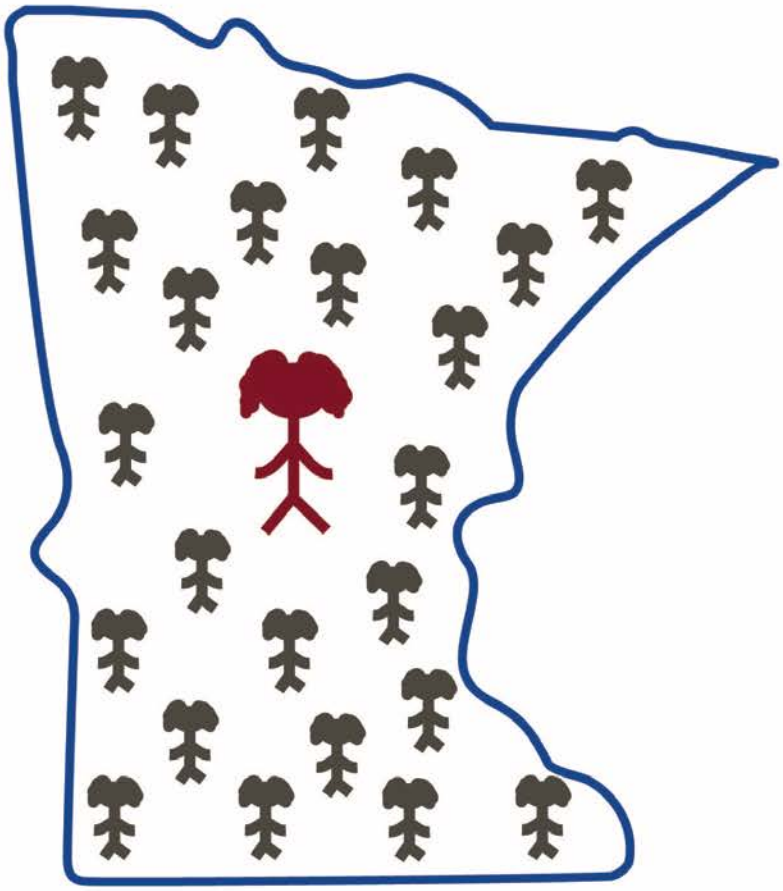
Early Intervention to Avoid Sex Trading and Trafficking of Minnesota's Female Youth: *A Benefit-Cost Analysis*

Full Report



THE NATHAN CUMMINGS FOUNDATION

MINNESOTA INDIAN WOMEN'S RESOURCE CENTER

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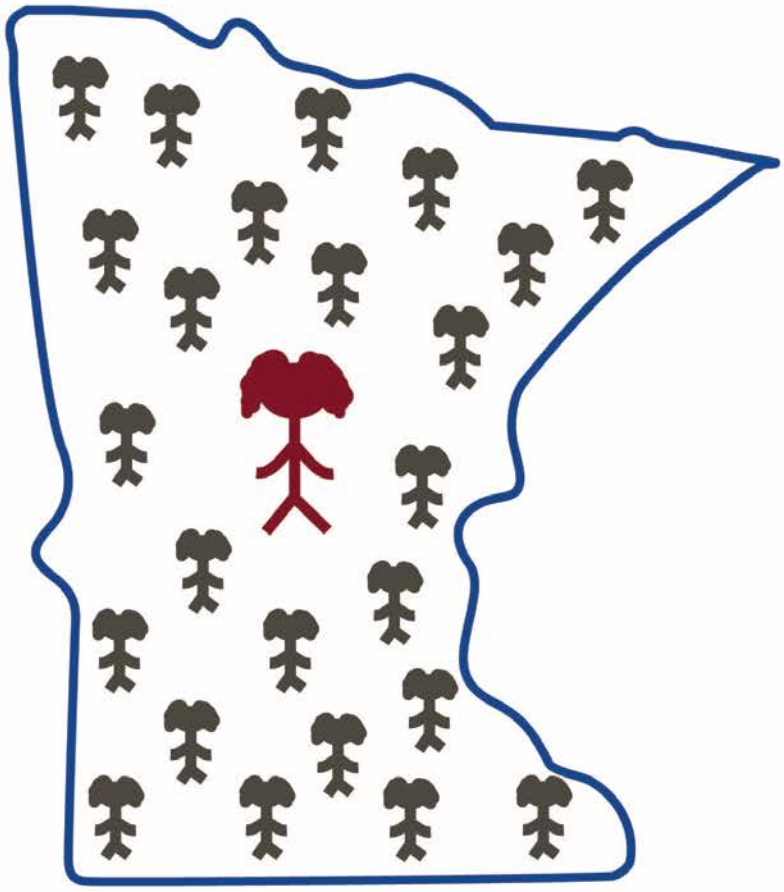

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Lauren Martin
Corresponding author
mart2114@umn.edu
Urban Research and Outreach-Engagement Center (UROC), University of Minnesota
2001 Plymouth Avenue North, Minneapolis MN 55411

Richard Lotspeich
Department of Economics, Indianan State University
RickL@indstate.edu

Lauren Stark
Research assistant to L. Martin
BA, Anthropology, University of Minnesota, 2011

For additional copies of the full report, or for a copy of the executive summary, please contact the Minnesota Indian Women's Resource Center at 612-728-2000, or Suzanne Koepplinger at skoepplinger@miwrc.org or Joni Buffalohead at jbuffalohead@miwrc.org.

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Contents

Tables and Figures

Abstract

We provide analysis of an innovative policy to reduce social harms from sex trading among female youth, including adolescents (e.g. survival sex, prostitution, sex trafficking). The policy consists of early intervention efforts with adolescent females to prevent and dissuade them from sex trading. Our framework treats the program as an investment project and calculates its net present value, where the benefits are understood to be harms avoided by successfully reducing the extent of sex trading. We approach the analysis from the narrow perspective of the public budget. That is, both the cost of the program and the specific harms from sex trading are evaluated in terms of the burden they impose on a community's government expenditures. We do not examine the full social costs of sex trading. Our valuation of harms is a conservative estimate based on available social science data. We conduct sensitivity analysis with respect to key model parameters such as program effectiveness, discount rate and other model parameters. The program returns positive Net Present Value in all but the most pessimistic scenarios, which we believe are highly unlikely to prevail. In our best estimate it returns $34 in benefit for each $1 in cost.

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Section One:
The Policy Problem and Our Framework of Analysis

Policy makers, the academic literature, and practitioners in the community offer multiple ways of describing, framing and dealing with youth involvement in commercial sex markets, sex trafficking and prostitution in the United States. Sex trading, prostitution, and sex trafficking are all terms used to reflect the act of exchanging sexual services for something of value. When the individual providing these services is under the age of 18, this activity is a federal crime under the Trafficking Victims Protection Act (TVPA).

We orient our analysis to the current policy context in the State of Minnesota. On August 1, 2011, the Minnesota State Legislature passed, and the Governor signed, several new provisions related to what it terms "juvenile prostitution" and "sexually exploited youth."[1] This legislation, known as the Safe Harbor for Youth Act, represents part of a larger policy debate in the state around issues of prostitution, sex trafficking and child welfare; policy driven by awareness that juvenile sex trafficking is a problem. The Twin Cities of Minneapolis and St. Paul were identified by the Federal Bureau of Investigation "as one of 13 cities with a large concentration of child prostitution enterprises."[2] The Safe Harbor Act more closely aligns Minnesota State statues with the federal law (TVPA) and creates structures for victimized youth to be routed into protective or healing services.

The policy context in Minnesota is two-pronged. (1) The act reclassifies youth under the age of 16 who are involved in prostitution and/or sex trafficking (as defined in Minnesota Statute) from a criminal/delinquent framework to a victim-centered public health focused approach. Full

[1] See Minnesota State Legislature, Special Session 1, 2011; SF0001, 2011 and HF0001, 2011

[2] http://www.fbi.gov/minneapolis/about-us/what-we-investigate/priorities#violent_crime; National Security Priority Area number 8.

implementation of the law is deferred until 2014 to allow law enforcement, service providers and judicial systems time to align with the new law's requirements. (2) The Act also clarifies and increases penalties for patrons, pimps, purchasers, promoters and traffickers of juveniles for the purposes of sexual exploitation or prostitution.

The legislation and policy agenda must necessarily incorporate a wide range of perspectives. It is therefore important that we are clear and straight-forward with the scope of analysis provided here and the terms and definitions we use throughout. We know of only two published benefit-cost studies analyzing youth involvement in sex trading (2005, 2006).[3] While informative for our project, DeRiviere's work pertains to a Canadian context and has a somewhat different scope and purpose.

For the purposes of our analysis, we must clearly define terms using language that does not prejudice the facts or our findings. We use the term "sex trading" to describe the sale of sex and sexual activity. Sex trading refers to selling or trading sex or sexual activities for money, food, drugs, clothes, a place to stay or anything else. Sex trading can be in the context of survival sex, engagement in local sex markets, and trafficking facilitated by a pimp or trafficker (herein called a "market facilitator"[4]). Thus our definition includes prostitution, survival sex, and sex trafficking of juveniles.

The current policy agenda in the State of Minnesota contemplates action with a specific population of adolescents deemed most at risk for involvement in sex trading. The legislation describes the population as follows: "homeless, runaway, and truant youth who are at risk of

[3] The Shapiro Group (Trouteaud, Parker, & Shapiro, 2010) conducted a benefit-cost study of policy in the State of Georgia, but it was not published in a peer reviewed journal and has some methodological shortcomings.
[4] Language used by Curtis, Terry, Dank, Dombrowski & Khan, 2008.

sexual exploitation."[5] Therefore, our analysis is framed around the impact of sex trading on this population of youth. We focus specifically on adolescent females and the impact of sex trading on their life course trajectory; although we note that a growing body of literature suggests adolescent males also comprise a significant proportion of children involved in sex trading (Curtis, Terry, Dank, Dombrowski, & Khan, 2008; Edwards, Iritani, & Hallfors, 2006; E. Saewyc, MacKay, Anderson, & Drozda, 2008; Weitzer, 2009).

In this research we ask the following question. What is the potential benefit to the **public budget** of early intervention and prevention of sex trading among female adolescents in the State of Minnesota, and how much would this cost? Public expenses to deal with and remediate some of the harms of sex trading are currently incurred by the State of Minnesota and local governments in a haphazard fashion. Could the State of Minnesota and local communities save money by providing services and coordinated prevention programs to female adolescents who might otherwise become involved in sex trading? To answer this question we analyze data on **costs to the public budget related to sex trading among female youth**. Many of the public costs related to sex trading are monetized expressions of various harms suffered by female youth that are caused by commercial sex activity and paid for by public dollars. Our model does not include the wider social, economic and personal costs of sex trading.

Several types of harm are caused by sex trading. These include damages to the mental and physical health of adolescents and adults who trade sex, reduction in their legal economic productivity during and after involvement in sex trading, burdens on public programs that address some of the personal damages incurred, law enforcement resources allocated to suppression, and harm to the community environment in which sex trading occurs. We compare

[5] S. F. No. 1, August 1, 2011: lines 24.27 through 24.31. An amendment of Sec. 8. Minnesota Statutes 2010, section 626.558, subdivision 2a, is amended to read: Subd. 2a. ~~Juvenile prostitution)~~

the portion of such costs that are a burden on state and local budgets to the potential costs of possible intervention. The Runaway Intervention Project (RIP) currently in operation in Ramsey County, Minnesota has been posed as a potential model program for the state and serves as the basis of intervention policy that we seek to evaluate in benefit-cost terms.[6] Housing is a critical need for adolescents at risk of sex trading and trafficking. Because the RIP model does not provide housing, our analysis adds the cost of housing for runaway and homeless youth to the cost of the model RIP program.

Current policy nation-wide with respect to sex trading and commercial sex is largely one of suppression through criminalization of the activity for all parties involved. Although this approach may diminish the extent of sex markets in comparison to legalization or decriminalization, criminalization is itself the source of some of the social damage (Weitzer, 2009). An alternative policy approach evaluated in our study consists of early intervention with female adolescents in order to avoid their entry into sex trading. Such an approach is described in recent legislation passed by the State of Minnesota. The legislation contemplates expenditures in two areas, a system-wide outreach effort to identify girls at risk and establishment of programs that prevent and/or intervene in the sexual exploitation of girls.[7] The goal of such programs is to restore these youth to a "healthy" developmental life course – one in which they recover from or avoid sex trading, are no longer homeless and/or running away from home, and exit involvement in street life.

[6] The Women's Foundation of Minnesota, MN Girls are Not For Sale campaign, provided funding to several entities in Ramsey County to support the development of a statewide model based on their county practices, including RIP (announced via press release on March 30, 2012).

[7] This is described as a sexually exploited youth outreach program. A multidisciplinary child protection team may assist the local welfare agency, local law enforcement agency, or an appropriate private organization in developing a program of outreach services for sexually exploited youth, including homeless, runaway, and truant youth who are at risk of sexual exploitation. (see S. F. No. 1, August 1, 2011: lines 24.27 through 24.31. An amendment of Sec. 8. Minnesota Statutes 2010, section 626.558, subdivision 2a.**)**

To the extent that prevention efforts are successful, the harms associated with commercial sex are avoided. On the other hand, a program of this nature requires resources, which responsible policy makers must take into consideration. Our study contributes to this policy debate through careful analysis of the costs and benefits of an early intervention strategy. We assess costs and benefits from the narrow perspective of the government budget, which ultimately are costs and benefits to Minnesota taxpayers. In an early intervention program funded by state and/or local government, the expenditures are budget costs. To the extent that a program reduces future expenditures from government budgets that would have been incurred to address the social harms, these are benefits to the budget. Another benefit to the government budget is increased tax revenue available from women who may be more productive in legitimate employment if they have avoided involvement in sex trading.

An alternative approach is to address the benefit-cost analysis from a wider social welfare perspective. Some of the costs and many of the benefits of intervention would accrue to individuals and groups independently of the government budget. For example, if a medical problem associated with sex trading is only partly rectified by spending of a public health agency, the remaining expenses and the personal suffering are part of the full social cost of the harm. If early intervention avoids the medical problem, the benefit to the government budget would be limited to the avoided expenses of the public health agency. But the full social benefit would include also the private expenses and personal suffering that are avoided through the intervention.

Our paper does not pursue this more general benefit-cost analysis. First, the impacts of sex-trading on public budgets are interesting and important by themselves. Second, the more general approach would have to embrace all the issues we raise in this paper, so our analysis can be seen

as a part of it. Third, moving from the narrow perspective of budgetary impacts to the viewpoint of social well-being broadly understood introduces considerably more complexity and uncertainty into the analysis. We leave that project for future research. Finally, a policy that passes a benefit-cost test within our narrow analysis would also pass under the generalized approach. Differences between the social value of harms avoided and the budgetary savings from harms avoided are likely to be quite large.

A critical assumption supporting our analytical framework pertains to the current practice of social policy in Minnesota. We presume that the community has previously established policies that address some of the negative consequences of sex trading and that these policies entail expenditures from the government budget. Examples include some degree of medical care provided by the government and attempts by police to suppress sex trading through arrests and criminal justice sanctions. It is the reduction of such expenditures that comprise benefits in our framework. We assume that current policy commitments would continue into a future shaped by the early intervention policy that we analyze. Without such commitments, intervention to help female adolescents avoid sex trading would not result in benefits to the government budget since the government would not have spent resources on the harms.

The next section of our study describes a quantitative model on which our benefit-cost analysis is based. In section 3 we identify several social harms associated with sex trading and describe their likely prevalence and time profile. An estimate of a unit cost for each harm is also developed based on available literature. We rely extensively on previous research on social harms associated with sex trading. Since this research spans many years, estimates of unit costs that we use are adjusted to 2011 dollars using the U.S. GDP deflator to put them on a common accounting unit. Establishing quantitative measures of the harms and their cost to the public

budget is complicated by significant variability and many uncertainties. In this process we take care to evaluate the reliability and precision of the data. If clear published evidence is lacking we adopted the most conservative estimate. In section 4 we describe the Runway Intervention Project (RIP) currently operating in Ramsey County, which is very similar to the kind of intervention and prevention project contemplated in the new Minnesota statues. Program operating costs for RIP have been assembled by Ramsey County, and a team of researchers has conducted evaluation outcomes that have been published. Additional costs of specialized housing are also considered. Section 5 is the core of the study, where we show the calculation results and directly compare benefits and costs. Based on data evaluation in the previous sections and different assumptions with regard to program effectiveness, we conduct some sensitivity tests on our calculations. A concluding section reviews key points and shortcomings and makes suggestions for refinement and further research.

