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ABSTRACT

This contribution develops an empirically informed measure of output in prostitution in Belgium. Its starting point is to measure income in one locational segment of the prostitution market: window prostitution. Output is decomposed in overall supply of sex workers, average transactions in a given working time, and price per transaction. These factors are estimated for existing red light districts. Data are based on systematic observations of supply and transactions, and of internet relics on prices.

The consolidated measure of heterosexual prostitution makes use of the window prostitution benchmark. This way, the relative size in transactions in other segments (such as brothels or escort services) are estimated. User-generated websites allow to collect data about each sex worker's page impressions, discussions and standardised review forms submitted. Principal component analysis indicates that all indicators refer to one latent variable. This multi-item proxy allows for an estimate of transaction shares of segments other than window prostitution. Combined with prices from internet relics, we measure output of every heterosexual prostitution segment. An increment of 5% for the market share of male sex workers allowed for a consolidated estimate of all income earned in prostitution activities in Belgium. Finally, non-resident production - production by migrants who reside less than a year in Belgium, that is - is accounted as an import in national accounts. This estimate was based on expert opinions combined with data on sex workers' country of origin.

Because the estimates are an outcome of ratios of multiple indicators, Fieller's theorem allows to model the confidence intervals. This results in an estimate of added value of prostitution in Belgium (2015) ranging between 617 and 688 million €, which is about twice as much as in the former estimate that was used in the national accounts.

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Introduction: existing estimates

In the first half of the 20th century, national accounts were quintessential in constructing systematic data on the economic activities of nations and other aggregate wholes (regions, sectors). Originally, these first estimates hardly dealt with the problem of taking prostitution[1] or other underground activities into account. This may seem surprising, given that prostitution, like some other underground activities, definitely is an economic activity of a "service type": It involves a market transaction where a party pays for a service. Nevertheless, it took quite a while before statistical instructions included 'illegal activities'[2]. As a point of illustration: the 1953 and 1968 versions of the System of National Accounts (SNA) hardly mention illegal activities. The debate did take place, however, with scholars arguing that illegal transactions should be included (e.g. Adler, 1982, pp. 129-130). Finally, the System of National Accounts 1993, and the 2008 versions state that illegal or semi-legal transactions based on mutual agreement are to be included in the accounts (European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, & World Bank, 2009). This principle is taken over in the most recent version of the *European System of Accounts*, the so-called 'ESA2010' (Eurostat, 2014). The instructions explicitly refer to smuggling, drugs and prostitution. As far as the European Union goes, estimates based on these instructions were published for the first time in September of 2014.

After 1993, acceptance of the idea did not yet mean implementation. Until recently, most governments did not put serious efforts into estimating these activities. A 2008 report (United Nations, 2008)[3], surveying 43 countries, concludes that only 11 countries estimate the 'illegal sector'. Most of these estimates were experimental, which means that the estimates weren't included in the accounts. Only eight countries actually made an effort to estimate production in prostitution (see

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1 Some object to the concepts of 'prostitution' and 'prostitutes', because it is seen as stigmatising. The alternatives –for instance, 'sex work' and 'sex workers' - are in turn criticized too. We chose to denote the phenomenon of physical commercial transactions as 'prostitution'. The people who actually perform the service, are designated as 'sex workers'.

2 We stress that the incorporation of prostitution into national accounts neither implies a moral assessment of the phenomenon, nor does it presume that exploitation is absent. It merely acknowledges the market-oriented nature of prostitution, implying that someone intentionally pays for a service. "Mutual agreement" exists at the point of the transaction, not necessarily in the organization of sex work.
The French statistical institute did not agree with this approach, stating that these transactions "are generally not a result of mutual agreement (due to the dependence of consumers)" (INSEE, 2014). This argument seems to be brought in to apply to (illegal) drug consumption, however, rather than prostitution.

3 The United Nations published two earlier reports (1993, 2003). The overall conclusions apply to these reports too.

annex, Table 20). All of these are Central- and Eastern-European countries. Methodologies are not extensively discussed, but the overview does show that all estimates rely on either existing material or expert opinions. The only exception seems to be the estimation by the Czech Republic, which is based on original data collection.

Things started to change at a faster pace after the SNA08 guidelines (Bos, 2008), followed by the most recent European rules (ESA2010). Both provide more detailed and explicit instructions to include measures of underground economic activities and the informal sector. The ESA2010 explicitly demands the inclusion of production in smuggling, illegal drugs and prostitution into the national accounts. This seems to have encouraged quite a few more systematic attempts.

The first published estimate was made by the Swedish statistical bureau (Magnusson Wärmark, Björling, Pappila, & Engdahl, 2008). The note cites some earlier estimates that are built on a survey of the general population. The reliability of this approach is considered too low. Then an attempt was made to construct an output estimate based on a breakdown into different market segments (street prostitution, internet based prostitution and sex clubs). For each segment, a different approach is suggested. Street prostitution estimates are based on a count of the number of sex workers in the streets of three cities.

Blades (2011) reports about the efforts of Western Balkan countries to estimate value added in prostitution: Albania and the former Yugoslav successor states Bosnia-Herzegovina, Croatia, Macedonia, Montenegro, and Serbia. The measures are built on an estimate of the number of sex workers, consequently estimating working days and clients per day. Except for Croatia, all countries made use of existing sources (police records, expert opinions, media coverage). The Croatian estimate builds on a survey of “taxi drivers, massage parlours and escort agencies in main cities”.

The estimate for The Netherlands states that a separate estimate of segments, although advisable, is not possible with the available data. Therefore, prostitution is estimated at the level of the whole sector, as a result of the multiplication of the following factors: number of sex workers, number of transactions per sex worker and price per transaction. The model assumes a flat rate per transaction in the base year and a 10% increase with the introduction of the euro. Neither have any cited empirical support apart from anecdotal evidence. The same applies to the number of sex workers and the number of transactions. The evolution of the demand is estimated with the help of the changing levels of the male population between 15 and 65 years old.

The UK estimate makes use of a parallel decomposition of production into sex workers, transactions and price. Numbers of sex workers are based on two sources: a published NGO-report on street prostitution, and a report from the police, both London-based. The London estimate is scaled up to the UK, based on population estimates. Sex workers' transactions are based on Dutch data.
The Belgian estimate is the only one based on a demand model.

Table 1: Overview of countries surveying the illegal economy publications from 2008 on

Country	Reference	Type
1. Sweden	(Magnusson Wärmark et al., 2008)	Estimate of sex workers per segment; assumed income per sex worker
2. Western Balkan	(Blades, 2011)	Estimates of numbers of sex workers, working days and clients per day. Mainly secondary analyses.
3. Netherlands	(Kazemier, Bruil, van de Steeg, & Rensman, 2013; Kazemier & Rensman, 2015; Rensman, 2014)	Overall estimation of turnover, based on assumption of number, transactions and price
4. United Kingdom	(Abramsky & Drew, 2014)	Extrapolation from 2 studies of number of sex workers in London, transactions per sex worker from a Dutch study, price from user-generated internet source (Punternet).
5. Luxembourg	(Weber & Emprou, 2014)	Vague indication that existing data have been compared to police sources.
6. Belgium	(Acx, 2014)	Mainly demand based: assumption of average consumption per male citizen.

