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ABSTRACT

An Economic Theory of Sexual Exchanges and Human Capital*

We develop a rational choice model of sexual exchange that unifies marriage and paid sex, explaining two key facts: the gendered segregation of sex markets and the decline in sexual activity and fertility. Individuals choose whether to engage in paid or unpaid sex based on income, human capital, and social norms. Gendered patterns emerge endogenously from the asymmetric distributions of these traits. The model also shows how the rise of digital sex reduces the cost of supplying sex, increases market participation, and reallocates time away from unpaid intimacy—leading to lower fertility even without biological constraints.

JEL Classification: 10, J10, J12, J16, J22, J24

Keywords: fertility, gender norms, human capital, sex buyer, sex work, sexual exchanges

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1 Introduction and motivation

It is a curious fact that, while economists have extensively studied the production and exchange of a wide array of goods and services, there is still no general economic theory of sexual exchanges. Sex has been subsumed into the marriage and fertility literature where it is simply part of the bundle exchanged within the relationship (Becker, 1973; Grossbard-Shechtman, 1984), while paid exchanges have been modeled as an entirely separate special market (Moffatt and Peters, 2001; Anderson, 2004; Arunachalam and Shah, 2008; Cunningham and Shah, 2016).

Yet none of these models explains what time and skill investments are involved in sexual exchanges. As a result, they do not address why, despite increasingly liberal sexual norms, sexual activity has been steadily declining in the human population (Twenge et al., 2017), contributing to lower fertility, or why in paid sex markets women typically supply and men typically demand (Edlund and Korn, 2002; Edlund et al., 2009).

The aim of this paper is to offer an answer to both puzzles by providing a rational choice model in which individuals allocate their time to satisfy the need for sex, and to satisfy their other needs through work, potentially including paid sex work. Our model proposes that observed gender differences in sexual behavior reflect the influence of gender norms, gender-specific labor market opportunities, and the unequal distribution of relational skills-cognitive and non-cognitive abilities that affect both workplace productivity (Heckman and Kautz, 2012; Castillo et al., 2013; Munir and Azam, 2017; Cantero et al., 2020) and access to sex (Jacob, 2002). These skills vary across individuals and are shaped by socialization processes and social expectations (Bertrand and Pan, 2013), as well as by labor market opportunities and wage differentials (Clarke et al., 2016; Kleven and Landais, 2017; Kleven et al., 2019, 2024).

In our model, all individuals face the same set of choices, and observed behavior arises as an equilibrium outcome determined by individual characteristics, constraints, and exogenous factors. We assume that any adult individual can, in principle, be both a buyer and a seller of paid sex. Whether these roles are optimal in equilibrium depends on opportunities in sex and non-sex-related labor markets as well as individual economic conditions and the market price of paid sex. We show that an individual may choose not to participate in the sex paid market if the price is too low to make sex work worthwhile, but too high to make purchasing sex attractive. Changes in the market price of paid sex, individual shocks such as divorce or unemployment, or changes in the economic status can shift behavior, causing a non-buyer to become a buyer, a non-seller to become a sex worker, or the reverse. Hence, the predominance of men among sex buyers and women among sex workers can be understood as the equilibrium result of an asymmetric distribution of relational skills and earning opportunities across genders. This asymmetric distribution mirrors the pattern observed in broader labor market trends, where

women are overrepresented in care-related occupations and in roles requiring relational skills (Ngai and Petrongolo, 2017), including work in household (Grossbard, 1978).

In societies with smaller gender-wage gaps, the model predicts that women with access to better-paid non-sex-related jobs are more likely to demand paid sex and less likely to sell it. Conversely, in more gendered and poor societies, women are more likely to sell sex (Cameron et al., 2021). Moreover, in societies where relational skills become scarcer, the demand for unpaid sex—whether within households or in occasional sexual encounters—may decrease. This prediction aligns with empirical evidence documenting a decline in the frequency of unpaid sex among adults, including within marriage (Twenge et al., 2017), as well as reduced sexual activity among youth in the post-COVID-19 period. The latter have experienced substantial disruptions in in-person social interactions—initially due to the rise of social media and further intensified by pandemic-related lockdowns—which likely hindered their accumulation of relational skills (Abma and Martinez, 2023).

In addition to explaining the decline in sexual exchanges and the sexual segregation of paid sex work, our paper allows us to relate individual wealth and transfers within the household to both marital and extramarital demand for sex (Edlund and Korn, 2002; Grossbard-Shechtman, 1984). We also contribute to understanding why economic vulnerability strongly correlates with the supply of sex work (Robinson and Yeh, 2011; Brussa, 2009), and why male and female individuals who would not buy sex in their home country, become sex buyers when traveling to destinations with lower prices, often in less economically developed regions (Oppermann, 1999; Sanders-McDonagh, 2016). We explain why higher wages increase the individual demand for paid sex (Cunningham and Kendall, 2011a; Cunningham et al., 2020; Cunningham and Shah, 2020) and why better non-sex-related earning opportunities reduce its supply (Mahadeshwar and Zhou, 2024). We also describe the conditions under which technological innovations that make virtual and real sexual encounters more easy–such as the introduction of digital platforms and mobile applications (Cunningham and Kendall, 2011c)–affect actual sexual exchanges, and why higher health risks (Gertler et al., 2005; Arunachalam and Shah, 2013) or higher reputational costs (Della Giusta et al., 2008, 2009) result in higher market prices. Finally, our paper provides a theoretical framework that can contribute to the debate about the effects of gender norms on patterns of human capital accumulation, particularly in STEM fields (Guiso et al., 2008; Fryer Jr and Levitt, 2010) and on female participation and fertility (Fernández and Fogli, 2009) as well as the potential effects of policy interventions in paid sex markets, such as the decriminalization of sex work (Weitzer, 2011; Cunningham and Shah, 2018)—or its criminalization (Cameron et al., 2021; Della Giusta et al., 2021)—and other regulatory approaches aimed at reducing public health risks and exploitation (Immordino and Russo,

2015; Brents, 2016; Lee and Persson, 2022; Cameron et al., 2021; Goehring and Hanlon, 2024).

The remainder of the paper is structured as follows. Section 2 presents a model of sexual exchanges as a time allocation problem. Section 3 shows how individual relational skills affect individual choices in the sex market. Section 4 discusses the role of gender norms in originating the observed asymmetric distribution of relational skills. Section 5 concludes.

2 A model of sexual exchanges

In this section we present a theoretical model of sexual exchanges, and labor and consumption choices.

Individual decisions. Since obtaining sex and supplying labor both take time, the model is framed as a time allocation problem in which individuals decide how to allocate their work and sex time endowments to earn an income and consume goods and services, among which there is sex (see Figure 1 for an illustration).