Section Two:
The Quantitative Model

A program like we analyze can be understood as an investment project: expenditures for the program now will yield a stream of benefits into the future, which consist of the monetary value of harms avoided. Although intervention may well involve a multi-year time frame, for simplicity we model these expenditures as occurring in an initial period, $t = 0$. For each year of running the program there will be a stream of future benefits tied to a cohort of program participants. Considering several years of running a program would simply replicate these streams.

We denote the cost of the program as *IC* (for investment cost). The stream of benefits is assumed to begin in the next period, $t = 1$, and to continue to a time horizon T. We denote per period benefits as B_t. Using r as a discount rate[8], the following expression summarizes the benefit cost comparison as a net present value calculation[9]:

$$NPV = \sum_{t=1}^{T} \frac{B_t}{(1+r)^t} - IC \qquad (1)$$

If this net present value is positive, the program passes a benefit cost test.

Thus far the model is simple and straightforward. Difficulties arise in identifying specific details for how the investment costs and the benefits are determined. The value of *IC* is determined as the cost of running the intervention program from the perspective of the

[8] The discount rate we use is the average yield on recent issues of Minnesota's general obligation bonds.
[9] The standard procedure in an economic analysis involving comparison of values that accrue in different time periods calculates "present values" through discounting future values using an appropriate rate of interest. (See previous note.) The basic notion is that a sum of money equal to a given present value could grow into an amount equal to the future value that was discounted, if it grew at the interest rate used in the calculation in a compounded manner.

government budget. This consists of expenditures for facilities, services and personnel who work in the program as well as housing for program clients.

Concept of Benefits – Harms Avoided

Identifying the details on the benefits side is considerably more complex than determining the value of programming (IC). The essential concept is that dissuading and preventing individuals from engaging in sex trading allows the community to avoid the harms associated with sex trading. These depend on several considerations. First, how large is the adolescent population engaged with intervention? We denote this as *Z*. Second, how effective is the intervention program? We adopt a simple representation of effectiveness in the form of a coefficient, α, which denotes the fraction of program participants that are dissuaded and prevented from trading sex. Third, we must identify specific harms that arise from sex trading, describe their temporal dynamics, and assign values to them, where these values represent burdens on the public budget. Other aspects of the social environment influence effectiveness of the program in reducing sex trading and must be brought under review in evaluating benefits.

Sex Trading Potential and Program Filtering

Even without intervention some members of the adolescent population engaged with the intervention (denoted as *Z*) may not engage in sex trading. To the extent that *Z* contains such individuals, avoided harms cannot be claimed as program benefits, since the harms would not have been incurred in any case. This diminishes *NPV* because some participants impose cost without returning any benefit. We use θ to represent the proportion of *Z* that has sex trading potential. This means that $\alpha \times \theta \times Z$ represents the number of female adolescents successfully dissuaded from engaging in sex trading as a result of participating in the intervention. Participants are drawn from a larger female adolescent population (*YP*) through a

process of referral and filtering by which individuals are selected according to their potential to engage in sex trading. Although *YP* is a population of concern because these female adolescents are in difficult economic and social circumstances, only a fraction of them are potential sex traders. We use γ as a symbol to represent this share. Estimates of *YP* and γ for Minnesota are developed in the Appendix, section A1.

The degree of accuracy in filtering youth into the intervention via screening and referral has a bearing on the NPV. More effective filtering will raise the *NPV* of early intervention. Yet filtering must be an imperfect process, so that some individuals from *YP* will be selected into the intervention program even though they are unlikely to ever engage in sex trading. We use β to represent the effectiveness of filtering. If a filtering process is completely ineffective, $\beta = 0$ and we have $Z = YP$ and $\theta = \gamma$. That is, all the female adolescent population of concern enters the program, and the share of participants with sex trading potential is identical to that of *YP*. If filtering is completely successful, $\beta = 1$, and only members of *YP* with sex trading potential are brought into the program, resulting in $Z = \gamma YP$ with $\theta = 1$. (See the Appendix for details.)

The Potential of Replacement in the Sex Market

Dynamics in the sex market also influence effectiveness. Female adolescents who are successfully dissuaded and prevented from trading sex might be replaced by others entering or entered into the market. If an individual is dissuaded but then replaced by a new recruit, then effectively there are no benefits from reduced harms because the extent of sex trading has not been reduced. The extent to which replacement like this would occur is an open question that ultimately must be answered by empirical research, and the existing literature provides little guidance here. We have devised an approach that allows us to incorporate the issue into the

model and then tied this to rough empirical information in a way that allows an approximate answer.

Conceptually this question can be framed as the net effect of the intervention program on the equilibrium quantity of sex trading in the relevant market – i.e. our sex trading venue of interest. This, in turn, is reflected in the labor market for sex trading. Our analytical framework involves answers to three questions: 1) How much does the intervention program reduce the quantity of sex traders? 2) To what extent does this reduction increase earnings in the sex market? 3) To what extent does this earnings increase induce an increase in the quantity of sex traders from other sources that replace individuals dissuaded by the program? Benefit estimates should be based on the net reduction in sex traders, which accounts for this replacement effect.

The first question is answered by examining the program effectiveness and its scope (i.e. how many adolescent females participate). An answer to the second question depends on the price elasticity of demand for adolescent sex traders, which is derived from the demand for their sexual services. The third question is answered using the price elasticity of supply of adolescent sex traders. In the extreme cases of either a perfectly inelastic demand or a perfectly elastic supply, there would be no effect on the equilibrium quantity of female youth trading sex. In other extreme cases – perfectly elastic demand or perfectly inelastic supply - there would be no replacement, in which case the intervention program would have maximum effect.

It is not reasonable to presume that these extreme cases apply to the actual conditions of the sex trading venue of concern here. We bring this replacement effect into the model through a "non-replacement" coefficient, ρ. Specifically, ρ represents the fraction of a dissuaded cohort that is <u>not</u> replaced by new entrants. For example, if experience in the intervention program dissuaded 100 female adolescents from trading sex, and if the subsequent market adjustment led

to 40 new entrants (say, by immigration), then $\rho = 0.60$. The interval [0,1] bounds ρ, and its precise value depends on estimates of the demand and supply elasticities. (See the Appendix for full details.) Bringing this into the model results in the following expression for the net reduction in female youth trading sex as a result of the program intervention: $\alpha \times \theta \times Z \times \rho$.

To our knowledge, there are no studies that have attempted to measure the demand elasticity for sexual services in any venue. However, we can surmise that for our venue of interest this would be a relative elastic demand because sexual services are not a necessity for buyers and there are substitutes in the form of pornography, sex shows in clubs, and sexual services available in other venues. We chose a value of -2 as a central estimate and undertake sensitivity analysis by also considering less elastic demand responses. Again on the supply side, there is very little empirical evidence in the literature. Considering the nature of this essential labor input suggests that the supply would be relatively inelastic. The social circumstances of female youth are not easily altered in a way that would induce them toward sex trading, natural population growth is slow, and inward migration is difficult to accomplish due to both cultural and legal institutions related to youthful female populations in the United States. We choose a value of 0.5 as a central estimate and undertake sensitivity analysis by considering greater and lesser values (1.0 and 0.2). Given these central estimates of the demand and supply elasticities, the value of ρ is 0.81. A table in the Appendix shows values of ρ for a range of assumed values for both price elasticities, and we use three additional values of ρ in sensitivity analysis.

We also note that other facets of proposed legislation in Minnesota may affect market outcomes and possibly the value of the non-replacement coefficient. Specifically, aspects of the legislation address the demand side of sex trading by increasing penalties for buyers who are convicted. This may have a reducing effect on demand, but it is not clear whether the demand

elasticity would be affected. Legislation also increases penalties for market facilitators, such as individuals who promote sex trading as managers and seek market opportunities in this role. As with increased penalties on buyers, this may have a reducing effect on supply. Moreover, it is reasonable to conclude that this will make facilitators less willing to respond to increased price by seeking new market entrants. That is, supply would likely become more inelastic, which reduces the replacement effect. Our analysis does not incorporate these other aspects of the developing legislation because all such effects are speculative at this point. Our approach is to provide a carefully constructed benefit – cost analysis for only the intervention program for adolescent females envisioned in the analysis as though this were the only part of new policy toward sex trading in Minnesota.

Modeling the Avoided Harms

We use H_{jt} to represent a quantitative measure of a harm j that occurs in year t, for a single representative individual engaged in sex trading. (We use the integer m to represent the number of particular types of harm, so $j = 1, m$.) All the harms we consider occur in a probabilistic sense, so the quantified representations are expected values of harms. Specification of the units for H_{jt} depends on the particular harm represented. For example, H_{jt} may be the average number of arrests experienced or the average loss of tax revenue from legitimate income in a given year, t. Some of the harms may take on integer values, but for other harms integer values are inappropriate. For example, one harm is infection by HIV, which we represent as the probability that a representative individual has become infected by the end of year t.

Clearly there will be a great deal of variability in H_{jt} across individuals. The extent of harms experienced will depend on the particular environment for sex trading as well as individuals' efforts to evade the harms, for example by using condoms and avoiding dangerous clients. For

our purposes we assume an individual experience based on a carefully constructed "average"[10] of adolescents and women engaged in sex trading.[11] The extent of harms of type *j* avoided in year *t* can then be calculated as: $\alpha \times Z \times \theta \times \rho \times H_{jt}$.

In general each type of harm will have a distinct time profile that describes the value of H_{jt} across the time horizon, $t = 1, T$. For example, the time profile of becoming infected with HIV is quite different from the profile of arrest and legal sanction. To help understand time profiles of harms we distinguish incidents from harms and sex trading trajectories from the time profiles of harms. But all three concepts are interrelated.

By incident we mean a particular event that precipitates harm or a series of harms. If an incident is associated with only one type of harm, the distinction is not necessary. But some incidents cause multiple harms. For example, an arrest for prostitution precipitates the harm of the arrest itself but also may lead to the harms of court appearance and incarceration. A criminal record inhibits a person's ability to rent an apartment or secure a job. The budgetary impact of each harm is distinct. An arrest does not necessarily lead to incarceration, so we need to distinguish the incident of arrest from the harm of incarceration. Similarly a violent attack is an incident that may precipitate harms including medical attention in an emergency room, psychological counseling, and long-term disability. Again, incidents and related harms should be distinguished. Likewise, an incident at one point in time may cause a harm that emerges later in life. For example, Chlamydia is often asymptomatic when first contracted, and it is easy to cure if treated immediately. If untreated, however, Chlamydia can lead to pelvic inflammatory

[10] Although best modeling practice would use population averages of the harms experienced in a representative individual model, data limitations force us to use non-representative sample means to approximate this average.
[11] The extent of harm may be be dependent on time through changes in behavior. If females learn through experience to avoid some of the harms, the time profile would fall. On the other hand, physical injury and psychological stress may cause some women to lose ability to avoid some of the harms due to cognitive impairment (caused by factors such as drug use and traumatic brain injury) and worsening economic situation. In this case H_{jt} may well rise through time for certain types of harm. Our model does not attempt to account for such changes.

disease and infertility later in life. Clearly the time profile of harms is dependent on the temporal patterns of incidents, but is also distinct from them. Two examples of time profiles for harms are illustrated in an appendix.

By trajectory we mean the temporal pattern of engaging in sex trading. For example, for a female adolescent sex trading might begin at age 14 and continue for four years until age 18. Or it might continue until she is age 28 or 45. We rely on prior studies to support reasonable assumptions with respect to trajectories of representative individuals. Because some harms persist after an individual ceases trading sex, the time horizon for harms is longer than that for sex trading trajectories. Moreover, the trajectory of sex trading may affect the time profile of harms within any given time period. If the time profiles of harms were uniform across trajectories, calculation of an aggregate value of all harms could proceed on the basis of a single representative individual with an average trajectory. This is not correct, however, when the time profiles of harms depend on trajectories.

A precise calculation would identify a continuous distribution of a sex-trading cohort across the range of possible trajectories and link it to profiles of harms unique to each trajectory. We approach this in an approximate way by assuming a discrete uniform distribution in which a cohort is equally divided into six groups with sex trading trajectories of 2, 4, 6, 8, 10 and 12 years. We use an index, g, to represent each of these groups, so $g = 1, 6$. This is applied to the measure of harms, H, along with indexes j and t. Thus H_{gjt} represents the quantitative measure of harm type j experienced by a member of group g at time t. For some types of harm, $H_{gjt} = H_{kjt}$ for all g and k, which simplifies calculations. But this is not true for all harms, and the model reflects these distinctions. The extent of harm j experienced at t by an average member of a

cohort is calculated as $\left[\frac{1}{6}\right]\sum_{g=1}^{6} H_{gjt}$. Effectively this treatment of trajectories defines a composite individual constructed in equal parts from all six groups of her cohort.

For every type of harm we specify a unit cost value, which consists of the amount of public expenditure required to address one unit of the harm under prevailing public policy. For example, if medical treatment is provided by a public health agency for an injury or infection, this expense provides the valuation. We denote these unit cost values as V_j , j = 1, m and assume they remain constant across time. When the harm at issue is reduced tax revenue, V_j is simply 1. For this particular harm, then, $1 \times \left[\frac{1}{6}\right]\sum_{g=1}^{6} H_{gjt}$ represents potential tax revenue not collected in year t because a (composite) woman engaged in sex trading earns less in legitimate employment than she would have, had she not engaged in sex trading. Combining the several harms with their valuations, and recognizing six distinct trajectories for a cohort, we have the following calculation for B_t:

$$B_t = \alpha \times Z \times \theta \times \rho \times \sum_{j=1}^{m} V_j \left[\frac{1}{6}\right] \sum_{g=1}^{6} H_{gjt} \qquad (2)$$

Because we model the benefits of intervention using a representative individual approach, we can perform a benefit-cost assessment independently of knowing the variable Z by considering the intervention cost IC on an individual basis. A positive NPV using equation (1) is equivalent to a positive value for the formula below,

$$NPV / Z = \sum_{t=1}^{T} \frac{B_t / Z}{(1+r)^t} - IC / Z \qquad (3)$$

where $B_t / Z = \alpha \times \theta \times \rho \times \sum_{j=1}^{m} V_j \left[\frac{1}{6}\right] \sum_{g=1}^{6} H_{gjt}$ is derived directly from equation (2). At the same time, knowing Z allows us to evaluate the full scale of potential net gains from an intervention

program, or full loss in the event that program cost exceeds the present value of benefits. We treat this scaling issue in detail in the Appendix. In section 5 we provide estimates of both the full *NPV* as well as *NPV* per program client, as specified in equation 3.

We turn now to consideration of the particular types of harm that arise from sex trading in the Minnesota environment, description of their time profiles and what kinds of issues must be addressed in assessing V_j for each one.

Section Three:
Harms Related to Sex Trading

Our benefit-cost model requires that we identify harms caused by sex trading and specify their prevalence, time profiles and unit cost in order to establish monetized expressions for them. Many studies have been undertaken to describe and document the harms associated with sex trading among female adolescents and adult women (Vanwesenbeeck, 2001), but never quite in the quantitative way that we undertake.

Our study focuses on sex trading in Minnesota within the context of recent policy decisions. The target population for intervention and prevention of involvement in sex trading in Minnesota consists of runaway and homeless adolescents, up to age 15 years. Therefore, in our use of previous research and empirical studies we give more weight to studies conducted on populations most similar in demographics and geography to runaway and homeless female youth in Minnesota. We also consider studies of adult women who traded sex as adolescents because a proportion of adolescents engaged in sex trading will continue sex trading into adulthood. Given typical trajectories of sex trading, it is important to consider studies on both populations in our examination of harms. Our study only looks at females, but does not address distinctions of race or ethnicity.

Venues and Trajectories of Sex Trading

Harms caused by sex trading vary substantially across individuals' experiences. The particular environment of the exchanges – which we call *venue* – and the duration of trading activity – which we call *trajectory* – are key factors that influence the extent of harms. Our model requires us to specify venues and trajectories relevant to the target population of the intervention program. Since there is no representative sample of all sex trading activity, we do

not know the proportion of female youth involved in different types of settings and therefore cannot easily weigh our calculation of harms according to venue and trajectory (Shaver, 2005).

As discussed in depth below, many studies suggests that runaway and homeless female youth tend to trade sex in street-based and other venues that are noted as dangerous and low paying, characterized by limited individual control. Our specification of trajectories is derived from the literature on girls and young women who trade sex in these same contexts. We rely less on studies based on venues described in the literature as relatively higher paying brothel and escort service environments.