What can we learn from this outline?
First of all, only a few estimates are based on data collected for the purpose at hand. Because of this, one often falls back on generalizations from other research. Estimates are for instance built on local studies, generalizing to the whole country, or borrow observations from other countries.
Second, none of the available information seems to acknowledge the reasonable assumption that male sex workers make up a significant group in the total supply of commercial sex. One data mining software firm illustrated for the UK case shows how significant it may be to disregard male sex work (Import IO, 2014a, 2014b).

Third, all estimates that provide enough detail seem to bring the number of sex workers into the equation somehow. The question is whether this is a necessary step in estimating production in prostitution. If the number of transactions is known, one need not, for the purpose of national accounts, know about the number of people carrying out those transactions. Due to the high turnover and mobility of sex workers, things may become more complicated when one bases the estimate on the number of sex workers.

Finally, only the Belgian estimate starts from demand for prostitution. All the other countries build their estimates on supply-side measures. Demand measures are usually based on surveys from the general population, probing into respondents' personal history as a prostitution client. If one aims for a reliable measure of the quantity of the transactions, this seems to be a problematic choice: social desirability bias and non-response are problems that probably lead to considerable type II-errors. One can expect that they lead to significant underestimation of total consumption (see also Carael, Slaymaker, Lyerla, & Sarkar, 2006). For instance, Kim (2013) asked respondents "Have you ever sought the services of a prostitute?" and "Have you frequently (more than 3 times each year) sought the services of a prostitute?". He then compared the responses in a direct response and a randomized response design in a sample of South-Korean men. The latter design is supposed to reduce social desirability bias (Chaudhuri & Christofides, 2013). This seems to be the case: the proportion of yeses increases from 48.8% to 64.6% for the first question, and from 24.2% to 40.3% for the second question. Note that a randomized response design does not promise that the bias decreases to zero, just that it reduces it.

To conclude, underground activities such as prostitution are, by their very nature, not systematically monitored. Therefore, it seems impossible to estimate illegal and underground activities with the same precision and reliability as in the case of other aspects of the national accounts. The lack of available data force us to make use of alternative data sources. However, we are convinced that a well thought-out and strategic use of methods that are often used by sociologists and anthropologists offers the chance of significantly improving the existing estimates. In the next section we propose a design for data collection and manipulation that provides the foundation for an estimate of production in prostitution in Belgium that meets these standards.

I. General approach

1.1. Starting points

As indicated, it is quite hard to obtain the same level of reliability for estimates of underground economic activities. Some even see this as an argument against inclusion of these transactions with national accounts (e.g. Landefeld, Seskin, & Fraumeni, 2008, p. 207). We think this strategy would basically play the ostrich. Shying away from a more reliable and valid estimate than the existing one, implies that one leaves even more room for the ideological overtones in the debate. One needs not necessarily measure the quality of estimates of the underground economy by those of the official economy yard-stick. The point of comparison is rather the existing measure: if the new estimate is significantly better than the former one, one can call it progress (or at the very least: reduction of error).

We develop an alternative design constructing an economic estimate of prostitution in Belgium. We attempt to learn from the existing estimates, and from approaches of underground and informal economies elsewhere.
The three starting points of our estimate are the following:

1. Parsimony in assumptions and estimated factors

   We assert that a high-quality estimate necessitates direct observations to replace heroic assumptions. The primary goal therefore is to maximize empirically validated estimates. As we decompose total output in prostitution into elements, we measure as many aspects of production as possible. Complete empirical estimation is unattainable, so for some aspects assumptions that are not directly validated empirically (or at least not entirely) are still made. These assumptions are constructed as consistently as possible with the help of expert and key witness opinions, and studies on prostitution markets in Belgium or elsewhere.

   In the same vein, we strive for production equations that select those variables that guarantee a better validity and higher reliability compared to the alternatives. For instance, we assert that a headcount of sex workers is redundant in constructing an estimate of gross output, and at the same time this estimate is fraught with difficulties. Therefore we prefer to estimate total working time in geographical entities or segments, rather than a count of the number of people involved.

2. Supply driven

   Contrary to the initial estimation for Belgium, we do not build our model on prostitution demand. We argue that there are convincing reasons concerning data availability and sources of bias that

make a choice for data starting from the supply of prostitution services more attainable and reliable. That is in particular the case for the supply of those services that are more or less publicly observable. Direct observation allows for a significant reduction in estimation error, in particular by avoiding or reducing nonresponse and social desirability bias.

3. Starting from an empirically informed measure of an observable segment in the market for prostitution

   The prostitution market consists of a strongly segmented set of connected markets (Weitzer, 2009). The underground status of the economic activity complicates measurement, but this difficult access to direct measurement is also connected to aspects that differ between segments: geographical dispersion, institutional setup and *governance* are not the same in different segments such as brothels, window prostitution, street hawking, escort and private services.

   Building valid estimates should therefore start at a lower level than a whole nation-state. Our design starts from the best observable segment in Belgian commercial sexual services, that is window prostitution, attempting to measure this segment as completely as possible. Window prostitution has the distinct methodological advantage that it is geographically concentrated in a red light district, and that it therefore is visible and observable. The starting point of our national estimation therefore consists of a detailed measurement of production in the two largest red light districts in Belgium: those of Antwerp and of Brussels.

1.2. Data collection and estimation of ratios

These starting points guide the data collection and analysis process. We make use of a broad set of collected data, based on systematic observations, internet relics and (additionally) secondary analysis of surveys and expert opinions. The data sources are summarized in Table 2.

Most of the data sources will be explained when we deal with the actual estimates. We should say something in general, though, about the internet as a data source. Commercial sex has been an important driver behind the growth in the socio-economic importance of the internet (Döring, 2009). Internet based prostitution has grown strongly the past decade or so, and partly replaced other prostitution segments, certainly in Western countries (Cunningham & Kendall, 2011b, 2011c). For the purpose of this study, we made use of two kinds of internet sources: user-generated content and advertisement sites.

Table 2: Overview of data collected

Nr	Type and source	Goal	Date[4]
I	Internet: www.raamwijzer.nl	Supply in RLD's	Accessed on 9/3/2015
II	Fieldwork: occupancy	Observations of occupancy of windows in RLD's	15/3/2015 - 19/7/2015
III	Fieldwork: transactions	Observations of client turnover: number of transactions per work hour in Antwerp and Brussels RLD's	7/5/2015-10/6/2015
IV	Internet client websites: www.hookers.nl	Price per transaction; relative market share of transactions of each market segment; distribution of the origin of sex workers	27/05/2015
V	Internet FSW[5] advertisements:	Triangulation; comparison with MSW-websites	21-29/5/2015
VI	Internet MSW[6] advertisements	Comparison of MSW with heterosexual websites; price per transaction by MSW	29/05/2015
VIII	*Sexpert* survey, Ghent University	Secondary analysis of the proportion of MSW-prostitution in total consumption	21/04/2015
IX	E-mail contacts with experts	Street prostitution in Brussels and Liège; rate of non-residents in supply; working hours and shifts in RLD's	15/5/2015-25/06/2015

The most important source consists of user-generated content: internet fora where clients asses transactions. Websites of this type mainly are organised in order to allow clients to exchange information. Clients are invited to submit reports to the site on experiences with sex workers they have recently encountered. The report is in a standardized form, and contains detailed information about the sex worker and the services provided: physical attributes, services rendered, location, duration, and the price paid. Researchers have already made use of this type of data, for example from the British Punternet website (Moffatt & Peters, 2004), from The Erotic Review in the US

4 In the case of websites the dates refer to the moment of crawling data from the site.

5 FSW stands for 'female sex workers'. Although there may be some nuances, transgender sex workers are included in this. For practical reasons, we also refer to prostitution supplied by FSW as 'heterosexual prostitution'.

