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Gender violence, poverty and HIV infection risk among persons engaged in the sex industry: cross-national analysis of the political economy of sex markets in 30 European and Central Asian countries

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Gender violence, poverty and HIV risk among persons engaged in the sex industry: cross-national analysis of the political economy of sex markets in 30 European and Central Asian countries

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Abstract:

Objectives: Persons engaged in the sex industry are at greater risk of HIV and other sexually transmitted infections than the general population. One major factor is exposure to higher levels of risky sexual activity. Expanding condom use is a critical prevention strategy, but this requires negotiation with those buying sex, which takes place in the context of cultural and economic constraints. Impoverished individuals who fear violence are more likely to forego condoms.

Methods: Here we test the hypotheses that poverty and fear of violence are two structural drivers of HIV risk in the sex industry. Using data from the European Centre for Disease Prevention and Control and the World Bank for 30 countries, we evaluate poverty, measured by the average income per day per person in the bottom 40% of the income distribution, and gender violence, measured using homicide rates in women and the proportion of women exposed to violence in the last 12 months and/or since age 16.

Results: We find that HIV prevalence among those in the sex industry is higher in countries where there are greater female homicide rates (β = 0.86, p = 0.018) and there is some

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evidence that self-reported exposure to violence is also associated with higher HIV prevalence (β = 1.37, p = 0.043). Conversely, HIV prevalence is lower in countries where average incomes among the poorest are greater (β = -1.05, p = 0.046).

Conclusion: Our results are consistent with the theory that reducing poverty and exposure to violence may help reduce HIV risk among persons engaged in the sex industry.

INTRODUCTION

HIV prevalence among those persons engaged in the sex industry — hereafter referred to, reflecting widespread usage, as "sex workers" — appears to be higher in some countries than others.[1,2] For example, although nationally representative data on HIV prevalence among sex workers are rare, in Armenia 1.2% of sex workers are estimated to have HIV while in the Lithuania 6.7% are estimated to be HIV positive. But, what explains this variation?

Patterns of high-risk behaviours – which vary across countries – may explain some of these cross-national differences in the prevalence of HIV among sex workers.[3-5] Two main risks for HIV are injection drug use and unprotected sex and the frequency of both activities may vary in the sex worker population in different countries.[6,7] Similarly, the prevalence of irregular condom use is also correlated with a higher risk of contracting HIV. For example, irregular condom use is more frequent in Lithuania (23%) than the Armenia (7.1%) and consequently, all other things being equal, HIV prevalence among sex workers would indeed be expected to be higher in Lithuania than Armenia.[1,7-9]

Those seeking to reduce HIV transmission among sex workers have often employed individual-level interventions, such as those seeking to entice or empower sex workers in ways that increase condom use. These interventions have achieved positive results but the effects are often modest.[1,10,11] This has turned attention to the importance of structural factors, such as legalization or decriminalization of sex work, which may shape the context in which decisions about potentially risky behaviours are made.[7,12] For example, if selling sex is illegal and police use confiscated condoms as evidence of sex work then women may be discouraged from carrying condoms lest they be arrested for doing so.[13] In short, if the structural constraints on condom use are alleviated then this might also increase the prevalence of regular condom use, thereby reducing HIV prevalence among sex workers.[1]

Two major structural factors may affect condom use among those engaged in the sex industry. First, across Europe, 'reasons for not using condoms [are] generally economically motivated'.[14] Sex workers are making decisions about condom usage according to widely different sets of criteria and constraints.[15] Some sex workers may be willing forego condoms if a client offers them more money for their services.[16,17] Precarious economic circumstances will likely alter prices in two important ways. First, poverty may lead a sex worker to accept a price for condomless sex that they would reject under less precarious economic circumstances. As one sex worker reports, "Sometimes I feel compelled to agree when I'm desperately in need of mone".[18] Second, poverty may reduce the price differential between condom-protected sex and con-

domless sex.[19] Poverty is expected to shift the constraints surrounding this negotiation in ways that lead to behaviours with greater HIV risk.[14,20] The distribution of income in a society, coupled with the overall level of economic development, can serve as proxies for these economic constraints;[21,22] particularly because women are often more likely to experience poverty than men.[23] In these situations, sex workers face a constrained set of choices in condom negotiations or in rejecting possible clients because they ask for unprotected sex.[24,25] Individual-level evidence consistent with this process has been observed in China, the Democratic Republic of Congo, and the Philippines.[4,15,19] This, of course, assumes some level of choice which may not be the case if these men or women are subjected to indentured servitude, and in these circumstances irregular condom use may not be a choice.[26] Financial constraints are only one driver of sex work but economically vulnerable sex workers (of various kinds) may be more likely to have unprotected sex (for more money or because they are coerced to do so) and so may also be at greater risk of HIV.[27]

