Umeå University

This is a submitted version of a paper published in *Leonardo*.

Citation for the published paper:

Holme, P. (2012)

"Social, sexual and economic networks of prostitution"

Leonardo, 45(1): 80-81

URL: http://dx.doi.org/10.1162/LEON_a_00342

Access to the published version may require subscription.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-51581>

<http://umu.diva-portal.org>

SOCIAL, SEXUAL AND ECONOMIC NETWORKS OF PROSTITUTION

Petter Holme, Department of Physics, Umeå University, 90187 Umeå, Sweden, and Department of Sociology, Stockholm University, 10691 Stockholm, Sweden. E-mail: <petter.holme@physics.umu.se>.

Submitted: October 24, 2010

Abstract

This article discusses the networks of prostitution, in particular those that can be extracted from online data, and what they can teach us about prostitution itself, disease spreading, cultural differences and a broader spectrum of socio-economical phenomena.

Prostitution is a peculiar socio-economic phenomenon. It has rarely been socially accepted, often outlawed and even purged; still it exists in almost all countries of the world, and has done so since time immemorial [1]. It is female dominated, labor intensive, requires little education, and still it is fairly well paid (contradicting standard theories of labor economics) [2]. Furthermore, sex-buyers are to a great majority male, but other than that, they have few properties in common. They come from different age classes, professions and ethnicities to a remarkable uniformity [3]. These examples illustrate the special nature of prostitution as an economic system. Add the strong cultural-dependent norms towards it, a diversity of legal statuses around the planet and an unusual age-wage curve of prostitutes (plateauing around 30–40 years to decrease for older sex sellers) [4] and one may wonder if prostitution can tell us anything about society at large? Or, is it an isolated system with a unique set of rules and mechanisms? We argue that, even though most research questions about commercial sex are rather specific, it is a system that can teach us something more general about network-economic systems of the future.

Buying sex could be a substantial investment for the customer, and it comes with the risk of being disappointed and even scammed. This should be incentive enough for the sex-buyers to share their experiences. Banished from the mass-medial channels of consumer advice, the information flow organizing prostitution is more lateral than mass-medial in nature. In other words, the information spreads to a large extent between the sex-buyers over their social network. Sometimes, this information sharing

takes place online in Internet forums and bulletin boards. This is a phenomenon older than the World-Wide Web—for example, in the 1980’s the Usenet group alt.sex.services (later alt.sex.prostitution) featured sex-sellers advertising their services and sex-buyers discussing them. These online channels offer new opportunities for researchers as data sources for high-throughput social science. Edlund, Engelberg and Parsons [4], and Cunningham and Kendall [5] have studied American media for exchanging information about escorts (high-end prostitutes) and Rocha, Liljeros and Holme [6] have studied a similar Brazilian dataset. These three studies take very different angles on the Internet-mediated sex market. The first paper discusses labor-economic aspects of the Internet for the escort business, the second addresses the potentially increasing indirect importance of the Internet for the spreading of sexually transmitted infections, and the third investigates the information dynamics itself and feedback effects from the information sharing between the sex-buyers to the economic success¹ and experience of the escorts and back to the information sharing. Data-driven studies of Internet-mediated prostitution seem to be an emergent interdisciplinary field.

Rocha, Liljeros and Holme [6] investigated 50,185 posts at a Brazilian Web forum, each one corresponding to an encounter between a sex-buyer and an escort. The posts were organized into threads, one for each sex-seller, and all openly visible on the Internet without logging in. From these posts, in the HTML format, the authors constructed a temporal network, probably the largest record of claimed sexual contacts where the explicit network structure is known. Apart from who bought sex from whom, the posts also contain a rating (into three categories: good, average, bad) and three categories of services performed: kiss on mouth, anal sex and oral sex without condom. To obscure their identities, both the sex-buyer and escorts use nicknames. This is a potential problem for the data quality (can we be sure one user actually correspond to one individual?), but perhaps not so severe as one might fear. It is of course in the sex-buyers best interest that an escort is identifiable. When an escort changes nickname, which do happen (to e.g. get a fresh start without the

old bad reviews), the forum curators merge the threads of different names of the same escort. For the sex-buyers, there is no such community control. On the other hand, it seems like they do not know the off-line identity of other members, so there is probably no substantial incentive for changing identity. It is hard, maybe impossible, to actually measure how many erroneous posts there are in this system. This is perhaps the largest general problem with data-driven, high-throughput methods relying on self-reported human activities. Even in surveys where the interviewees are asked direct questions, the accuracy of their answers can be surprisingly low [7], and in online data we often study indirect questions, which adds another layer of complications. In practice, focusing on medians or averages, rather than extremal, values is, at least to some extent, a way to circumvent the data quality problem. In general, one needs to focus on quantities that are only weakly affected by statistical problems.

