

# Changes to National Accounts: Inclusion of Illegal Drugs and Prostitution in the UK National Accounts

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## Executive Summary

This article covers the inclusion of illegal drugs and prostitution activity in GDP and its components; this will be introduced when revised figures for the UK National Accounts, consistent with Blue Book 2014, are published in September 2014.

This change is a result of ensuring comparability in measuring Gross National Income (GNI) across EU countries.

The article explains the methods and data used to estimate the level of illegal drugs and prostitution activity in the UK and the effects of including this activity on GDP and its components, and sets out suggestions for further action. It does not include numerical impacts – please find these in the article ‘Impact of ESA95 changes on current price GDP estimates’.

The article concludes that there are significant limitations in the availability of data to calculate these estimates, and that this means that such calculation requires a number of assumptions on which the estimates are, therefore, partly based. This applies especially to the estimates of prostitution activity.

## 1 Introduction

Gross National Income (GNI) is an important statistic within the National Accounts. It is used in the calculation of a Member State’s contribution to the EU budget. Due to the operational importance, the EU statistical office (Eurostat) carries out regular audits of the methods and data used to estimate GNI. In 2012, following a comprehensive audit of the methods used across EU countries, a number of areas for improvement were identified which Member States have to address by 2014. The UK National Accounts, consistent with Blue Book 2014, will be published in September 2014 and will include improvements to methods and data to address these issues in respect to the UK.

One of the improvements is to include illegal drugs and prostitution activity in GDP; this article provides a technical overview of associated methodology. This article does not provide a numerical assessment of the impact, this can be found in the article [‘Impact of ESA95 changes on current price GDP estimates’](#).

The European System of National Accounts 1995 (ESA95) – see Eurostat (1996), section 1.13 – states that illegal transactions to which all units involved consent are included within the production boundary and therefore the relevant items in the National Accounts.<sup>1</sup>

However, the treatment of such transactions in the National Accounts of the EU and EEA Member States varies between individual Member States. Some Member States include

<sup>1</sup> This is also the case within ESA95’s successor, ESA 2010; see Eurostat (2010), section 1.79. There are no changes in this area between ESA95 and ESA10.

them,<sup>2</sup> others do not. Among the former, different types of illegal activity are included. This impairs the international comparability of the National Accounts.

ONS will therefore be including illegal drugs and prostitution activity within the estimates of UK GDP and its components, starting with the publication of Blue Book 2014 in September 2014.<sup>3</sup>

### 1.1 Current situation and scope

Currently, the only type of illegal activity covered by the UK National Accounts is the smuggling of alcohol and tobacco (included within the estimates of imports of goods and household final consumption expenditure (HHFCE)). Therefore, ONS is required to estimate and include the levels of the activities of the manufacture, sale and consumption of illegal drugs, and the sale and consumption of prostitution. This is the first time that any such estimates will have entered the UK National Accounts.<sup>4</sup>

Furthermore, ONS will not include prostitution or illegal drugs in the short-term measures of GDP by production, but quarterly GDP estimates will include them.

### 1.2 Previous work

Groom and Davies (1998) represents the last comprehensive attempt by ONS to estimate the level of illegal activities.

The authors estimated the level of illegal drugs activity from both supply-side (police seizures) and demand-side (users multiplied by use) and reconciled these estimates by applying balancing adjustments. Furthermore, on both sides they looked at impacts based on several different assumptions and took the one considered most plausible. For prostitution they used a single supply-side estimate.

We do not attempt to replicate the authors' approach to estimating illegal drugs activity. We believe that the data available are insufficient to support a balancing process that is anything more than arbitrary. The Home Office publication in which seizure data is released states specifically that: "the number of drug seizures made and quantity of drugs seized should not be taken as measures of drug prevalence in England and Wales" (Home Office, 2012).

We therefore use a single demand-side estimate of illegal drugs activity<sup>5</sup>

On prostitution, our approach is similar to that of Groom and Davies. We use a more recent study, although the data is less "rich" than theirs. Since 1998, the Netherlands has done work on this subject which we exploit (Smekens and Verbruggen, 2005; de Heij, 2007). This is a supply-side approach.<sup>6</sup>

### 1.3 Structure of article

This paper sets out the national accounts conceptual framework, the data sources, methods and assumptions used to generate the estimates that will be included in the accounts from Blue Book 2014.

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<sup>2</sup> As at 2012, Estonia, Austria, Slovenia, Finland, Sweden and Norway.

<sup>3</sup> The legislative framework for doing this is a request by Eurostat's GNI Committee for all EU Member States to include illegal drugs and prostitution activity and alcohol and tobacco smuggling in their estimates of GDP and the relevant components. This is so that Member States meet the accounting requirements in ESA95.

<sup>4</sup> As mentioned, the GNI Committee requested Member States to include illegal drugs and prostitution activity and alcohol and tobacco smuggling. The UK already includes alcohol and tobacco smuggling, so the approach mentioned complies with the request. Other Member States also include other illegal activities, such as fencing (the sale of stolen goods), illegal gambling, illegal labour and the illegal copying of trademarked or copyrighted products. As the GNI has not requested these, ONS has not included them.

<sup>5</sup> The GNI Committee recommended that demand-side estimates be used for drugs – which we have done – but that these should be balanced against supply-side estimates. For the reasons given in the main text, we have not undertaken this balancing.

<sup>6</sup> This is in accordance with the recommendations of the GNI Committee. There is no recommendation to balance with demand-side estimates.