The second main factor leading sex workers to forego using a condom with clients is pressure or the fear of violence.[13, 15-17] Violence is coercive and is used to push some people into the sex industry – especially among individuals who are trafficked in connection with the sex industry. Violence may also force sex workers into particular kinds of sexual encounters.[20,26] Even when there is no physical harm, the threat of violence remains coercive.[28] Those in the sex industry, whether willingly or unwillingly, are particularly vulnerable to violence and, in societies where women face greater violence, they may be even more fearful.[20] This may lead individuals to feel unable to reject pressure to engage in unprotected sex, and, for those who are trafficked, rape may occur without condoms if acquiescence is not forthcoming. This has been observed in such diverse settings as South Africa mining communities,[24,25,29-32] and Armenian female sex workers who had histories of physical abuse.[30] Female sex workers in Moscow, for example, were three times more likely to test HIV positive if they reported experiencing violence or the threat of violence in the last year.[20,33]

There are other important drivers of condom negotiation in sex work, such as access to condoms and other services, injecting drug use, and legal regulations around sex work.[6,14] However, in this paper we focus our attention on how two structural determinants of HIV, i.e., cultural norms and economic development, may affect HIV prevalence among sex workers across the Europe region.[27,34,35]

METHODS

DATA SOURCES

Data on HIV among sex workers are derived from the European Centre for Disease Prevention and Control's (ECDC) latest estimates for 30 countries.[2] In this paper we use data on HIV prevalence provided to the ECDC in connection with the Dublin Declaration and the Global Aids Response Progress Reporting (GARPR). Despite this being the best available source, it does contain several sources of measurement error and potential bias. One is that the true number of active sex workers is unknown, and likely to be underestimated, especially in countries where

sex work is criminalised. For example, some countries report they have no sex workers with HIV, which is highly unlikely and almost certainly reflects a lack of data.[2] Second, although the ECDC data primarily measure HIV prevalence among female sex workers, which serves as the focus of our analysis, there are three countries where male sex workers are included in the prevalence estimates.[2] However, male sex workers appear to be only a small fraction in these data sets. For example, in Bulgaria they form less than 5% of the total sample. Finally, survey procedures vary across countries, in terms of how data is collected and the sizes of the samples. To address this we weight samples based on their size to reduce measurement error. More details on data sources and collection can be found in Web Appendix 1.

MEASURING EXPOSURE TO GENDER VIOLENCE AND POVERTY

To measure gender violence we use two indicators: first, female homicide rates per 100,000 women from the World Health Organization European Health for All cause-specific mortality database 2016 edition (WHO-MDB).[36] Second, we use the prevalence of violence against women developed by the European Institute for Gender Equality (EIGE).[37] This scale is based on a cross-national survey on self-reported exposure to i) physical violence by a partner since the age of 15 or ii) in the last 12 months, iii) sexual violence by a partner since the age of 15 or iv) in the last 12 months, v) sexual violence by a non-partner since the age of 15, and vi) psychological violence by a partner since the age of 15. We follow their coding for the purposes of these analyses (see Web Appendix 2 for more details). These gender norms are predominantly concerned with relations between men and women and female sex workers are the vast majority in our data are women.[27]

To measure economic development and poverty we use two indicators. First, we collect data on average incomes per person among the bottom 40% of the population, again adjusted for inflation and purchasing power. Second, and as a sensitivity test, we collect data on gross domestic product per capita, adjusted for inflation and purchasing power. Both economic development indicators come from the World Bank data.[38] Data for all covariates are listed in Web Appendix 2.

STATISTICAL MODELS

To test whether cultural norms or economic development are associated with HIV prevalence among sex workers, we first present unadjusted models of the association between each of our main predictors, for example:

$$HIV_i = \beta_0 + \beta_1 Risk_i + \epsilon_{it} \tag{1}$$

Here i is country. HIV is the logged prevalence of HIV among sex workers drawn from the latest available data. The data are logged to adjust for positive skew in the distribution of HIV prevalence. $Risk$ represents four separate indicators which are examined sequentially in four separate regression models. We explore two measures of gender violence (i.e., female homicide rates per 100,000 women and the prevalence of violence against women) and two measures of economic development (i.e., average incomes per person among the bottom 40% of the pop-

ulation and gross domestic product per capita in 2005, adjusted for inflation and purchasing power).

As a sensitivity test, we also examine whether HIV prevalence among sex workers is associated with the EIGE's index of gender violence, which measures the prevalence of various forms of violence across the life-course and within the last 12 months from partners and non-partners, although we only have data on 16 countries.[37] As additional robustness checks, we examine whether the association between female homicide rate remains associated with HIV prevalence among sex workers after controlling for average incomes per person among the bottom 40%, GDP per capita, and the legislative environment (contrasting countries where sex work is unregulated, criminalised, an administrative offence, and legalised or decriminalised).[14]

Equation 1 – and all other regression models – are weighted according to the sample size of the country-specific data. To reduce the possible influence of measurement error, this places greater weight on HIV prevalence estimates coming from large samples, whilst recognising that larger sample sizes are still potentially biased. Our assumption is that larger samples of this hard-to-reach population are still more representative of this population as a whole than smaller samples. All models were estimated using STATA v13.0.

