4.5 for females and 1.0 for males).

The estimated presumed victims are mainly females of non-Irish nationality trafficked for sexual exploitation within the country. In 2015, 66 per cent of the estimated cases related to trafficking for sexual exploitation and 34 per cent to other types (mainly trafficking for forced labour).

The results of the MSE on the Irish data over 2014, 2015 and 2016 show that the estimated numbers of presumed victims are 50 per cent larger than the recorded numbers (a ratio of 1.5 in 2015).

Due to small numbers, no conclusions can be drawn concerning the ratios of different subgroups, other than that the ratios are larger for minors than for adults. This suggests that cases of trafficking involving minors are less likely to be detected than those of adults.

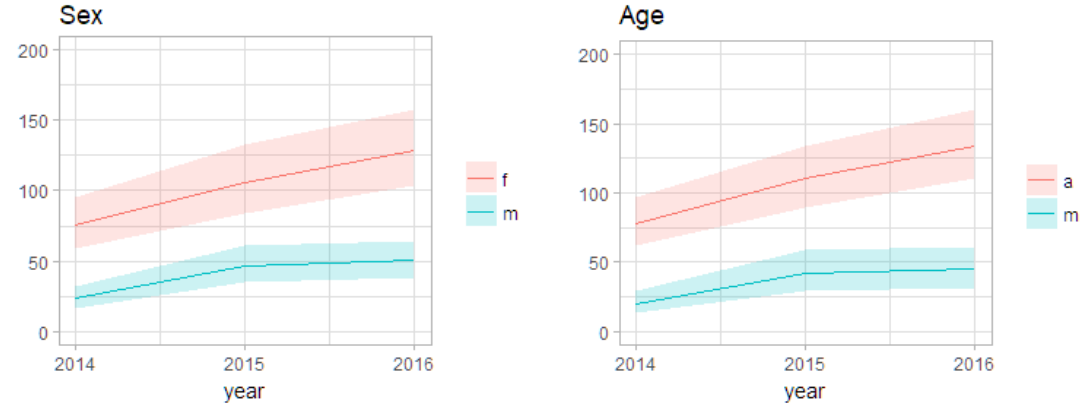
Figure 1: Trends in observed presumed victims (in black) and estimated totals of presumed victims (in red) in Ireland, 2014-2016



(est=estimated number of victims)

The 95 per cent confidence interval around the estimates is depicted in shaded red. The results show that the estimated numbers are fifty percent larger than the observed numbers. Moreover, the estimated number of victims of trafficking in 2016 is higher than in 2014. The results indicate that the discrepancy between recorded and estimated numbers has increased slightly.

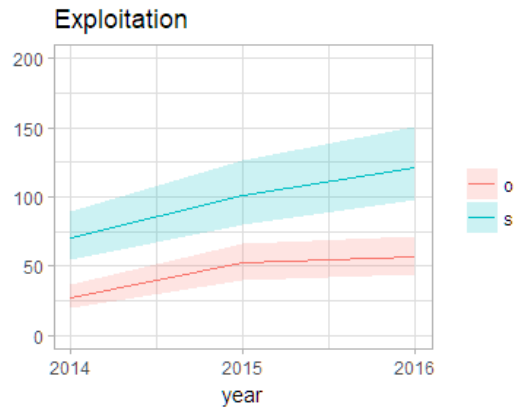
Figure 2: Trends in estimated totals of presumed victims in Ireland, 2014-2016, by sex and age



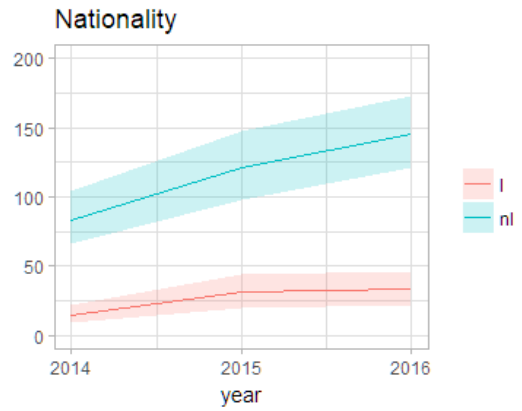
(f=female; m=male) (a=adult; m=minor)

The results show that the estimated numbers of female victims are more than twice as high as those of males. The estimated numbers of presumed child victims make up a third of the estimated numbers. The proportion of minors may be inflated due to the inclusion of victims of (domestic) sexual abuse of minors in the Irish definition of human trafficking.