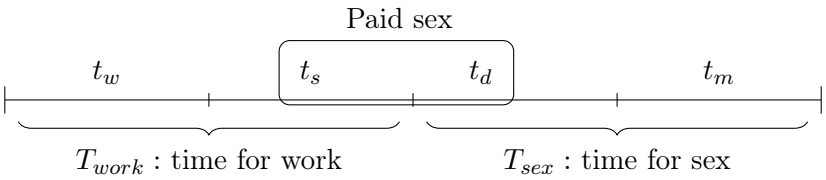

Figure 1: Time allocation between work and sex. Working time is divided into non-sex-related work (t_w) and sex work (t_s). Time for sex can be used for paid sex (t_d) and for unpaid sex (t_m). All time allocations are non-negative and do not exceed the respective time endowments.

Consider two types of jobs, one that involves providing sexual services denoted as sex work.[1] Working time allocated to a non-sex-related job (t_w) generates income $w \cdot t_w$, with w denoting the wage offered in the non-sex-related labor market. Income from sex work is given by $p_s \cdot t_s$ where p_s is the wage rate of the sex worker.

Hence, individual income is the following,

$$w \cdot t_w + p_s \cdot t_s + B \tag{1}$$

where B represents monetary transfers not related to working time, such as those that occur within the household or in stable relationships (Grossbard-Shechtman, 1984; Edlund and Korn,

[1] Throughout the paper, when considering paid sex work, we refer to "exchange of sexual services for money or goods between two mutually consenting adults" (Shah, 2021). Coercion or trafficking are important and feasible extensions of the model, but are not considered in this analysis. For a theoretical investigation on the optimal regulation of sex markets where supply is partially coerced, see Cameron (2002); Lee and Persson (2022).

2002). The sign of B can either be positive or negative, depending on relationship-specific agreements that are typically influenced by social and gender norms, and the occupational condition of the partners.[2] If B is interpreted as an income flow from assets, it can alternatively be considered a proxy for individual wealth and socioeconomic status.

Overall income (1) can be used to purchase sex services at price p_d per unit of time, and a composite good (q) which is used as the numeraire. The time spent purchasing sex (t_d) directly converts into paid sex without any uncertainty. Income expenditure is thus $p_d \cdot t_d + q$.

Individuals can also allocate time to obtain unpaid sex (m), either within a stable relationship such as marriage or cohabitation, or through occasional encounters. These sexual exchanges do not involve a price per encounter, although lump-sum transfers (B) may occur between partners. A further distinction from paid sex is that the time spent to obtain unpaid sex (t_m) does not necessarily result in a sexual encounter. This is formalized by assuming that the amount of unpaid sex actually exchanged is given by $m = \pi \cdot t_m$.[3] The parameter $\pi \in [0, 1]$ can be interpreted as the probability of converting time spent with a partner or a stranger into actual unpaid sex (Eastwick and Hunt, 2014). Although it is possible that an individual is not married and exchanges unpaid sex outside of stable relationships, for expositional simplicity in the proceeding we refer to unpaid sexual exchanges (m) as sex within the marriage.

The individual utility function is

$$U\left(x,\ t_s,\ q\right) \tag{2}$$

where $x = \alpha \cdot t_d + m$ denotes consumed sex. Term $\alpha = \tilde{\alpha} + \sigma$ is a measure of the relative value for paid sex with respect to sex within the marriage. It is function of two elements. The first $\tilde{\alpha}$ is an idiosyncratic preference parameter that depends on individual characteristics of the buyer–including social norms, education and reputation concerns. Individuals with $\tilde{\alpha} < 1$ like paid sex less than unpaid one, while those with $\tilde{\alpha} < 0$ dislike paid sex. The second element (σ) represents the perceived quality of paid sex services.

Since sex and consumption are human basic needs (Baker, 2024), the individual utility function is increasing in the amount of consumed sex (x) and in the composite good (q), with $U_x\left(0, t_s, q\right) \to \infty$ and $U_q\left(x, t_s, 0\right) \to \infty$.

Empirically, selling sex is often disliked and socially stigmatized (Della Giusta et al., 2008;

[2] The intra-household transfer B can include an unconditional component as well as components that depend, e.g., on the time allocated within the household. For example, Grossbard-Shechtman (1984) considers the case in which the intra-household transfer increases with the time an individual devotes to household labor, and decreases with the time employed by the partner in that same activity, according to quasi-wages associated to work in the household that depend on the specific within-couple agreements, as well as the social and economic context (Grossbard-Shechtman, 1984).

[3] An individual with high relational skills is often better at investing in one's own relationship, a finding that is consistent with the evidence that sex workers who are better able to command higher wages are also married (Arunachalam and Shah, 2008; Cunningham and Kendall, 2011b).

Della Giusta, 2016; Della Giusta and Munro, 2016; Bettio et al., 2017). It also carries health risks (Gertler et al., 2005; Shah, 2013; Immordino and Russo, 2015; World Health Organization, 2025), and sex workers are more likely to be victims of robbery, assault, and violence with respect to non-sex workers (Cameron, 2002; Della Giusta et al., 2009; Cunningham and Shah, 2018). To account for individual distaste for physical proximity, the cost of social stigma, and the risks associated with sex work, we assume that utility is decreasing in the amount of time used to sell sex (t_s). The utility function $U(\cdot)$ is assumed to be strictly concave and separable in its arguments.

From individuals to interactions. Given individuals' occupational and relational choices, interactions in the model are structured through three distinct matching environments, each leading to a market outcome. In the sex market, buyers are matched with sex workers, and each encounter results in a transaction at a market-determined price so that $p_d = p_s$. In the domain of unpaid sexual encounters, individuals are mutually matched, and each meeting leads to a probability π of exchanging sex. Finally, in the labor market, individuals not engaged in sex work are matched with firms, and the outcome of each match is a wage w set by the firm. These matching processes operate in parallel and determine the allocation of both labor and sexual interactions across the population.

Each individual, indexed by i, is endowed with a level of human capital h_i, broadly defined to include cognitive and non-cognitive skills, genetics and interpersonal abilities. Among its various components, we emphasize *relational skills*—such as empathy, communication, and trust-building—which play a central role in shaping the outcomes of social and economic interactions.[4] Consistent with the literature on human capital (Becker, 1962) and soft skills (Bowles et al., 2001; Heckman and Kautz, 2012), we assume that human capital increases firms' productivity. Based on the empirical evidence of a skill premium in sex markets (Cunningham and Kendall, 2011b, 2017), we assume that the quality of sex service is function of the individual skills, i.e., $\sigma' \geq 0$. Finally, we assume that when individuals i and j are matched, the probability of exchanging unpaid sex is an increasing function of their abilities, so that $\pi = \pi(h_i, h_j)$ with $\frac{\partial \pi}{\partial h_i}, \frac{\partial \pi}{\partial h_j} \geq 0$.