RESULTS

GENDER VIOLENCE

It is striking that the country with the highest HIV prevalence among sex workers (i.e., 22.2% in Latvia) is also among the countries with the highest female homicide rate (3.48 per 100,000 women). In contrast, the Czech Republic, the country with the lowest HIV prevalence among sex workers (0.1%) has a far lower female homicide rate (0.88 per 100,000 women). Looking across our whole sample we see a similar trend. Figure 1 shows the association between logged female homicide rates per 100,000 women and the logged HIV prevalence among sex workers. We observe a positive association (β = 0.86, p = 0.018). In countries where the female homicide rate is 1% higher, the HIV prevalence is 0.86% higher among sex workers.

We also observe that in countries where disclosed violence against women is greater than the European average (38% or higher) that the HIV prevalence rate is higher (β = 1.37, p = 0.043) (Table 1). We then split this measure into those indicators that capture the experience of violence in the last 12 months compared to those indicators that capture the experience of violence since the age of 15. We observe that HIV prevalence among sex workers is most closely associated with the experience of violence in the last 12 months (β = 1.32, p = 0.073) rather the experience of violence since the age of 15 (β = -0.032, p = 0.972), pointing to the apparent importance of the current situation.

Figure 1: Higher average incomes among the poorest groups is associated with lower HIV prevalence among sex workers among European and Central Asian countries.
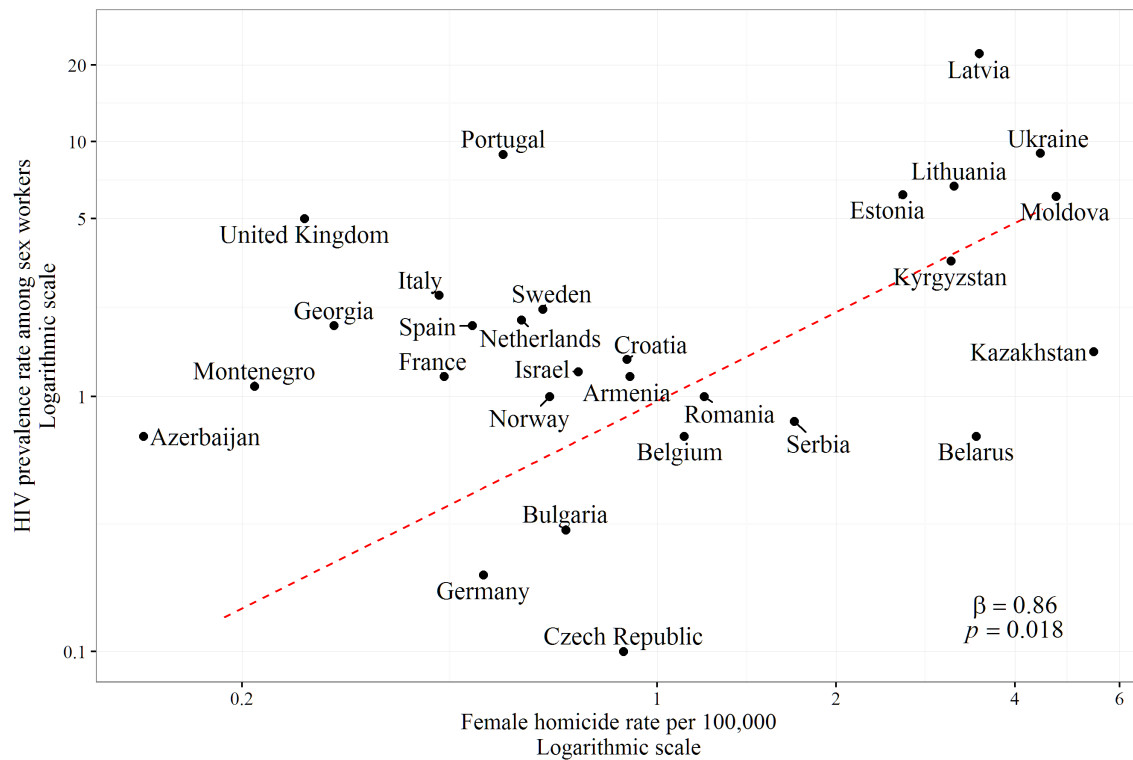
Notes: Source: ECDC and World Bank. Regression line weighted by sample size of the HIV prevalence data.