6 MSW stands for 'male sex workers'. These are men, mainly working for male clients.

(Cunningham & Kendall, 2011b; Cunningham & Shah, 2014) and from hookers.nl for Belgium and The Netherlands (Adriaenssens & Hendrickx, 2012).
We made use of the market leader in the Low Countries: the site www.hookers.nl. The sheer quantity of sex workers covered (3 753 in this wave), reviews about transactions (27.854) and the peer control (and control by webmasters) guarantee that the price records are reasonably accurate. Our earlier data covered reviews between 2002 and November 2013. For this research, a new data collection round was organised on the 27th of May 2015.

A second type of internet data comes from advertisements. They have been used elsewhere because of their ability to capture market size and activities (compare Cunningham & Kendall, 2011a). However, one could safely state that advertised prices may differ significantly from actual prices. First of all, one usually advertises prices per hour or per service component, which does not translate linearly into concrete transactions. Also, advertisements may be a less reliable indicator of the transaction price because they are no more than a proposal by the supplier. Finally, information provided in advertisements on personal characteristics are not controlled by peers or clients. Nevertheless, we have also attempted to make use of this type of sites when user-generated alternatives were unavailable (see section IV, page 24).

The estimation strategy is quite straightforward. Most partial estimates consist of simple products of components of production. Specifying confidence intervals, on the other hand, is a bit more complicated. Quite often in social and behavioural sciences, estimations are just combined as an index. This may lead to biased confidence intervals. The problem of confidence limits for ratios has a classic solution, called “Fieller's theorem” (Fieller, 1954; Franz, 2007).

II. Window prostitution

Window prostitution mostly takes place in so-called 'red light districts' in a limited number of cities in Belgium. To our knowledge, red light districts with window prostitution exist in Antwerp, Brussels, Ghent (see Boels, 2014a; Weitzer & Boels, 2015), Liège, Seraing and Ostend. Our criterion to speak of window prostitution includes both the way the service is organized, and the geographical concentration in a club economy (Cameron, 2004). Therefore, some premises organizing window prostitution outside of concentrated areas are excluded: they are not in red light districts, but in rural areas, usually along arterial roads. The output of these latter premises is added to the estimates in the end of this section. In practical terms this means that the estimate for these scattered premises is added after the estimate of all the RLD's has been made.

The red light district of Brussels was treated as though it consisted of two neighbourhoods. The fieldwork indeed showed that the sex workers, clientele and average occupation rates between the windows in the Aarschotstraat / Rue d'Aerschot (Schaarbeek/Schaerbeek) and the premises in Sint-Joost-ten-Node (Saint-Josse-ten-Noode) differ significantly, although they are adjacent to one another. In order to give space to the differences, we decided to treat them as separate RLD's. This way, we ended up with seven districts:

1. Antwerp, Schipperskwartier
2. Brussels, Aarschotstraat / Rue d'Aerschot
3. Brussels, Sint-Joost-ten-Node / Saint-Josse-ten-Noode
4. Ghent
5. Liège
6. Ostend
7. Seraing

Our strategy consists of a simple breakdown of gross output into three elements: the supplied service time by sex workers (measured from the occupancy rate of sex workers per working space), the number of transactions with a client in the same time period and the price per transaction. If we represent these components as E(H), E(T/H) respectively E(P), we can see them as factors that allow us to measure total production in Belgian red light districts according to the following formula:

$$Production\ in\ RLD's = \sum_{\substack{all \\ RLD's}} E(H)E(T/H)E(P)$$

Table 3: Elements of the estimation of production in window prostitution

Element	Source	Number of districts?
1. Number of windows and workers	Desk research; counts of all Belgian areas with window prostitution	7
2. Occupation	Fieldwork in all the Belgian red light districts (*n*=7): in situ counts, throughout the week and the 24-hour cycle	7
3. Transactions	Observational fieldwork (Antwerp and Brussels)	2
4. Price of transactions	Internet client fora. Reports of transactions (*n*=3 569)	7

We start from an estimate of the red light districts of Brussels and Antwerp. These red light districts have received some social-scientific attention as a basis for comparative research (Weitzer, 2013). They are also the largest areas (Loopmans & Van Den Broeck, 2011; Van den Hazel et al., 2008).

In focusing on these two red light districts, we should be able to construct a full-fledged empirically founded estimate of gross output. Data sources are summarized in Table 3. The original fieldwork focusses on observations and counts of the number of premises and windows (point 1), the average occupation of windows (point 2) and of production in a given time period, i.e. clients served (point 3). The average prices of transactions (point 4) are taken from internet data.

2.1. Base observations of occupancy in red light districts

The count of the windows is a check of the available inventories on www.raamwijzer.nl, at least as far as the red light districts of Antwerp, Brussels and Ghent go. The districts of Ostend, Liège and Seraing are not presented on this website or elsewhere. All districts were therefore visited for the first time in order to make an inventory of premises with windows. This allowed us to define the frame of premises to be observed throughout the fieldwork.

The first phase of our fieldwork mainly consisted of observations throughout the 24/7 economy that red light districts represent[7]. In most districts sex workers rent rooms for 12 hour shifts, usually seven days a week. In Antwerp and Brussels and Ghent, the windows are rented for a day shift (6-18 hours),

[7] These observations were a test to control for seasonal variation in supply. The results from these observations are discussed in the next section (page 13).

and for a night shift between 18 and 6 in the morning[8]. Therefore, there is a permanent occupation of rented windows, in theory that is. In reality this is not the case: some windows are (partially) vacant, sex workers sometimes arrive later or stop working during off-hours. The observation thus consisted of regular walks through the districts, surveying the windows for sex workers present and ready to service clients[9]. Between the 15th of March 2015 and the 13th of June 2015, the red light districts of Brussels, Antwerp, Liège, Seraing, Ghent and Ostend have been visited 39 times in total (Table 4). In order to be able to correct for seasonal variation, a follow-up study repeated this operation for Brussels and Antwerp in the course of July 2015.