Figure 3: Trends in estimated totals of presumed victims in Ireland, 2014-2016, by type of exploitation and nationality



(o=other forms of exploitation than sexual; s=sexual exploitation)



(I=Irish citizens; nI=non-Irish citizens)

Model without sexual abuse cases

At the request of AHTU, an analysis was done of the dataset with repression of the cases of sexual abuse of minors. The estimates based on the new model were practically the same as those of the full model (see Annex I D for results)

Data

Data were included on the years 2014 to 2016 (n= 312). The AHTU brings together data from the Police (An Garda Síochána), the Border Police and other government agencies, and NGOs (Ruhama, SVCC and DL).

Distribution over the registers

- G: An Garda Síochána (219 observations)
- M: MRCI, ICI, IOM (83 observations)
- R: Ruhama, SVCC, DL (90 observations)

Covariates

- S: Sex (204 females, 97 males, 1 transgender)
- A: Age (244 adults, 58 minors)
- N: Nationality (43 Irish, 259 non-Irish)
- E: Exploitation, (194 sexual, 108 non-sexual, mainly forced labour)
- Y: Year (75 in 2014, 102 in 2015, 125 in 2016)

Model selection

The model selection procedure was basically the same as in the analysis of the Dutch data, presented above. The model search started with a simple model and included interaction terms until the fit of the model to the data became adequate. The additional variables sex (S), age (A), exploitation (E), nationality (N) and year (Y) were included. In the STEP procedure, the

BIC was preferred over the AIC as the selection criterion, because of its protection against overfitting when the sample is relatively large, and an additional restriction on the parameters of the model was imposed as well. The model (concerning 312 presumed victims) that was selected as the most parsimonious is presented below (for an elaboration of the model selection see Annex A).

Effects of quadratic step model (BIC)

G, M, R, S, A, N, E, Y2, AN, SE, RS, NE, RA, SN, ME, RY2, GS, MR, MA, RE

Literature

Bales, K., O., Hesketh & B. Silverman (2015), 'Modern slavery in the UK: How many victims?', *Significance*, 12(3), 16-21.

Lum, K. M. E. Price & D. Banks (2013), 'Applications of Multiple Systems Estimation in Human Rights Research,' *The American Statistician*, 67:4, 191-200.

Silverman, B. (2014), *Modern slavery: an application of multiple systems estimation*. Gov.UK.

UNODC (2017), *Monitoring Target 16.2 of the United Nations Sustainable Development Goals; A multiple systems estimation of the numbers of presumed human trafficking victims in the Netherlands in 2010-2015 by year, age, gender, form of exploitation and nationality*; Research Brief. Vienna: UNODC.

Van der Heijden, P.G.M., M. Cruyff & G.H.C. van Gils (2015), *Schattingen illegaal in Nederland verblijvende vreemdelingen 2012-2013*. WODC. (Estimations of illegal residents in the Netherlands 2012-2013).

Van Dijk, J.J.M. and P.G.M. van der Heijden (2016), *Research Brief. Multiple Systems Estimation for Estimating the number of victims of human trafficking across the world*. Vienna: UNODC.