## 1.4 Time span of estimates

For drugs, the methods described in what follows apply only to estimates from 1997 onwards. Before that date, drug prices are taken from research by independent organisations and drug volumes are modelled based on assumed start dates of the activity. Both prostitution and drugs activity are assumed to start in 1960.

## 2 National Accounts Concepts

Before attempting to measure illegal drugs and prostitution it is necessary to consider how it fits into the national accounts framework. What components of GDP are illegal activities included in? The assumptions set-out in this section are elaborated in Annex A.

In what follows, GDP(P) stands for GDP measured by the production method, GDP(E) stands for GDP measured by the expenditure method, and GDP(I) stands for GDP measured by the income method. HHFCE stands for household final consumption expenditure.

### 2.1 Classifying the sale and consumption of imported illegal drugs

**Table 1 - Classifying imported illegal drugs across GDP approaches**

GDP(P)	GDP(E)	GDP(I)
<ul style="list-style-type: none"> <li>• Resellers of imported drugs are margin traders</li> <li>• Product is imported and sold on without changing it</li> <li>• Domestic output from sale of imported drugs = margin between import and retail price</li> <li>• Import does not count as intermediate consumption (IC)</li> <li>• Output classified to retail industry (SIC: 47)</li> <li>• Trade margins classified to pharmaceutical products (CPA: 21)</li> </ul>	<ul style="list-style-type: none"> <li>• Drugs are consumed only by households as final consumption expenditure</li> <li>• HHFCE is equal to retail sales of the drugs</li> <li>• Imports of the drugs are classified as imports of goods</li> <li>• HHFCE and Imports classified to pharmaceutical products (CPA: 21)</li> </ul>	<ul style="list-style-type: none"> <li>• Drug dealers assumed to have no labour costs</li> <li>• Classified to the household sector</li> <li>• Change in output = Change in Mixed Income</li> <li>• Classified to the retail industry (SIC: 47)</li> </ul>

## 2.2 Classifying the manufacture, sale and consumption of UK-produced illegal drugs

In what follows, IC stands for intermediate consumption and GFCF stands for gross fixed capital formation.

**Table 2 - Classifying UK produced illegal drugs across GDP approaches<sup>7</sup>**

GDP(P)	GDP(E)	GDP(I)
<ul style="list-style-type: none"> <li>• Assume only drug produced domestically is cannabis - which is not retailed but sold by producer as domestic market output</li> <li>• Production costs equal IC</li> <li>• Output allocated to pharmaceutical industry and product (SIC/CPA: 21)</li> <li>• IC allocated to agriculture and electricity (CPA: 01 and 35)</li> <li>• Assume that IC of agriculture is not in HHFCE - but recorded correctly within output</li> <li>• Assume that IC of electricity is already in HHFCE - therefore needs to be deducted</li> </ul>	<ul style="list-style-type: none"> <li>• Drugs are consumed only by households as final consumption expenditure</li> <li>• Assumed there is no GFCF or exports of UK produced drugs</li> <li>• HHFCE is equal to retail sales of the drugs</li> <li>• Classified to pharmaceutical products (CPA: 21)</li> <li>• IC of electricity by cannabis production is assumed to already be recorded in the HHFCE data source - hence is deducted from HHFCE</li> </ul>	<ul style="list-style-type: none"> <li>• Drug dealers assumed to have no labour costs</li> <li>• Classified to the household sector</li> <li>• Change in output less intermediate consumption = Change in Mixed Income</li> <li>• Classified to the pharmaceutical industry (SIC: 21)</li> </ul>

<sup>7</sup> Note that intermediate consumption of agricultural products may be allocated to different industries within the balancing process; future work includes constraining the balancing process to put it in the pharmaceuticals manufacturing industry. The impact on the use table is minimal.

### 2.3 Classifying the sale and consumption of prostitution services

**Table 3 - Classifying prostitution across GDP approaches**

GDP(P)	GDP(E)	GDP(I)
<ul style="list-style-type: none"> <li>• Assume no international trade in prostitution</li> <li>• Domestic output = Total sales</li> <li>• IC made up of:                             <ul style="list-style-type: none"> <li>• rental of buildings to house activities</li> <li>• condoms</li> <li>• working clothes</li> </ul> </li> <li>• All IC items assumed to already be measured in HHFCE</li> <li>• Output classified to other personal services (SIC/CPA: 96)</li> </ul>	<ul style="list-style-type: none"> <li>• Assume no international trade in prostitution</li> <li>• As a result HHFCE increases by the value of prostitution sales</li> <li>• Prostitution classified to other personal services (CPA: 96)</li> <li>• HHFCE decreases by the values of IC for the three products shown in GDP(P)</li> </ul>	<ul style="list-style-type: none"> <li>• Assume not Compensation of Employees associated with prostitution</li> <li>• Assume only household units engage in providing prostitution services</li> <li>• Hence, output less IC = mixed income</li> <li>• Mixed income classified to other personal services (SIC: 96)</li> </ul>

### 2.4 How is it balanced?

Given the assumptions set-out in the preceding sub-sections, the impact of including these illegal activities, is not balanced (see Box 1). However, as will be seen in due course, the imbalances are small.