Table 1: Violence against women is associated with higher HIV prevalence among sex workers in 16 European and Central Asian countries.

	Percentage point change in food deprivation (%)
Covariates	(1)
Countries with above average disclosed violence toward women (A)	0.49
	(0.28)
Countries with average or below-average disclosed violence toward women (B)	-0.88
	(0.55)
Difference (A-B)	1.37*
	(0.62)
p-value for the difference (A-B)	0.043
Observations	16
R^2	0.21

Notes: Source: ECDC and EIGE. Regression line weighted by sample size of the HIV prevalence data.
Standard errors are in parentheses.
* $p < 0.05$, ** $p < 0.01$

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Taken together these results suggest that in countries where violence toward women is more common, HIV prevalence among sex workers is higher.

POVERTY

Consistent with the HIV prevalence among sex workers, people in the bottom 40% of the income distribution in Latvia are much poorer (Average spending = (PPP) $8.3 per capita per day in 2011) than the same group in the Czech Republic (Average spending = (PPP) $15.8 per capita per day in 2011). Figure 2 shows the association between logged average incomes of those in the bottom 40% of the population and the logged HIV prevalence among sex workers (Figure 2). We find a negative association between these variables (β = -1.05, p = 0.043), suggesting that the HIV prevalence among sex workers is lower in countries where the poorest in society have higher incomes. As a sensitivity test, we also examine whether variation between countries in logged GDP per capita, adjusted for inflation and purchasing-power, is associated with the logged HIV prevalence among sex workers (Figure 3). Our measure of GDP has more observations and enables us to see whether we observe a consistent relationship between indicators. We observe a negative association (β = -0.44, p = 0.022), such that a 1% increase in GDP is associated with a 0.44% decline in the HIV prevalence among sex workers. However, note that the coefficient for GDP is approximately half of the coefficient for average incomes among the poorest groups. This is consistent with the hypothesis that average incomes across the whole population matter less than average incomes among the poorest.

One possible confounder for the relationship between economic development and HIV is historical exposure to communism. Post-communist countries tend to be poorer than the other countries included in the sample and, although they promoted labour market equality for women, these countries also enabled a flourishing sex trade, which may in turn increase exposure to HIV.39 However, we find that the relationship between average incomes among the poorest and HIV among sex workers becomes stronger but less precise (β = -1.91, p = 0.054), even after we control for a dummy variable signifying countries that had communist governments prior to 1989-91.

ALTERNATIVE EXPLANATIONS

Although economic factors and pressure are the two primary motivations for inconsistent condom use among sex workers, other factors may also play an important role. Female sex workers who are also injecting drug users are more likely to forego protection whilst with clients.[14] However, even after we control for the proportion of sex workers who are injecting drug users, we find that both the female homicide rate and the level of income among the bottom 40% of the income distribution remain association with HIV prevalence among sex workers (Web Appendix 1).

Access to health information and free condoms may also influence condom usage and these services are largely provided by charities and other non-governmental organizations aimed at helping sex workers.[6] We include a measure of prevalence of these services per 1000 female

Figure 2: Higher average incomes among the poorest groups is associated with lower HIV prevalence among sex workers among European and Central Asian countries.
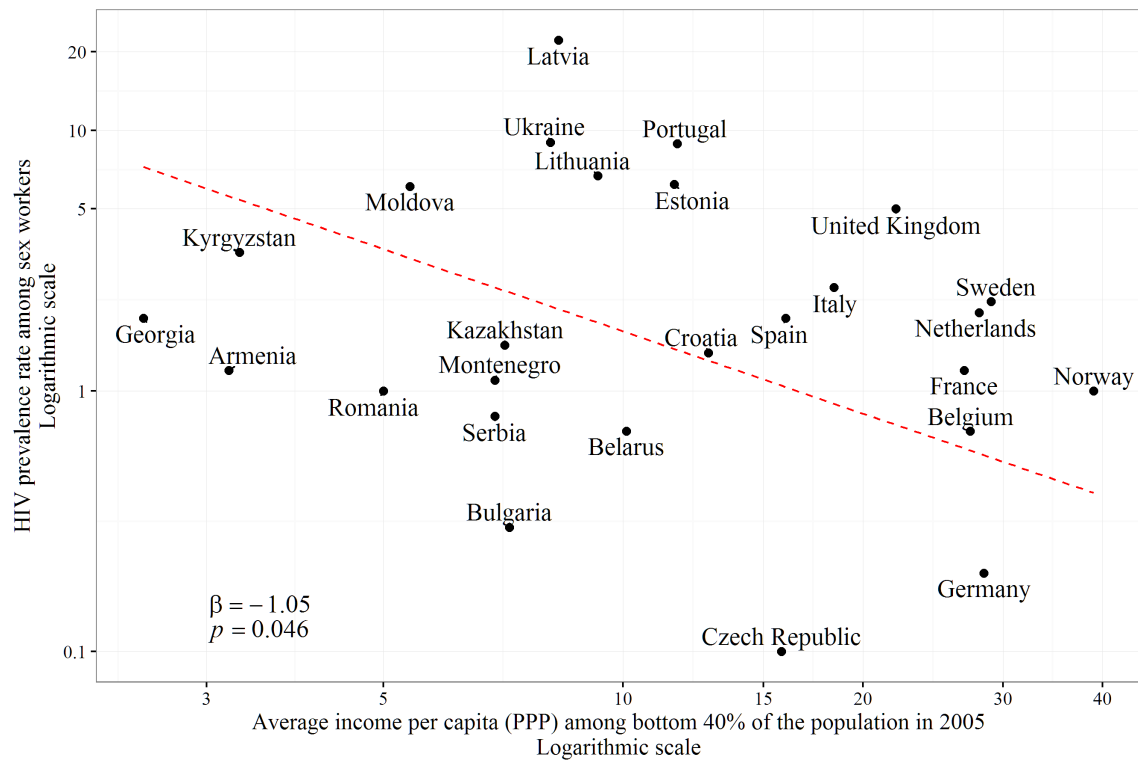
Notes: Source: ECDC and World Bank. Regression line weighted by sample size of the HIV prevalence data.