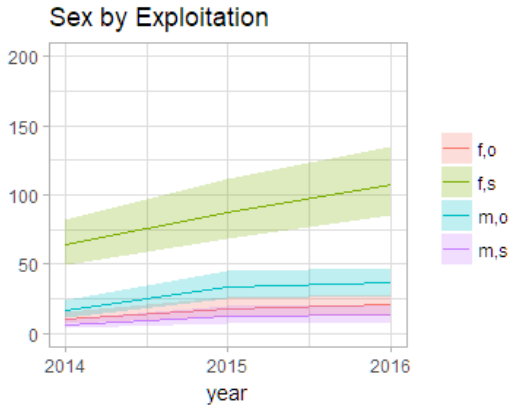
Annex I: Further details - Ireland

I A: Model selection

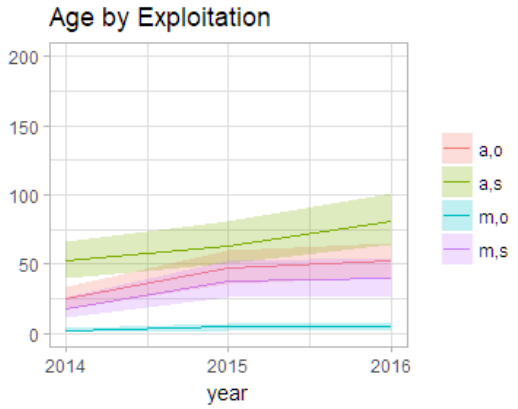
Fit measures

	DEV	par	df	AIC	BIC	Nhat
Linear Independence model	679	9	327	887	921	465
Linear step model (BIC)	171	20	316	401	475	430
Linear step model (AIC)	147	25	311	387	480	443
Quadratic Independence model	679	10	326	889	926	465
Quadratic step model (BIC)	152	23	313	388	473	430
Quadratic step model (AIC)	126	28	308	373	476	429

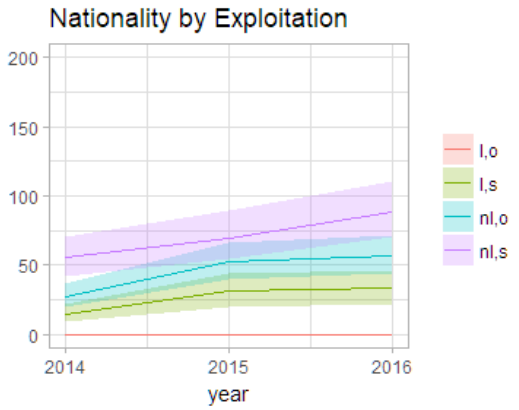
I B: Two-dimensional plots of disaggregated findings



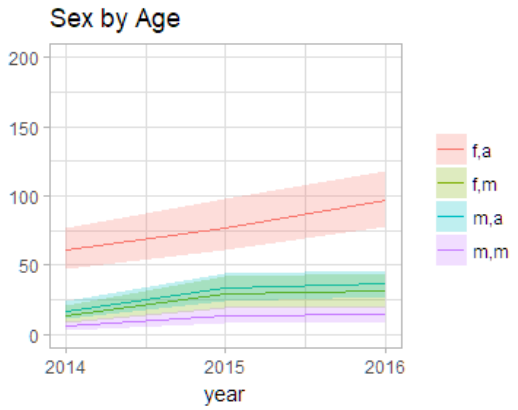
Legend: f=female; m=male; s=sexual exploitation; o=other, non-sexual forms of exploitation.



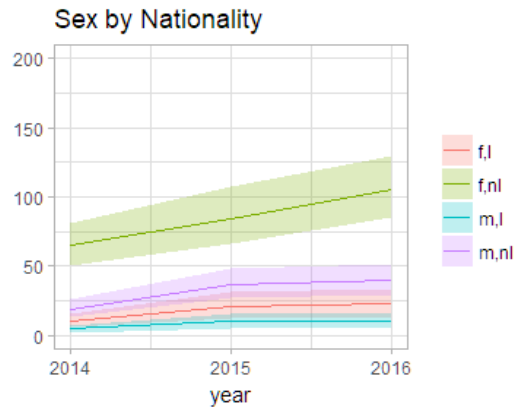
Legend: a=adult; m=minor; s=sexual exploitation; o=other, non-sexual forms of exploitation.