Table 4: Number and dates of surveys of the red light districts

Red light district	Number of visits	First visit	Final visit
WAVE 1: BASE OBSERVATIONS			
Antwerp	8	15/3/2015	9/4/2015
Brussels	8	15/3/2015	7/4/2015
Ghent	5	20/5/2015	7/6/2015
Liège	5	22/5/2015	13/6/2015
Seraing	5	22/5/2015	13/6/2015
Ostend	8	16/5/2015	17/5/2015
Total wave 1	39	15/3/2015	13/6/2015
WAVE 2: SEASONAL VARIATION CHECK[10]			
Antwerp	4	11/7/2015	16/7/2015
Brussels	4	15/7/2015	19/7/2015
Total wave 2	8	11/7/2015	19/7/2015
General total	47	15/3/2015	13/6/2015

We first estimated the average occupancy in the core red light districts of Brussels and Antwerp. "Average occupancy" means the number of sex workers that are encountered, present behind the window that is, at the moment of observation, compared to the full occupation of all spaces in the

8 E-mail conversation with Ron Weitzer, 18 and 20 June 2015. Apart from being an expert on prostitution and prostitution policies in general. Weitzer did extensive fieldwork on red light districts in general (Weitzer, 2014), and particularly in those of Antwerp, Brussels and Ghent (Weitzer, 2013; Weitzer & Boels, 2015).

9 Occupation was measured with the help of vocal recording, and coding afterwards. In the pre-tests, direct coding with paper met with negative reactions and even downright hostility. Recording with the help of a mobile phone was less recognizable as data collection.

10 Explained in the section 2.2 (page 13).

red light district. The latter was estimated as the maximum number of sex workers ever present in each of the premises. We took care to distribute the observations quite evenly throughout the week and the week-end, and throughout the 24-hour cycle. A z-test for equality of proportions indicates that the occupancy rate between the week and the weekend does not differ significantly. The same test does show a difference in occupancy rate between the day and the night, however, with a higher overall occupancy rate during the night.

These data helped us to estimate the occupancy in all the red light districts, also those that were visited less often. Because there is a significant difference between day and night occupancy, all observations were calibrated with the help of the difference observed in Brussels and Antwerp. This way we were able to estimate average occupancy in every red light district (Table 5).

Table 5: Average occupancy rate per red light district (except for summer months[10])

		Occupancy rate		
	n	Estimate	Lower	Upper
Antwerp	2440	38.9%	37.0%	40.8%
Brussels (Schaarbeek)	1040	42.2%	39.2%	45.2%
Brussels (Saint-Josse)	832	24.4%	21.5%	27.3%
Ghent	537	43.0%	38.8%	47.2%
Liège	280	32.3%	17.5%	47.2%
Ostend	45	50.0%	44.1%	55.9%
Seraing	520	23.5%	19.5%	27.4%
TOTAL	**5694**	**36.6%**	**35.3%**	**37.9%**

Source: Surveys of the RLD's

Finally, these data allowed us to estimate the numbers of hours sex workers are present behind the windows, as presented in Table 6.

Table 6: Estimated hours per week at windows per red light district (except for summer months[10])

		Hours/week		
	Capacity	Estimate	Lower	Upper
Antwerp	305	19 929	18 938	20 920
Brussels (Schaarbeek)	130	9 219	8 563	9 875
Brussels (Saint-Josse)	104	4 263	3 753	4 773
Ghent	109	7 877	7 110	8 644
Liège	9	489	265	713
Ostend	35	2 940	2 596	3 284
Seraing	104	4 099	3 415	4 783
TOTAL	**5694**	**48 816**	**47 114**	**50 518**

Source: Surveys of the RLD's

It is obvious that in terms of the number of hours that sex workers are available for service, Antwerp is by far the largest red light district (also if both Brussels parts are summed up). Also, Brussels and Antwerp together make up two thirds of the total supply of windows sex workers' hours in Belgium.

2.2. Correction for decreased occupancy in summer

One objection against the data collected is that the observations were organised in a limited period between March and June 2015. In the case that significant seasonal variation might occur throughout the year, they cannot be captured with the data collected. The most serious candidate for a supply change probably is summer. Therefore, we controlled seasonal variation during the month of July with the help of a number of repeated observations in Brussels and Antwerp. Eight counts were organised in the time period of 11-19 July 2015. The observations were at the same time and day of the week as in the phase 1 observations. This allows for a controlled comparison between both seasons.

A fixed-effects regression (at the level of premises) indeed shows that there is a sizeable seasonal effect: supply is only slightly higher than half of the average occupation in the phase 1-observations (51.06%). We assume that the July observations can be generalized to the whole of the months of July and August. We also apply the estimated decrease in supply during the months of July and August to the other RLD's in Belgium. The only exception, where a decrease in supply is the seaside town of Ostend (due to the increased inflow of tourists in this season).

2.3. Observation of transactions

The most complicated and costly data collection was set up with the goal of estimating reliably the number of services provided within a given time period in each district. Direct observation of transactions during longer periods proved unsafe for the fieldworkers, and interfered quite a lot with normal business. For instance, if traffic is a bit quieter, clients seem to be scared away from time to time if a bystander is hanging about. This tends to trigger negative reactions by sex workers or madams, causing further disturbance. Because of these safety and interference issues, we decided to record a limited sample of windows during periods of 24 hours or longer. The recorded images were stored locally for a short period. After coding, the images were definitively deleted. The coding contains arrival and leaving times of clients throughout the 24-hour periods, and the presence of the sex worker at the premise.

Recordings differed between the Antwerp and Brussels situation, due to locations. The Antwerp observations were from a neighbouring building, allowing us to have an overview of several premises (three premises with a total theoretical capacity of 13 in the first round; two premises with a total capacity of 6 in the second) and for longer periods (88 hours and 48 hours respectively). In Brussels the observation was much more difficult. Observations were made from a car, which restricted observations to periods of more or less 24 hours, due to the obligation to rely on batteries and due to parking regulations. The observations only covered one premise. Also, the limited number of observations forced us to focus on the largest part of the Brussels red light district in Schaarbeek Aarschotstraat / Rue d'Aerschot, adjacent to the railroad tracks. Because of the differences, and because of the paucity of data of transactions in Brussels, we decided to pool the transaction data.

The data were organised in a way that was inspired by an earlier research, estimating income from begging (Adriaenssens & Hendrickx, 2011). There the data documenting the frequency of receiving alms was organised according to the time needed to get an extra gift. Here we mimicked this design by distributing the observation in more or less equal parts of around 3 hours. We recorded the number of clients that initiated a transaction in this period, and recorded the total number of working hours in the period. This resulted in an estimate of the number of transactions per working hour. This is $\mu_{1,}$ which was directly estimated from our data (see Table 7).

The first phase of direct observations in the red light districts, however, was only able to measure occupancy rates behind the windows. Our estimation therefore should mimic the observations of this first phase, so that these results can be matched to the rates of the previous sections (2.1 and 2.2).

We therefore need to exclude those working hours when sex workers service a client, or are not presenting themselves publicly for other reasons. This finally leads to an estimate of the number of transactions in relation to the number of hours of visible work behind the windows (μ_2). In order to transform μ_1 into μ_2, we proceeded as follows.