One of the findings in Ref. [6] is that there is a broad distribution of economic success of the escorts and that this can partly be explained by a feedback loop. The authors note that there is a positive correlation between the average grade over a period of time, and the future rate of new customers. The reverse is also true: the expected future grade is higher the more experience the escort has. These correlations can be explained by a distribution of skills, and the less skilled escorts exiting the escort business sooner than the more skilled.² However, considering escorts of a specific total number of contacts, the expected rate of new contacts are increasing with time. This, together with the correlations above, suggests a feedback between on-line information spreading and an off-line economic activity that is likely to exist in other socioeconomic systems too. Large-scale data for such network-economic systems is scarce. Perhaps Internet-mediated prostitution is a suitable model system to study emergent properties of socioeconomic feedback. With the increasing presence of Web2.0 applications spreading information between buyers, this lateral economy may increase in importance, and the analogy to Internet-mediated prostitution would increase with it.

¹ “Success” and other words in this section feel cynical, given that prostitutes are a marginalized and stigmatized group in society, but are intended as analogies to economy.

² In her *The Wisdom of Whores*, Elizabeth Pisani tells a story of transsexual street prostitutes from Indonesia where they themselves are aware of a broad distribution of economic success and attributes that to differences in attractiveness [8].

Sexually transmitted infections (STIs) spread over sexual networks. The wiring of the network affect the dynamics of the spreading process—if, for example, promiscuous people and those with fewer partners primarily have sex with others like themselves, so called assortative mixing [9], then outbreaks happen very easily but are confined to those with many contacts. In addition to such network topological effects, temporal effects also affect sexual contact patterns. For a simple example of such an effect, consider three agents A, B and C where B and C have sex first and A and B later. Then these agents are all connected in a standard, static network representation, but a disease cannot spread from A to C. Extending this example, it is easy to see that overlapping sexual relationships are important for the propagation of STIs. An early measure of risk behavior based on this observation (but still taking static graphs as starting point) is “concurrency” of Kretzschmar and Morris [10]. Another type of dynamic property of the interaction is the irregular, “bursty” time series of contacts between a pair of individuals. In fact, in Ref. [6], most contacts happen only once. The recurrent contacts, on the other hand, can be frequent for a short period, then absent for a longer time (like patterns observed in e.g. e-mail traffic) [11]. This type of bursts is visible in Fig. 1 focusing on the activity between one escort and one of her customers (both much more active than the average and much less active than the extremes). This figure also shows a problematic sampling effect—the sex-buyer start by posting a cluster of posts. As the time stamp comes from the post (as a proxy for the time of the actual event) this initial cluster of posts is, likely, an account of the sex buyer’s activities some period of time into the past. The authors have tested various ways of compensating for this bias, but these methods essentially give the same results as the raw data, so to avoid *ad hoc* decisions of which method to use, the authors use unmassaged data. One strategy to elucidate the effects of this intermittent dynamics, with respect to disease spreading, is to simulate disease outbreaks over the contact set and compare it with disease outbreaks on a set of contact sequences with the same network-topological properties but a random temporal ordering. This study shows that temporal effects speed up the spreading process, at least in a later stage of the process [12]. This is in contrast to similar studies of a different type of temporal

network, namely the network of cell-phone calls [13], where the temporal structure slow down the potential information flow.