[4] Relational skills encompass non-cognitive abilities including emotional regulation, active listening, conflict resolution, and the interpretation of social cues. These skills are influenced by genetic endowments, early childhood environments, social learning, and cultural exposure. While often less observable than formal education or cognitive ability, they are increasingly recognized as key determinants of individual performance across personal, social, and professional domains.

3 Solving the model

3.1 The individual problem

The individual allocation problem requires allocating time and choosing the amount of consumption that solves the following problem:

$$\begin{aligned} \max_{t_d,t_s,t_m,t_w,q} \quad & U\left(\alpha t_d + \pi t_m,\ t_s,\ q\right) \\ \text{s.t.} \quad & w \cdot t_w + p_s \cdot t_s + B = p_d \cdot t_d + q \\ & T_{sex} = t_d + t_m \qquad T_{work} = t_w + t_s \end{aligned} \tag{3}$$

where T_{sex} is the time endowment to be used for demanding sex and T_{work} is the time endowment for work (e.g., the lenght of the working day).

If an individual supplies and demands no paid sex ($t_s = t_d = 0$), the corner solution $t_m = T_{sex}$, $t_w = T_{work}$ and $q = w \cdot T_{work} + B$ obtains. The mere existence of a sex market, however, suggests that other solutions can be optimal. To investigate these solutions and investigate the associated trade offs, consider the following expressions:

$$\frac{\partial \mathcal{L}}{\partial q} = U_q - \lambda, \tag{4}$$

$$\frac{\partial \mathcal{L}}{\partial t_d} = \alpha U_x - \lambda p_d - \tau_{sex}, \qquad \frac{\partial \mathcal{L}}{\partial t_m} = \pi U_x - \tau_{sex} \tag{5}$$

$$\frac{\partial \mathcal{L}}{\partial t_s} = U_s + \lambda p_s - \tau_{work}, \qquad \frac{\partial \mathcal{L}}{\partial t_w} = \lambda w - \tau_{work} \tag{6}$$

The terms λ, τ_{sex} and τ_{work} represent the Lagrange multipliers associated to the budget constraint and the time constraints for sex and work, respectively, and $\mathcal{L}$ is the the Lagrangian function associated to the maximization problem.[5]

Expression (4) is the familiar optimization condition that determines the demand for a consumption good depending on its marginal utility and its marginal cost. Since q is the numeraire good, the marginal opportunity cost of consumption and leisure is simply given by the shadow price of income (λ).

Expressions (5) determine the demand for paid and unpaid sex, respectively. The marginal benefits correspond to the marginal utility of each type of sex, which also takes into account the relative preference parameter for paid sex (α) and the conversion factor for unpaid sex (π). By

[5] See Appendix A.1 for necessary and sufficient Kuhn-Tucker conditions. Subscripts of the utility function denote partial derivatives. For example, $U_x = \partial U/\partial x$. We simplify further by writing $U_s = \partial U/\partial t_s$. The same convention applies to the constrained utility function V introduced below, so that, for instance, $V_s = \partial V/\partial t_s$ and $V_d = \partial V/\partial t_d$.

definition, unpaid sex does not require a payment per encounter, so its marginal cost consists only of the shadow price of the time endowment for sex (τ_{sex}). In contrast, the demand for paid sex also depends on the opportunity cost of spending money on sex rather than on the composite good, as captured by $p_d\lambda$.

Expressions (6) determine individual labor supply for sex and non-sex work, respectively. The marginal benefits of sex work depends on the price of sex (p_s) and the shadow price of income (λ). The marginal costs consists of the marginal disutility from sex work and the shadow price of the working time endowment (τ_{work}). Since non-sex-related work is assumed to yield no disutility, its marginal cost is solely given by τ_{work}.

3.2 Optimal demand and supply of paid sex

Replacing the budget and time constraints into the utility function U yields function V, which only depends on the time allocated to paid sex:

$$V(t_s, t_d) = U\Big(\underbrace{(\alpha - \pi)\, t_d + \pi T_{sex}}_{x},\ t_s,\ \underbrace{wT_{work} + B + (p_s - w)\, t_s - p_d \cdot t_d}_{q}\Big) \tag{7}$$

This formulation allows to compactly describe the conditions for the optimal demand and supply of paid sex, as shown below:

$$V_d = (\alpha - \pi)\, U_x - p_d U_q \tag{8}$$

$$V_s = (p_s - w)\, U_q + U_s \tag{9}$$

The optimal solution (t_d^*, t_s^*) can lie either in the interior of the choice set $[0, T_{sex}] \times [0, T_{work}]$ or on its boundary. Figure 1 illustrates the interior case in which an individual allocates time to both paid and unpaid sex and works in both a sex-related and a non-sex-related job. Boundary cases arise when at least one of the time endowments is entirely allocated to one activity. Formally, this occurs when either V_d or V_s, or both, are non-zero for all interior allocations.

The individual's optimal behavior depends on individual preferences as well as on economic factors such as earning opportunities, productivity and the market price of paid sex. Consider, for example, the case in which the optimal choice is to neither demand nor supply paid sex, i.e. the corner solution $(t_d^*, t_s^*) = (0, 0)$. In this scenario, the individual consumes only unpaid sex, all working time is allocated to a non-sex-related job, and all labor income is spent on the composite good. Inspection of (8) shows that a sufficient condition for not demanding paid sex is that the individual derives disutility from it., i.e. $\alpha < 0$. More generally, demanding no paid sex is more likely when the marginal utility of paid sex (αU_x) is low, its price (p_d) is high, the

probability of obtaining unpaid sex (π) is high, and the marginal utility of the composite good (U_q) is high.

Now consider the supply of sex work (eq. 9). The individual does not supply it if the wage rate of sex work is lower than that of the non-sex-related alternative job (i.e., if $p_s < w$). More generally, supplying no paid sex is more likely when the wage rate of sex work (p_s) is low, the disutility of selling sex is high, and the non-sex-related wage rate (w) is high. Unlike the conditions for demanding no paid sex, the likelihood of supplying no paid sex increases when the marginal disutility of selling is higher.

The literature on sex markets typically focuses on the boundary cases of *sex buyers*—individuals who buy sex but do not supply sex work ($t_d^* > 0$ and $t_s^* = 0$)—and *sex workers*—individuals that sell sex but do not buy paid sex ($t_d^* = 0$ and $t_s^* > 0$). Based on the previous observations, recall that necessary conditions for theses cases are that $\alpha > \pi$ and $p_s > w$, respectively. The former condition implies that the marginal utility of paid sex exceeds the expected marginal utility of unpaid sex. The latter implies that the marginal productivity of time is higher when allocated to sex work than to a non-sex-related job.