Suppose there are h working hours in a fixed time period (say a day), then the number of transactions in this period equals $h \cdot \mu_1$. We presume that the time needed to service a client is t (included the time to take a break after the transaction [11]). In our observations, t equals 25 minutes. In that case the total time sex workers are visibly working behind the window equals

$$h - t \cdot h \cdot \mu_1 = h\,(1 - t \cdot \mu_1).$$

This boils down to the total number of working hours, minus the time one works providing services to a client or taking a break. Therefore, the number of transactions per visible hour is

$$h \cdot \mu_1 / h\,(1 - t \cdot \mu_1) = \mu_1 / (1 - t \cdot \mu_1).$$

This finally leads to

$$\mu_2 = \mu_1 / (1 - t \cdot \mu_1)$$

As $\mu_1 / (1 - t \cdot \mu_1)$ is an increasing function in μ_1, we can transform a confidence interval for μ_1 immediately into a confidence interval for μ_2. The estimation of these data results in the estimations in Table 7.

Table 7: Estimates of clients per work hour and per hour visible for clients

	Average	95% Lower	95% Upper
Average number of clients per work hour (μ_1)	0.69	0.60	0.78
Average number of clients per hour visible for clients(μ_2)	0.96	0.79	1.15

Source: Observations of transactions in Antwerp and Brussels

The standard error has also been determined with the help of the transformation

$$\mu_2 = g(\mu_1) = \mu_1/(1 - t \cdot \mu_1).$$

So, if we have an estimate x for μ_1, we will find an estimate y for μ_2 through the same transformation: $y = g(x)$. The standard error SE(y) can also be calculated from the standard error SE(x) with the formula

$$\mathrm{SE}(y) = \mathrm{SE}(x)/(h'(y)),$$

where h is the inverse function of g, and h' is the first derivative from it.

[11] The observations in Brussels allowed for a qualitative estimation of these breaks, and the coders agreed that five minutes on average was a realistic estimate.

If $g(x) = x/(1-t\cdot x)$, then the inverse function $h(y) = y/(1+t\cdot y)$ and the derivative is $h'(y)=1/(1+t\cdot y)^2$, which results in

$$SE(y) = SE(X)\cdot(1+t\cdot y)^2.$$

This allows us to estimate the number of transactions in window prostitution . In Table 8 these final estimates are presented. These final estimates take the seasonal correction as discussed in section 2.2 into account.

Table 8: Estimated transactions per year in window prostitution

	Estimate	Lower 95%	Upper 95%
Antwerp	915 370	757 890	1 072 850
Brussels (Schaarbeek)	423 443	347 984	498 903
Brussels (Saint-Josse)	195 806	156 896	234 716
Ghent	361 814	293 690	429 937
Liège	22 456	12 334	32 578
Ostend	147 281	120 209	174 354
Seraing	188 285	145 842	230 728
Other	36 055	32 885	39 224
TOTAL	**2 290 511**	**2 092 279**	**2 488 742**

2.4. Price per transaction

Finally, the average prices per transaction are based on data crawled from hookers.nl, as explained in the data section (page 6). We now also estimate a residual category of window prostitution premises in rural areas or along arterial roads. This is the only category that has significantly higher transaction prices than the average. This may be due to a more elaborate service provided, which makes this type of premise more akin to brothels. The less intense competition due to lower spatial clustering, is assumed to have a price effect too. Finally, the Brussels red light district in Saint-Josse, as expected, yields significantly lower returns per transaction than the average. The estimated prices are presented in Table 9.

Table 9: Average price per transaction in window prostitution

	Sample size	Mean	Lower 95%	Upper 95%
Antwerp	2 446	68.25	66.25	70.24
Brussels (Schaarbeek)	342	61.79	58.67	64.90
Brussels (Saint-Josse)	129	41.78	38.38	45.19
Ghent	561	63.02	59.61	66.44
Liège	36	81.39	54.23	108.54
Ostend	37	60.89	45.48	76.31
Seraing	37	60.89	45.48	76.31
Other	45	121.44	95.52	147.37
TOTAL	3 596	66.59	65.01	68.16

2.5. Combined estimate for window prostitution

The generalisation of the estimate assumes that the average number of transactions in a given time applies to districts outside of Antwerp and Brussels too (as discussed in 2.3, page 16). Also, the measure of the scattered window prostitution premises, has been estimated with the methodology developed in the next section (section III, page 19).

Table 10: Estimates of yearly transactions and revenues in window prostitution (2015)

	Transactions per year			**Revenue per year**		
	Mean	**Lower**	**Upper**	**Mean**	**Lower**	**Upper**
Antwerp	915 370	757 890	1 072 850	62 469 729	51 567 894	73 371 563
Brussels (Schaarbeek)	423 443	347 984	498 903	26 163 096	21 317 617	31 008 575
Brussels (Saint-Josse)	195 806	156 896	234 716	8 181 365	6 425 448	9 937 282
Ghent	361 814	293 690	429 937	22 801 994	18 333 582	27 270 406
Ostend	22 456	12 334	32 578	11 987 047	7 526 720	16 447 375
Liège	147 281	120 209	174 354	1 367 391	661 919	2 072 862
Seraing	188 285	145 842	230 728	11 465 045	7 637 555	15 292 535
Other	36 055	32 885	39 224	4 378 624	3 390 684	5 366 564
Total	**2 290 511**	**2 092 279**	**2 488 742**	**148 814 291**	**134 622 866**	**163 005 715**

Overall the segment of window prostitution represents an estimated gross output of 161 million €. The largest red light district of Antwerp represents almost half of the gross output of the whole sector.

III. Generalization to heterosexual prostitution

In the previous section we estimated the production in window prostitution in Belgium. This estimate is built, to a large extent, on observed quantities. However, other segments than window prostitution are harder to observe. It is impossible to map them in the way window prostitution has been approached. Moreover, there are good reasons to accept the idea that other segments have grown in importance. Internet based services have grown during the past decade or so, and they partly replaced other prostitution segments. A US study supports the view that the internet both fostered growth and displacement (Cunningham & Kendall, 2011b, 2011c). Escort and private services (in apartments that are not openly recognizable as such) therefore now probably have become important segments in total production, while the relative weight of street prostitution is quite limited and probably has diminished significantly.

The central goal in this section is to estimate the relative size of segments that were not covered in relation to the known segment of window prostitution. This way we can infer estimates for other female sex workers' segments than window prostitution[12]. As far as Belgium goes, these other segments (apart from window prostitution) are mainly the following: street prostitution, brothels and brothel-like organizations (mainly clubs and massage parlours), private prostitution (usually from an apartment) and escort services. As indicated, the transaction costs of the latter two have strongly decreased under the influence of new communication technologies.

The expected total production per segment is the expected number of transactions $E(T)$ in a given segment multiplied by the average price per transaction $E(P)$ in that segment. The total production can thus be written as

$$E(FSW\ Production) = \sum_{\substack{all \\ segments}} E(T)E(P)$$

[12] For methodological reasons, the market in which male sex workers provide commercial sexual services, is dealt with in the next section (section IV, page 22).