<p><b>Box 1: Balanced impacts in current prices on GDP and the Supply and Use Framework</b></p> <ul style="list-style-type: none"> <li>• An impact on GDP is “balanced” in terms of GDP if it affects the three measures of GDP (production, expenditure and income) equally.</li> <li>• An impact on GDP is “balanced” in terms of the Supply and Use Framework if all impacts on the supply of a product within the economy are equal to the impacts on demand for (use of) the same product; <i>and</i> all impacts on the output or intermediate consumption of a particular industry are equal to appropriate impacts to either or both of the operating surplus/mixed income of and compensation of employees paid by that industry (and vice versa).</li> <li>• Any impact on GDP that is balanced in terms of the Supply and Use Framework must also be balanced in terms of GDP.</li> </ul>
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#### 2.4.1 Balancing imported illegal drugs

The activity of reselling imported drugs is balanced: domestic output increases by the value of the margin and imports increase by the value of sales less the margin; together supply increases by the value of sales. HHFCE increases by the value of sales, increasing demand. All this happens within the pharmaceuticals product.

In terms of GDP, GDP(P) increases by the value of domestic output, or the margin. GDP(I) increases by the value of mixed income, which is also equal to the margin. GDP(E) increases by the value of HHFCE (sales) but decreases by the value of imports (sales less margin) so the net increase in GDP(E) is equal to the margin. All three measures are equal, so this is balanced.

**Table 4 – Balancing imported illegal drugs in tabular form**

Product	Supply component	Value of increase	Demand component	Value of increase
Pharmaceuticals	Domestic output	Margin on resold imported drugs	HHFCE	Sales of imported drugs
	Imports	Imports of drugs		
	Total supply	Sales of imported drugs	Total demand	Sales of imported drugs

### 2.4.2 UK produced illegal drugs

UK cannabis production, however, is not balanced (see Box 1). Domestic output increases by the value of sales and this is the increase in supply; HHFCE increases by the value of sales; less the value of electricity consumed, and intermediate consumption increases by the value of the seeds and planting stock and electricity used in production. So there is “extra” demand equal to the value of the seeds and planting stock used. This is because we assume that the seeds and planting stock were previously recorded on the supply side but not the demand side.

**Table 5 - Balancing UK produced illegal drugs in tabular form**

Product	Supply component	Value of increase	Demand component	Value of increase
Pharmaceuticals	Domestic output	Sales of UK-grown cannabis	HHFCE	Sales of UK-grown cannabis
	Total supply of pharmaceuticals	Sales of UK-grown cannabis	Total demand for pharmaceuticals	Sales of UK-grown cannabis
Agricultural products	(None)	0	Intermediate consumption	Value of seeds and planting stock used in cannabis production
	Total supply of agricultural products	0	Total demand for agricultural products	Value of seeds and planting stock used in cannabis production
Electricity	(None)	0	Intermediate consumption	Value of electricity used in cannabis production
			HHFCE	Value of electricity used in cannabis production multiplied by -1
	Total supply of electricity	0	Total demand of electricity	0

In terms of GDP, the impacts on GDP(P) and GDP(I) are the same: sales less intermediate consumption. The impact on GDP(E) is higher by the value of seeds and planting stock consumed, as it is equal to the impact on HHFCE which is equal to sales less intermediate consumption of electricity only.

### 2.4.3 Balancing prostitution

The impact of including prostitution is balanced (see Box 1). Supply increases by the value of sales of prostitution, which increase domestic output. HHFCE increases by the value of sales of prostitution, but decreases by the value of intermediate consumption. Intermediate consumption increases by the latter value. The sales of prostitution are of the personal services product; the intermediate consumption is of the rental services, clothing and rubber goods products, and HHFCE decreases in the same products as intermediate consumption increases. So this is balanced.

In terms of GDP, GDP(P) increases by the value of sales less intermediate consumption. GDP(I) increases by the value of mixed income – the same – and the increase in GDP(E) is the same as the increase in HHFCE, which is again equal to sales less intermediate consumption.

**Table 6 - Balancing prostitution in tabular form**

Product	Supply component	Value of increase	Demand component	Value of increase
Personal services	Domestic output	Sales of prostitution services	HHFCE	Sales of prostitution services
	Total supply of personal services	Sales of prostitution services	Total demand for personal services product	Sales of prostitution services
Rental services, clothing, rubber goods	(None)	0	Intermediate consumption	Value consumed by prostitution activity
			HHFCE	Value consumed by prostitution activity multiplied by -1
	Total supply of rental services, clothing, rubber goods	0	Total demand for services, clothing, rubber goods	Sales of prostitution services

## 2.5 Classification within COICOP

Whilst the Supply and Use Framework is classified using the SIC (Standard Industrial Classification) industry and CPA (Classification of Product by Activity) product classifications, HHFCE is classified using the Classification of Individual Consumption by Purpose (COICOP). Within this classification, there are specific codes which relate to illegal drugs and prostitution. Illegal drugs are classified within Alcoholic beverages, Tobacco and Narcotics under 02.3 – Narcotics. Prostitution is classified within Miscellaneous Goods and Services as 12.2.

Given the issues with data quality, neither of these 3-digit series are required to be published within the ESA 2010 Transmission Programme (European Parliament 2013).

## 3 Data Sources & Methodology

### 3.1 Illegal Drugs

As mentioned, we use a demand-side method. The data sources and specific methodology are below.

#### 3.1.1 Stratification of drug types

In what follows, the six drugs included are all calculated separately and added together to create totals at the end of the process. No other drugs are included in the estimates. The drugs are: crack cocaine, powder cocaine, heroin, cannabis, ecstasy and amphetamines.

From section 2, we recall that the following series are required: sales, imports, and margin for imported drugs; sales, intermediate consumption of electricity, and intermediate consumption of seeds and planting stock for home-grown cannabis.

#### 3.1.2 Creation of reference year 2003 values

Over the period 2003-2006, the Home Office conducted a set of detailed surveys – some of the whole population, some of particular groups – regarding drug use; one of the key surveys was one-off, which is why the study has not been repeated (Home Office, 2006). From this, the researchers derived an estimate of the sales of illegal drugs in 2003.