If time profiles of harms were uniform across different trajectories, we could proceed to evaluate harms experienced by a cohort on the basis of a representative individual characterized simply by an average trajectory. However, because criminal justice harms and cumulative harms (such as HIV/AIDS and child foster care) are not uniform with respect to trajectory, the model calculations must identify distinct time profiles of harms for each kind of trajectory. As noted above, we approach this problem by specifying six different trajectories that are defined in two-year increments, from 2 to 12 years of trading activity. Moreover, we assume that equal parts of a cohort are represented in each of these groups. The remainder of this subsection discusses empirical research on which our assumptions of venue and trajectories are based.

It is often assumed that all adolescents who trade sex will become adults who trade sex. Cohen & Piquero note, with respect to crime in general, that "a consistent finding indicates that antisocial and deviant behavior that emerges early in the life course tends to continue into childhood, adolescence, and adulthood" (2009, p. 26). Thus, the literature suggests a strong trend toward continued deviant behavior as adolescents become adults. The focus in these studies tends to be on juveniles who commit "serious" crimes, such as murder, assault, and theft.

They are not differentiated by gender and none specifically examine sex trading (M. Cohen & Piquero, 2009; Delisi & Gatling, 2003; Farrington & Welsh, 2007; Welsh et al., 2008). Some recent studies on sex trading question this conclusion, finding that some females who trade sex as adolescents will not trade sex as adults (Edwards et al., 2006); likewise not all adults who trade sex did so as adolescents (Martin, Hearst, & Widom, 2010).

Most information about sex trading trajectories comes from retrospective data collected from adult women about their experiences as adolescents (Dalla, 2006; DeRiviere, 2006; Martin et al., 2010; Wilson & Widom, 2010). The existing literature suggests great variability in sex trading trajectories. Many women continue sex trading into their 30s and 40s (Dalla, 2006; Martin et al., 2010). Potterat, Woodhouse, Muth & Muth (1990) found an average of 5 years involvement in prostitution. Their conclusion is based on nearly 20 years of public health surveillance data on 1,022 women engaged in sex trading in Colorado Springs, CO. On the other hand, in retrospective interviews with adults who were homeless and traded sex as adolescents, a recent study found an average length 19.9 years of involvement in sex trading (Miller et al., 2011).[12]

Many studies show that engagement in crime and delinquency, as well as homelessness as an adolescent, can inhibit educational attainment and present challenges to entering mainstream society as an adult (M. A. Cohen, Piquero, & Jennings, 2010). Low educational attainment, lack of involvement in mainstream employment and early pregnancy all contribute to a propensity to engage in sex trading (Martin et al., 2010). In the absence of clear empirical evidence from a longitudinal study, we assume a pattern of trajectories in which equal parts of a cohort trade sex for 2, 4, 6, 8, 10 and 12 years. This implies an average duration of 7 years, which is consistent

[12] table A2 in the Appendix summarizes studies related to sex trading trajectories.

with the limited empirical evidence. If trading begins at age 14, our assumed pattern implies that two thirds of adolescents who trade sex will continue this into adulthood.[13]

Identifying Harms

While many studies describe personal and social harms caused by sex trading, a comprehensive and systematic assessment is difficult to derive from the literature. Still, we have found much useful empirical information. We describe this literature and how we use it to identify and quantify the harms in order to show readers the reasoning and assumptions built into our model. Most studies are based on convenience and snow-ball samples and focus on correlations between sex trading and harms, often without clearly establishing causation.

Some of the harms described are precursors to sex trading or create vulnerabilities exploited in sex trafficking, such as childhood sex abuse or running away from home (Estes & Weiner, 2001). Harms that pre-date sex trading are not included in our model because the early intervention program to prevent sex trading would not prevent these harms. Other studies posit a causal link between sex trading and future harm, documenting that some specific harms are directly attributable to sex trading. For some harms, such as chemical dependency, the literature is mixed on whether the harm leads to sex trading or was caused by sex trading (Dalla, 2006; Graham & Wish, 1994; McClanahan, McClelland, Abram, & Teplin, 1999; Surratt, Inciardi, Kurtz, & Kiley, 2004). Causality can run both ways. In our study we include only harms that have reasonable scientific backing as having been caused by sex trading, and we use very conservative estimates.

[13] There is no clear and definitive scholarly evidence of an average age of first sex trade. The research literature shows a wide range of age of first sex trade for juveniles, ranging from very young to age 17. Many studies find an average age of first sex trade for juveniles between 13 and 14 years old (see Martin et al., 2010). We did not want to overestimate the degree of cumulative harm in early adolescence, therefore for our model we selected age 14 as the onset of sex trading in line with our conservative approach. Further, we believe the early intervention and prevention program will likely focus on younger girls.

Some of the most damaging harms of sex trading include such consequences as low self-worth, mental illness, physical pain, fear, loneliness, reduced cognitive capacity, and diminished potential. These are difficult to quantify and to express as monetary values. However, most of these harmful outcomes do not impose any direct demands on the government budget, and so they do not enter our narrowly constructed benefit cost analysis. But these harms without direct impact on the government budget are not entirely absent from our model. They impose monetary costs related to sex trading indirectly through reduced tax revenue and greater need for public assistance due to reduced employment.

Harms that impact the government budget can be organized into four categories: (1) public health (violence, pregnancy, sexually transmitted infections, chemical dependency and other mental health problems); (2) law enforcement (arrests, court proceedings, and corrections, including probation); (3) social welfare programs (child protection, medical assistance and income support) and (4) reduced income tax revenue.[14] In the following subsections we carefully consider social science literature related to each of the identified harms caused by sex trading. We explain our reasoning for inclusion and provide estimates of time profiles and unit costs. We also evaluate the reliability of information we must rely on to support a quantitative model and the assumptions we must make. These descriptions of harms form the building blocks for our benefit-cost results presented in section 5. Table 1 at the end of this section provides a summary of the harm descriptions developed here and utilized in the computational model.

[14] We exclude consideration of sales tax revenue because a youth would pay roughly equivalent amounts whether she earned income from sex trading or legitimate employment. But only in the lattter case would government collect income tax from her.

Public Health

Numerous harms of a public health nature result from trading sex. We organize our analysis around five classes of health effects: physical injury from violence, sexually transmitted infections (STIs), pregnancies, mental health and chemical dependency.

Impacts of Violence

Studies of teens and women who trade sex show that violence, both physical and emotional, is common in their lives (Church, Henderson, Barnard, & Hart, 2001; Kurtz, Surratt, Inciardi, & Kiley, 2004; Martin et al., 2010; R Parriott, 1994; Romero-Daza, Weeks, & Singer, 2003; Salfati, James, & Ferguson, 2008). However, not all of it can be seen as *caused* by sex trading. Violence that occurs in the context of sex trading – such as assaults by clients and market facilitators – is directly attributable to the activity and so is included as a *harmful incident* in our framework. We do not describe these forms and types of violence in detail. Rather we estimate the contribution of violent incidents to several related harms that induce public expenditures for medical treatment. These include physical injuries as well as mental health damage, such as PTSD and traumatic brain injury. Our model does not account for the physical and psychological impact of the threat of violence and long-term stress, which recent research suggests has a stunning, negative impact on the development of the adolescent brain (Glaser, 2000; Wilson & Widom, 2010). In this regard our results understate the benefits of an intervention program.

Physical injuries that do not require medical attention, while very real and common, are excluded from our model since there is no associated government expenditure. Injuries requiring medical treatment are distinguished at two levels of severity: major injuries require hospitalization; minor injuries do not. The mental health damages from violent incidents elicit

direct expenditures from the government but also affect government budgets indirectly. For example, PTSD reduces capacity of individuals to work, which in turn increases income support payments and reduces taxable income. While these consequences of violence are quite real and documented in research, it is impossible to know precisely how much of such harm is caused by violence experienced in the context of sex trading.

The literature on violence in sex trading does not provide a clear or straightforward estimate of violence. Several authors posit lower rates of violence among adult women who trade sex in higher paid so-called "indoor" sex trading venues versus lower paid so-called "outdoor" venues which are street-based and public (Church et al., 2001; Weitzer, 2009). Further, these studies argue that workers in indoor venues tend to be adults who were not exploited as youth. Therefore, we will exclude these studies from consideration here and focus on empirical research among teens and women who traded sex as adolescents. To derive an estimate of violent incidents for a typical individual engaged in sex trading, we consulted several studies focusing on sex trading among runaway/homeless youth and adult women who trade sex in so-called outdoor venues to derive a conservative estimate of an "average" rate of occurrence. We then use reasonable assumptions to tie incidents of violence to specific harms.

Empirical research reveals a wide range of lifetime experience of violence in the context of sex trading. Field studies find between 50% and 99% of all persons who trade sex are victims of violence (Judd, Roman, & Eddy, 2007; Martin et al., 2010; Nixon, Tutty, Downe, Gorkoff, & Ursel, 2002; Romero-Daza et al., 2003). Saewyc et al. (2008) studied a sample of 1,465 street-engaged youth and found that 95% of sexually exploited females had been physically abused by a relative, friend, controller, purchaser or stranger (p. 41). Not all of this was directly linked to sex trading, however. This same study, in their sample of older street youth, found that in the

context of sex trading 18% reported being sexually abused and 25% physically abused (pp. 27, 43). Church et al. (2001) found that 48% of women who traded sex in-doors had been assaulted by a client, while 81% who worked out-doors had been assaulted (p. 524). Assault by market facilitators was not included in this study and could only increase the total incidence of violence.

Other research has found that 75% of women reported being subjected to violence at the hands of market facilitators (e.g. pimps and traffickers), and 84-86% reported aggravated assault and physical violence (Hunter, 1993; Jody Raphael, Reichert, & Powers, 2010; Raymond, 2001). Raymond and Hughes (2001) also found that 80% of women were sexually assaulted, and 85% experienced psychological abuse by market facilitators. Collectively these data suggest that it is reasonable to make a conservative estimate of 0.80 for a cumulative probability of experiencing assault as a direct result of sex trading. At the same time, the figures on which the trajectory-long likelihood of 0.80 is based do not distinguish experience of violence from multiple incidents, nor do they indicate the length of trajectory.

While these studies are informative, our model requires an estimate of violent incidents on an annual basis that is consistent with this trajectory-long probability. We also need distinction by severity of injury. Other studies have examined the experience of violence during shorter time periods. Some surveys asked samples of women who traded sex about their recent experience with violence. Kurtz et al. (2004) found that around half the women who traded sex in a street venue from which their sample was drawn had been assaulted by a client in the past year, and one third had been assaulted in the previous month (Kurtz et al., 2004). The sample surveyed by Church et al. (2001) found that half of the sample in an “outdoor” venue reported violence from clients in the previous six months (Church et al., 2001). These studies do not

reveal, however, whether this includes multiple incidents in the preceding months or to what extent the attacks resulted in medical care.

Research by Hunter (1993) shows an annual assault rate from market facilitator of 58 incidents among the women in the sample who experienced assault (84%). The annual rate of rape perpetrated by market facilitators reported by the sample was 16 among the women who reported being raped (78%). However, these rates do not include violence perpetrated by clients. A survey by Raymond et al. (2001) of women trading sex found that 50 percent of them experienced assaults frequently, sometimes daily. A study in Rhode Island found that women who trade sex on average require treatment in an emergency room 3 times per year (Open Doors, 2009). But it is not known whether these visits resulted from violence perpetrated against the women.

What is clear from this empirical information is that violence against women who trade sex is quite common. But the variety of circumstances, limited sample sizes and inconsistencies in survey reporting do not provide reliable guidance to determine a good estimate of the rate of assaults that would precipitate medical expenditure by state and local government in Minnesota. We are left with a need to specify two distinct assault rates for the model with highly imperfect empirical bases. Yet this field research does place some boundaries on reasonable assumptions.

If we assume a sex trading trajectory of 7 years and a likelihood of 0.80 that a typical female youth will experience one or more assaults across the trajectory that require medical attention (including rape) the corresponding (constant) annual probability of such assault is approximately 0.2. This is well below the prevalence reported by some of the research reviewed above, but those researchers did not speak to the need for medical care. We apply the annual probability of

0.2 for minor assault (requires outpatient medical care) and reduce this by a factor of 4 to calculate a probability of 0.05 for major assault (requires hospitalization).

It is similarly difficult to determine required medical expenditures resulting from this violence. The National Center for Injury Prevention and Control (NCIPC 2003) has calculated the costs of intimate partner violence, which is similar to the kind of violence experienced in sex trading. For physical assault the mean medical cost is $2,665 for those who receive treatment.[15] We will use this as the unit cost of minor assault and multiply it by 20 to provide a rough unit cost for major assault of $53,300. The NCIPC also found an average of $1,017 in mental health costs associated with an assault.[16] We assume that in all incidents of assault requiring medical attention victims are also provided mental health care as part of their treatment. For minor assault we add medical and mental health costs to arrive at $3,682, which is converted to $4,433 in 2011 dollars. The mental health treatment for major assault is treated below as post-traumatic stress disorder (PTSD) with a separate cost entry. The unit cost of medical treatment for major assault is converted to $64,174 in 2011 dollars.

The accumulation of experience with violence and the threat of violence can lead to emotional problems later in life, manifesting as a diagnosed mental illness such as post-traumatic stress disorder (PTSD), impaired cognitive functioning, traumatic brain injury, and inability to sustain employment. While all these harms may impose costs on public budgets through mental health treatment expense, higher levels of income support and reduced income tax revenue, it is difficult to establish a quantitative assessment.

For purposes of this study we only include PTSD in our model since it can be directly linked to violence and threat of violence caused by sex trading. PTSD is more likely to affect someone

[15] (National Center for Injury Prevention and Control, 2003) p. 29.
[16] Op. cit., p. 30.

with repeated exposure to violence, so it would have a higher prevalence among cohort groups that trade sex across longer trajectories. The effects may emerge well after the event that caused it, so the actual time profile of the harm would extend beyond the trajectory. Treatment may require longer than a year, which adds to the aggregate value of the harm as well as altering the time profile. We are not able to address all of these complexities.

We assume all incidents of major violence requiring hospitalization also require treatment for PTSD. This is justified for several reasons. First, our estimate of the cost of medical treatment for assault is very conservative. It does not account for adolescents and women who do not receive medical attention for assault. It is likely that a high proportion of those affected by assault never seek treatment. Second, our model does not include the threat or perceived threat of assault. Third, we are not accounting for the repeated exposure to assaults over the course of the longer trajectories specified in our model. The incidence of PTSD is likely much higher than just for those who experienced major assault. Rand (2008) estimated that PTSD costs approximately $5,900 to treat among returning war veterans.[17] We adopt his estimate as our unit cost for PTSD and convert it to 2011 dollars resulting in $6,159 as the unit cost. This does not include the cost of treating co-morbid occurrence of major depression and anxiety, which are likely high among adolescents and teens who trade sex. Thus using the figure from Rand is a conservative estimate of the cost of this harm.

Sexually Transmitted Infections

Trading sex is a high risk behavior that increases the likelihood of contracting an STI, including HIV/AIDS. Condom use could remediate some of this harm, but condom use is not universal in the venue of sex trading that we address in this research.. The literature suggests

[17] Cost figure retrieved from the following URL on April 9, 2012.
http://www.rand.org/publications/randreview/issues/summer2008/wounds2.html

that condoms are used more frequently in transactional sex than in non-transactional sex and that adolescents tend to use condoms less frequently than adults (Martin et al., 2010; Ruth Parriott, 1994; Romero-Daza et al., 2003). A nationally representative sample of adolescents in the U.S. found that 19.8% of girls who traded sex had been told by a doctor that they had HIV or another STI compared to 4.1% of girls who did not trade sex; clear evidence that HIV and STI can be directly attributable to sex trading (Edwards et al., 2006).

The prevalence of HIV/AIDS among adolescents and adults who trade sex is extremely variable by study and locale ranging from 1.5% in a self-reported study in Minneapolis (Ruth Parriott, 1994) to 78% in an international brothel context (Willis & Levy, 2002). Self-reported positive HIV rates tend to be much lower than rates reported from testing. In a sample of women who use drugs in a street-based sex trading context in Miami, Kurtz et al. (2005) found that 22.4% were HIV positive. A study of 255 women in Vancouver, BC who had been street-entrenched youth found that 23% were HIV positive (Miller et al., 2011). Curtis et al. (2008) in an extensive study of youth who trade sex in New York City found that 2% self-reported being HIV positive.