Using (8) the following holds:

Proposition 1 (Sex buyers) *Consider individuals who do not sell paid sex and work exclusively in a non-sex-related job.*

- *There exists a reservation price* $\bar{p}_d = (\alpha - \pi)\, U_x/U_q$ *such that an individual demands paid sex if the price* p_d *is lower than* $\bar{p}_d$*, and does not demand it otherwise.*
- *Conditional on being a sex buyer, the individual demand* t_d^* *for paid sex*
  - *Decreases with price* (p_d) *and the probability of obtaining unpaid sex* (π)*,*
  - *Increases with the non-sex-related wage rate* (w)*, the unconditional income* (B) *and the length of the working day* (T_w)*.*

Note that the reservation price $\bar{p}_d$ is increasing in the quality of the sex service. Accordingly, the decision to buy sex depends on whether a potential buyer meets a sex worker willing to accept the reservation price $\bar{p}_d$. Proposition 1 makes testable predictions about the role of prices and income in determining the extensive and intensive margin of the demand for paid sex among individuals who are not sex workers ($t_s^* = 0$). It essentially predicts that for sex buyers the law of demand applies, and that paid sex is a normal good. This result aligns with empirical observations on sex tourism, where individuals who do not engage in paid sex in their home countries may do so when visiting destinations with lower prices (Oppermann, 1999; Sanders-McDonagh, 2016).

The latter result implies that richer individuals, and individuals with higher income or socioeconomic status are predicted to demand more paid sex than those with lower income.[6] Moreover, a larger income transfer to a spouse or partner in a stable relationship— represented here by a lower B in the budget constraint—reduces the demand for paid sex by the person making the transfer. Conversely, it increases the demand for paid sex by the person receiving the transfer.

The previous Proposition refers to the demand for sex by individuals who do not sell sex. Consider now expression (9) and individuals who do not buy sex, but might sell it:

Proposition 2 (Sex workers) *Consider individuals who do not purchase paid sex and allocate all available income to consumption.*

- *There exists a reservation price* $\bar{p}_s = w - U_s/U_q > 0$ *such that an individual supplies paid sex if the wage rate* p_s *is larger than* $\bar{p}_s$*, and does not supply it otherwise.*
- *Conditional on being a sex worker, the individual supply of paid sex*
  - *Increases with the wage rate* (p_s) *if income effects are sufficiently small,*
  - *Decreases with the non-sex-related wage rate* (w)*, the unconditional income* (B)*, and the length of the working day* (T_w)*.*

The decision to engage in sex work depends on whether there exists a buyer willing to pay at least the reservation price $\bar{p}_s$. This threshold is higher—and entry into sex work less likely—when individuals higher wealth (high B), or have access to well-paid alternatives in non-sex-related employment (high w). These mechanisms are consistent with the findings of Mahadeshwar and Zhou (2024), who show that a reduction in the price premium associated with sex work leads individuals to substitute toward other forms of employment. They are also consistent with the notion that high marginal disutility of sex work due to factors such as personal discomfort, stigma, or reputational concerns, reduce participation in the sex market (Della Giusta et al., 2009; Kotsadam and Jakobsson, 2014).

Conversely, the existence of limited opportunities in other sectors increase the likelihood of choosing sex work (Brussa, 2009; International Union of Sex Workers, 2025). Proposition 2 further predicts that individuals with low non-work-related income B–typically those with low socioeconomic status–are more likely to enter sex work and, conditional on participation, to supply more paid sex to the market (Vandepitte et al., 2006; Robinson and Yeh, 2011).

[6] Longer working days are predicted to increase the demand for paid sex because they increase income. Since the time endowments for sex and work are independent, this result is only due to income effects, and cannot be attributed to a substitution between working time and time to obtain sex.

The responsiveness to changes in B is amplified when the marginal income gap $(p_s - w)$ is larger, consistent with evidence that sex workers often come from economically and socially disadvantaged backgrounds and use sex work as a response to negative economic shocks (Sahni and Shankar, 2013). When income effects dominate, the sex work supply schedule can be backward bending. Although this outcome is theoretically possible and may apply to high-end sex workers, the empirically relevant case appears to be one with a positively sloped supply schedule (Gertler et al., 2005).

Consumption of the composite good (q), the time employed for non-sex-related work (t_w) and the time devoted to obtain unpaid sex (t_m) can be immediately obtained from the budget and time constraints described in 3. When unpaid sex (m) is interpreted as occurring within stable relationships, the results above provide also a useful framework for analyzing fertility and childbearing. For example, one can assume that the number of children born within stable relationships increases with the amount of marital sex m. While this is a simplifying assumption–since children can also result from encounters outside stable relationships–it conceptually links reproduction to the traditional role of stable partnerships (Becker, 1973, 1974). Historically, this role has been assigned to marriage, which facilitates reproduction and plays a central role in child-rearing and resource management. In fact, marriage, along with cohabitation, continues to account for most births (Doepke et al., 2023).

The model can be used to examine how shocks originating outside the sex market affect its functioning. For instance, one can use it to study shifts that reflect broader macroeconomic trends, localized labor market booms, or social and demographic changes that alter individuals' opportunity costs or demand and supply patterns (Cunningham and Kendall, 2011a; Cunningham et al., 2020; Mahadeshwar and Zhou, 2024). These types of shocks can be incorporated into the model through changes in the wage parameter w or in the mass of potential buyers and sellers.

Intra-household dynamics can also be included in the analysis. Shifts in bargaining power within couples, as well as changes in marriage and divorce rates, can influence intra-household transfers B, which in turn affect both the demand for and supply of paid sex (Edlund and Korn, 2002; Grossbard-Shechtman, 1984).

The model is also suitable for addressing technological change. The emergence of digital platforms and mobile applications (Cunningham and Kendall, 2011c) can be modeled as changes in the search or matching frictions within the paid and unpaid sex market. For example, innovations that primarily affect unpaid sex–such as dating apps–can be represented as shifts in π (Sorokowski et al., 2021).

Our framework also accommodates the study of stigmatization of sex workers or clients,

Shock		Sex buyers t_d^*	Sex workers t_s^*
p	Price of sex services	$-$	$+/-$
B	Wealth / Unconditional income	$+$	$-$
T_{work}	Total working hours	$+$	$-$
w	Non-sex-related wage	$+$	$-$
σ	Sex work quality	$+$	0
π	Probability of unpaid sex	$-$	0

Table 1: Comparative statics. Effects of a positive shock on the intensive margin of individual demand and supply of paid sex for sex buyers and sex workers, respectively. The effects of a change in p refer to p_d for sex buyers and to p_s for sex workers. The effects of a change in σ apply when the supply schedule is upward sloping. The effects on time allocated to unpaid sex (t_m^*) and to non-sex-related work (t_w^*) are the opposite of those for t_d^* and t_s^*, respectively.

which can be modeled as a reduction in utility for buyers (through a lower α) or an increase in disutility for sellers (Della Giusta et al., 2009; Kotsadam and Jakobsson, 2014; Della Giusta and Munro, 2016; Della Giusta, 2016; Della Giusta and Hui, 2021).