Half of cannabis sales are set aside as domestic production. The remainder (i.e. 50% of cannabis sales plus all sales of other drugs) leaves the sales of imported drugs. Dividing this value by retail drug prices sourced from the United Nations' World Drugs Report—remembering that the UN prices are in \$ and so must be converted to £—gives us a quantity of drugs sold in kilograms. Adjusting this for purity<sup>8</sup> using data from police and border seizures and multiplying by the UN wholesale drug prices gives us imports. We now have sales and imports, and the margin is simply the difference between the two.

For home-grown cannabis, we assume that the only inputs are electricity and seeds and planting stock. DEFRA produce annually an estimate of UK domestic agricultural output and intermediate consumption, the latter broken down by categories including “energy and lubricants” and “seeds and planting stock.” Using the ratio of output to intermediate consumption in these categories in this data, we estimate the two components of intermediate consumption.

### 3.1.3 Creation of time series

It is now possible to derive all the required values for the reference year 2003, and therefore to create National Accounts variables for that year as set out in section 2.1. The next step is to create time-series. As sales is an input to the process set out above, and we do not have a time series of sales, we need to create this by applying an index to the 2003 value. Since the 2003 value is a current price value, the appropriate index is a composite one: (volume index) x (price index). The chosen volume index is the number of users of the drug from the Crime Survey for England and Wales (scaled up using population to the United Kingdom), while the price index is the price series from the UN.

The other variables used above do not require indices, as data either exists for the whole period, or is estimated using X-12-ARIMA modelling.<sup>9</sup> Therefore, we now have all the variables used above and can derive the required National Accounts values.

### 3.1.4 Possible alternative methods

Time-series for volumes of seized drugs are available, and were used by Groom and Davies (1998). We do not use these for the reasons mentioned in that paper: seizure rates can change for reasons other than the underlying total volume changing, notably law enforcement policy – either a formal rule change like the reclassification of cannabis to Class B, or an informal greater or lesser focus on drugs crime by law enforcement agencies.<sup>10</sup>

Drug price series may also be available for some years by charities concerned with drugs. We do not use these because the UN prices are part of a published report, and can be compared with prices from other Member States in the same publication.

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<sup>8</sup> We do this because we want to measure drugs as a good that is homogeneous over time, i.e. we want to measure the amount of the same good in 2003 as 2004. “Drugs” refers only to psychoactive material, so a kilo of cut cocaine that contains only half a kilo of actual cocaine is twice the amount of the good as a kilo containing a quarter-kilo of cocaine. If the purity was 50% in 2003 and 25% in 2004, but the amount of cut drugs sold was the same, the output has gone down by 50%.

<sup>9</sup> X-12-ARIMA is the modelling package developed by the US Census Bureau for seasonal adjustment. It can also be used to forecast or backcast timeseries.

<sup>10</sup> This is also why the GNI Committee recommended that these supply-side sources not be used.



**Box 2: Summary of Method for Drugs**

- The method is demand side.
- Estimates made for import of drugs which are all assumed to be consumed by households
- Use 2003 level to extrapolate current price and volume estimates
  - $\text{Volume} = \text{Number of Users in Eng \& Wal scaled up to UK population}^{(\text{Eng \& Wales Crime Survey Data})} \times \text{Average Amount Consumed Per Person Purity Adjusted}^{(\text{Home Office})}$
  - $\text{Current Price} = \text{Volume} \times \text{Price}^{(\text{UN World Report on Drugs})}$
- Method broken down by type of drug
- Estimates for home grown production of cannabis included

## 3.2 Prostitution

As mentioned, we use a supply-side method.

Some Member States give a detailed breakdown of prostitution types (eg, street, escorts, etc.) We are not able to do this with the data available.

Finally, extensive data gaps have been filled with assumptions, recognising that this area of the economy is very difficult to measure. This is set out in detail in Annex A.<sup>11</sup>

### 3.2.1 Recap of required estimates

We recall from section 2.4.2 that the following estimates are required: output, intermediate consumption of clothes, intermediate consumption of condoms and intermediate consumption of rental services.

### 3.2.2 Calculation of estimates for 2004

The benchmark for extrapolation is set as 2004. For that year Eaves (2004) estimates the number of off-street prostitutes in London. We also have an estimate from the Metropolitan Police for the number of on-street prostitutes in London (Home Office (2004).

We assume that prostitution is related to population to scale up from London to the United Kingdom.

We make assumptions about the average number of clients seen by each prostitute per week (Smekens & Verbruggen, 2005), the number of weeks worked per year and the payment per client (Punternet). We can then multiply these three terms and the total number of prostitutes to get output for 2004.

We make assumptions, largely derived from the Netherlands (CBS, 2012), about the intermediate consumption involved per prostitute in the production of prostitution services for each of the three categories. Because the Netherlands have assumed values in €, we convert them to £. Each of these can then be multiplied by the number of prostitutes in the United Kingdom to give the three totals for intermediate consumption.

We can now derive all variables set out in 2.4.2.

<sup>11</sup> The GNI Committee recommended that the breakdown of prostitution types be given. However, the recommendations allow for varying practices where data is not available, recognising that this area of the economy is very difficult to measure.

### 3.2.3 Calculation of time-series

We must now create a time-series of all the variables mentioned in 3.2.2, from which we can build up estimates in the same way as in that section.