sex workers and find that this too does not alter the observed relationship between the female homicide rate and the average level of income among the poorest in society (Web Appendix 2).

Finally, the legislative environment may change how sex workers seek and meet clients.[1,14] Sex workers may be more vulnerable in contexts where sex work is criminalised because condoms can be used as evidence of illegal activity and so sex workers may be dis-incentivised to carry them. Further, if sex workers cannot turn to the police for help then punters may be more willing to use or threaten to use force in condom negotiations. However, even after controlling for legal regulation, we find that our results remain largely unchanged (Web Appendix 3).

While these factors may be important in their own right, they do not attenuate the observed associations of HIV prevalence among sex workers with economic constraints and violence toward women.

Figure 3: Higher GDP is associated with lower HIV prevalence among sex workers among European and Central Asian countries.

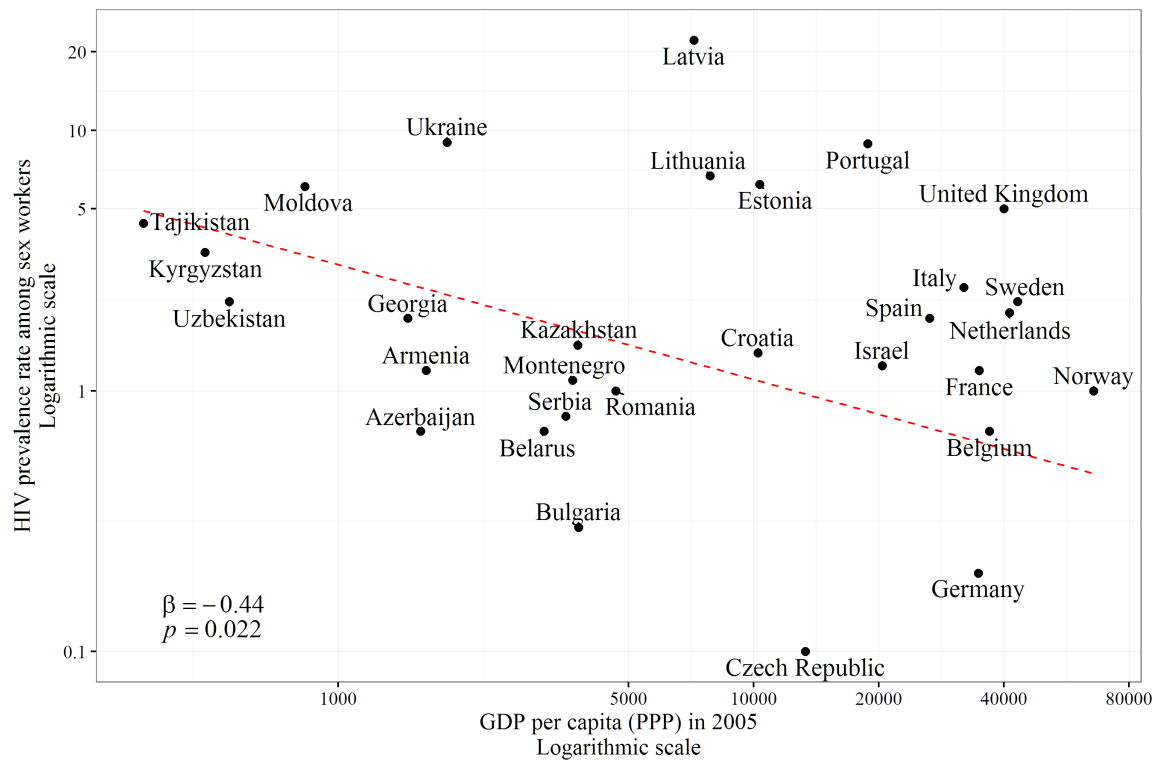*Notes*: Source: ECDC and World Bank. Regression line weighted by sample size of the HIV prevalence data.