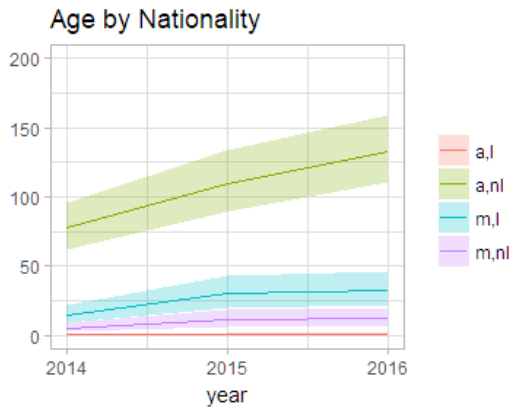
Legend: I=Irish; nI=other citizenships (not Irish); s=sexual exploitation; o=other, non-sexual forms of exploitation.



Legend: f=female; m(1st column)=male; a=adult; m(2nd column)=minor.



Legend: f=female; m=male; I=Irish; nI=other citizenships (not Irish).



Legend: a=adult; m=minor; I=Irish; nI=other citizenships (not Irish).

I C: Observed, estimated, min and max of 95% confidence interval and ratios estimated/observed

Y	obs	est	min95%	max95%	ratio
1	75	98	78	123	1.3
2	102	153	123	184	1.5
3	125	179	148	213	1.4

Y	S	obs	est	min95%	max95%	ratio
1	f	55	75	58	95	1.4
2	f	73	106	84	133	1.4
3	f	77	128	104	157	1.7
1	m	20	23	16	32	1.2
2	m	29	47	35	61	1.6
3	m	48	51	38	64	1.1

Y	A	obs	est	min95%	max95%	ratio
1	a	62	78	62	97	1.3
2	a	78	110	90	133	1.4
3	a	104	133	111	160	1.3
1	m	13	20	13	29	1.6
2	m	24	42	30	59	1.8
3	m	21	45	32	61	2.2

Y	E	obs	est	min95%	max95%	ratio
1	o	22	28	20	36	1.3
2	o	34	52	40	66	1.5
3	o	52	57	44	72	1.1
1	s	53	71	54	90	1.3
2	s	68	100	80	127	1.5
3	s	73	121	98	150	1.7

Y	N	obs	est	min95%	max95%	ratio
1	I	8	15	9	22	1.9
2	I	15	31	20	44	2.1
3	I	20	33	22	46	1.7
1	nI	67	83	67	104	1.2
2	nI	87	121	98	147	1.4
3	nI	105	145	121	173	1.4

Y	S	E	obs	est	min95%	max95%	ratio
1	f	o	8	11	7	15	1.3
2	f	o	13	18	12	26	1.4
3	f	o	14	20	14	29	1.5
1	m	o	14	17	12	24	1.2
2	m	o	21	34	25	45	1.6
3	m	o	38	37	27	47	1.0
1	f	s	47	65	49	82	1.4
2	f	s	60	88	69	112	1.5
3	f	s	63	108	85	135	1.7
1	m	s	6	6	4	10	1.1
2	m	s	8	13	8	20	1.6
3	m	s	10	14	8	20	1.4

Y	A	E	obs	est	min95%	max95%	ratio
1	a	o	19	25	18	33	1.3
2	a	o	31	47	36	60	1.5
3	a	o	52	52	40	65	1.0

1	m	o	3	2	1	4	0.7
2	m	o	3	5	2	8	1.6
3	m	o	0	5	3	8	-
1	a	s	43	53	40	67	1.2
2	a	s	47	63	50	81	1.3
3	a	s	52	81	64	101	1.6
1	m	s	10	18	11	26	1.8
2	m	s	21	38	26	53	1.8
3	m	s	21	40	28	54	1.9

Y	N	E	obs	est	min95%	max95%	ratio
1	I	o	0	0	0	0	-
2	I	o	0	0	0	0	-
3	I	o	0	0	0	0	-
1	nI	o	22	28	20	36	1.3
2	nI	o	34	52	40	66	1.5
3	nI	o	52	57	44	72	1.1
1	I	s	8	15	9	22	1.9
2	I	s	15	31	20	44	2.1
3	I	s	20	33	22	46	1.7
1	nI	s	45	56	42	71	1.2
2	nI	s	53	69	55	89	1.3
3	nI	s	53	88	70	110	1.7