A focus on Minnesota data seems prudent given the variability of HIV rates across the US. In Minnesota the rates of HIV among all adolescents are low, close to 0%, with only 232 known cases (Minnesota Department of Health, 2011). A 2000 needs assessment study of sex traders in the Twin Cities, conducted by the Hennepin County Community Health Department, found that 13% of respondents self-reported being HIV positive (Persell, 2000). For the purposes of our model, we need the annual probability of becoming infected with HIV, in order to calculate a cumulative probability that a person will be in a state of being HIV positive in any given year of their trajectory. The study by the county health department does not indicate how long the sex

traders had been engaged in sex trading. However, if we presume active sex trading across 10 years, an annual probability of around 1.4% would result in the cumulative likelihood of 13%. We employ this annual probability in our model with respect to the HIV/AIDS harm.

The quantitative representation of the harm is the cumulative probability of being infected by HIV, which we assume will become revealed through testing followed by treatment with anti-retroviral therapy (ART) as well as for consequences of AIDS. The time profile for this harm is rather complex because it depends on trajectories of sex trading and will be present for the remainder of an infected individual's life. We specify different time profiles for each of the six cohort groups in accordance with the groups' distinct trajectories. A graphical representation of this is shown in the appendix.

We make a simplifying assumption regarding the ending of these time profiles, which we presume is precipitated by death of the individual. Antiretroviral therapy (ART) for people infected with HIV continues to evolve, and this changes the cost of medical treatment and life expectancy, both of which are used to calculate benefits in our model. We use the most current and authoritative estimates (Sloan, 2012). Sloan et al. uses an HIV simulation model (CEPAC: Cost Effectiveness of Prevent AIDS Complications) to analyze sensitivity of survival and therapy costs to particular features of disease etiology, such as the evident extent of infection at the time a patient presents to care. They also speculate that, despite the emergence of generic drugs for ART that will lower pharmaceutical costs, lifetime cost of care for HIV positive patients will likely increase in future as they have over recent decades.

We ignore these details and adopt their "base case" for survival (26.5 years, p. 45) and annual cost per patient (20,170 constant 2010 euros, p. 54). Since their cost calculations are in constant 2010 euros, we convert to dollars using the average 2010 dollar/euro exchange rate

(1.326 $/euro[18]) and then inflate the converted figure to constant 2011 dollars using the U.S. GDP deflator, as we have for all cost figures. (See table A2.) These calculations return annual cost per patient of $27,309 (constant 2011 dollars).[19] This becomes the unit value that we apply to the expected number of individuals who become HIV positive as a result of sex trading. We truncate the survival estimate to 26 years, which imposes a slight downward bias to our benefit calculations.

Using the survival value of 26 years, and assuming sex trading begins at age 14, if an individual became infected in the first year they are expected to die at an age of 40. Since new infections will be contracted in a cohort through year 12, given our assumptions on trajectories, some individuals will be expected to die of AIDS as late as age 52. Given that our model implies half the HIV infections in a cohort will be incurred by year 4 of the trajectories, we use the expected death year for individuals infected in year 4 as the assumed truncation year for all HIV profiles. This is year 30 from the start of sex trading, when the representative individual has reached age 44.

Prevalence data is available on STI rates that are reported to the federal Centers for Disease Control and Prevention. In addition to HIV/AIDS, this includes gonorrhea, syphilis and Chlamydia. Except for Chlamydia, we lack clear data on the rates of infection among adolescents who trade sex. Therefore, for STIs other than HIV we will consider only Chlamydia; it has the highest prevalence, and we have good estimates on cost of treatment. By

[18] Calculated from daily rates reported by the European Central Bank. Accessed on 29 May 2012 from: http://www.ecb.int/stats/exchange/eurofxref/html/index.en.html

[19] This annual cost of HIV/AIDS therapy is quite close to an estimate by Schackman et al. (2006) based on the U.S. health care system using 2004 data (Schackman et al., 2006). Using the same simulation model, their base case estimate of annual treatment cost is $25,574 in 2004 dollars. Adjusting to 2011 dollars results in a cost of $29,933. We choose to rely on Sloan et al. because their research is more recent and the cost estimate is somewhat lower, which is part of our attempt to be conservative in the assessment of benefits in our model.

excluding other STIs from the model, we derive benefit estimates that are understated to the extent that these result in additional public health expenditure. Moreover, reducing the rates of STIs among people who trade sex may lower the overall rates of STIs in the general population. However, we exclude this potential general public health benefit because there are fewer people who trade sex with STIs. Again, our estimate of benefits is conservative.

Chlamydia is often asymptomatic and thus likely under counted in self-report surveys and public health data generally. In Minnesota youth are disproportionately affected; 69 percent of Chlamydia cases (N=9,788) infect youth ages 15-24, a group who account for only 14 percent of the total Minnesotan population (Lynfield, 2011). Because Chlamydia is often asymptomatic, many cases go unnoticed and untreated, potentially leading to other problems. The Centers for Disease Control and Prevention (CDC) estimate that 75 percent of cases are not treated in early stages (Centers for Disease Control and Prevention (CDC), 2004). Long term health complications from untreated Chlamydia include sequaelae, Lymphogranuloma venereum, ectopic pregnancy, infertility, and chronic pelvic pain (Partnership, 2011). Chesson, et al. (2004) report that 10 percent to 40 percent of untreated chlamydia infections will result in pelvic inflammatory disease (PID). We do not have good prevalence data for many of these complications, so our model does not address them in detail. However, we do consider two variants of Chlamydia harm: a short-term experience that is discovered and treated soon after infection, and a long term infection with more costly consequences that is discovered and treated three years after contracting the pathogen.

A recent study of sexually exploited girls in St. Paul, Minnesota who participated in the RIP program found that 55% tested positive for Chlamydia at enrollment (L. D. Edinburgh &

Saewyc, 2009) and had likely contracted the infection during the preceding year.[20] The girls were tested whether they had symptoms or not. We use this proportion as an annual probability of incidence during active sex trading. We rely on the previously cited epidemiological research to support two further assumptions that allow us to convert this into annual rates of harm. We assume that 25% of cases will be discovered and treated in the year of infection and that another 25% of the cases are discovered and treated three years after infection and require more extensive medical attention because of health complications such as sequaelae and PID. The remaining cases are assumed never to be discovered and so not treated. Thus in both cases the quantity of this harm is 0.55/4 = 0.1375, but in the long term variant this appears with a three year lag. This approach seems to us conservative in that we presume that half of the infections by Chlamydia result in no harms at all.

Estimates of unit costs come from The Minnesota Chlamydia Partnership (2011). The Partnership estimates that one case of Chlamydia costs $108 to treat, and cases that involve sequaelae and/or PID cases cost $1334. As these are 2011 estimates, we use them directly in the model. Chesson, et al. (2004) calculate average productivity losses for untreated Chlamydia at $130, and for cases that resulted in PID the loss is estimated at $649. However, these productivity losses are not direct costs to governments in Minnesota and are excluded from our calculations.

Pregnancy

Reliable data on pregnancy and sex trading among adolescents are not available, but several studies provide some direction. One study found that 50% of adolescents who trade sex have had at least one pregnancy (Deisher, Farrow, Hope, & Litchfield, 1989). Some of these result in

[20] Personal communication with Laurel Edinburgh, M.S., P.N.P., R.N.C., Midwest Children's Resource Center, Minnesota Children's Hospital, St. Paul, Minnesota (26 February 2012).

elective abortions. A study of adult women involved in prostitution in the Twin Cities by Parriot (1994) found that 25% of pregnancies resulted in elective abortion. Martin et al. (2010) found that over 50% of the adult women who traded sex as adolescents had at least one live birth while involved in sex trading. A very recent study of sex trading among women attending family planning clinics in Northern California found an increased rate of unintended pregnancies and almost double the rate of abortions among the 8.1% of their sample who had traded sex compared to the women who had not traded sex (Decker et al., 2012). Yet it is difficult to determine how many unintended and unwanted pregnancies directly result from transactional sex.

However, whether a pregnancy occurred as the result of transactional sex or not, evidence suggests that sex trading has ramifications in the child welfare system. Early prevention of sex trading or intervention that restored female adolescents to a normal developmental trajectory would help women avoid unwanted pregnancy and child welfare burdens. These welfare issues are addressed below. In this section we consider only the medical costs of pregnancy results: live births or abortion.

If we use the Deisher et al. finding (50%) as the cumulative likelihood of becoming pregnant and assume 4 years of trading, this implies an annual probability of becoming pregnant at 0.16.[21] We will presume that half of these pregnancies result in abortions and the other half in live births. As the governmental burden of a live birth and subsequent child dependency is a much higher cost, our assumptions here are conservative in that field research suggests a smaller proportion end in abortions.

[21] This estimate captures pregnancies prior to age 18.

The costs for an abortion in the Midwest range from $520-790 depending on the length of pregnancy and procedure type. The unit cost we use is an average cost of abortion: $635.[22] We assume this is an estimate for 2011 and use it directly in the model. A recent study conducted by the Brookings Institution, Center on Children and Families, estimated the average cost to the tax payer of unintended pregnancy using 2008 dollars. They found the public cost of a birth, including limited prenatal care and delivery, to be between $5070 and $8,697, with $7,171 as an average (Monea & Thomas, 2011), p. 89). This average is the unit cost we use for live birth. This figure is reasonable in a Minnesota context, as the Minnesota Council of Health Plans found that the cost for a "perfect" pregnancy with prenatal care and uncomplicated vaginal birth in 2003 was $8,751 on average.[23] We use the average of the Council of Health Plans estimate and the middle figure from Monea and Thomas (2011) as the cost of a live birth: $7,960. Inflating this to 2011 dollars results in $8,493.

Monea and Thomas (2011) also found that a year's worth of medical care for an infant on Medicaid costs $6,100. We only include medical costs for infants during the first year. This cost is added to the cost of live birth for a total unit cost of $13,271 for pregnancy that results in live birth. The Monea and Thomas cost data are for 2008, so converting this to 2011 dollars results in $13,855.

Mental Health Harms

Victims of child sexual abuse experience much higher rates of mental health problems (Browne & Finkelhor, 1986). Youth engaged in sex trading are likely to experience many of the same short and long-term mental health issues. Research on runaway adolescents suggests that they experience much higher rates of mental illness than their peers. Furthermore, runaway

[22] Midwest Health Center. http://www.midwesthealthcenter.org. July 18, 2011.
[23] Minnesota Council of Health Plans, 2005 "How much does it cost, 2005," accessed online March 15, 2012.

adolescents are more likely to become chemically dependent and to have more depressive symptoms as they become young adults (Tucker, Edelen, Ellickson, & Klein, 2011). A preponderance of research evidence indicates that sexual exploitation and sexual abuse of children cause high rates of severe mental health problems (Browne & Finkelhor, 1986; Estes & Weiner, 2001; E. Saewyc et al., 2008; E. M. Saewyc & Edinburgh, 2010; Willis & Levy, 2002; Yates, MacKenzie, Pennbridge, & Cohen, 1988). It is quite clear that sexual, physical and emotional abuse, which often accompany sex trading, have negative impact on the mental health of adolescents and that this impact lasts well into adulthood.

However, the research literature does not contain sufficient data for us to estimate the probability of incidence for individual mental health harms that can be directly attributable to sex trading by female youth. This would be a purely speculative exercise. Nor does the literature provide figures on treatment costs. Mental illness tends to be under treated, which implies that, compared to physical illness, even less of the cost of these harms is borne by the public budget. Thus we are not able to directly include these harms in the model. At the same time, we recognize that compromised mental health is ubiquitous among youth who trade sex and sometimes leads to a series of harms including: low educational attainment, difficulty maintaining legitimate employment, reduced income, homelessness, and substance abuse. Such personal difficulties place fiscal burdens on government in the form of income support, reduced income tax revenue and expenses for substance abuse programs. Some of these are identified below and included in the model, but we exclude any direct public burden for mental health damages other than those associated with incidents of assault, which are described above in the section on violence.

Chemical Dependency

While it is clear that trading sex is associated with substance abuse and chemical dependency (Jody M. Greene, Susan T. Ennett, & Christopher L. Ringwalt, 1999; J. Raphael & Shapiro, 2004; E. M. Saewyc & Edinburgh, 2010; Surratt et al., 2004; Weber, Boivin, Blais, Haley, & Roy, 2002), the causal relationship is hotly contested in the literature. A study by one of the authors found that sex trading typically pre-dated substance use for adult women who first trade sex as a minor (Martin et al., 2010). Likewise, a large study in Vancouver Canada found that whether or not substance use predated sex trading, the onset of sex trading accelerated the use of drugs. They also found that sexually exploited youth were more likely to use psychoactive drugs than non-sexually exploited youth (E. Saewyc et al., 2008).

We include a harm of chemical dependency in our model. Many studies report that the rate of chemical dependency and substance use among sexually exploited girls is at least 50% (Curtis et al., 2008; J M Greene, S T Ennett, & C L Ringwalt, 1999; E. M. Saewyc & Edinburgh, 2010; Weber et al., 2002). We use this to identify a 0.5 cumulative probability that an adolescent will become chemically dependent across 4 years of trading sex. We assume that the dependency will result in one instance of treatment. This cumulative probability implies an annual likelihood of dependency at 0.16. Many studies show that individuals who continue trading sex into adulthood are even more likely to become chemically dependent as they age (Dalla, 2006; J. Raphael, 2002; J. Raphael & Shapiro, 2004). We estimate that continued trading raises the 4-year cumulative probability of chemical dependence to 0.75.[24] This implies an annual likelihood of incidence at 0.29 for youth who trade sex into adulthood. We apply this higher annual probability to years 7 to 12 of a sex-trading trajectory (thus it does not apply to cohort groups 1

[24] Our study does not encompass women who first traded sex as an adult. The relationship between sex trading and substance use may be different for adult women who first traded sex as adults (Martin et al., 2010).

through 3) while we use the lower annual probability for the first 6 years of a trajectory. As with the earlier years, we presume that an incident of chemical dependency will result in one treatment. Although not all who become chemically dependent will undergo treatment, we believe our assumption of only one treatment is conservative because relapse is common and many people undergo more than one treatment, some as many as twelve.

A group of graduate students from the University of Minnesota, Humphrey Institute conducted a return on investment study of the PRIDE Program of the Family Partnership in Minneapolis, including costs associated with chemical dependency treatment; the program supports adolescents and women who trade sex with advocacy, case management and supportive services (Cunnigham, Klauber, & Sylvain, 2006). They found that typical treatment costs $117 a day for 90 days, which totals $10,534 per instance of treatment. Additional costs include a chemical health assessment ($92) and aftercare, which they estimate costs $23,169 per year. This includes case management, attendant mental health services, transportation, child care if needed, and transitional sober housing. All these elements sum to a unit cost of $33,795, which becomes $37,102 in 2011 dollars.

Law Enforcement

In the mid 1980s Pearl reported that around 40 percent of public money spent on prostitution control was spent on law enforcement (Pearl, 1987). Law enforcement costs related to arrest, trial and corrections for prostitution charges can be directly attributed to sex trading. However, juveniles are rarely charged for prostitution in Minnesota. This will become even less likely in the future as many county prosecutors publicly stated that they will no longer charge juveniles with prostitution.[25] Most law enforcement costs directly related to sex trading result from arrest

[25] Statements reported in *Minneapolis Star Tribune*, February 26, 2011, "Teen Prostitutes Get New Status," http://www.startribune.com/local/east/116933628.html.

and conviction of females who continue trading sex into adulthood.[26] We presume that juveniles may be arrested and then released once their age is determined, so our model includes the cost of arresting them.

Our assumptions on trajectories imply that two thirds of a cohort of female adolescents will continue sex trading into adulthood if they start at age 14. Thus several additional criminal justice costs are relevant. Yet we know that not all women who trade sex into adulthood are arrested for prostitution (Martin et al., 2010; Shaver, 2005; Weitzer, 2005). A recent study in Minneapolis found that only one-third of its community-based sample of adults who traded sex had ever been arrested for prostitution. Analysis of criminal justice data in Hennepin County (the location of Minneapolis) provides some guidance on arrests and convictions among women who have been arrested for prostitution. Among women convicted of prostitution in 2006 the lifetime average number of arrests per person was six.[27] Women on probation for prostitution have an average number of two probation supervision entries.[28] A woman who is incarcerated for prostitution will spend an average of six months in jail (Cunnigham et al., 2006). (Table A5in the Appendix provides estimates of the criminal justice cost imposed by a typical individual who is convicted of prostitution.)