DISCUSSION

Our analysis yields several important observations. First, we found a clear association between HIV prevalence among those engaged in the sex industry and gender violence. This association was consistent when measuring gender violence using objective and subjective measurements. Second, where incomes are greater, particularly for people at the bottom of the income distribution, HIV prevalence among sex workers is lower. Third, these associations endure even after we adjust for other factors that may alter condom negotiations, such as access to health and legal services, the prevalence of injecting drug use among sex workers, and legal regulations pertaining to the sex industry.

Of course, there are important limitations to this study. First, it is possible to conduct representative sampling of hidden populations but regrettably HIV prevalence estimates are often based on unrepresentative samples of these hard to reach groups.[2] Among this set of countries, data collection procedures between surveys are not consistent and so the representativeness of the data analysed here may vary in important ways. Second, it is also important to recognise that sex workers are often extremely heterogeneous, both in the settings that they work and

the control that they have over their working conditions, factors which vary according to cultural norms, the legislative framework, and much else. Our analysis has tried to address some of these differences but more work will be needed as new data becomes available. Third, these ecological measures are not perfect proxies of the economic circumstances of sex workers, or their perceptions of the risk of violence. However, these cross-national associations are consistent with a wealth of individual level data which has demonstrated that condom negotiations are primarily influenced by economic motivations and pressure from those attempting to buy sex.[14] Moreover, when we checked our results with a more precise measure of the prevalence of violence toward women, albeit available for fewer countries, we find similar results.[37] Fourth, our measures do not capture change over time, limiting our ability to move beyond documenting correlations. Finally, our paper has focussed on violence toward women – and specifically females engaged in the sex industry – and so may have limited relevance to the many male or transsexual sex workers who experience violence or the threat of violence in their work. More work is needed to explore the economic and cultural determinants of HIV among these groups.

Given these limitations, our findings can only be considered to be suggestive. However, they serve as a reminder of why it is so important to obtain high quality data on all vulnerable populations, as a basis for understanding the epidemiology of HIV not only among such groups but also the wider population.[10]

Perhaps the most important conclusion from our study is that although individual-level risk factors for HIV are important, structural factors may be as important, influencing the pattern of individual-level risk factors within a country. Our results suggest that gender violence and poverty at the country-level may influence micro-interactions between those individuals engaged in the sex industry and those buying sex, particularly around condom negotiation.

Despite these limitations, our results have important complementarities with the SDGs and suggest measures that can contribute to achieving the WHO's target of reducing new adult HIV infections to 500 000 in 2020.[40,41] Reducing poverty (SDG 1), especially among vulnerable populations, may alter the dynamics of sex work in general and condom negotiations in particular, potentially empowering sex workers to increase condom usage in order to minimize the number of new infections.[41] However, our results do not provide guidance on how any specific country may reduce the economic vulnerability of sex workers but our results do suggest that economic growth alone will not necessarily improve the economic situation of sex workers. In addition to growth, our results suggest reducing contemporary gender violence (SDG 5) may also reduce the risk of HIV among sex workers. This is particularly important in countries where sex work is a criminal offense or legally prohibited (even if there is no criminal penalty).[42] Only when sex workers are able to communicate with police services about (the threat of) violence without incriminating themselves will they be spared the risk of physical abuse and HIV exposure. Both structural drivers and individual agency impact on condom use and HIV risk, and thus future HIV intervention programmes must assume a more holistic view in order to meet the needs of those engaged in sex work. Long-term sustainable reductions in HIV/AIDS (SDG 3.3) may require effective steps towards poverty reduction, in particular female poverty, and reduction of violence toward women.

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Web Appendix

Web Appendix 1: Raw data on HIV prevalence among sex workers

Web Appendix 2: Index of gender violence

Web Appendix 3: Raw data on covariates

Web Appendix 4: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for the prevalence of injecting drug use among sex workers

Web Appendix 5: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for the number of services offered to sex workers

Web Appendix 6: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for legal regulation of sex work