Y	S	A	obs	est	min95%	max95%	ratio
1	f	a	49	61	47	76	1.3
2	f	a	55	77	61	98	1.4
3	f	a	65	97	78	118	1.5
1	m	a	13	17	12	24	1.3
2	m	a	23	33	24	44	1.5
3	m	a	39	36	27	46	0.9
1	f	m	6	14	9	21	2.3
2	f	m	18	29	19	42	1.6
3	f	m	12	31	20	44	2.6
1	m	m	7	6	3	9	0.9

2	m	m	6	13	8	20	2.2
3	m	m	9	14	9	20	1.6

Y	S	N	obs	est	min95%	max95%	ratio
1	f	I	3	10	6	16	3.5
2	f	I	11	21	13	32	1.9
3	f	I	11	23	14	34	2.1
1	m	I	5	5	2	8	0.9
2	m	I	4	10	5	16	2.5
3	m	I	9	11	6	16	1.2
1	f	nI	52	65	50	81	1.3
2	f	nI	62	85	67	107	1.4
3	f	nI	66	105	86	130	1.6
1	m	nI	15	19	13	26	1.2
2	m	nI	25	37	27	48	1.5
3	m	nI	39	40	29	51	1.0

Y	A	N	obs	est	min95%	max95%	ratio
1	a	I	0	0	0	1	-
2	a	I	0	0	0	2	-
3	a	I	1	1	0	2	0.6
1	m	I	8	15	9	22	1.8
2	m	I	15	31	20	43	2.0
3	m	I	19	33	22	46	1.7
1	a	nI	62	78	62	96	1.3
2	a	nI	78	110	89	133	1.4
3	a	nI	103	133	110	159	1.3
1	m	nI	5	6	3	9	1.1
2	m	nI	9	12	6	19	1.3
3	m	nI	2	13	6	20	6.3

I D: Special model, with cases of sexual abuse repressed

The original data includes 42 sexually exploited Irish minors. These victims only appear in the police register R1, since they cannot appear in the registers R2 and R3. To accommodate for this, the categories minor and Irish and sexual exploitation in combination with observed in the registers R2 or R3 are treated as structural zeros. This means that the observed zeros for these categories do not contribute to the parameter estimation, and that the estimated frequencies of these categories are not included in the total population size estimate.

The original model for the full data and the present special model for the data with structural zeros include the same parameters except for the interactions R2*A and R3*A, that are lacking in the latter. The population size estimates of both models, however, are practically identical.

The estimate of sexually exploited Irish minors over the three years is 81 with 95 per cent CI (57, 112).

Annex II: Past MSE studies - United Kingdom

In the United Kingdom, the obligation to identify presumed victims of human trafficking is discharged by the NRM, a framework for identifying victims and ensuring they receive appropriate protection and support. Its datasets are managed by the United Kingdom Human Trafficking Centre (UKHTC) of the Home Office. The National Crime Agency (NCA) of the Home Office collates data from various sources to produce Strategic Assessments of presumed victims. In 2013, 2,744 unique presumed trafficking victims were identified. The information about presumed victims came from a large number of separate source organizations. This information can be summarized into five lists based on the source type:

• LA: Local Authority
• NG: Non-governmental organization
• PF: Police force/National Crime Agency
• GO: Government Organization (mostly Home Office agencies e.g. UK Border Force, Gangmasters Licensing Authority)
• GP: The general public, through various routes

Of the 2,744 victims included in the 2013 database some appeared on two and a few on three or four of the five lists. Table 1 shows the distribution of the identified victims over the five lists.