**Table 7 - Indices used in prostitution extrapolation method**

Variable	Index	Brief justification
No. of prostitutes	UK male population 16+	Assumed to relate to size of market. This is the only data available.
No. of clients per prostitute per week	None – remains constant	No information available
No. of weeks worked	None – remains constant	No information available
Payment per prostitute	Deflator for personal services product (CPA2008 div. 96)	Division 96 contains inter alia services such as lap dancing and escort agencies. These are the closest activities we have to prostitution.
Intermediate consumption of clothes per prostitute	CPI for clothing (COICOP: 03.1)	Products will mostly or entirely be bought legitimately – CPI should capture this.
Intermediate consumption of condoms per prostitute	CPI for chemists' goods	Products will mostly or entirely be bought legitimately – CPI should capture this.
Intermediate consumption of rental services per prostitute	Rental per room as used for imputed rental (COICOP: 04.1)	Products will mostly or entirely be bought legitimately – CPI should capture this.

### 3.2.4 Possible alternative methods

Europap (2002) also attempts to estimate the number of prostitutes in the UK. However, we were not able to obtain a copy and so could not ascertain the method. Furthermore the reference year is 1999 and so is more remote than Eaves (2004) from the later periods we are most interested in. Matthews (1998), quoted in Groom and Davies (1998) attempts to estimate the earnings by different types of prostitution in 1995. The study is based on a survey which may suffer from under-reporting, while the Eaves methodology attempted to correct for this effect.

**Box 3: Summary of Method for Prostitution**

- The method is supply side
- Use point in time level to extrapolate current price and volume estimates
- Level: No. of active prostitutes<sup>(Eaves)</sup> x No of client episodes per week<sup>(Smekens & Verbruggen)</sup>  
x 52 x Average Charge Per Client<sup>(Punternet)</sup>
- Volume is extrapolated using the male population aged 16+<sup>(Census)</sup>
- Price is extrapolated using CPI for Personal Services
- Other sources used to estimate intermediate consumption

## 4 Impact of the changes

Output, HHFCE, imports and mixed income all increase. Intermediate consumption also increases by a very small amount.

Information on the numerical impact can be found in an associated article [‘Impact of ESA95 changes on current price GDP estimates’](#).

## 5 Conclusions

This article aims to provide users with an overview of the data source and methods that will be introduced in September 2014 to measure illegal drugs and prostitution in the national accounts. The estimates are based on data of variable quality, with the estimates of illegal drugs activity markedly stronger than those of prostitution, but both definitely weaker than the estimates of legal activity. Given this, a continuous process of improvement should be applied to these estimates to ensure that they are the best possible quality. The following areas are noted.

### 5.1 Reconciliation with new estimates of illegal activity

The Home Office has released a new estimate of drug sales (Home Office, 2013b). This was published too late to be incorporated into our estimate. In line with the model set out in this paper, this is based on an updating of the 2003 estimate previously published by the Home Office. Any future work should involve reconciling the two estimates.

### 5.2 Analysis of new data sources

The latest UN World Reports on Drugs do not appear to contain the drugs prices we have used to create these estimates. Therefore, alternative sources must be found. One such source may be the International Drugs Monitoring Unit, a professional expert witness firm. Investigations into the quality and methodology of this data source are ongoing and a decision on whether to use them should be part of any future work.

Furthermore, the closure of the Forensic Science Service means that no purity data will be available for future years. Any future work should include a search for a new source.

### 5.3 Finalisation of National Accounts treatment

As noted in footnote 7 **Error! Bookmark not defined.**, intermediate consumption of agricultural products may be allocated to different industries within the balancing process; future work includes constraining the balancing process to put it in the pharmaceuticals manufacturing industry. This should be part of any future work.

### 5.4 Tourism

The estimates presented in this paper assume that there is no international trade in prostitution owing to a lack of data sources. However, the national accounts should account

for prostitution services consumed by non-resident households (tourists) as well as purchases of prostitution serviced by resident households from non-residents, in particular as tourists abroad.

This assumption should be reviewed again in any further work.

## 5.5 Extending scope

As noted in Section 1.1, the scope of this paper has been limited to illegal drugs and prostitution, but there are other areas of illegal activities which should potentially be included, such as:

- Fencing, the handling of stolen goods
- Illegal temporary employment through employment agencies
- Illegal gambling
- Illegally copying software, games, movies and music

Any further work should encompass investigating these areas.

## 5.6 Short-term estimates

As noted in Section 1.1, it was mentioned that whilst estimates will be included in annual and quarterly GDP, there are no specific indicators included in the leading short-term GDP estimate – GDP(O). Given the data challenges that exist in this area, there may be no alternative to this approach, but any further work should include improving estimation beyond the last actual data points.

## 5.7 Feedback

The authors welcome feedback on this article, particularly in relation to other potential data sources which may exist as well approaches for the other areas of illegal activities.

## 5.8 Acknowledgements

The authors would like to thank Chris Davies ( previously ONS, now UK Intellectual Property Office) for his original work on this subject as well as the contributions from Kathryn Coleman of the Home Office. We are also grateful to the pioneering work carried out by Chris Groom and Tom Davies in their original paper from 1998.