These observations do not provide precise estimates of law enforcement harms to include in the model, but they do inform reasonable estimates. We rely on the Minneapolis study that showed 33% of women trading sex had been arrested for prostitution. If we assume an average 7 year trajectory for the group, this implies a probability estimate of 0.05 as the likelihood of being

[26] It is quite likely that adolescents who trade sex have law enforcement contact related to other activities, including drug use, curfew and truancy violations, and shop-lifting (Curtis et al., 2008; Green et al., 1993; Tyler, 2009). However, it is not possible to directly attribute these costs to sex trading, so we exclude them.

[27] Data analysis conducted in conjunction with the GIFT Research Project, research conducted with GIFT a probation approach to prostitution in Hennepin County. Data provided to L. Martin by Julie Rud, Manager, Office of Policy, Planning and Evaluation, Hennepin County Department of Community Corrections and Rehabilitation in an email dated 11/26/07.

[28] Julie Rud, personal communication

arrested in any given year. For women 18 years and older, we presume that each arrest results in a court appearance, conviction and sentencing to either a jail term or probation. We assume that 2/5 of convictions result in a jail sentence of 183 days, and that 3/5 of convictions result in probationary supervision. Applying these shares to the arrest probability, the annual expected value of days in jail is 3.66, and the expected value of probation is .03.

Each arrest takes a considerable amount of police time. The process includes: obtaining a solicitation, making the arrest, transporting the arrestee to the police station, confirming identification, completing reports and testifying in court (Pearl, 1987).[29] In a prostitution case police spend on average three hours, typically working as a team of two. At $50 an hour, adding operation and maintenance for a squad car, and participation of other personnel and facilities, Cunningham et al. (2006) estimate that an average arrest costs $2000. This figure has been criticized as too high. However, an arrest event involves further steps of processing and evaluation that require public resources. We use the estimate of $2000 as the unit cost for arrest, noting that this harm involves more than mere apprehension.[30] Transforming into 2011 dollars, this unit cost becomes $2,196.

Arraignment costs include district court operation costs, judges, clerks (judicial and law), court reporters, interpreters and psychological services. In 2004 overall court costs ranged from $98 to $244 per offender depending on the charge.[31] Cunningham et al. (2006) found that the cost of arraignment and court appearance per prostitution arrest averaged $176 and required public defender fees of $351. We combine these to use $527 as the unit cost for a court

[29] Also validated by personal correspondence with Lt. Nancy Dunlap, Sex Crimes Unit, Minneapolis Police Department, email dated June 16, 2011.
[30] We thank Devere Woods of the Indiana State University Department of Criminology and Criminal Justice for these insights.
[31] Julie Rud, Policy, Planning and Evaluation Manager, Department of Community Corrections and Rehabilitation, Hennepin County, personal communication via email, June 3, 2011.

appearance, assuming that all arrests are processed like this. This is a conservative estimate because these figures do not include the cost of failure to appear, issuance of bench warrants, judicial reviews and other incidental court costs. In 2011 dollars, this cost is expressed as $579.

Post-adjudication costs must also be considered. Incarceration in jail costs about $90 per day in Hennepin County.[32] We use this as the unit cost and assume it is already expressed in 2011 dollars. Some cases result in probationary supervision rather than a jail sentence. Women convicted of prostitution can be referred to differing levels of probation supervision, depending on the charge and prior history.[33] The main costs include a probation officer's salary at $45.52 an hour and associated administrative support. Cunningham et al. (2006) estimated the average cost for a probation sentence in Hennepin County at $807. We use their estimate as a unit cost for a standard sentence to probationary supervision and convert it to 2011 dollars as $886.

Social Welfare Programs

The literature identifies numerous social welfare programs that produce expenditures related to harms caused by adolescent sex trading. These include child protection, medical assistance and income support.

Child Protection Expenditures

Many adolescents and women who trade sex are mothers of young children during their trajectory of trading sex. Public intervention in the interest of child protection may impose costs on government budgets for foster care and adoption. An arrest with incarceration makes the need for foster care even more likely. A recent study of sex trading in Minneapolis found that 75% of women with children did not live with their children, thus imposing public costs for child

[32] Marcy R. Podkopacz, Ph.D., Director of the Research Division and Business Practice Unit, Personal communication, June 3, 2011.
[33] J. Rud and L. Martin, "GIFT Research Project: AFS Historical Prostitution Supervision Approaches," May 2010, report for Hennepin County, Department of Community Corrections and Rehabilitation.

welfare (Martin et al., 2010). On average, women in the study had two children. While many teens and women who trade sex eventually lose custody of their children, this does not usually happen until the child is over one year of age. We include estimates of the cost of foster care as a harm, but not the cost of adoption. The larger element from the public perspective is the subsidy for foster care.

Although we have an estimate from the Martin et al. (2010) study that informs the likelihood of losing custody, it is not clear how many women who trade sex actually have children. To provide a reasonable estimate, we use the cumulative likelihood of a live birth to a member of the cohort (based on an annual probability of 0.08) and adjust this downward by half to account for adoptions. Using the cumulative probability reflects the increased likelihood that a child will be placed in foster care when the cohort member trades sex over a longer trajectory. (We do not explicitly analyze prospects of a sex trader having more than one child that would go into foster care.) As with the HIV/AIDS harm, a distinct time profile is required for each possible trajectory. We assume further that 75% of the children not adopted would go into foster homes (based on Martin et al., 2010), that custody loss would occur only after the first year, and that foster care would prevail only during the mother's trajectory of active trading. That is, we assume children sent into foster care are returned to the mother after she ceases sex trading activity. We recognize that this is not always the case, but these assumptions make our cost calculations conservative. Accounting for more extended periods of foster care would impose greater burdens on the public than we include. Our assumptions effectively truncate the time profile of this harm at year 12.

Minnesota Department of Human Services releases daily maintenance and difficulty of care subsidy rates by age to be paid for out-of-home placements (Minnesota Department of Human

Services, 2010). Daily rates in 2011 were: $20.69 for children 0 to 11 years; $23.90 for children 12-14; and $24.63 for children 15-20. There is also a one-time initial clothing allowance rate per out-of-home placement for each age category: $417, $705, and $798. The State also pays an additional daily rate based on a "difficulty of care" assessment. Given the unfavorable circumstances for many of the children of women who trade sex, it is more likely that the higher rates will apply in comparison to the general population of children. Since we have no direct information on the "difficulty of care" status of such children, however, we ignore this special subsidy. Given the young age of the target population and our assumptions on trajectories, only the first subsidy rate category is relevant. Thus the unit cost for this harm comes to $20.69 x 365 = $7,552. We add the $417 clothing allowance for a total unit cost of $7,969 for foster care.

Reduced Earnings Potential

Involvement in sex trading may diminish an individual's earning potential across their lifetime, but the extent of such effects depends on the details of their experience. Factors in play here include low educational attainment, health and mental health issues that may cause disabilities, criminal record, and lack of job skills. Aside from the criminal record, these factors are related to the physical and psychological damages that female youth incur from sex trading, particularly in the venues with which we are concerned. In addition to these long run effects, earnings in legitimate employment may be reduced because a woman is using her time in sex trading across the period of her trajectory. Diminished earnings impose a burden on the public budget in two ways: increased need for income support and reduced tax revenue from earnings in the formal economy.

Research has shown that sex trading activity and earnings in the formal economy are inversely correlated. Martin et al. (2010) collected earnings and employment information from a

sample of adult women active in sex trading in Minneapolis (n = 117). In this group 66% had earned less than $10,000 in the year preceding the survey (2005) and 89% were not employed in the formal economy at the time of the survey; most lived in extreme poverty. Although not reported in the published study, the rates of public assistance provided to people in their survey was very high. In other research Parriott (1994) found that 74% of females who were trading sex received public aid during the time they were actively trading sex. Causality, however, can run in both directions. The search for income often drives women into sex trading.

The time profile for the harm of diminished earnings could extend across the life span of the individual. However, we have no research to use in quantifying this connection, so we cannot incorporate these harms into our model without completely arbitrary assumptions. But exclusion pushes our estimates toward understating the benefits of reducing sex trading by an intervention program. Finding a way to incorporate these earnings issues would strengthen the case supporting such investment.

Reduced Income Tax Revenue

We have included the harm of reduced earnings in a limited way, using reasonable assumptions based on the field research of Martin et al. (2010). The specific harm is reduced income tax revenue that can be linked to sex trading activity. The essence of our calculation is to find a difference between what a female youth would earn in legitimate work if she were not engaged in sex trading and what she might be earning in legitimate employment while also trading sex. The difference in income tax revenue is our measure of the harm. The time profile extends only across the trajectory of sex trading, and we also assume individuals enter the labor force at age 16, the standard for labor statistics. Thus this harm is irrelevant to cohort group 1, which has ceased trading sex by age 16.

In their survey (conducted in 2006), Martin et al. asked respondents about annual income levels (M) in brackets: $M \leq \$10{,}000$; $\$10{,}001 \leq M \leq \$20{,}000$; $\$20{,}001 \leq M \leq \$30{,}000$; and $M > \$30{,}000$. If we apply the shares of their sample declaring incomes in each bracket and assume the midpoint of each bracket as average for that group, and set the top bracket average income at $35,000, we calculate an average income for the group at $11,241. It is not clear from the survey whether the respondents were reporting only legitimate income or all forms. We will assume this to be legitimate income and thus taxable, an assumption that errs on the side of understating the harm of reduced tax revenue. We need to compare this with an estimate of what women in this demographic group potentially earn were they not engaged in sex trading. Since the data we rely on for the two income estimates are from different years (2006 and 2010) we adjust them to 2011 dollars using the U.S. GDP deflator. Thus income of $11,241 in 2006 dollars is adjusted to an equivalent of $12,341 in 2011 dollars.

We calculate potential earnings using data from the Bureau of Labor Statistics (U S Bureau of Labor Statistics, 2011) on median weekly earnings by educational attainment combined with data on educational attainment for women in Minnesota aged 18 to 64 (U.S. Census Bureau, 2012). Among this group of women, 39.5% had attained a college degree, 54.1% had only reached a high school diploma, and 6.6% had not achieved a full high school education. Among the demographic group targeted by the intervention policy, it is certainly possible for some to be successful in completing higher education, but it is likely that the proportions in these three categories of attainment will be skewed toward less achievement. To remain conservative in our calculation of this harm, we will assume their educational attainment is limited to high school or less. Using the proportions cited above, we calculate that about 89% (i.e. 54.1/60.7) would complete a high school education and 11% (i.e. 6.6/60.7) would not. Median weekly earnings in

2010 are reported at $626 for workers with a high school diploma and $444 for those with less than a high school education (U S Bureau of Labor Statistics, 2011), (p. 8). Assuming a work year of 50 weeks implies annual earnings of $31,300 and $22,200 for each group. Finally, applying the weights of 89% and 11% we reach an estimate of average annual earnings at $30,299. Adjusting this to 2011 dollars we have $30,937.

Minnesota has three income tax brackets, but at the relevant level of income only two rates apply: 5.35% on income up to $23,670, and 7.05% on income between $23,670 and $77,730.[34] We assume filing status as single and not head of household. Since we are looking at the increase of earnings over a baseline, the standard deduction used in Minnesota is not relevant. Thus our calculation of tax revenue not received due to sex trading is:

$$HarmTxR = 0.0535 \times (\$23{,}670 - \$12{,}341) + 0.0705 \times (\$30{,}937 - \$23{,}670) = \$1{,}118.$$

Summary Comments on Harms and Their Values

Any attempt to calculate the value of harms from sex trading is fraught with uncertainty and inaccuracy. This applies to both quantifying the harms (H_{jgt}) as well as establishing unit costs (V_j). Table 1 summarizes our results from this effort, which are incorporated into our benefit calculations presented in section 5. The harm profiles that are shown in this table represent the case for an 8-year trajectory of sex trading that begins at age 14. The computational model contains five additional trajectory representations. Many assumptions and rough estimates are involved in reaching these results, and we admit a high degree of uncertainty in the outcomes. We have tried to explain clearly how we arrived at these estimates, all of which are based on

[34] Rates and brackets from Minnesota Revenue website: http://taxes.state.mn.us/individ/pages/residency_and_filing_status_filing_requirments_for_individuals_inctxrates.aspx

empirical studies. That said, we welcome critical information on both method and evidence that may improve the model.

Where choices had to be made regarding larger and smaller figures, we have chosen in a way to understate the benefit calculation of our project. For example, we know that physical, psychological and legal harms from sex trading also reduce earnings potential and thus burden the public budget through increased income support. We have excluded this from our calculations. We expect that some adolescent females in the target population may earn college degrees, but we assume not. This approach of conservatism in claiming benefits from an intervention policy strengthens any conclusions that such a policy passes a benefit-cost test and casts doubt on a conclusion that it fails such a test.

Table 1. Summary of Harms Descriptions - Assumes 8 Year Sex Trading Trajectory Starting at Age 14

Class and Type of Harm	Unit of Measure (expected values)	Estimate of Unit Cost ($)	Time Profile (d)	Harm Quantity Year 1	Year 4	Year 8	Year 11	Year 12
Public Health Expenditures								
Injury from Assault								
Minor (a)	prob. of incidence	4,433	During trajectory	0.20	0.20	0.20	0	0
Major	prob. of incidence	64,174	During trajectory	0.05	0.05	0.05	0	0
PTSD	prob. of incidence	6,159	During trajectory	0.05	0.05	0.05	0	0
STI's								
Chlamydia-early treatment	prob. of incidence	108	During trajectory	0.138	0.138	0.138	0	0
Chlamydia-late treatment	prob. of incidence	1,334	During trajectory w/ 3 yr lag	0	0.138	0.138	0.138	0
HIV/AIDS	prob. of infected state	27,309	Persists until death at age 44	0.014	0.055	0.107	0.107	0.107
Pregnancy with abortion	prob. of incidence	635	During trajectory	0.08	0.08	0.08	0	0
Pregnancy with birth (c)	prob. of incidence	13,855	During trajectory	0.08	0.08	0.08	0	0
Chemical dependency	prob. of incidence	37,102	During trajectory	0.16	0.16	0.29	0	0
Criminal Justice Expenditures								
Adolescents: Arrests	prob. of incidence	2,196	During trajectory	0.05	0.05	0	0	0
Adults								
Arrests	prob. of incidence	2,196	During trajectory	0	0	0.05	0	0
Court hearings	prob. of incidence	579	During trajectory	0	0	0.05	0	0
Incarceration	days	90	During trajectory	0	0	3.66	0	0
Probation supervision	no. of sentences	886	During trajectory	0	0	0.03	0	0
Child Foster Care Expenditures	child-years	7,969	During trajectory	0	0.083	0.166	0	0
Forgone Income Tax Revenue	dollars	1	During trajectory after age 18	0	1,118	1,118	0	0

Notes:
(a) Minor injuries require medical attention but no hospitalization.
Major injuries require hospitalization.
(b) Assumes trading starts at age 14 and adult treatment under law enforcement begins in year 5.
(c) Includes public expense for prenatal care, delivery, postpartum care and infant Medicaid cost for first year of life.
(d) During trajectory means the harm is incurred when the individual is active in sex trading.

Case Study of Multiple Harms

Because our quantification of harm values is complicated by their variety, probabilities and time profiles, we also present a constructed case study of the public cost of harms imposed by an individual adolescent who experiences many of harms included in our model. This provides readers with useful perspective to help in understanding our results in section 5. Our case study

seeks to be compatible with respect to the published literature by describing an experience that is fairly typical. It is also shaped by one of the author's field research. Rather than the composite individual of our model, we specify a trajectory and experience of harms as follows.

We presume an adolescent who trades sex from age 14 through age 26 (12 years). In the public health category we assume the following: one episode of minor assault per year; one episode of major assault during the 12 years, which requires hospitalization; diagnosis and treatment for PTSD; contraction of Chlamydia with late treatment; three pregnancies with one abortion and two live births; and two chemical dependency treatments, one as an adolescent and the second as an adult. We assume the individual does not become infected with HIV. In the criminal justice category we presume six arrests, six court proceedings, two probation referrals, and six months in jail. Finally, we assume twelve child-years of foster care payments, as well as lost tax revenue across 10 years at the annual average used in the model. Calculations of the public expenditures required to address these harms is presented in table 2. The total burden across this individual's trajectory comes to $354,165 (undiscounted).