Finally, the model supports the analysis of a wide range of policy interventions, such as the decriminalization of sex work (Weitzer, 2011; Cunningham and Shah, 2018), its criminalization (Arunachalam and Shah, 2008; Della Giusta et al., 2021), and regulatory approaches aimed at reducing health risks, violence and trafficking (Immordino and Russo, 2015; Brents, 2016; Cameron et al., 2021; Lee and Persson, 2022). In formal terms, such interventions can be represented as changes in the utility or monetary costs borne by market participants, depending on how the specific policy affects the legal environment of the transaction or the associated incentives. The effects of these comparative statics exercises are summarized in Table 1 (see Appendix A.2 for the proofs).

3.3 Interaction mechanisms and the role of human capital

In the following, we show how wage rates and earnings in the sex and non-sex labor markets can depend on human capital, of which relational skills are a component. We assume that in the non-sex-related sector, compensation arises from interaction with the firm side of the market, typically through a wage-setting process. Similarly, earnings from sex work are determined through a matching process between buyers and sellers, which is influenced by preferences, individual characteristics, and possibly bilateral bargaining. Unpaid sexual encounters, although not involving per-transaction monetary compensation, are modeled as outcomes of a mutual matching process in which the probability of exchange depends on the characteristics of both partners. These assumptions allow us to analyze the role of relational skills, which affect match-

ing probabilities, the surplus generated within each match, and the division of that surplus. Accordingly, relational skills influence occupational choices, sexual behavior, and the overall allocation of time and effort across market and non-market activities.

Unpaid sex and fertility. In unpaid sexual encounters, whether a meeting leads to sex often depends on the relational skills of the two individuals. Skills such as empathy, confidence, and conversational ability help individuals connect, signal interest, and build mutual trust or attraction—traits that matter especially in the absence of monetary incentives. Formally, if individuals i and j are matched, the probability that sex occurs is given by $\pi = \pi(h_i, h_j)$, where h_i and h_j denote their respective human capital. Since we assumed $\frac{\partial \pi}{\partial h_i}, \frac{\partial \pi}{\partial h_j} \geq 0$, higher skill levels increase the likelihood of unpaid sex.

This formulation can be naturally extended to describe fertility outcomes by defining fertility between partners i and j as function $f_{ij} = f(\pi(h_i, h_j), \min\{t_m^i, t_m^j\})$. Here, fertility is assumed to increase with the probability of sexual exchange(π) and with the time t_m^i and t_m^j that each individual invests in the unpaid sexual relationship. The following Remark applies:

Remark 1 *For a given partner's human capital h_j, a higher h_i increases the probability π of unpaid sex and reduces the individual's willingness to pay $\bar{p}_d$ for paid sex. Moreover, for a given π, a greater allocation of time to unpaid sex by both partners increases fertility.*

The relation between human capital and demand for paid sex follows directly from Proposition 1, which shows that an individual's willingness to pay for sex ($\bar{p}_d$) decreases as the probability of unpaid encounters (π) increases. Accordingly, individuals who are less successful at initiating unpaid sexual interactions—those with lower h_i—are predicted to demand more paid sex.

This insight highlights a simple yet important implication of our model: human capital influences not only economic outcomes like earnings and productivity, but also relational outcomes. First, individuals with stronger relational and emotional skills are more likely to engage in unpaid sexual encounters, reducing their propensity to purchase sex. Second, a greater incentive to invest time in unpaid sex positively affects fertility. We build on this second aspect in Section 4, where we explore how technological shifts that change the relative appeal of paid sex—such as the rise of digital platforms, can lead to a reallocation of time away from unpaid sex, thereby contributing to fertility declines.

Prices of sexual transactions. In the sex market, the specific price at which transactions occur depends on market features, such as the level of competition, the bargaining power of sellers and buyers, the matching process between sellers and buyers, and the distribution of

relational skills in the population. For example, consider a potential buyer i searching for quality σ and with reservation price $\bar{p}_d^i$. Assume that the buyer meets a potential seller j with reservation price $\bar{p}_s^j$ and can observe the quality σ of the seller's services. A transaction occurs if there exists a price $p = p_s = p_d$ such that $p \in [\bar{p}_s^j, \bar{p}_d^i]$ and the amount of time allocated to this transaction by buyer i equals that allocated to the same transaction by sex worker j. For concreteness, one can think to the transaction price as

$$p = \xi \cdot \bar{p}_s^j + (1 - \xi) \cdot \bar{p}_d^i \tag{10}$$

where $\xi \in [0, 1]$ can be interpreted as the bargaining power of the buyer (Gertler et al., 2005). Consistent with the empirical existence of a beauty premium (Arunachalam and Shah, 2012; Islam and Smyth, 2012), the maximum transaction price ($\bar{p}_d^i$) increases with the quality of sex services provided by the seller, which is in turn increasing in their level of human capital. This allows us to conclude the following:

Remark 2 *Sex workers with higher human capital h_i receive a higher price for their services.*

This Lemma highlights the economic value of human capital in the sex market. Beyond physical attributes and technical skills, the ability to make clients feel comfortable, provide companionship and tailor experiences to individual preferences, enhances the perceived quality of the sexual transaction. As a result, better sex workers can command higher prices, reflecting a form of soft-skill premium that parallels similar findings in other labor markets. This mechanism provides a microfoundation for the observed beauty and charisma premia in sex work, aligning with empirical evidence that links interpersonal traits to earnings.

Wage rate in the non-sex-related market. In the non-sex-related market, the individual can be hired by a firm. For simplicity, we assume that each firm only needs the productive input of one worker. Following Acemoglu (1998), firms are able to adapt their production technologies and learn how to make use of their workers' skills in the production process. The firm's output $Y(t_w, h)$ is thus an increasing function of both the worker's working time t_w and skills h. Output is sold in a competitive market at a normalized price of 1, and each firm sets the wage that maximizes its profits. Under these assumptions, when a firm is matched with a worker i, its profit is given by $\pi = Y(t_w, h_i) - wt_w$, and the profit-maximizing wage equates the marginal productivity of labor, so that $w(h_i) = \frac{\partial Y(t_w, h_i)}{\partial t_w}$. This allows to conclude the following:

Remark 3 *In the non-sex-related markets, workers with higher h_i receive a higher wage.*

Taken together, the two Lemmas show that human capital h_i, though potentially comprising different attributes valued differently across markets, is positively associated with wages in both

sectors. However, the relative return to h_i—and to its specific components, such as relational or cognitive skills—may vary substantially between the sex and non-sex-related markets. This creates a sorting margin: individuals will tend to select into the occupation where their specific skill set is more highly valued. Accordingly, the choice between markets is driven not only by the absolute level of human capital, but also by its relative valuation across sectors.