We cannot directly measure the first factor: the number of transactions is unknown, and cannot directly be observed. Therefore, we will estimate *E(T)* with the help of a relative measure. This approach has some similarity with the approach of Dank et al (2014), who used this logic to distinguish between underground activities in different sectors. For instance, for brothel prostitution this would mean:

$$T_{brothels} = \frac{T_{brothels}}{T_{windows}} T_{windows}$$

$$E(T_{brothels}) = \pi_{brothels} E(T_{windows})$$

For female sex workers, we propose to estimate market shares of transactions with the help of indicators from the internet. We build an estimate with three types of indicators derived from the internet discussions on the website www.hookers.nl. This is the website that comprehensively covers mainstream prostitution scenes in Belgium, as argued earlier. The coverage of prostitution supply by hookers.nl, was tested by a comparison with websites that advertise prostitution businesses (mainly clubs and brothels on www.redlights.be). Hookers.nl covered all the establishments documented elsewhere, and had other establishments on top.

In short, the website www.hookers.nl covers the main segments of the prostitution market fairly well. The following question is which indicator(s) are able to infer **segment shares of transactions**. Three proxies provide indications of the relative weight of each segment: the number of review forms submitted, the number of text-based discussions on a particular sex worker and the number of page views.

Clients are asked to post a review when they have visited a sex worker (a more detailed discussion in Adriaenssens & Hendrickx, 2012). These reviews are standardized questionnaire-like forms which allow clients to provide detailed information about the services provided, price, duration of the visit, and satisfaction rates for a number of the services. The indicator consists of a count of the number of reviews that were posted by clients on a given sex worker.

Second, there are the text-based discussions. Clients make contributions to ongoing debates on a particular sex worker. These are each time counted as a unique contribution, and somehow reflect the attention sex workers get from clients who are actively contributing.

The final indicator counts the page views (or page impressions) of a sex worker. This may reflect attention from average clients, and does not limit itself to clients active on the web page.

The distribution of these three indicators is presented in Table 11.

Table 11: Proportion of reviews, discussions and page views per segment

	Reviews	Discussions	Page views
Window prostitution	33.3%	27.4%	24.8%
Street prostitution	0.4%	0.4%	0.5%
Clubs and brothels	13.2%	13.9%	11.7%
Massage parlours	18.2%	17.4%	16.6%
Escort and private	35.0%	40.9%	46.4%
Observations (n)	10 665	27 854	36 033 459

Source: www.hookers.nl

These indicators do not necessarily reflect the number of sex workers involved in each section, because the average working time and the average working time per transaction may differ. For instance, in windows and street prostitution sex workers need to invest considerable working time before they service a client, while this is supposed to be much less the case in escort prostitution. The goal is, however, to capture the relative weight of sexual commercial transactions in a given segment taking place, not the number of workers or total working time.

The question is whether these three indicators represent the same latent variable of transactions, and whether they do so in a reliable way. The internal consistency of a potential common measure would be highly consistent, with a Cronbach α of 0.945 (standardized scores). A principal components analysis (sometimes referred to as factor analysis) shows that the first common factor explains 88% of the total variance. Each variable correlates highly and quite evenly with this component (communalities are 0.93, 0.95 and 0.94). Because the scores load almost identically for each variable (factor scores are 0.35, 0.36 and 0.36), we decided to work with the average of the standardized variable scores.

The estimation strategy of the market shares and their confidence intervals boils down to an attempt to estimate the population parameter $(\pi_1+ \pi_2+ \pi_3)/3$ (the average of the fraction). π_1 (respectively π_2, π_3) represent the population fraction of review forms (respectively discussions and page impressions). This is estimated by $(P_1+P_2+P_3)/3$, that is to say the average of the sample fractions.
The calculation of the confidence interval necessitates an estimate of the standard deviation of this estimator (i.e. the standard error). If P_1, P_2 and P_3 were independent, the variance of this estimator would be:

$$\mathrm{Var}((P_1+P_2+P_3)/3) = (1/9)\,(\mathrm{Var}(P_1) + \mathrm{Var}(P_2) + \mathrm{Var}(P_3)) = (1/9)\,(\pi_1(1- \pi_1)/n_1 + \pi_2(1- \pi_2)/n_2 + \pi_3(1- \pi_3)/n_3),$$

π_1, $\pi_2$and π_3 are estimated once again by P_1, P_2 and P_3.

However, our estimate does not meet the requirement of independence: P_1, P_2 and P_3 are effectively strongly correlated, as shown in the earlier discussion. Therefore, the earlier formula is to be adapted, taking the covariances into account. The formula then becomes:

$$\mathrm{Var}((P_1+P_2+P_3)/3) = (1/9)\,(\mathrm{Var}(P_1) + \mathrm{Var}(P_2) + \mathrm{Var}(P_3) + 2\,\mathrm{Cov}(P_1,P_2) + 2\,\mathrm{Cov}(P_1,P_3) + 2\,\mathrm{Cov}(P_2,P_3))$$

To estimate the covariances, we take into account that the maximum correlation is 1. This conservative strategy prevents an underestimation of the margins of error. This means that

$$\mathrm{Cov}(P_1,P_2) \leq \sqrt{(\pi_1(1-\pi_1)\pi_2(1-\pi_2)/(n_1 n_2))}$$

This estimation is presented in Table 12.

Table 12: Corrected scores for mean market share per sector, three population parameters (perfect correlation assumed)

	%	Relative to windows prostitution	SE	95% confidence interval	
				Lower	Upper
Windows	**29.9%**	100.0%	0.245	29.4%	30.4%
Street prostitution	**0.9%**	2.9%	0.067	0.75%	1.01%
Clubs and brothels	**11.4%**	38.0%	0.173	11.0%	11.7%
Massage parlours	**15.9%**	53.2%	0.196	15.5%	16.3%
Escort and private	**42.0%**	140.4%	0.255	41.5%	42.5%

We attempted to triangulate these results with other sources. The problem is that only a few sources provide information about more than one segment. Anecdotal evidence indicates that the segment of street prostitution is significantly underestimated. For instance, Kristin Gillis, a researcher involved in ethnographic fieldwork in the street prostitution zone around the 'Alhambra district' in Brussels, counted some 20 to 35 sex workers during the day[13]. This is a high number in comparison to the counts of reports in the same area in hookers.nl. Also, there is some street prostitution in Liège: Espace P reports having had contact with 70 to 90 sex workers[14]. From these indications we inferred that street prostitution is underestimated. We therefore doubled the relative weight of this segment in the total estimated transactions.

[13] Conversations with Kristin Gillis, University of Antwerp, 15/5/2015, 16/6/2015 (e-mail) and 17/6/2015 (interview).

[14] E-mail conversation with Espace P, Liège on 20 and 21 May 2015.

The **transaction prices** were estimated building on the same source and according to the same method as described in the section on window prostitution. This allows us to build quite consistent price estimations.

Table 13: Average price per transaction in heterosexual prostitution segments

	Sample size	Mean	Lower 95%	Upper 95%
Street prostitution	42	**80.90**	62.78	99.03
Clubs and private houses	1399	**103.98**	101.51	106.45
Massage parlours	1797	**97.90**	96.00	99.80
Escort and private	3793	**148.12**	145.12	151.12

The combination of the relative size of transactions in each segment as compared to the reference segment of window prostitution with the average price per segment, allows us to estimate the total revenue of heterosexual prostitution per segment in Belgium. This is presented in Table 14.