Table 2. Calculation of Harm Values for Constructed Case Study

Public Health Expenditures	*Unit Type*	Cost/unit ($)	#/units	Total cost ($)
Injury from Assault				
Minor (a)	treatment	3,209	12	38,508
Major	treatment	64,174	1	64,174
PTSD	treatment	5,900	1	5,900
STI: Chlamydia-late treatment	treatment	1,334	1	1,334
Pregnancy with abortion	procedure	635	1	635
Pregnancy with birth	medical care	13,855	2	27,710
Chemical dependency	treatment	37,102	2	74,204
Criminal Justice Expenditures				
Arrests	number	2,196	6	13,176
Court hearings	number	579	6	3,474
Incarceration	days	90	183	16,470
Probation supervision	cases	886	2	1,772
Child Foster Care Expenditures	*Child-years*	7,969	12	95,628
Forgone Income Tax Revenue	*annual revenue*	1,118	10	11,180
Total (across 12 years, undiscounted)				**354,165**

Section Four:
Program Costs

The cost side of our benefit-cost analysis identifies the public resources required to operate an intervention program. This is *IC* in our model notation. The Safe Harbor for Youth Act recently enacted by the State of Minnesota envisioned three primary components to a statewide intervention model: identification of adolescents who are at risk for, or are currently, trading sex; screening and referral to appropriate programs; and program services to match level and type of program needed (this includes program intensity and possible cultural considerations).[35] There are many exemplary intervention and prevention programs in the State of Minnesota that address sex trading among adolescent females. For this paper we review the Runaway Intervention Project (RIP) developed by Ramsey County, Minnesota. This initiative was selected because it closely matches the criteria laid out in the Minnesota Safe Harbor for Youth Act, and we have published evaluation results and program descriptions, as well as cost data from program managers.[36] We use the experience of this program to inform the cost side of our analysis. We supplement this with cost information on housing provided by the Homeless Youth Services Coordinator for Minnesota to arrive at a central estimate for cost per person served by an intervention program.

[35] The Safe Harbor Youth Intervention Project (SHYIP) was initiated by Sexual Offense Services of Ramsey County, Ramsey County Attorney's Office – Juvenile Division, and Midwest Children's Resource Center as a pilot project funded by the Minnesota Legislature (S.F. 2915). Its goal was to promote coordination and communication among key stakeholders in the county (Safe Harbor Youth Intervention Project, Report to the Legislature, January 8, 2008). See also, Edinburgh et al., 2012.

[36] In addition to published sources we rely on personal communications with the following program staff: Laurel Edinburgh, Midwest Children's Resource Center, Children's Hospital, nurse practitioner and researcher with the Runway Intervention Project; Elizabeth Saewyc, program evaluator for RIP, University of British Columbia School of Nursing and Division of Adolescent Medicine, Vancouver, Canada; and Kathryn Richtman, Ramsey County Attorney's Office, RIP documents provided on December 9, 2011.

Description of RIP Program

RIP is a public health, systems approach that seeks to reestablish a healthy developmental trajectory for female adolescents who are at risk for sexual exploitation (or have experienced it) related to running away from home and truancy from school. RIP focuses on girls aged 15 years and younger. The program seeks to stabilize runaway youth within their families of origin, although that is not always possible. It provides services through screening, referral, and levels of programming based on need. At risk and exploited adolescent females are identified by law enforcement, school staff, social workers and others in the course of ongoing duties and referred to RIP. The program has been in operation for five years, and evaluation results have been published in peer reviewed journals (E. Saewyc et al., 2008; E. M. Saewyc & Edinburgh, 2010). RIP is the only example of a comprehensive systems approach to remediate experience and risk of sexual exploitation among runaway and homeless adolescent females in the State of Minnesota. RIP is for young adolescents and provides services specific to sexual exploitation. It does not provide all the services that adolescents may need as they age into early adulthood, such as job training and chemical dependency treatment). Nor does it provide housing for those adolescents who cannot be unified with their families. We therefore add consideration of the cost of housing to our model (see below, p. 60).

RIP has four primary components. The first is screening and referral that provides initial assessment and places the individual in an appropriate level of programming. The second is the County Attorney's Truancy Intervention Project (TIP), a county program designed to improve school attendance and family connectedness. This component is used with girls deemed to be at low to moderate risk for sexual exploitation. A third component is for girls deemed at moderate

risk for sexual exploitation, running away and other risky behaviors. They are referred to empowerment support groups offered through Sexual Offense Services (SOS).

The fourth component is for girls who have already experienced some form of sexual exploitation or are at great risk of experiencing sexual exploitation and are at high risk for running away. These youth are referred to intensive intervention services provided through the Midwest Children's Resource Center (MCRC). Because family unification is one of the goals, RIP does not serve girls who are victims of family abuse. These girls are referred to Child Protective Services. Similarly, girls whose families are homeless are referred to other services within Ramsey County (E. Saewyc, 2011).

Most RIP referrals were runaways with significant disconnection from school who had not experienced sexual exploitation and/or abuse and were served by parts two and three of the program. Program evaluation results for part four, the intensive component, of RIP suggest that the program offered through MCRC is highly effective at intervening with girls who have experienced high levels of sexual exploitation including rape, sex trading and trafficking. In fact, program evaluators report a 96.7% overall effectiveness rate at intervening in and preventing further sexual exploitation.[37] The intensive program in RIP reduces risk factors known to inhibit healthy development and increases protective factors known to promote healthy adolescent development and remediate trauma (E. M. Saewyc & Edinburgh, 2010). The intensive services provided by RIP essentially seek to remediate many of the "harms" we describe above. This type of programming is likely to be similarly successful with the target population envisioned by the Minnesota Safe Harbor for Youth Act. Unfortunately, we do not have evaluation or effectiveness data for the less intensive components of RIP. We therefore do

[37] Personal communication, evaluator Dr. Elizabeth Saewyc, University of British Columbia, Vancouver, Canada, April 6, 2012.

not know if this portion of the program effectively dissuades and preventions female adolescents from engaging in sex trading.

Cost Estimates

Because our conceptual framework is based on a representative individual, we calculate the cost per participant for RIP using a weighted average of the intensive and less intensive components. We assume that the intervention requires one year, so costs are expressed in annual terms. Some of the work of RIP is conducted by government agencies and community non-profits that are already operating in Ramsey County. This includes the Saint Paul Police Department (SPPD), the Ramsey County City Attorney's Office, school staff and others. Ramsey County uses a shared community-wide protocol for identification and approach to adolescents who trade sex or are victims of sexual exploitation (L. Edinburgh, Huemann, Richtman, Marboe, & Saewyc, 2012). We do not include a pro-rated portion of their costs, but it is reasonable to assume that they would be operating with or without RIP in place and so their contribution to RIP programs is modest.

We derive cost estimates for RIP based on cost information from 2010 provided by the Ramsey County City Attorney's Office, published estimates of cost, and numbers of clients served at each level of RIP. Government is a vital supporter of RIP operating costs. The contribution in 2010 was $318,023.[38] According to published sources, the intensive component of RIP costs between $2,500 and $3,000 per client in a one-year program (E. M. Saewyc & Edinburgh, 2010). We adopt the high end of this range for use in our model.

In 2010, out of 1,637 runaways identified in Ramsey County, 509 were deemed eligible for RIP after screening and enrolled in some aspect of the RIP model (E. Saewyc, 2011), (p. 2).

[38] Personal communication, Kathryn Richtman, Ramsey County Attorney, personal communication, December 12, 2011.

Of those 49 were referred to MCRC for intensive services. In addition, 24 youth who had been referred to MCRC late in 2009 received approximately six months of intensive RIP at MCRC during 2010. Thus, in 2010 the intensive component of RIP cost approximately $183,000.[39] That leaves approximately $135,023 to be divided among the remaining 460 RIP clients in 2010.[40] So, lower intensity elements of RIP cost approximately $295 per client. These figures include the cost of screening and referral.

Each RIP client who is referred to the intensive program requires a comprehensive medical evaluation that costs between $125 and $400.[41] Other clients receive a medical exam in some cases, but not all. The staff of RIP is of the opinion that a medical exam should be standard for all clients of such a program, so we will represent such a cost in our model and set this at the midpoint of the range cited: $262. Thus a client referred into the intensive component costs $3,262 to serve while clients served by the other components cost $557 each.

Approximately 10% of clients referred for RIP services required the intensive component of the program. Applying this weight to calculate an average cost, we have $828 per client-year for a representative individual. Adjusting this to 2011 dollars brings the cost to $845.

This does not include provision of housing for program clients, which adds much more to the cost. Most clients served by RIP do not require housing because they are reintegrated with their family. But much of the target population for the Safe Harbor for Youth Act are homeless, and the expense required to provide shelter must be considered in our model for youth who cannot or will not be reunited with their families. If Minnesota social policy broadly intends to provide shelter to adolescents, then housing costs are not properly a component of the

[39] 49 clients x $3,000 for one year of RIP = 147,000. 24 clients x $1,500 for six months of RIP = 36,000.
[40] The total program cost in 2010 of $318,023 minus $183,000 equals $135,023.
[41] Personal communication with L. Edinburgh, January 24, 2012.

intervention program cost as they would have been born by the budget in any case. Yet it is not clear that all program clients would have received housing support from the state if they were not participating in the program. We avoid settling this issue by presenting estimates of net benefits both with and without the housing cost.

The Minnesota Department of Human Services provides three types of housing for youth: emergency shelter, transitional housing and permanent supportive housing. Each type has a different cost and is required in a different degree. In a statewide program, some of this need would be in rural areas and small towns, and some would be needed in urban areas, where it is more costly. However, we do not know the urban and rural proportions of the homeless youth in the target population. For purposes of our analysis we use urban cost figures derived from Hennepin and Ramsey Counties in the Twin Cities Metropolitan area. These will likely overstate the actual cost of providing housing in a state-wide program.

The Homeless Youth Services Coordinator for the State of Minnesota has provided cost estimates for each type of housing as well as an estimate of the proportion of homeless youth that would require each type.[42] Emergency shelter with 24-hour support services costs on average $160 per day per youth, and the average stay is 28 days. We presume that all youth served by the statewide model would require emergency shelter. The Coordinator estimates that around half of all homeless and runaway youth will require only emergency shelter before finding stable housing that does not require governmental subsidy. This is because some runaway youth are able to be reunited with their families, some may find other relatives or caring adults with whom to live, and some are referred to residential services for mental health and/or chemical dependency.

[42] Data produced for this report by Beth Holger-Ambrose, Homeless Youth Services Coordinator, Minnesota Department of Human Services, personal communication, February 14 and 15, 2012. Figures are for 2011.

Roughly half of homeless and runaway youth, therefore, will need additional housing support beyond emergency shelter. Transitional housing in the metro area costs on average $87 per day per youth[43], and permanent supportive housing in the metro area costs $51 per day per youth. The Coordinator estimates that approximately 35% of homeless youth will require transitional housing and 15% will require supportive housing. We assume one full year of housing support for half of program clients, with four weeks in the emergency shelter and the rest in one of the two latter forms. For the other half of clients only emergency shelter is provided.

While these assumptions imply a substantial housing cost (over 10 times the program intervention cost), the State of Minnesota only pays for a fraction of these housing support programs. In 2011 Minnesota contributed nothing to the budget for supportive housing, about 5.2% of the transitional housing budget, and about 8.4% of the emergency shelter budget. Applying these proportions to the three daily rates for housing cost, we have the following as the Minnesota share of the daily costs: emergency shelter, $13.39; transitional housing, $4.48; supportive housing, $0.0. If the federal subsidy is reduced, adjustments should be made. Either state funds would be increased or the extent of housing support diminished. For the purposes of our analysis, we assume federal programs continue as they were in 2011.

In sum, we have the following estimate for annual shelter cost for a representative individual: *Shelter Cost* = 28 x $13.39 + 337 x $4.48 x 0.35 = $903. This is already in 2011 dollars so needs no adjustment for inflation. Combining intervention programming and housing, we estimate the annual cost of the intervention program per client served will be approximately $1,748 with shelter cost included.

[43] This is the average of costs for two types of shelter service, a congregate site cost ($133.72/day) and a scattered site cost ($39.56/day). Information provided by Beth Holger-Ambrose, personal communication with L. Martin.

Section Five:
Quantitative Evaluation: Comparing Benefits with Costs

Because we presume that the intervention is a program of a one year duration, the present value of cost is simply the calculated program cost. Moreover, this cost is relatively certain, although we consider cost with and without the housing component. The benefit side of the analysis is more complicated. Table 3 shows estimates of the present value of benefits for one representative individual as a program client. We include sensitivity analysis with respect to discount rate and program effectiveness. As noted in section 2, the benefit calculations take into account the effectiveness of filtering youth into the program in order to induct participants who have potential to engage in sex trading and divert others. The calculations in table 3 assume 90% efficiency in filtering, which means the θ parameter is set at 0.77. (See appendix for details.) Benefit calculations also address the replacement problem, whereby dissuaded and prevented adolescent sex traders are replaced by new market entrants. Results in table 3 use our best estimates for market elasticities (demand: -2.0; supply 0.5), which result in a non-replacement coefficient, ρ, at 0.81.

Table 3. Model Results: Present Value of Benefits in $ per Client with Sensitivity Analysis

Discount Rate	Effectiveness Parameter					
	α = 1	α = .90	**α = .70**	α = .50	α = .30	α = .10
1.38%	93,541	84,187	65,479	46,771	28,062	9,354
2.38%	85,682	77,114	**59,977**	42,841	25,705	8,568
3.38%	78,933	71,039	55,253	39,466	23,680	7,893

Assumes: 90% filtering effectiveness and γ = 0.25, so that θ = 0.77.
Assumes: demand elasticity at -2 and supply elasticity at 0.5, so ρ = 0.81.
See section 2 or appendix for details. Best estimate in bold.

Across the rows we vary the discount rate, with the middle row being our central estimate of the rate. Top and bottom rows are calculated with rates one percentage point lower and higher respectively. Across the columns we vary the effectiveness of intervention, understood to be the proportion of cohort (Z x θ) that is dissuaded from engaging in sex trading. In the model notation this is the α parameter, and here we consider six values ranging from 0.10 to 1.0. The model program on which we base the cost estimates, RIP in Ramsey County, found an effectiveness rate of 96.7% for the intensive and most expensive component. But we do not have data to clearly articulate the effectiveness of the other aspects of RIP. Therefore we cannot specify a precise figure for α, so our approach is to consider a wide range of values. Discussion with the RIP staff indicates that on average they are successful with the less intensive intervention components as well. Taken together, setting α somewhere between 0.9 and 0.70 is a reasonable assumption. Following a conservative approach, we adopt $\alpha = 0.70$ as our best estimate. Combining it with the actual discount rate calculated from recent yields on Minnesota general obligation bonds, our best estimate for the present value of benefits is $59,977 per client.

Sensitivity to the discount rate is modest; with the lower discount rate returning benefit estimates 7% higher than the actual prevailing rate. The higher discount rate resulted in benefits 6% lower. This is not surprising because the major part of the benefits accrue during the period of active sex trading in years 1 to 12, which is not very far into the future. (The time profile of aggregate benefits is explored below.) Because all benefits are treated alike with respect to the effectiveness parameter, the present value calculations are simply proportional to α. Thus the benefit per client when $\alpha = .50$ is 71% of the value when $\alpha = .70$. (i.e. This is the ratio of the effectiveness coefficients: 0.5/0.7 = 71%)

Comparing the values in table 3 to our estimates of program cost per individual with housing included ($1,748) the results show that the program as modeled here passes a benefit-cost test in all cases. In the best estimate case the program returns about $34 in avoided harm for each dollar of investment. In the most pessimistic estimate in table 3, with the lowest program effectiveness (10%) and the highest discount rate, the estimates show return of about $5 for each dollar of cost. If we consider that some form of housing support would be provided even without the intervention program to dissuade sex trading, one could argue that the program cost exclusive of the housing component is the relevant comparison to make. Our estimate of this cost is only $845 per client, which implies that the program would return about $9 for each dollar invested even under the most pessimistic effectiveness assumption and highest discount rate.

Table 4 is structured similarly to table 3. Here we subtract the estimated cost per client from the benefits in table 3 to provide estimates of the net present value (*NPV*) per client. In the top part of this table we include housing costs in the calculation, while the lower part excludes these costs entirely. As discussed above, the actual net burden of housing cost on the Minnesota government imposed by an intervention program is likely somewhere between these two extremes. Even when the full burden of housing is included in program cost, however, for all levels of program effectiveness our estimates show a positive *NPV* per client. Given this outcome, we include the full state expense on housing as part of program cost in the other results presented below with our sensitivity analysis.