Proposition 3 *An individual with human capital h_i will choose to work in the sex market rather than in the non-sex-related market if and only if the return to h_i is higher in the former. In particular, individuals with higher h_i are more likely to work in the sex market when the marginal income gain $\frac{\partial p}{\partial h_i}$ exceeds the marginal wage gain $\frac{\partial w}{\partial h_i}$ in the non-sex-related market.*

The proof for the above Proposition follows from comparing the individual-specific returns to human capital in the two markets. From Remark 2, higher h_i implies a higher transaction price p in the sex market. From Remark 3, higher h_i also implies a higher wage w in the non-sex-related market. The individual chooses the sector where their human capital yields the greater income, which occurs if and only if $\frac{\partial p}{\partial h_i} > \frac{\partial w}{\partial h_i}$.

This result provides a microfoundation for occupational sorting across markets with different technologies and reward structures. It also underscores the importance of considering the specific skill content of h_i, since even individuals with the same overall human capital level may make different occupational choices depending on how their skills map into productivity in each sector.

4 Discussion

The results presented in the previous section highlight the relevance of human capital in influencing both sexual exchanges and labor market participation. This raises the question of how human capital and its components are distributed across the population, and what factors contribute to this distribution.

Importantly, our framework offers a potential explanation for two empirical regularities related to sex and gender. First, sex work is strongly gendered: women are typically on the supply side, while men are overwhelmingly on the demand side. Second, despite increasingly liberal norms around sexuality, rates of sexual activity have been declining across advanced economies, alongside long-term declines in fertility rates (Twenge et al., 2017).

Gender, Human Capital, and Access to Sex. Our model shows that participation in the sex market—on either side—depends on the type and level of human capital individuals possess. Those with strong relational or interpersonal skills are more likely to engage in unpaid,

mutual sexual interactions. In contrast, individuals with lower levels of these skills tend to face greater difficulty in accessing unpaid sex and are more likely to purchase it. At the same time, individuals with high relational capital may be able to monetize it by supplying sex.

Human capital also plays a role outside sex markets, but the returns depend on the nature of the occupation. Some roles reward cognitive and formal skills, while others place greater value on social and emotional abilities. As a result, the economic return to human capital varies with the composition of an individual's skills and the requirements of the job.

The empirical evidence shows that relational skills, empathy, and emotional intelligence are asymmetrically distributed by gender (Cornwell et al., 2013), and that, on average, women score higher on these dimensions (Jacob, 2002). This gendered distribution aligns with broader patterns in which women are over-represented both in the provision of paid sex (Edlund and Korn, 2002), in caring occupations, and, more generally, in activities that draw on relational skills (Ngai and Petrongolo, 2017), including those that involve household duties.[7] Institutional and familial factors such as parental beliefs, explicit or implicit stereotypes, and intra-family education mediate and often reinforce these gendered patterns (Alan et al., 2018; Carlana, 2019; Kleven and Landais, 2017; Miho et al., 2024).

The origin of the asymmetric distribution of relational skills is often attributed to essentialist explanations, which link this asymmetry to biological predispositions—such as a greater tendency among women to provide care or to refuse sex, and a lower capacity among men for empathy and caregiving. An alternative perspective highlights the role of gender and social norms in shaping both the distribution and valuation of relational skills, as well as in reinforcing their persistence over time (Bertrand and Pan, 2013; Clarke et al., 2016). This view accommodates intergenerational mechanisms: when labour market returns to relational skills exhibit stable and substantial gender gaps, parents may encourage girls to develop such skills. If the gaps are small or narrowing, parental investments may shift, with less emphasis on relational skills for girls and more for boys, gradually contributing to a reallocation of these skills across genders.

Social norms and values have long been incorporated into economic analyses of individual and group behavior. These norms shape identity formation and individual decision-making (Akerlof and Kranton, 2000), influence sexual practices, marriage choices (Stevenson and Wolfers, 2007), and fertility patterns (Kleven and Landais, 2017; Kleven et al., 2019). They also affect the distribution of relational skills and their associated economic and social returns, either directly or through channels such as labor force participation and wage determination (Blau

[7] These patterns are also mirrored in the asymmetric patterns of human capital accumulation between genders, as gender norms influence educational choices, particularly in STEM fields (Guiso et al., 2008; Fryer Jr and Levitt, 2010; Carrell and West, 2010).

and Kahn, 2017; Marianne, 2011; Boelmann et al., 2021), educational attainment (Niederle and Vesterlund, 2007; Huber and Paule-Paludkiewicz, 2024), and the formation of aspirations and expectations (Exley et al., 2020).

The literature on sexuality highlights how prior to the 18th century, sexual anatomy and desire were often viewed as symmetric across genders. The development of modern theories of reproduction, alongside the influence of Victorian moral norms, contributed to the stigmatization of female sexual pleasure and to the cultural framing of women as sex refusers (Laqueur, 1992). This framing remains present in essentialist economic theories of sexual exchange (Becker, 1973, 1974, 1993; Posner, 1994; Edlund and Korn, 2002), including models of mate competition and paid sex (Baumeister and Vohs, 2004; Baumeister and Leary, 2017).

Such theories often treat gender norms as fixed, despite evidence that these norms, while persistent, evolve in response to historical, economic, and institutional contexts. For example, less egalitarian gender beliefs have been observed among descendants of societies that practiced plough agriculture (Alesina et al., 2013). Likewise, the regulation of female sexuality has been linked to land-based livelihoods and expectations around familial caregiving. These patterns have become less pronounced with the rise of wage labor for both genders and the development of state-based welfare systems (Becker, 2019).

The sexual revolution and the broader availability of contraception, particularly since the 1970s, have contributed to a loosening of norms that restrict female sexuality. As women's earning potential has increased, their bargaining power within long-term relationships has shifted, influencing both household arrangements and societal norms around sexual behavior across different markets. Consistent with this view, legislation regulating paid sex tends to be more permissive in countries with higher levels of democracy and gender equality—except where such exchanges are perceived as exploitative or coercive (Elías et al., 2017).