## 6 Contact

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## Annex A. Methods, Data Sources and Assumptions

### Methods, Data Sources and Assumptions for Illegal Drugs

**Table 1 – Methods for Illegal Drugs**

Method	Area	Details
1	Indices	<p>We need to create volume and price indices with base year 2003 for the sales of drugs.</p> <p>The price index is simple: we use street (retail) prices from the UN World Report on Drugs (Data Source 1), converted to an index.</p> <p>The volume index is more complex and has two components. The first should be the amount by unit of drugs sold - unfortunately, we have data only on the number of users in England and Wales (Data Source 2), not on the amount consumed per user (Assumption 1). These numbers are scaled up by total population to cover the UK - implicitly assuming that the same proportion of the Scotland and Northern Ireland populations use drugs (Assumption 2) - and converted to an index.</p> <p>The second component of the volume index is purity. Drugs are commonly "cut" (effectively diluted) with non-psychoactive chemicals and sold in this form. The proportion of psychoactive material (purity) changes over time, and this needs to be taken into account in the indices used to vary drugs output (Data Source 3) recalling that this output is of cut drugs. Determining the index used to vary through time requires making one of two assumptions about drug purchasing decisions in response to changes in the purity of cut drugs.</p> <ul style="list-style-type: none"> <li>• Case 1. One assumption is that users buy the same amount of <i>pure</i> (uncut) drugs no matter what the purity of the cut product they actually buy is. If the purity halves, twice the amount will be bought. With perfect information and perfect demand elasticity to price, this is what should happen (and the price should halve) - of course neither applies to the drugs market in any way.</li> <li>• Case 2. The alternative assumption is that users buy the same amount of cut drugs no matter what the purity of it is. If purity halves, the amount of actual drugs consumed will halve. This would happen if demand was perfectly price inelastic - of course, in this case suppliers would be incentivised to supply no actual drugs.</li> </ul> <p>In Case 1, the appropriate index is <math>(I_U \times I_{PRS})/I_{PYS}</math> where <math>I_U</math> is the index of the number of users, <math>I_{PRS}</math> is the index of the street price (of the uncut drug) and <math>I_{PYS}</math> is the index of the purity of drugs sold (on the street). Note that this step involves Assumption 7.</p> <p>In Case 2, purity doesn't matter, as it has no effect on purchasing decisions. The index is <math>(I_U \times I_{PR})</math>. (Purity would affect only the volume series.)</p> <p>We believe that Case 1 is more appropriate, as it fits better with the intuitively reasonable assumption that utility from using cut drugs varies proportionally with the psychoactive content.</p> <p>As a final note, herbal cannabis cannot be "cut" in the same way as other drugs, so we do not apply a purity index to cannabis. The formula is as in Case 2.</p>
2	Calculation of Variables	<p>The indices calculated above are applied to the 2003 values given in the quoted study for each drug. This creates a time-series of sales for each drug. In a formula, for year t:</p> $\text{Sales} = P \cdot 1_{2003} \times [(I_{U,t} \times I_{PRS,t})/I_{PYS,t}]$ <p>A proportion of 0.5 is applied to the cannabis sales value and this is allocated to home-grown cannabis (Assumptions 8, 12).</p> <p>For imported drugs, the sales value is deflated by the street price index used above and this implied quantity is multiplied by wholesale prices from the UN World Report on Drugs (Data Source 1); these wholesale prices must be adjusted for the differing purity of wholesale and imports by multiplying by the ratio of the two purities (Data Source 4; Assumption 6) and converted from USD to GBP using an</p>

Method	Area	Details
		<p>exchange rate from the Bank of England (Data Source 5). The result is imports of goods (P.71).</p> <p>If <math>I_{PYW}</math> is the imported or wholesale purity index (2003 = 100) of the drug and <math>I_{PRW}</math> is the wholesale price index of the drug:</p> $P.71 = P.1 \times I_{PYW} / I_{PYS} \times I_{PRW} / I_{PRS}$ <p>The margin, or output (<math>P.1 = P.11</math>), is just Sales – P.71. HHFCE = <math>P.1 = P.11</math>; B.3g = Sales – P.71.</p> <p>For home-grown cannabis <math>P.1 = P.11</math> and is equal to Sales. Intermediate consumption is calculated using DEFRA data (Data Source 6; Assumptions 9 and 10) which contains the ratios of agricultural output to intermediate consumption of “energy and lubricants” and “seeds and planting stock.” These ratios are applied to the sales value for home-grown cannabis to give the intermediate consumption values in the two categories.</p>
3	Allocation to Industries and Products	<p>Output of reselling imported drugs is allocated to the retail industry (SIC 47). Products are allocated in the usual way: the margin is assigned to the retail product (CPA 47) at basic prices, then valuation adjustments are applied to reassign it to pharmaceuticals (CPA 21) at purchasers’ prices. HHFCE and imports are of pharmaceuticals.</p> <p>See main text for the treatment of home-grown cannabis.</p>

**Table 2 - Data Sources for Illegal Drugs**

No	Data Source	Details
1	Wholesale and retail prices	The UN World Report on Drugs is published annually and contains prices for a wide variety of different drugs. These are based on data supplied by law enforcement agencies in member countries. The data is obviously patchy and contains many instances of covering gaps with the latest available year, although this is not made clear in the actual report. This is especially true of wholesale prices. No explicit quality information is available but it is possible to say that since the data is supplied by law enforcement agencies it will represent only the part of the drugs market of which they have knowledge. See United Nations (2013).
2	Number of users	This comes from the England and Wales Crime Survey, conducted by the Home Office. Similar surveys exist for Scotland and Northern Ireland but not to a sufficient level of detail. Quality information for the EWCS can be found within the publication. See ONS (2012b).
3	Purity values	The purity values used in the output indices come from analysis of drugs seized by police forces; purity rates from these are published by the Home Office. UK Border Agency (UKBA) seizures are also recorded (see next entry) and we assume that these are all of imports which have not already been sold on at retail (Assumption 5). Quality information for this data is sparse as it derives ultimately from what police have managed to seize, and so is not in any sense a representative sample of the underlying population for which the usual statistical measures can be derived. See Home Office (2012).
4	Purity values	The purity values used to reflate output to get imports and intermediate consumption come from UKBA seizures. Thus, we assume that all drugs seized by police have already been sold at retail (Assumption 6), an assumption which is probably much weaker than the converse regarding the UKBA. The remarks on the quality of Data Source 3 apply here as well.
5	Exchange Rates	The Bank of England publishes time-series for exchange rates including the desired USD->GBP rate. We use the average annual spot rate, which represents the average position over the year for most currency transactions. This data is of good quality as it is based on observations of actual market states, although the rates are not “official” ones. See Bank of England (2014b).
6	Intermediate	The Department for the Environment and Rural Affairs (DEFRA) publishes a