Table 1: **Contingency table for the National Crime Agency Strategic Assessment data, 2013***

LA	X					X	X	X								X	X
NG		X				X			X	X	X				X	X	X
PF			X				X		X			X	X		X	X	
GO				X				X		X		X		X	X		X
GP					X						X		X	X			

Source: Silverman (2014).
**Each column shows the number of cases which fall in the combination of lists indicated by the cells marked.*

Columns corresponding to patterns which do not occur in the observed data are omitted. The bottom row of Table 1 gives the numbers of presumed victims falling under each of the possible categories. MSE allows an estimation of the number of individuals not appearing on any of the lists, given the distribution of individuals in the contingency table. This is done by assuming that each of the counts is derived from a Poisson distribution, a distribution for the occurrence of rare events. A restrictive Poisson log-linear model is estimated for each of the cells and the parameter estimates are projected on the cell with the non-appearing (or hidden) individuals. With log-linear modeling, it is possible to assess how much being on one particular list affects a person's chances of being on another. Possible interactions between lists can be detected, and controlled for in the estimates. The condition of independence can therefore be relaxed.

Bales, Hesketh and Silverman (2015) fitted a log-linear model to the data presented in Table 1 which allows for individual list effects, and also for interaction between lists. The estimated number of victims was 11,304. The 95 per cent confidence interval for the actual population size was estimated between 10,000 to 13,000, including the 2,744 victims already known.

This suggests that the Strategic Assessment was aware of roughly 20 per cent to 30 per cent of all possible victims in the UK in 2013. In round numbers, therefore, the dark figure is around 7,000 to 10,000.

There is a positive correlation between list LA and each of lists NG and PF, so that being known to the local authority apparently increases the chance of being known to NGOs or the police. This may reflect the existence of referral pathways for potential victims between these agencies, in particular in relation to minors who, unlike adults, do not need to consent to referral to the NRM, or joint operations between the local authorities and other agencies. The upshot of the exploratory MSE carried out on the lists of the National Crime Agency is that the true number of victims during 2013 is estimated at 11,300, or four times the numbers of detected victims (2,744).

Annex III: Past MSE studies - Netherlands

A multiple systems estimation (MSE) was carried out using the statistics on possible victims identified by different groups of organizations reporting to CoMensha1 on behalf of the Dutch National Rapporteur on Trafficking in Human Beings and Sexual Violence against Children over a period of six consecutive years (2010 - 2015) (UNODC, 2017). In total six different groups of organizations (lists) reported to CoMensha, among which the Border Police. The presumed victims reported by the Border Police concern presumed victims of a particular type of trafficking that is not informed by the Palermo Protocol. Moreover, this type of trafficking is no longer upheld as human trafficking by the Supreme Court in the Netherlands. For these reasons, two log-linear models were fitted: one including those reported by the Border Police (based on six lists, concerning 8,234 presumed victims between 2010 and 2015), and one excluding those exclusively reported by the Border Police (based on five lists, concerning 6,935 presumed victims between 2010 and 2015). To enhance the robustness of the estimates, they were stratified by four covariates, namely age (minor/adult), gender (female/male), form of exploitation (sexual/non-sexual) and nationality (Dutch/non-Dutch).

A model search was carried out using the stepwise selection procedure of the R-package STEP. This procedure is similar to well-known stepwise regression analyses, that is, it starts with a simple model and includes significant and deletes non-significant interaction terms between the lists until the fit of the model to the data is deemed adequate. The criteria for model selection are the Aikake Information Criterion (AIC) and/or the Bayesian Information Criterion (BIC); the model with the lowest AIC and/or BIC is selected. In the context of MSE models, we prefer the BIC because it offers better protection against overfitting.

The key finding of the analysis is that in 2014 and 2015, the most recent years for which records are available, the total number of presumed victims of human trafficking in the Netherlands was approximately 6,500 (six lists) / 6,250 (five lists) per year. This means that the estimated numbers are four to five times higher than the recorded numbers of victims that come to the attention of the authorities.

Figure 1 shows in black the trend in the total presumed victims recorded by CoMensha and in red the total estimated numbers of victims. The 95 per cent confidence interval around the estimates is depicted in shaded red.

Figure 1: Trends in observed presumed victims and estimated totals of presumed victims in the Netherlands, 2010-2015 (a: based on model with six lists, b: model with five lists)