Web Appendix 1: Raw data on HIV prevalence and their data sources

Country	Year	HIV Prevalence Estimate	Sample size	Sex	Source
Armenia	2010	1.2	250	F	IBBS
Azerbaijan	2011	0.7	300	F	IBBS
Belarus	2011	0.7	150	F	IBBS in Minsk
Belgium	2011	0.2	901	F	Routine programme data
Bulgaria	2011	0.3	700	F/M[1]	IBBS
Croatia	2006	1.4	1361	F	UNGASS
Czech Republic	2010	0.1	2566	F	NGO: Bliss without risk
Estonia	2011	6.2	210	F	IBBS Talinn
France	2011	1.2	166	F	BSS
Georgia	2009	1.9	273	F	IBBS in Tbilisi and Batumi
Germany	2010	0.2	3037	F	Sentinel Surveillance
Israel	2002-8	1.25	571	F	ECDC
Italy	2001	2.5	121	?	ECDC
Kazakhstan	2011	1.5	2286	F	IBBS
Kyrgyz Republic	2010	3.4	531	F	Sentinel Surveillance
Latvia	2011	22.2	117	F	IBBS
Lithuania	2010	6.7	46	F	IBBS
Moldova	2009	6.1	451	F	IBBS
Montenegro	2010	1.1	176	F	BBS
Netherlands	2002/4	2	1417	F	Mathematical Modelling
Norway	2008	1	746	F/M	Oslo Clinic
Portugal	2010	7.9	176	F	Behavioural Survey
Romania	2010	1	299	F	Time location sample
Serbia	2010	0.6	155	F	IBBS
Spain	2010	0.5	1141	F	20 Urban clinics
Sweden	2006/07	2.2	46	F	Swedish Prison Project
Ukraine	2011	9	4816	F	IBBS
United Kingdom	2006	5	120	F	London outreach clinic

Notes: 1 – Bulgaria sample = 666 Females; 34 Males.

Web Appendix 2: Index of gender violence

Data were taken from European Institute for Gender Equality index of gender violence. Survey data. Each respondent was asked a series of detailed questions about their experiences and these were then grouped into seven different areas:

1. Physical violence by a partner since the age of 15

2. Sexual violence by a partner since the age of 15

3. Sexual violence by a non-partner since the age of 15

4. Psychological violence by a partner since the age of 15

5. Physical violence by a partner in the 12 months prior to the interview

6. Sexual violence by a partner in the 12 months prior to the interview

7. Sexual violence by a non-partner in the 12 months prior to the interview

These measures are then aggregate to document parts of Europe where there is high level of disclosed violence (countries where the proportion of women disclosing experience of violence is 5 percentage points or more above the European average (33%)).

Web Appendix 3: Raw data on covariates

Country	Female Homicide rate[1]	GDP[2]	Income[3]	Gender violence[4]	Injecting drug users[5]	Legal regulation[6]	Services for sex workers[7]
Armenia	0.90	1625	3.2	.	1	2	0.93
Azerbaijan	0.14	1578	.	.	1	0	0.55
Belarus	3.44	3126	10.1	.	15	2	0.39
Belgium	1.11	36927	27.3	1	.	3	0.94
Bulgaria	0.70	3785	7.2	0	2	0	1
Croatia	0.89	10224	12.8	0	36	2	1.2
Czech Republic	0.88	13318	15.8	0	10	0	0.22
Estonia	2.59	10336	11.6	0	7	0	2.19
France	0.44	34880	26.8	1	.	3	0.37
Georgia	0.29	1470	2.5	.	6	0	0.62
Germany	0.51	34649	28.4	0	3	3	0.18
Israel	0.74	20377	.	.	0.1	3	.
Italy	0.43	31973	18.4	0	9	3	0.56
Kazakhstan	5.43	3771	7.1	.	12	0	1.47
Kyrgyzstan	3.12	477	3.3	.	5	0	0.91
Latvia	3.48	7165	8.3	1	53	3	0.27
Lithuania	3.16	7851	9.3	0	1	2	1.62
Moldova	4.69	831	5.4	.	11	2	.
Montenegro	0.21	3665	6.9	.	.	2	0.78
Netherlands	0.59	41199	28	1	16	3	0.88
Norway	0.66	65767	39	.	.	1	3.52
Portugal	0.55	18784	11.7	0	55	0	1.34
Romania	1.20	4651	5	0	22	1	0.31
Serbia	1.70	3528	6.9	.	27	2	0.27
Spain	0.49	26510	16	0	1	0	0.16
Sweden	0.64	43085	29	1	.	3	.
Ukraine	4.41	1828	8.1	.	24	1	0.52
United Kingdom	0.25	39934	22	0	4	3	0.72

Notes: (1) Female homicide is measured per 100,000 women and is taken from the World Health Organization's mortality database. (2) GDP is measured per capita adjusted for purchasing power and inflation. Data are from 2005 and come from the World Bank. (3) Income is a measure of the average incomes per person among the bottom 40% of the population, again adjusted for purchasing power and inflation. This data also comes from the World Bank. (4) Gender violence is taken from the European Institute of Gender Equality and measures the prevalence of disclosed gender violence where a 1 equals countries with levels of gender violence that are the above the European Average. All other countries – that is, those with average of below average disclosed gender violence – are coded as 0. (5) Proportion of female sex workers who are injecting drug users. Data are reported in Platt et al. (2013). (6) Legal status of selling sex in each country. 0 = unregulated, 1 = Administrative Offense, 2 = Criminal Offense, 3 = Legal. Data are taken from Platt et al. (2015). (7) The number of services available to female sex workers per 1000 sex workers in an area. Data are taken from the web appendix of Platt et al. (2013). Single period indicates a missing value.