No	Data Source	Details
	consumption	production and income account for the UK agricultural sector from which output and expenditure on the relevant products can be derived. This data is based on surveys of UK farmers with 90%-100% coverage, although for the data we are using the latest years have to be forecast. See DEFRA (2013) for contacts for further information.
7	Population data	The ONS population release; see ONS (2012b)

**Table 3 - Assumptions for Illegal Drugs**

Assumption	Details
1	We assume that the purity-adjusted amount of drugs consumed by the average user remains constant over time. This assumption is probably false, but we have no data to challenge it.
2	We assume that the prevalence of use of all drugs in Scotland and Northern Ireland is the same as in England and Wales. Again, we have no data either way.
3	We assume that there is no activity of registered corporations or quasi-corporations in drugs. This is reasonable as the risk of reporting such income would be a pointless one.
4	We assume that there are no labour costs within drugs activity. This is probably false, but it is impossible to distinguish salaried employees from self-employed individuals.
5	We assume that no drugs are re-exported from the UK after being imported. In the absence of contradictory evidence, this is reasonable as there is no geographical or legal incentive to import first into the UK and go through multiple customs. This is a sub-set of Assumption 11 and is identified separately because it affects the Balance of Payments.
6	We assume that all UKBA seizures of drugs happen before the drugs are cut for retail. Without further information to the contrary this is reasonable given the UKBA's role, especially as the reported purities are consistently higher than the police seizures as one would expect for imported drugs compared to drugs sold on the street.
7	We assume that all police seizures of drugs happen after the drugs have been cut. While this has some support as the purities are consistently lower than the UKBA's, we do know that the police and UKBA conduct a joint operation which means that this assumption is not entirely true. It is less likely to be true than Assumption 5 because the police have a wider-ranging role than the UKBA.
8	We assume that half of cannabis sold in the UK is imported and half home-grown. This is an arbitrary assumption.
9	We assume that cannabis production involves only energy and seed stock. This is based on an intuitive assessment of the cannabis production process.
10	We assume that the ratios of the two categories of cannabis intermediate consumption are the same for cannabis production as they are for legal agriculture. This is a weak assumption as the indoor greenhouse nature of cannabis production is different to the majority of legal agriculture; however we have no other data.
11	We assume that the only use of drugs is as final household consumption expenditure. In other words there is no use of drugs as GFCF, change in inventories, change in valuables, exports (Assumption 5), intermediate consumption, or government final consumption expenditure. The GFCF and change in valuables assumptions are reasonable because drugs are not a capital good, nor are they a good which can be an object of intrinsic value. The government final consumption expenditure assumption is reasonable because government units are very unlikely to spend money on illegal drugs. The intermediate consumption assumption is reasonable because illegal drugs cannot be used in any production process. The change in inventories assumption is probably false, but there is an incentive not to hold drugs as inventories because of the risk of detection.
12	We assume that no drugs other than cannabis are produced in the UK. While this is probably false, we do not have any evidence to the contrary.
13	We assume that electricity used in cannabis production is captured within the existing data sources for household final consumption expenditure. This is based on the intuition that it is difficult to buy electricity without it being recorded, and producers would have an incentive to avoid detection by reporting it as for private use.

Assumption	Details
14	We assume that seeds used in cannabis production are not captured within any existing data source. This is based on the intuition that reporting such transactions might lead to detection of the activity.
15	We assumed imported illegal drugs are not transformed. It could be argued that “cutting” or adulterating drugs with non-psychoactive substances – which self-evidently takes place – is a transformation activity. However, we consider that the product in question is the psychoactive drug and that any adulteration does not transform the product but simply increases the price of a given quantity of it. An analogy would be a retailer selling alcohol that they have illegally diluted – they are still a retailer.