What is the future of data-driven prostitutionology? Many of the system-specific questions still remain. A major question on the economic side is how much the information sharing between the customers can affect the prices of the services. To answer this one would need a revised theory, perhaps combining the economics approach of Edlund and Korn [2] with an agent-centric model of information spreading, including the feedback loops observed in Ref. [6]. Another open questions relate to the role of prostitution in the spreading of STIs. At present, the two theoretical studies based on online data, that we are aware of, Refs. [3] and [12], disagree (and so does more traditional field studies). Refs. [3] and [12] are based on data from different countries, which brings us to the next open question—can we understand, or at least quantitatively map, the cultural diversities of prostitution? In this context one have to remember that the Internet-mediated version are a fraction of the total size of the sex trade, and the fraction itself is also culturally dependent. One a more speculative note, as mentioned above, Internet-mediated prostitution may also help us to understand a wider spectrum of socioeconomic phenomena driven by a more laterally organized information flow. A general problem with data-driven methods is to infer mechanisms rather than just correlations. In natural science has traditionally used a cycle of experiment and theory development to tease apart cause and effect, the experiment part is of course hard in social sciences. The promising part is that governmental policies and the legal status of prostitution vary fairly often. Studying the response of the sex market to such perturbations could help us discovering mechanisms perhaps not only limited to prostitution.

A first step would be to, starting from the current data-driven studies, derive predictive models for policy changes that could be validated or repaired in the future.

References and Notes

* This paper was presented as an invited talk at the High Throughput Humanities satellite symposium at ECCS2010. See <<http://hth.eccs2010.eu>>

1. K. Davis. ‘The Sociology of Prostitution.’ *Am. Soc. Rev.* **2** (1937) pp. 744–755.
2. L. Edlund, E. Korn, ‘A Theory of Prostitution’ *J. Pol. Econ.* **110** (2004) pp. 181–214.
3. M. K. Pitts, A. M. A. Smith, J. Grierson, M. O’Brien and S. Misson. ‘Who Pays for Sex and Why? An Analysis of Social and Motivational Factors Associated With Male Clients of Sex Workers.’ *Archives of Sexual Behavior* **33** (2004) pp. 353–358.
4. L. Edlund, J. Engelberg and C. A. Parsons. ‘The Wages of Sin.’ *Columbia University Economics Discussion Paper* (2009) 0809–16.
5. S. Cunningham and T. D. Kendall. ‘Risk Behaviours Among Internet-Facilitated Sexworkers: Evidence From Two New Datasets’ *Sex Transm. Infect.*, published online before print.
6. L. E. C. Rocha, F. Liljeros and P. Holme. ‘Information Dynamics Shape the Sexual Networks of Internet-Mediated Prostitution.’ *Proc. Natl. Acad. Sci. USA* **107** (2010) pp. 5706–5711.
7. H. R. Bernard, P. Killworth, D. Kronenfeld and L. Sailer. ‘The Problem of Informant Accuracy: The Validity of Retrospective Data’ *Annual Review of Anthropology* **13** (1984) pp. 495–517.
8. E. Pisani, *The Wisdom of Whores* (London, UK: Granta, 2008), pp. 88–89.
9. M. E. J. Newman, ‘Assortative Mixing in Networks’ *Phys. Rev. Lett.* **89** (2002) art. no. 208701.
10. M. Kretzschmar and M. Morris. ‘Measures of Concurrency in Networks and the Spread of Infectious Disease’ *Mathematical Biosciences* **133** (1995) pp. 165–195.
11. J.-P. Eckmann, E. Moses and D. Sergi. ‘Entropy of Dialogues Creates Coherent Structures in E-Mail Traffic’ *Proc. Natl. Acad. Sci. USA* **101** (2004) pp. 14333–14337.
12. L. E. C. Rocha, F. Liljeros and P. Holme, ‘Simulated Epidemics in an Empirical Spatiotemporal Network of 50,185 Sexual Contacts’ *PLoS Comp. Biol.* **7** (2011), art. no. e1001109.
13. M. Karsai, *et al.*, ‘Small But Slow World: How Network Topology and Burstiness Slow Down Spreading’ *Phys. Rev. E* **83** (2011), art. no. 025102.

Fig. 1. The temporal structure of the contacts between an escort and a sex-buyer, and the temporal structure of their overall activity. The top-bars represent the activity of the escort, the bottom bars show the times of the events the sex-seller has been involved in, the middle bars are the encounters between the two. The time is counted from the start of the forum.