The considerations above suggest that the current gender-specific distribution of males among sex buyers and females among sex sellers aligns with the gendered distribution of relational skills and, ultimately, gender norms. These norms can shape both the distribution of relational skills by gender and the premiums associated with them. If the distribution of relational skills were more symmetrical and labor opportunities more equal, our model predicts a more balanced gender distribution across occupations, including sex work, as well as among sex buyers. This outcome would occur without assuming that females and males have inherently different, biologically determined predispositions to consume or sell sex, or to work in specific occupations.

Digital Sex and Fertility. A second stylized fact is the long-term decline in fertility and sexual activity, particularly in advanced economies. While economic and demographic expla-

nations remain relevant, our model can offer a complementary mechanism for this trend.

Crucially, the decline has coincided with major technological and cultural shifts in how individuals access intimacy. One significant transformation is the rise of *digital sex*—including pornography, virtual companionship, and AI-based surrogates—which has reshaped the landscape of sexual exchange.[8] In our framework, this digital transformation acts as an exogenous shock that lowers the psychological or social cost of selling paid sex. Formally, we model this as an increase in the marginal utility of supplying sex, such that it becomes $U_s + \delta$, with $\delta > 0$ capturing the reduced stigma or increased acceptance.

Accordingly, the seller's reservation price becomes:

$$\bar{p}'_s = w - \frac{U_s + \delta}{U_q} = \bar{p}_s - \frac{\delta}{U_q}, \tag{11}$$

Since $\delta > 0$, the new reservation price is strictly below the pre-shock level derived in Proposition 2. If δ is sufficiently large—specifically, if $\delta > wU_q - U_s$—then the reservation price may even drop to zero. Intuitively, as digital alternatives reduce the emotional cost of market participation, they increase the willingness to supply sex.

This reduction in reservation prices affects the outcome of the matching process described above. A transaction occurs between a buyer i and seller j if the price p lies within the new acceptable range $[\bar{p}'^j_s, \bar{p}^i_d]$. By lowering $\bar{p}'^j_s$, the digital shock widens this interval, increasing the probability of a successful match. Moreover, under the pricing mechanism in equation (10), the equilibrium price adjusts downward for a given bargaining power (ξ):

$$p' = \xi \cdot \bar{p}'^j_s + (1 - \xi) \cdot \bar{p}^i_d. \tag{12}$$

This lower price increases demand: more buyers find the transaction worthwhile and enter the market. According to the buyer's optimality condition (8), this leads to an increase in the optimal time allocated to demand paid sex (t^*_d), accompanied by a decline in the time devoted to unpaid sex (t^*_m). Together with Remark 1, this leads us to the following proposition:

Proposition 4 *If the digital transformation reduces the stigma on sellers, fertility decreases.*

Proof. If individuals i and j are matched and their time allocation is t^i_m, t^j_m, the level of fertility is $f(\pi(h_i, h_j), \min\{t^i_m, t^j_m\})$. All other things equal, the rise of digital sex reduces the time devoted to unpaid sex t^i_m and t^j_m, and f_{ij} drops in the single interaction. As a result, fertility drops in the population. ■

[8] While digital formats are not perfect substitutes for in-person sex, they replicate enough relational or sensory features to be perceived as viable alternatives, particularly by individuals who previously avoided commercial sex due to stigma, logistics, or emotional discomfort. These formats also reduce the incentive to invest effort into unpaid intimacy, as gratification becomes accessible without it.

Because fertility in our model arises solely from unpaid interactions, this shift has demographic implications. The result is a structural reallocation of emotional and temporal resources: fewer unpaid sexual encounters, reduced matching opportunities in the non-commercial domain, and lower fertility. Notably, this is not due to a decline in desire, but it is as a consequence of changes in the technological and social incentives.

5 Conclusion

Sexuality has long been studied in disciplines such as biology, medicine, psychology, and anthropology (Foucault, 1990; Laqueur, 1992; Posner, 1994; LeVay, 2023). Economics lacks a general model of sexual exchange—a domain that influences physical and mental health, relationship dynamics, family formation and dissolution, and fertility. This paper proposes an economic framework that incorporates insights from these fields and enables the analysis of sexual behavior as the outcome of rational choice.

Our model features individuals who devote time to pursuing sexual exchanges, exchanging sex both for other sex and for monetary and non-monetary compensations, which can happen both within and outside stable relationships. The productivity of individuals in obtaining sex across the different markets depends on their endowments of human capital and the particularity of relational skills. This endowment, the market price for sex, and the wages from non-sex-related jobs jointly determine the allocation of a person's time in obtaining sex in spot or repeated relationships (including marriage) and buying or selling sex in the paid sex market, as well as the total amount of sex that will be exchanged in society. Gender norms affect the distribution of human capital and relational skills, their relative remunerations, gender pay gaps in paid work, and gaps in work done in households. Our model thus envelopes existing models of paid sex and of marriage as special cases and allows to explain current patterns of declining sexual exchanges as well as simulate the effect of different policy interventions.

Our conceptual starting point is that sex can be exchanged in various forms, and in principle, anyone can participate in the sex market. Whether or not this happens in practice depends on individual preferences, skills, constraints, and the broader institutional, social, and economic contexts. Paid sex work can be understood as labor, and in some cases, as a criminal activity. Unpaid sexual exchanges, whether occasional or recurring, may not involve monetary compensation but often carry expectations of reciprocity, emotional connection, or material support. Social norms, earning opportunities, and the availability of outside options play an important role in affecting individual behavior.

In our model, all individuals face the same set of choices, and the observed behavior emerges as an equilibrium outcome influenced by individual characteristics, constraints, and exogenous

factors. We show that individuals buy sex when the market price is below their reservation price and sell sex when the price exceeds another individual-specific reservation price. Between these two prices, they neither buy nor sell sex, or they may engage in both behaviors.

Our approach contrasts with alternative models that assume inherent differences between sex workers and buyers (see, e.g., Edlund and Korn, 2002; Della Giusta et al., 2009). We argue that an important dimension of individual variation lies in the endowment of relational skills and the set of earning opportunities available to individuals. These factors play a crucial role in determining whether an individual chooses to be a sex worker, a sex buyer, or neither.

Our framework helps explain why, empirically, most sex buyers are male and most sex sellers are female (Cameron et al., 2021). We argue that this is due to heterogeneity in relational skills, which indirectly affect the reservation prices determining whether and in what role an individual participates in the sex market. These relational skills are not evenly distributed across genders. They are determined by gender norms, education, and social expectations.

Our approach generalizes and builds on previous theories that view sex work as a low-skill activity with high compensation due to factors like lower marriage prospects (Edlund and Korn, 2002), high health risks (Gertler et al., 2005; Immordino and Russo, 2015), or reputational costs (Della Giusta et al., 2009). It can be applied to study the role of education and stigma, the effects of changes in the legal status of sex work, the impact of technological change, as well as the influence of evolving social norms and sex work regulations.