## Methods, Data Sources and Assumptions for Prostitution

**Table 4 - Methods for Prostitution**

Method	Area	Details
1	Output Volume Series	The method is to calculate annual volume as $P * C * 52$ , where P is the number of prostitutes active in a given year (Data Source 1), W is the average charge per client (Data Source 3), and C is the average number of clients per week [Data Source 2]. As there is no time series, we vary the point estimates in time using the male population (Assumption 1).
2	Output Price Series	The method is to calculate W following an estimate from Punternet supported by a 2004 journal article. This is £55 in 2004. This is varied through time using the CPI for the personal services product (CPA: 96). [Data Source 3]
3	Intermediate Consumption Series	Intermediate consumption is assumed to consist of 3 elements: rental (CPA: 68.1-2), clothes (CPA: 14) and condoms (CPA: 22). Method 3a. Rental is calculated as $P * RR * T$ , where P is the number of prostitutes, RR is the average room rental used in the imputed rental calculations, and T is the proportion of renters:owner-occupiers used in those calculations. This obviously involves several large assumptions [Assumption 2a]. As we have no data the only other option is to follow the Netherlands and use a fixed proportion of revenue. Method 3b. Following a paper by de Heij (2007), we assume that each prostitute spent the equivalent of €125 per year on clothes and €0.50 per client on condoms in 2007 [Assumption 2b]. These values are converted to £ using the Bank of England annual average spot rate and varied through time using the CPI for clothes and footwear and chemists' products respectively. These values are then multiplied by the estimated number of prostitutes to give levels in each year. Method 3c. These values must be subtracted from HHFCE, as they will already be counted as HHFCE in the data for that variable. This creates an imbalance.
4	Split into Income Variables	After this calculation of GVA(P), it must be split into the income components. As mentioned, we reasonably assume that there is no activity of corporations or quasi-corporations [Assumption 3a] and no employment [Assumption 3b]. So all of GVA(P) is mixed income (B.3g)
5	Split into Expenditure Variables	As mentioned, we assume no trade [Assumption 5], no government FCE, and no intermediate consumption [Assumption 6]. So all expenditure is HHFCE.
6	Industry and Product Allocation	Prostitution output will be assigned to industry and product 96, as it is explicitly mentioned in the SIC and CPA descriptions.

**Table 5 - Data Sources for Prostitution**

No	Data Source	Details
1	Number of prostitutes in UK	Variable P in the formula in table 5, line 1. We first estimate the number of prostitutes in the UK in each year. A study in 2004 by Eaves (a charity helping prostitutes) estimated that there were approx 7000 off-street prostitutes in London in that year; this was done by calling numbers advertised in various media and asking how many prostitutes were in each place. In the same year the Metropolitan Police estimated 115 prostitutes on the street at any one time in London (Home Office (2004)). Adding these and scaling up by UK population [Assumption 5] gives c. 58,000 prostitutes in the whole country.
2	Number of clients per week	Variable C. We also have to estimate the number of clients seen by each prostitute per week. Following a Netherlands assumption with some research support, quoted in Smekens and Verbruggen (2005), we calculate estimates based on 20, 25 and 30.
3	Prices	Variable W (the payment to prostitutes per client). This was estimated based on research on Punternet <sup>12</sup>
4	Exchange rate	The EUR->GBP exchange rate. See table 2, data source 6; exactly the same comments apply.

**Table 6- - Assumptions for Prostitution**

Assumption	Details
1	We assume that the number of prostitutes has the same pattern through time as the 16+ male population. This is a weak assumption based on the market for prostitutes' services. It is necessary because we have no time series data for the number of prostitutes.
2	These are assumptions used to plug holes in the source data for intermediate consumption: 2a. Prostitutes or their pimps pay the same average rent as is used in the imputed rental calculation, and the renter:occupier ratio among them is the same as in the data used in that calculation. This assumption is because there is no other data. 2b. Prostitutes spent the equivalent of €125 per year on clothes and €0.50 per client on condoms in 2007. Unlike the Netherlands we assign this to intermediate consumption, not HHFC; this is because we consider that this expenditure consists of inputs to the production process and not final consumption. The exchange rate used comes from the Bank of England and is the average annual spot rate (Data Source 4)
3	These are assumptions used to split GVA(P) into income components: 3a. There is no activity of corporations or quasi-corporations in prostitution. This is simply based on the intuition that prostitution is illegal, and the reporting to government required to achieve corporate or quasi-corporate status would be a pointless risk. 3b. There is no employment in prostitution; all prostitutes and pimps are self-employed. This is a controversial assumption based on reasoning from two premises. Firstly, we intuit that voluntary employment in prostitution - pimps paying regular wages to prostitutes - does not exist, because the relationships that make up employment are based on legal protections that are unavailable in illegal activity. Secondly, reasoning from the principle that involuntary transactions are not included in the production boundary and hence not in the accounts, we discard all involuntary employment, where prostitutes are forced to work, and assume that this does not exist in the numbers we have as there is no direct evidence. The results of the UK Census 2011 were analysed; however the Census occupational classification does not include illegal prostitution, only legal sex work like lap dancing.
4	These are assumptions that there is no trade in either direction in prostitution: 4a. There are no imports of prostitution services. All prostitutes in the UK are UK residents; British residents do not consume prostitution services abroad. The former has some justification, since a large proportion of foreign national prostitutes are here illegally and the fixed costs of smuggling them in and out are not negligible. The latter is obviously false, but we have no chance of obtaining data on this.

<sup>12</sup> <http://en.wikipedia.org/wiki/Punternet>

Assumption	Details
	<p>4b. There are no exports of prostitution services. All prostitution in the UK is consumed by UK residents. Again, this is obviously false, but the UK is not a centre of sex tourism, so the amounts are assumed to be negligible.</p>
5	<p>These are assumptions that expenditure components other than HHFCE do not exist for prostitution:</p> <p>5a. There are no P.5 components (GFCF, change in inventories or change in valuables) of the prostitution product. This is self-evident as prostitution is not a physical good that can be invested in, nor a transaction cost of investment; nor is work-in-progress possible between reference periods.</p> <p>5b. There is no intermediate consumption of the prostitution product. While there is anecdotal evidence for businesses buying sex for senior employees, this is not strong, widespread or quantifiable enough to enter the accounts.</p> <p>5c. There is no government final consumption expenditure on the prostitution product. This should be self-evident.</p>
6	<p>London contains the same proportion of UK prostitutes as it does of UK population. This is used to scale up the London estimates of a study on prostitution. We might expect that the proportion would be higher in London (as an economic and internal tourism centre) but the study's estimates are stated to be under-estimates anyway.</p>

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