Table 4. Model Results: Net Present Value in $ per Client

Discount Rate	Effectiveness Parameter α = 1	α = .90	**α = .70**	α = .50	α = .30	α = .10
Part A: State Funded Housing Cost Included						
1.38%	91,793	82,439	63,731	45,023	26,314	7,606
2.38%	83,934	75,366	**58,229**	41,093	23,957	6,820
3.38%	77,185	69,291	53,505	37,718	21,932	6,145
Part B: No Housing Cost Included						
1.38%	92,696	83,342	64,634	45,926	27,217	8,509
2.38%	84,837	76,269	**59,132**	41,996	24,860	7,723
3.38%	78,088	70,194	54,408	38,621	22,835	7,048

Assumes: 90% filtering efficiency and $\gamma = 0.25$, so $\theta = 0.77$.
Assumes: demand elasticity at -2 and supply elasticity at 0.5, so $\rho = 0.81$.
See section 2 or appendix for details. Best estimate in bold.

Further Sensitivity Analysis

How sensitive are these results to other key parameters of the model? Table 5 presents further analysis with respect to our assumptions on filtering efficiency and market elasticities, which affect the non-replacement coefficient. These results are *NPV* calculations analogous to part A of table 4, while varying these other model parameters. We present calculations only for the central estimate of the discount rate (r = 2.38%) and our assumed value of 25% of the female youth population of concern having potential to become sex traders ($\gamma = 0.25$). Part A of table 5 assumes program effectiveness at 70 %, our best estimate. Part B presents the same NPV comparisons with program effectiveness lowered to only 50%, a very pessimistic assumption. The lowest figure here still shows a positive *NPV* per client with the most pessimistic assumption for filtering efficiency (10%) and market conditions that provide the most replacement of dissuaded adolescent females. Under these pessimistic assumptions the *NPV* remains positive until program effectiveness falls below 14% (i.e. $\alpha < 0.14$). Our conclusion that this program passes a benefit ~ cost test is quite robust to a range of values for these parameters.

Table 5. Sensitivity Analysis of *NPV* per Client

		Elasticities and non-replacement parameter			
	E_D	-2	-2	-1	-0.5
	E_S	0.2	0.5	0.5	1
Filtering Efficiency	$\theta \setminus \rho$	0.91	**0.81**	0.68	0.35
Part A: α **= 0.7**					
$\beta = 1.0$	1	85,761	76,145	63,643	31,909
β = 0.9	**0.77**	65,634	**58,229**	48,603	24,168
$\beta = 0.7$	0.53	44,632	39,535	32,909	16,090
$\beta = 0.5$	0.4	33,256	29,409	24,409	11,715
$\beta = 0.3$	0.32	26,255	23,178	19,177	9,022
$\beta = 0.1$	0.27	21,879	19,283	15,908	7,339
Part B: $\alpha = 0.5$					
$\beta = 1.0$	1	60,759	53,890	44,960	22,293
$\beta = 0.9$	0.77	46,382	41,093	34,217	16,764
$\beta = 0.7$	0.53	31,380	27,740	23,007	10,994
$\beta = 0.5$	0.4	23,255	20,507	16,935	7,868
$\beta = 0.3$	0.32	18,254	16,056	13,199	5,945
$\beta = 0.1$	0.27	15,129	13,274	10,863	4,743

Assumes full housing cost, $r = 2.38\%$ and $\gamma = 0.25$. Best estimate in bold.

Aggregate NPV Results

Table 6 presents our calculations for total *NPV* of the intervention program with the assumptions described in section 2 and in the Appendix with respect to the total number of participants. Both program and housing costs are included. Essentially this scales up table 4 results by the projected number of clients: $Z = 496$. Our best estimate for key parameters (interest rate, program effectiveness, filtering efficiency and market conditions that influence replacement) shows net return of $28.9 million in value to the public budget in Minnesota per year of intervention.

Table 6. Model Results: Aggregate Net Present Value ($1000s)

Discount Rate	Effectiveness Parameter					
	α = 1	α = .90	**α = .70**	α = .50	α = .30	α = .10
1.38%	45,530	40,890	31,611	22,331	13,052	3,773
2.38%	41,631	37,381	**28,882**	20,382	11,882	3,383
3.38%	38,284	34,369	26,538	18,708	10,878	3,048

Assumes: 496 clients in intervention program and same parameter values as in Table 4. Best estimate in bold.

Patterns of the Benefits

Given that the benefit side of this model is rather complex, it is useful to consider the information partly disaggregated. Figure 1 and table 7 show the pattern of benefits per individual client over the time horizon of the model. The graph and the third column of table 7 represent the present value of the harms avoided in each year aggregated across all types, using the middle discount rate, program effectiveness at 70% and other parameter values set as in table 3. This confirms a comment made above – most of the benefits accrue in early years. The gradual step down pattern follows from our assumption on trajectories, as 1/6 of the cohort falls out of sex trading every two years. The only harms extending beyond year 12 are long-term Chlamydia infection and HIV/AIDS.

Specific dollar amounts of aggregate benefit that underlie figure 1 are presented in table 7, which also shows aggregate benefit for other assumed values of program effectiveness. This table shows estimates of the annual budgetary savings to Minnesota governments that would result from reduced sex trading by the target group of our study on a per client basis. Given the estimated cost of intervention per client ($1,748), our estimates show that the program more than pays for itself in the first year of benefit except under the most pessimistic assumption of program effectiveness (i.e. 10%).

Figure 1. Time Profile of Aggregate Benefit per Client ~ Present Value; r = 2.3845

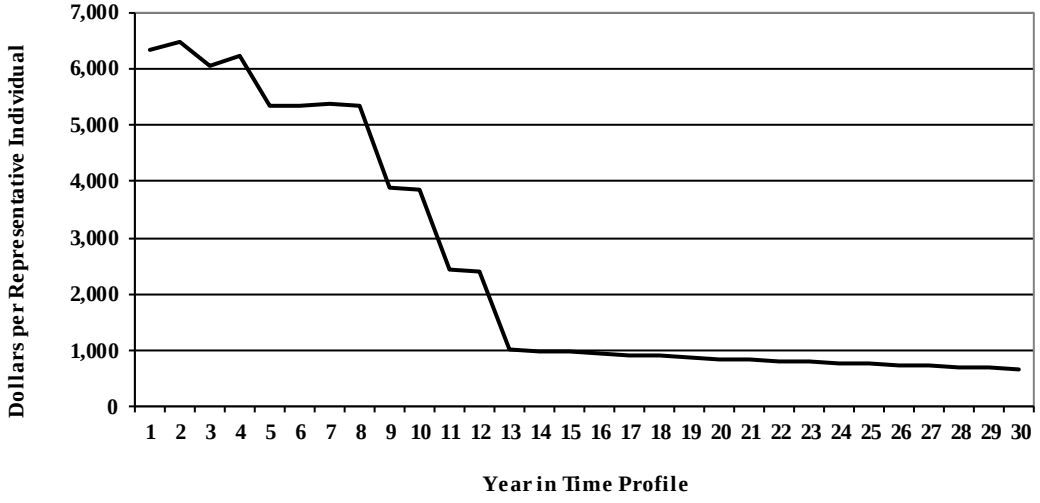


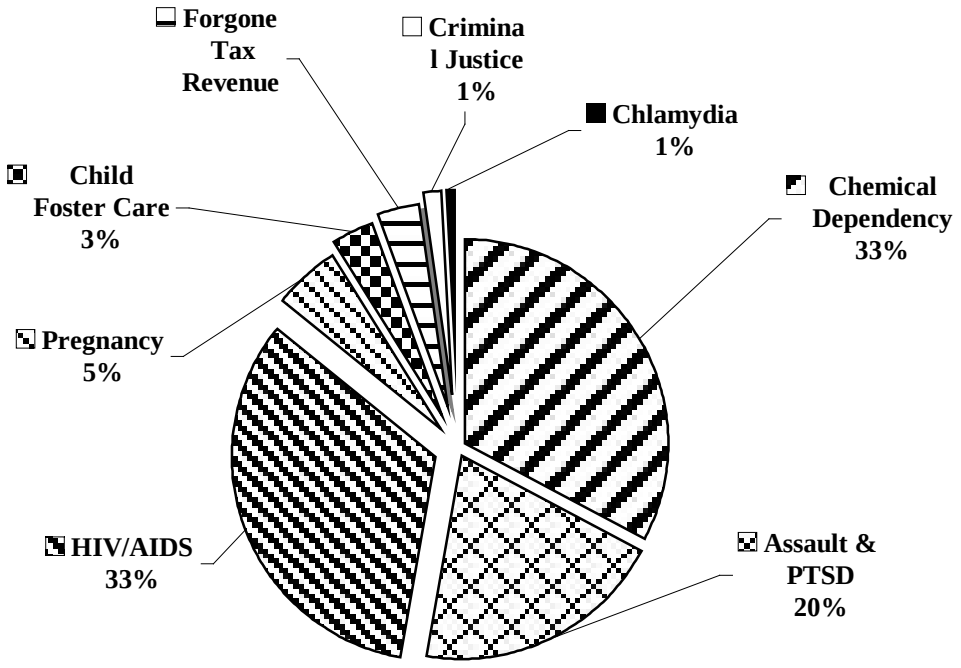
Table 7. Annual Aggregate Benefit per Client in Present Value

Year	$\alpha = 0.90$	$\boldsymbol{\alpha = 0.70}$	$\alpha = 0.50$	$\alpha = 0.30$	$\alpha = 0.10$
1	6,582	**5,120**	3,657	2,194	731
2	6,759	**5,257**	3,755	2,253	751
3	6,313	**4,910**	3,507	2,104	701
4	6,501	**5,057**	3,612	2,167	722
5	5,546	**4,313**	3,081	1,849	616
6	5,573	**4,335**	3,096	1,858	619
7	5,590	**4,348**	3,106	1,863	621
8	5,560	**4,324**	3,089	1,853	618
9	4,044	**3,145**	2,247	1,348	449
10	4,004	**3,114**	2,225	1,335	445
11	2,533	**1,970**	1,407	844	281
12	2,492	**1,938**	1,384	831	277
13	1,074	**835**	597	358	119
14	1,037	**806**	576	346	115
15	1,012	**787**	562	337	112
16	977	**760**	543	326	109
17	954	**742**	530	318	106
18	932	**725**	518	311	104
19	910	**708**	506	303	101
20	889	**692**	494	296	99
21	869	**676**	483	290	97
22	848	**660**	471	283	94
23	829	**644**	460	276	92
24	809	**629**	450	270	90
25	790	**615**	439	263	88
26	772	**600**	429	257	86
27	754	**586**	419	251	84
28	736	**573**	409	245	82
29	719	**559**	400	240	80
30	703	**546**	390	234	78
Total	77,114	**59,977**	42,841	25,705	8,568

Notes: Calculations based on authors' model assuming parameter values as in Table 3: $r = 2.38\%$; $\theta = 0.77$; $\rho = 0.81$.

Figure 2 shows the composition of the present value of harm values by major type relative to each other. Again these values are based on the same parameter settings used for figure 1. This perspective shows that the main sources of benefits from an intervention lie in public health issues. If we include the assault-related harms, these account for 90% of the benefits that would accrue from dissuading adolescent females away from sex trading.

Figure 2. Composition of Aggregate Benefit ~ Present Value



Section Six:
Conclusions

We provide a quantitative evaluation of benefits and costs for an innovative program that addresses a social problem in the state of Minnesota: sex trading by female youth. We focus on experiences likely to occur among female adolescents in situations of socio-economic disadvantage. We conceive the benefits of such a program as harms avoided by successful intervention that dissuades female adolescents from trading sex, where these harms reflect public spending that intended to address problems related to sex trading. This is a difficult and uncertain empirical task. We identify and evaluate 16 specific harms, each with a degree of complexity and not well studied by previous research. This effort involves considerations of epidemiology, law enforcement, and labor markets combined with behavioral variability of the targeted population.

We derive cost estimates through examination of an existing program of this nature currently operating in an urban area, the RIP program in Ramsey County. The costs of operation are very modest in comparison to the benefits we project, but if we consider in addition the need to provide shelter to program participants, the cost is increased by a factor of 2.

Table 4 summarizes our calculations as the Net Present Value per client served. This is our best effort to provide a quantitative assessment along with sensitivity analysis pertaining to two main model parameters. Table 5 presents further sensitivity analysis with respect to other model parameters. In all cases presented in these tables, Net Present Value per client is positive. Only by driving parameter values to extremely pessimistic levels does Net Present Value become negative. We do not believe values like this are reasonable approximations to reality in Minnesota, so we conclude that tax payers in Minnesota would receive a net gain if such a

program were implemented. In our best estimate the aggregate Net Present Value returned would be approximately $28.9 million.

Given that our work in estimating the value of harms avoided took pains to understate their quantity and unit cost when judgment was required, and given that we have entirely excluded some forms of harm, we believe that the evidence we have compiled argues strongly that pursuit of social policy of this nature is in the best interest of Minnesota citizens even from the narrow perspective of public budgets. If a broader conception of benefit and cost were the basis of such an evaluation, the recommendation would only be stronger.

The most important work ahead to build on our analysis is to improve its empirical foundation. This includes refined evaluations of all the harms, but work is especially needed with respect to mental health issues and how lifetime earnings potentials are affected by a period of engaging in sex trading. Another area of empirical research that is needed is longitudinal surveys of sex trading behavior to provide more accurate characterization of trajectories and experience of harms. Finally, a more complete census of female adolescents at risk for moving into sex trading is another important piece of empirical information that would improve the accuracy of this kind of research.

Appendix:
Technical Details of the Model and Empirical Information

A1. Filtering Parameter β , translating YP into Z and deriving θ

Total female youth population of concern is *YP*, of which a fraction γ are potential sex traders. All are referred for evaluation through a filtering process that inducts γ *YP* into the intervention program while attempting to divert $(1-\gamma)YP$ toward other sources of support. We assume the filtering process admits all of γ *YP* but is imperfect in that a portion of $(1-\gamma)YP$ are also admitted. The effectiveness of filtering is specified as β, where $\beta = 0$ means no discrimination is possible and $\beta = 1$ means perfect discrimination. Thus $(1-\beta)(1-\gamma)YP$ denotes the number of clients admitted who have no sex trading potential. The total number of clients served is expressed as Z, of which a fraction θ are potential sex traders. The relationships between *Z*, *YP* and β and between θ, γ and β are as follows:

$$Z = \gamma YP + (1-\beta)(1-\gamma)YP \qquad \text{(A1)}$$

$$\theta = \frac{\gamma YP}{Z} = \frac{\gamma YP}{\gamma YP + (1-\beta)(1-\gamma)YP} = \frac{\gamma}{\gamma + (1-\beta)(1-\gamma)} = \frac{\gamma}{1-\beta(1-\gamma)} \qquad \text{(A2)}$$

Thus if filtering is completely ineffective $Z = YP$ and $\theta = \gamma$. If filtering is completely effective, $Z = \gamma$ *YP* and $\theta = 1$. If filtering effectiveness is 90%, $YP = 1{,}525$ and $\gamma = 25\%$, we find the following values:

$$Z = .25 \times 1{,}525 + (1-.9)(1-.25) \times 1{,}525 = 496$$

$$\theta = \frac{0.25}{1-0.9(1-0.25)} \cong 0.77$$

Table A1 shows values for Z and θ for seven assumed values of filtering efficiency.

Table A1. Sensitivity of Key Parameters to Filtering Efficiency

Filt. Efficiency: β	1	0.9	0.7	0.5	0.3	0.1	0
Parameter: θ	1.00	0.77	0.53	0.40	0.32	0.27	0.25
Cohort Size: Z	381	496	724	953	1182	1411	1525

Assumes YP = 1525 of which 25% are potential sex traders: $\gamma = 0.25$.

A2. Estimates of the Target Population in Minnesota

There are no data documenting the size of the female adolescent population who trade sex in in the State of Minnesota. Two observations aid us in establishing a reasonable estimate. First, we have survey counts of the number of homeless female youth in Minnesota. Second, we rely on research using particular samples of homeless female youth that report the fraction who trade sex. The resulting estimate will likely under count the target population because some female youth who are not homeless may trade sex, and some homeless youths are not counted in the surveys. However, the estimate will serve as a good proxy for the female adolescent population targeted in the Safe Harbor for Youth Act described in the introduction. In our model notation, these individuals are represented by *YP*.