Web Appendix 4: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for the prevalence of injecting drug use among sex workers

Table A	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged female homicide rate per 100,000	0.86*	0.88*
	(0.34)	(0.41)
Prevalence of injecting drug use among		0.073
sex workers[1]		(0.24)
Countries	28	23
R^2	0.34	0.37

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Data collected from: Platt, L., Jolley, E., Rhodes, T., Hope, V., Latypov, A., Reynolds, L., & Wilson, D. (2013). Factors mediating HIV risk among female sex workers in Europe: a systematic review and ecological analysis. BMJ Open, 3(7). * $p < 0.05$, ** $p < 0.01$

Table B	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged average income among bottom	-1.05*	-1.11*
40% of the population	(0.50)	(0.45)
Prevalence of injecting drug use among		0.49
sex workers[1]		(0.37)
Countries	26	21
R^2	0.21	0.37

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Data collected from: Platt, L., Jolley, E., Rhodes, T., Hope, V., Latypov, A., Reynolds, L., & Wilson, D. (2013). Factors mediating HIV risk among female sex workers in Europe: a systematic review and ecological analysis. BMJ Open, 3(7). * $p < 0.05$, ** $p < 0.01$

Web Appendix 5: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for the number of services offered to sex workers

Table A	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged female homicide rate per 100,000	0.86*	0.87*
	(0.34)	(0.34)
Services per 1000 female sex workers[1]		0.23
		(0.40)
Countries	28	25
R^2	0.34	0.36

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Services offered include a wide range of sexual health, social support and legal services and excludes standard STI clinics and health services that treat non-sex working populations. Data collected from: Platt, L., Jolley, E., Rhodes, T., Hope, V., Latypov, A., Reynolds, L., & Wilson, D. (2013). Factors mediating HIV risk among female sex workers in Europe: a systematic review and ecological analysis. BMJ Open, 3(7).
* $p < 0.05$, ** $p < 0.01$

Table B	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged average income among bottom	-1.05*	-1.14*
40% of the population	(0.50)	(0.53)
Services per 1000 female sex workers[1]		0.44
		(0.39)
Countries	26	21
R^2	0.21	0.37

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Services offered include a wide range of sexual health, social support and legal services and excludes standard STI clinics and health services that treat non-sex working populations. Data collected from: Platt, L., Jolley, E., Rhodes, T., Hope, V., Latypov, A., Reynolds, L., & Wilson, D. (2013). Factors mediating HIV risk among female sex workers in Europe: a systematic review and ecological analysis. BMJ Open, 3(7).
* $p < 0.05$, ** $p < 0.01$

Web Appendix 6: Gender violence (A), poverty (B), and HIV prevalence among sex workers adjusted for legal regulation of sex work

Table A	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged female homicide rate per 100,000	0.86*	0.87*
	(0.34)	(0.34)
Legal regulation (baseline = unregulated)[1]		
Criminalised		1.63**
		(0.58)
Administrative offense		0.87
		(0.69)
Legal		0.45
		(0.98)
Countries	28	28
R^2	0.34	0.49

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Data collected from: Platt, L., Jolley, E., Hope, V., Latypov, A., Vickerman, P., Hickson, F.,... Rhodes, T. (2015). HIV epidemics in the European region: vulnerability and response. Washington, D.C.: World Bank.
* $p < 0.05$, ** $p < 0.01$

Table B	Logged HIV prevalence among sex workers	
Covariates	(1)	(2)
Logged female homicide rate per 100,000	-1.05*	-1.20*
	(0.50)	(0.50)
Legal regulation (baseline = unregulated)[1]		
Criminalised		2.15**
		(0.63)
Administrative offense		0.71
		(0.63)
Legal		1.20
		(1.22)
Countries	26	26
R^2	0.21	0.52

Notes: Source: WHO and ECDC. Model 1 is the unadjusted association while model 2 adjusts for the prevalence of injecting drug use among sex workers.
1 - Data collected from: Platt, L., Jolley, E., Hope, V., Latypov, A., Vickerman, P., Hickson, F.,... Rhodes, T. (2015). HIV epidemics in the European region: vulnerability and response. Washington, D.C.: World Bank.
* $p < 0.05$, ** $p < 0.01$