Table 14: Estimates of yearly revenues in heterosexual prostitution (2015)

	Mean	Lower 95%	Upper 95%
Window prostitution	148 814 291	134 622 866	163 005 715
Street prostitution	5 457 692	4 179 585	6 735 799
Clubs and private houses	90 572 622	82 444 850	98 700 393
Massage parlours	119 387 960	108 798 967	129 976 954
Escort and private	476 266 121	433 933 601	518 598 642
Total	**840 498 687**	**793 880 452**	**887 116 922**

Due to high average prices and a high market share in transactions, escort and private prostitution make up for more than half of the gross output. Prostitution in establishments such as brothels or massage parlours brings in more economic weight than window prostitution. As expected, street prostitution, even after correction, represents only a small fraction of total gross output.

IV. Incrementing estimates for male sex work

A notable yet quite distinct market for prostitution is that of male sex workers (MSW): men supplying sexual services to other men in return for money. Some guess that MSW make up for 10% of the prostitutes globally (Scott, Callander, & Minichiello, 2014); the only existing estimate for Belgium estimates that 5% of sex workers are male (Brussa, 2009). The same report estimates that for all the 26 European countries covered in the report, 6% of the sex workers are males. For purposes of practicality, we refer to this market as a market of 'male sex workers', meaning that suppliers here are marketing themselves as males[15].

Male sex work is "markedly different from its female counterpart" (Logan, 2010) in more than one dimension: the clientele differs, marketing and services differ, and it usually is geographically separated from the prostitution by female sex workers. At the level of scholars and research, there also seems to exist a quite strong division of labour, leading to few studies comparing both markets explicitly (Weitzer, 2005), leaving aside exceptions (e.g. Castle & Lee, 2008; Koken, Bimbi, & Parsons, 2010). This may be why none of the reviewed attempts to estimate production in prostitution has taken male sex work into account. We assume that the cited numbers, however tentative they may be, legitimate our making a serious attempt to estimate the size of MSW-prostitution too.

The first approach towards estimating the market of male sex workers, was to measure the demand for male prostitution in relation to that of female supply with the help of a survey of the general population. The ratio of the demand for commercial sex supplied by males as compared to females could have allowed us to estimate the relative demand for male prostitution. The only recent survey that has items that are specific enough, is the so-called 'Sexpert' survey on sexual behaviour and sexual health in the Dutch speaking part of Belgium (Buysse et al., 2014). Respondents who admitted having purchased sex in prostitution at least once in their lives, were then asked how often this had happened in the past 6 months[16]. Respondents who admitted to prostitution consumption in the past 6 months, were then asked about the gender of the sex worker[17]. Responses are summarized in Table 15. Because of the absence of self-reported MSW-prostitution, this survey cannot help us to estimate the size of the male sex worker market. It is obvious that the market exists, so alternative approaches were necessary in order to estimate its size.

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15 Concurrently virtually all clients are male too, although some anecdotal evidence suggests that the proportion of female clients is on the rise (Scott et al., 2014).

16 Exact wording:
"Hoe vaak ben je in je leven naar een prostitué(e) geweest?"
"Hoe vaak ben je in de afgelopen zes maanden naar een prostitué(e) geweest?"

17 Wording: "Was dat toen met (1) een jongen/man, (2) een meisje/vrouw, (3) andere?".

Table 15: Response to the prostitution items in the Sexpert survey (2011)

Item	%	n (n valid)
Visited sex worker at least once	11.7	101 (862)
Visited sex worker past 6 months (if ever visited)	24.1	26 (108)
Visited a male sex worker	0%	0 (10)

Source: Sexpert survey, Ghent University[18]

To our knowledge no user-generated web content exists that might mimic the existing heterosexual prostitution resources. An alternative approach consists of the construction of a proxy of the relative size of the advertisements found from male sex workers versus those of female sex workers. Basically we attempted to mimic the approach of heterosexual prostitution segments with a different type of data. Instead of transaction reports, we attempted to estimate the proportion of advertisements (reflecting relics of sex workers). This did not work very well, because the ratio seemed to be strongly dependent on the advertisement site used.

Table 16: Proportion of male sex workers in advertisement sites

Website	Sex workers (n)	% male sex workers
www.redlights.be	3 298	23.01%
www.kinky.be	228	19.58%
www.girls4ube & www.boys4u.be	422	53.79%
Overall average	3 948	26.17%

Also, we do not have any objective test to isolate output of male sex workers. Therefore, the risk is quite high of overestimating the size of the MSW-market in relation to the heterosexual market if one can, only fall back on numbers of advertising sex workers. In the UK some indications were reported that male prostitution advertisements hardly receive any attention in views and client reviews (Import IO, 2014a). This suggests that the number of transactions an average MSW attracts, is lower than that of an average FSW. We therefore decided to increment the heterosexual prostitution transactions with 5% as a rough estimate of the market share of MSW. This probably is a conservative approach, bordering on the lowest estimate of numbers of sex workers available (Brussa, 2009).

[18] Thanks to Katrien Symons (Ghent University) for providing the results.

Price is not measured in the same way as in the case of heterosexual prostitution: no known websites exist that deliver this type of direct price measures. Therefore we need a detour to estimate transaction prices in MSW-prostitution. We took a random sample of advertised prices in a commercial websites that allow for a good comparison: www.boys4u.be versus www.girls4u.be. The average advertised price per hour in the MSW-market is 107.1 € (n=213), and 145.7 € in the FSW-market (n=201). The average advertised hourly price for MSW is thus 73.5% of FSW. Because advertisements often do not reflect consumed transactions, but rather price per hour or per service, it is not possible to deduce the average price of a transaction from that. Also, advertised prices may be biased in relation to the real agreed prices. Therefore, we estimate an average price per transaction by imputing the ratio of 73.5% to transaction prices measured in FSW markets.

Table 17: Estimated transactions, average price and revenue of MSW and overall (2015)

	Mean	Lower 95%	Upper 95%
MSW: Transactions	383 199	350 035	416 363
MSW: Price	77.76	76.71	78.81
MSW: revenue per year	29 798 164	27 187 858	32 408 471
Total output (FSW+ MSW)	**870 296 851**	**823 605 594**	**916 988 109**

V. Intermediate consumption

Sex workers incur costs in order to gain their income. They spend on items such as rent for windows, purchases of clothing, and condoms. There seems to be a quite general agreement that intermediate consumption amounts to 20 percent of gross output (Blades, 2011; Kazemier et al., 2013). Costs paid to intermediaries in the prostitution market are not considered to be intermediate consumption, as we assume that these payments are underground too, and are part of the prostitution sector.

We assume that the lion's share of intermediate consumption will be spent on accommodation. We have some indications for the cost for renting windows. Boels reports a cost of 100 to 150 € per shift (Boels, 2014b)[19]. For Antwerp, there are reports of 100 €, and for Brussels 200 € (Weitzer & Boels, 2015, footnote 3). A rough estimate learns us that these costs alone may make up for almost one fifth of the overall income generated in windows prostitution. This estimate makes us assume that the overall estimate of 20% for the whole market is not exaggerated. Therefore we adopted this standard in our estimates too, as shown in the final consolidated estimate.