Every three years Wilder Research conducts an extensive one-night count of the homeless population in the State of Minnesota (Wilder, 2010). The last survey for which we have data was conducted in 2009. Wilder found that "on any given night, an estimated 2,500 Minnesota youth experience homelessness" (2010, p. 45). Of that number, sixty-one percent were female; thus we can estimate that there were approximately 1,525 homeless female youth. This serves as our estimate of *YP*. Wilder notes that this is likely a low estimate since independent homeless youth

are less likely to stay in formal shelters than homeless adults and families, and are thus harder to find and count. Further, the count does not capture many youth who experience short-term homelessness (p. 48). To put this number in context, a recent study conducted by the Center for Advanced Studies in Child Welfare at the University of Minnesota estimated that there are 9,460 homeless and highly mobile students enrolled in public school across all age ranges in Minneapolis, St. Paul and Duluth (Larson, 2008). Roughly one-third of them are adolescents (Larson & Meehan, 2009). This second source of data confirms that the Wilder estimate of 1,525 is reasonable.

Several studies evaluate the share of homeless female adolescents engaged in sex trading, with estimates ranging from 10 percent to 50 percent (J M Greene et al., 1999). Here we selected three primary studies with the most appropriate population, sample size and sampling techniques. With a nationally representative sample of youths in shelter and a multi-city sample of street youth, Greene et al., 1999 found that 26% of females had traded sex (p. 1407). Saewyc et al. developed a sample size of 1,845 homeless youth in cities across British Columbia, Canada and found that one in three had been "sexually exploited" (E. M. Saewyc, Taylor, Homma, & Ogilvie, 2008) (p. 6). Finally, Tyler found that 20% of female homeless youth traded sex from a sample of 151 homeless young adults in the Midwestern United States (Tyler, 2009).

Therefore we will assume that 25% of the female adolescent homeless population will trade sex. This serves as our estimate of γ. This implies that 381 female adolescents that might result in intervention benefit in the form of avoided harms, i.e. this is the estimate of *YP* with potential for sex trading. However, an intervention program would likely engage a larger proportion of homeless female adolescents because filtering will not be perfect. If we assume filtering is only 90% effective, the minimum number of program participants is increased from 381 to 496. With

this filtering effectiveness, and given an estimate of 25% of *YP* having the potential to engage in sex trading, the proportion program participants who are potential participants in sex trading is calculated as 0.77. We use these values, $Z = 496$ and $\theta = 0.77$, in deriving our central estimates for benefit per program participant and the overall *NPV* in section 5.

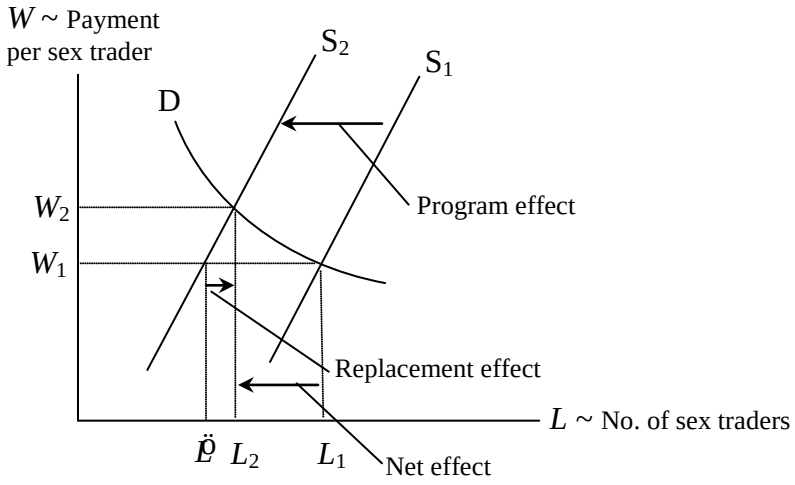
A3. Market Analysis for Replacement by New Market Entrants: Values for ρ

The main text described the problem posed by the potential for one female adolescent who is successfully dissuaded or prevented from trading sex through the intervention program to be replaced by a new, different individual who enters or is brought to the venue. To the extent that replacement occurs, the benefits from the program are reduced because decreases in the extent of sex trading and its associated harms is offset to some extent by the new individuals entering the market to replace those who were dissuaded. This problem can be approached through analyzing how the equilibrium quantity of sexual services responds to the program intervention, which depends on the program effectiveness, program scope and the price elasticities of demand and supply in the relevant venue.

This market adjustment extends to the "derived" market for sexual services labor. Our analysis is illustrated in figure A1, which shows a stable demand curve (D) and two equilibria that result from an original supply curve (S_1) and a supply curve shifted leftward (S_2) due to a degree of success in dissuading adolescent females away from sex-trading. The market illustrated is the derived demand for sex trader labor (L) with the quantity variable (horizontal axis) is expressed as number of workers. The original equilibrium quantity of workers is denoted as L_1. Impact of the intervention program is shown as the leftward shift of the supply curve, which is derived from the program effectiveness coefficient, α, multiplied by the number of

potential sex traders in the program cohort, θZ. This is shown as the horizontal distance from L_1 to $\ddot{L}$. If there were no price effects, $L_1 - \ddot{L}$ would also be the extent of reduction in sex trading. However, the reduction in the supply of sex traders due to the intervention raises the wages, which in turn calls forth an increase in the quantity supplied of sex traders along the supply curve S_2. This change from $\ddot{L}$ to L_2 represents the replacement effect that offsets the direct impact of the intervention program, so that the net reduction in sex traders is $L_1 - L_2$. We capture this effect in the model by specifying a coefficient, ρ, that is applied to the benefit calculation for a representative individual. A stronger replacement effect implies a smaller ρ and thus diminished benefits. In relation to figure A3, $\rho = \frac{L_1 - L_2}{L_1 - \ddot{L}}$, and the range of ρ is [0, 1].

Figure A1. Market Analysis of Replacement Effect



The replacement effect is smaller, and the net reduction larger, when demand is more elastic (i.e. more price sensitive) and supply is less elastic (i.e. less price sensitive). In the extreme case of a perfectly inelastic (i.e. vertical) supply, the absence of any wage influence on the quantity of sex traders would result in a zero replacement effect ($\rho = 1$). In the extreme case of perfectly elastic demand (i.e. a horizontal demand) there would not be any wage rise, and again there

would not be any replacement effect. By contrast, perfectly elastic supply or perfectly inelastic demand would result in complete replacement and ρ=0. Figure A3 shows an intermediate case where the impact of the intervention program is partially offset by new market entrants. Table A1 shows values of ρ for three assumed values for each of the price elasticities. These figures were derived from market simulations using constant elasticity forms for the demand and supply relations as follows. Demand: $W = bL^{-\frac{1}{\eta}}$; Supply: $W = kL^{-\frac{1}{\varepsilon}}$; where η = price elasticity of demand and ε = price elasticity of supply. To model the program effect on supply, the *k* parameter was increased to cause a 10% reduction in *L* at a constant wage. Boldface indicates our best estimate assumed values, and sensitivity analysis is presented using values along the table diagonal with ρ values at 0.35, 0.68 and 0.91.

Table A2. Values for Non-replacement Coefficient ρ in Relation to Price Elasticities

	Demand Elasticity		
Supply Elasticity	-0.5	-1	**-2**
0.2	0.73	0.84	0.91
0.5	0.51	0.68	**0.81**
1.0	0.35	0.51	0.68

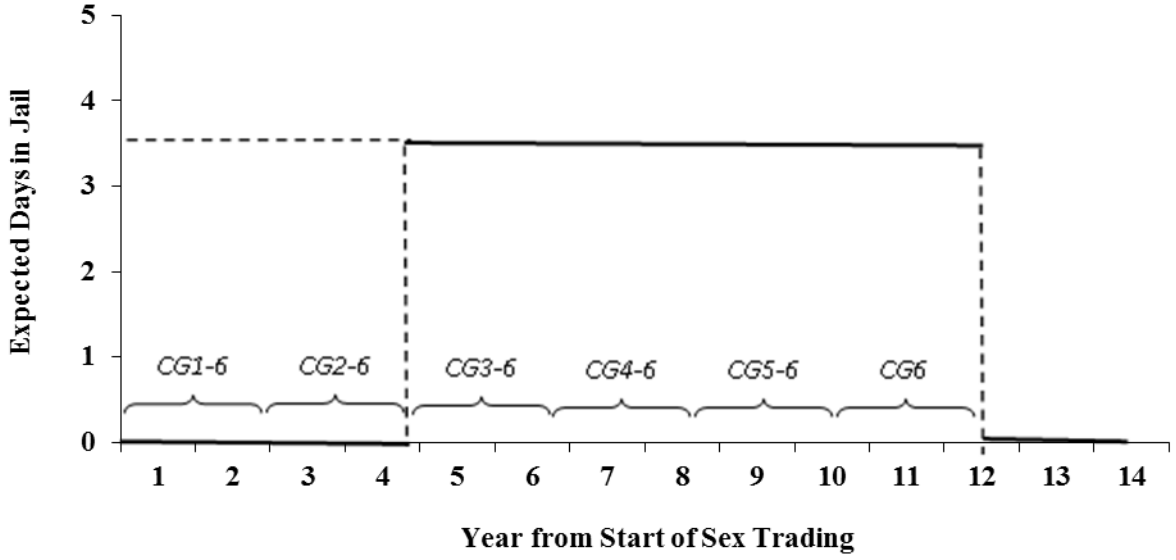
Because of the way ρ enters the model (see equation 2) reducing or increasing ρ has proportionate impact on program benefits. Thus if demand elasticity is at -2 and the supply elasticity is changed from 0.5 to 1.0, program benefits would be reduced by about 16%, the same as the reduction of ρ from 0.81 to 0.68.

A4. Examples of Time Profiles for Harms

Our idea of time profiles for harms is unusual, so we present these illustrations to assist the reader with an intuitive understanding. We consider two harms in the illustrations: incarceration and being infected with HIV. We assume a cohort composed of six groups, each of which follows a distinct trajectory of sex trading that differ by two years. Thus cohort group 1 (*CG1*) trade sex for 2 years, *CG2* trade for 4 years, *CG3* trade for 6 years, and so on to *CG6*, who trade sex for 12 years. We also assume the sex trading activity begins at age 14.

Figure A2 shows the harm time profile for incarceration. Since incarceration only occurs if the individual is engaged in sex trading after age 18, this harm profile begins at 0, jumps to a constant expected value of 3.66 incarceration days in year 5, and then falls back to 0 at year 13, when all members of the cohort have discontinued trading sex. The profile does not apply to all cohort groups across the time range, and the relevant groups are noted in the figure. For example, in years 11 and 12, the profile applies only to *CG6*. But in years 9 and 10, it applies to *CG5* and *CG6*. Model calculations account for the cohort fractions to which harms apply.

Figure A2. Time Profile for Harm: Incarceration



The harm of infection by HIV is more complicated. As repeated exposure occurs, the cumulative probability of being infected rises at the rate of 1.4% annually. When a cohort group ceases trading sex, the probability stops rising but will remain at the level reached for the rest of an individual's life. Because each cohort group has a different trajectory for trading sex, each has a unique cumulative probability at the end of sex trading. This complicated time profile is shown in figure A3, where labels connect cohort groups to harm profiles. For illustration we show these profiles only out to year 15, but in reality they extend across the individuals' life spans. For modeling purposes we simplify by truncating these time profiles at year 30 from the start of sex trading, when the representative individual has reached age 44. Details supporting this assumption are provided in the text.

Figure A3. Time Profile for Harm: HIV/AIDS

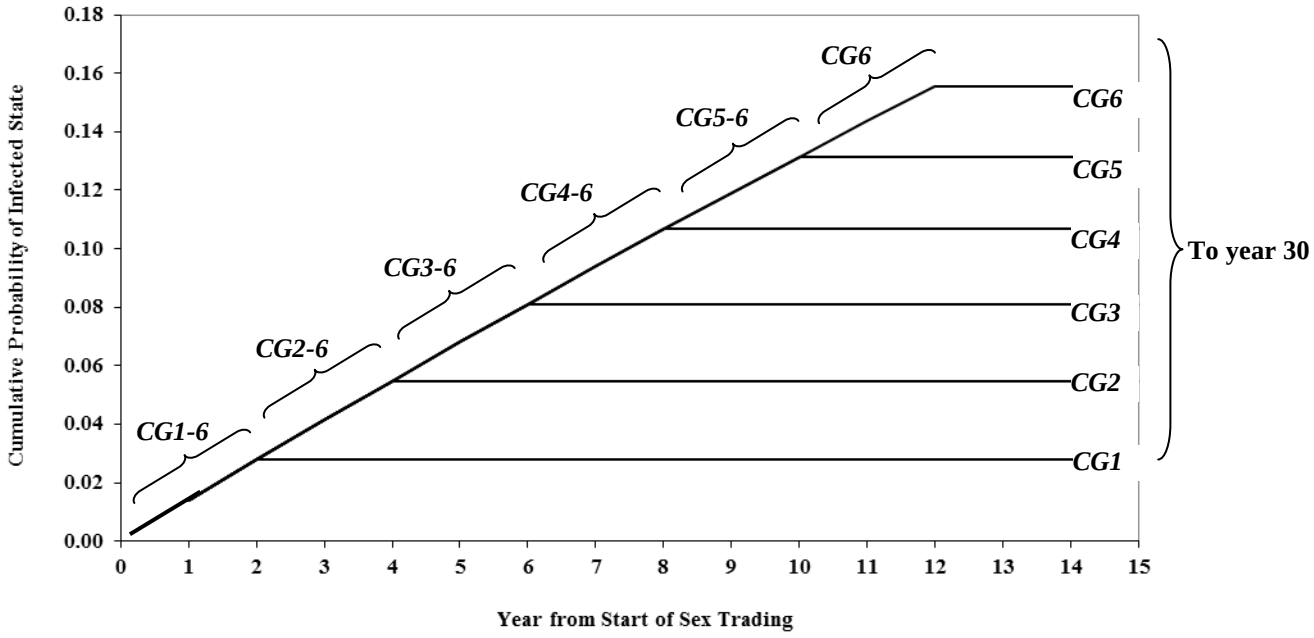


Table A3. Studies on Typical Trajectories in Sex Trading

Average Length	Sample Size	Sample Characteristics	Source
5+ years	65	Retrospective interviews	(DeRiviere, 2006) p. 369
16.4 years	35	Retrospective interviews	(Dalla, 2006) p. 279
5 years	1,022	Longitudinal study, length of "career"	(Potterat et al., 1990) p. 240
11.5 years	36	convenience	(Oselin, 2010) p. 532
13.6 years	130	Longitudinal study	(Ward & Day, 2006) p. 416
19.9 years	255	Retrospective interviews	(Miller et al., 2011) p. 36

These studies did not use representative samples. All but one used convenience sampling and they mostly focus on street-based, outdoor sex trading venues and/or adults who were street-engaged youth.

Table A4. Adjusting Unit Cost Estimates to Constant 2011 Dollars

GDP Deflator		Estimates of Harm Unit Costs			
Year	Index	Description	Year	Current $s	2011 $s
2000	88.7	Minor assault	2003	3,682	4,433
2001	90.7	Major assault	2003	53,300	64,174
2002	92.2	PTSD	2008	5,900	6,159
2003	94.1	Chlamydia-early	2011	108	108
2004	96.8	Chlamydia-late	2011	1,334	1,334
2005	100.0	HIV/AIDS	2010	26,745	27,309
2006	103.2	Pregnancy ~ abortion	2011	635	635
2007	106.2	Pregnancy ~ birth	2008	13,271	13,855
2008	108.6	Chemical dependency	2006	33,795	37,102
2009	109.7	Arrests	2006	2,000	2,196
2010	111.0	Court hearings	2006	527	579
2011	113.3	Incarceration	2011	90	90
		Probation	2006	807	886
		Child Foster Care	2010	7,508	7,666
		Tax Revenue	2011	1	1

Sources
Harm values: various, see text.
Deflator: US Department of Commerce, Bureau of Economic Analysis.
http://www.bea.gov//national/nipaweb/DownSS2.asp#XLS
Accessed 29 February, 2012.

Table A5. Criminal Justice Harms for Typical Individual Convicted of Prostitution (2011 dollars)

Harm Type	Unit Cost	Number	Total Cost
Arrest	2,196	6	13,176
Court	579	6	3,474
Probation	886	2	1,772
Jail time	90	183	16,470
		Sum	34,892

Sources: Various. See text.

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