[19] Conversation by e-mail with Dominique Boels, Ghent University, 18 June 2015. Dominique Boels did extensive fieldwork in the red light district of Ghent (e.g. Boels, 2014a, 2014b; Weitzer & Boels, 2015).

VI. Non-resident production

Migration in Europe has changed fundamentally, both in quality and quantity, since the collapse of the central-European communist regimes. In the decade between 1985 and 1995, migration stocks in Europe not only doubled (Lowell, 2007), but it also became mainly an inter-European affair. These recent migration waves introduced a pattern of short-term movements of migration (Morokvasic, 2004), in periods ranging from a few weeks to a year or two. This new form of migration introduced some sort of seasonal commuting.

This general shift is reproduced in prostitution, where migration already played a crucial role before the recent migration changes. A recurring characteristic of prostitution in developed societies is that supply is often extremely mobile. The most recent TAMPEP study estimates that more or less half of the sex workers are migrants (Brussa, 2009, p. 15); of this migrant group 71% have worked in more than one country. In Brussels (Van den Hazel et al., 2008, p. 32) and Antwerp (Siegel, 2012), studies indicate that the supply of especially Bulgarian and (to a lesser extent) Romanian sex workers has increased considerably in the past decade or so. The TAMPEP report estimates that 60% of the female Belgian sex workers are migrants (Annex 3, p. 29).

The national accounts need to take this short-term migration into account, because services provided by sex workers who reside less than a year in Belgium, are registered as import rather than production. The question thus is, whether and how often migrant sex workers are non-residents. Research based on interviews with 82 Bulgarian women working in prostitution markets abroad showed that three quarters (76%) had only been working in one country (Petrunov, 2010, p. 33). This suggests that short-term mobility may be lower than some suggest.

We assume that this type of short-term commuting for the purposes of prostitution, is typically done by central-European groups, and not by other migrants. In order to estimate the share of non-resident sex workers, we first attempt to find the proportion of supply from Central-Europe. This is achieved by the indication given by clients on hookers.nl, who provide a rough indication of the country of origin of the sex worker. “Central-European” is one of the categories. We estimated the proportion of Central-European sex workers for each segment, based on the client reports (Table 18).

In order to estimate output by non-residents, we need to know how many of these Central-European sex workers are non-resident. Because no precise data are available, we fall back on an expert

opinion of Georgi Petrunov[20]: "(…) we should not underestimate the fact that there are Bulgarian women who travel and work with short visits for several months and after that they go back. If I have to give an expert opinion, I will say that 1/3 from the Bulgarian sex workers live less than a year in Belgium."[21] This starting point of a non-resident proportion of one third is generalized to the whole Central-European population. As no other groups are susceptible to this commuting type of prostitution supply (based on the available reports), the other migrant categories are assumed to be residents[22]. We apply this estimate to the FSW-population only. Also, equal output levels are assumed for residents and non-residents.

The effects of these starting points on the ascription of output to non-resident production is shown in Table 18.

Table 18: Proportion of Central-European sex workers and estimated non-residents

		Central-Europeans			Non-residents		
	n	%	Lower	Upper	%	Lower	Upper
Window prostitution	3578	52,9%	51,3%	54,6%	17,6%	17,1%	18,2%
Street prostitution	40	37,5%	22,5%	52,5%	12,5%	7,5%	17,5%
Clubs & private houses	1364	22,3%	20,1%	24,5%	7,4%	6,7%	8,2%
Massage parlours	1772	12,8%	11,3%	14,4%	4,3%	3,8%	4,8%
Escort & Private	3725	9,4%	8,5%	10,3%	3,1%	2,8%	3,4%
Total	**10479**	**26,6%**	**25,8%**	**27,5%**	**8,9%**	**8,6%**	**9,2%**

Source: hookers.nl, expert opinion

20 The expertise of Petrunov on underground economic activities in Bulgaria is widely recognised (see e.g. Petrunov, 2006, 2011, 2014)

21 Conversation with G. Petrunov by e-mail on 24 and 25 June 2015.

22 Of course this is a purely factual state of affairs. This assumption does not presume anything about the migration status (see also Adriaenssens et al., 2009).

VII. Consolidated estimate

The elements discussed and elaborated in sections II to VI, are the basis for a consolidated estimate of prostitution production in Belgium in 2015. We present these final estimates in Table 19.

Table 19: Aggregates for production in prostitution (2015)

	Estimate	Lower 95%	Upper 95%
Total output	870 296 851	823 605 594	916 988 109
Of which import (non-residents)	53 683 684	50 747 229	56 620 138
Intermediate consumption	163 322 633	154 402 200	172 243 067
Value added	653 290 534	617 608 800	688 972 268

Added value in the former estimate by the institute of national accounts was 305 million € (for 2010), less than half of the lower bound of the new estimate (Acx, 2014, p. 71). At the same time the new estimate of import (output by non-residents) is in line with the estimate of last year.

Annex: Overview of earlier estimates

Table 20: Overview of countries reporting estimates of prostitution (in United Nations, 2008)

Country	Comment	Estimation basis
Croatia (p. 81)	Experts estimate the total number of prostitutes (700–1000), number of active days (5-6 services per day - 70% full time working 250 days, 30% moonlighters working 100 days), and average prices (500 HRK on average). Intermediate costs (clothes, accommodation and other expenses) are estimated at 20% of total receipt.	Experts
Czech Republic (p. 96)	Three studies, among which a telephone survey on home-based prostitution. Result: an estimated 6300 persons involved in sex work with an average daily income of 2500 CZK. Breakdown of customers according to experts: 65 percent non-residents. Overall costs (based on experts?): 20% intermediate consumption.	Direct supply, experts
Estonia (p. 115)	The estimation builds on "the supply side based on the number of brothel-clubs and rented apartments". No further specification as how the average price of services, the number of services per day per brothel and the number of brothel-clubs and apartment-brothels are measured.	Supply side
Hungary (p. 133)	Quite vague: "Estimations are made by the NA department. In the case of prostitution, according to the estimates, about 25 per cent of GVA is already included in the official GDP data. The work on the estimation of illegal activities started recently and is made independently from other non-exhaustiveness adjustments."	Not provided
Latvia (p. 174)	"Output of prostitution is calculated in a simple way using information from the police about average number of persons working as prostitutes and their likely earnings from this activity."	Police records
Poland (pp. 226-7)	Estimate is based on "newspapers, media and police reports". Any other explanation is lacking.	Police records, media
Serbia (p. 273)	Based on data by "research journalists", providing data on prices per services, total number of prostitutes (7000) and monthly earnings. Results are provided by the Ministry of the Interior. Estimation of 20% intermediate costs.	Media
Sweden (p. 284)	In the spring of 20005, experimental calculations have been made for prostitution, drugs, and smuggling of alcohol and tobacco. No specific information about the estimation of prostitution.	Not provided

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