More broadly, by highlighting the asymmetric distribution of relational skills between genders (Fortin et al., 2021) and suggesting that this asymmetry is reinforced by social expectations and norms, this paper provides a theoretical framework for analyzing the effects of educational interventions aimed at enhancing emotional and relational competencies, and to understand the emerging evidence about the reduced sexual activity among young adults who experienced the COVID-19 lockdowns. Extensions to explicitly include risky health behavior, family and household decisions, fertility, intra-family bargaining, and the role of coercion and sexual exploitation are left for future research.

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A Appendix

A.1 Solving the model

The problem to solve is the following

$$\begin{aligned} \max_{t_d,t_s,t_m,t_w,q} \quad & U\left(\alpha t_d + \pi \cdot t_m,\ t_s,\ q\right) \\ \text{s.t.} \quad & w \cdot t_w + p_s \cdot t_s + B = p_d \cdot t_d + q \\ & T_{sex} = t_d + t_m, \qquad T_{work} = t_w + t_s, \\ & t_d, t_m \in [0, T_{sex}], \qquad t_s, t_w \in [0, T_{work}], \end{aligned} \tag{13}$$

The Lagrangian function associated to the maximization problem reads as follows:

$$\begin{aligned} \mathcal{L} = & U(\alpha t_d + \pi t_m, t_s, q) + \lambda \left(w \cdot t_w + p_s \cdot t_s + B - p_d \cdot t_d - q\right) \\ & + \tau_{sex}(T_{sex} - t_d - t_m) + \tau_{work}(T_{work} - t_w - t_s) \\ & + \phi_d^0 t_d + \phi_d^T (T_{sex} - t_d) + \phi_m^0 t_m + \phi_m^T (T_{sex} - t_m) \\ & + \phi_s^0 t_s + \phi_s^T (T_{work} - t_s) + \phi_w^0 t_w + \phi_w^T (T_{work} - t_w) \end{aligned} \tag{14}$$

The Kuhn-Tucker conditions are

$$\frac{\partial \mathcal{L}}{\partial t_d} = \alpha U_x - \lambda p_d - \tau_{sex} + \phi_d^0 - \phi_d^T = 0, \qquad \frac{\partial \mathcal{L}}{\partial t_m} = \pi U_x - \tau_{sex} + \phi_m^0 - \phi_m^T = 0$$

$$\frac{\partial \mathcal{L}}{\partial t_s} = U_s + \lambda p_s - \tau_{work} + \phi_s^0 - \phi_s^T = 0, \qquad \frac{\partial \mathcal{L}}{\partial t_w} = \lambda w - \tau_{work} + \phi_w^0 - \phi_w^T = 0$$

$$\frac{\partial \mathcal{L}}{\partial q} = U_q - \lambda = 0, \qquad \frac{\partial \mathcal{L}}{\partial \lambda} = w \cdot t_w + p_s \cdot t_s + B - p_d \cdot t_d - q = 0$$

$$\frac{\partial \mathcal{L}}{\partial \tau_{sex}} = T_{sex} - t_d - t_m = 0 \qquad \frac{\partial \mathcal{L}}{\partial \tau_{work}} = T_{work} - t_w - t_s = 0$$

where

$$\phi_d^0, \phi_d^T, \phi_m^0, \phi_m^T, \phi_s^0, \phi_s^T, \phi_w^0, \phi_w^T \geq 0 \tag{15}$$

and $U_x = \frac{\partial U}{\partial x}$, $U_s = \frac{\partial U}{\partial t_d}$, $U_q = \frac{\partial U}{\partial q}$, $x = \alpha t_d + \pi t_m$. The complementarity slackness conditions on the time allocations are

$$\begin{aligned} \phi_d^0 \cdot t_d &= 0, & \phi_d^T \cdot (T_{sex} - t_d) &= 0 \\ \phi_m^0 \cdot t_m &= 0, & \phi_m^T \cdot (T_{sex} - t_m) &= 0 \\ \phi_s^0 \cdot t_s &= 0, & \phi_s^T \cdot (T_{work} - t_s) &= 0 \\ \phi_w^0 \cdot t_w &= 0, & \phi_w^T \cdot (T_{work} - t_w) &= 0 \end{aligned}$$

To obtain the reduced utility function V used in the text, replace q, t_m and t_w from the constraints to obtain

$$V(t_s, t_d) = U\Big(\underbrace{(\alpha - \pi) t_d + \pi T_{sex}}_{x},\ t_s,\ \underbrace{w T_{work} + B + (p_s - w) t_s - p_d t_d}_{q} \Big) \tag{16}$$

where $t_d \in [0, T_{sex}]$ and $t_s \in [0, T_{work}]$. This formulation of the objective function compactly describes the objective function as a function of t_d and t_s. Instead of analyzing the associated Lagrangian function and the Kuhn-Tucker necessary conditions, consider the following first-order derivatives:

$$V_d := \frac{\partial V}{\partial t_d} = (\alpha - \pi) U_x - p_d U_q \tag{17}$$

$$V_s := \frac{\partial V}{\partial t_s} = (p_s - w) U_q + U_s \tag{18}$$

In the main text, we focus on three cases:

1. $t_d \in (0, T_{sex}]$ and $t_s = 0$: individuals are sex buyers. This condition is optimal when either $V_d = 0$ for some $t_d \in (0, T_{sex}]$ or $V_d \geq 0$ at $t_d = T_{sex}$, and $V_s < 0$ for all $t_s \in (0, T_{work}]$ and $V_s \leq 0$ at $t_s = 0$,

2. $t_d = 0$ and $t_s \in (0, T_{work}]$: individuals are sex workers. This condition is optimal when either $V_s = 0$ for some $t_s \in (0, T_{work}]$ or $V_s \geq 0$ at $t_s = T_{work}$, and $V_d < 0$ for all $t_d \in (0, T_{sex}]$ and $V_d \leq 0$ at $t_d = 0$,

3. $t_d = t_s = 0$: individuals are neither sex buyers nor sex workers because either $V_s = V_d < 0$ for all $t_d \in (0, T_{sex}]$ and $t_s \in (0, T_{work}]$, and both V_s and V_d are nonpositive at $t_d = t_s = 0$.

A.2 Comparative statics

In the following we present the analytical conditions for the comparative statics results presented in Section 3.2.

Sex buyers

For the comparative statics exercise focusing on sex buyers who do not sell sex ($t_d^* > 0$, $t_s^* = 0$), we apply the implicit function theorem using the first order condition (18).

By concavity,

$$V_{dd} := p_d^2 U_{qq} + (\alpha - \pi)^2 U_{xx} < 0 \tag{19}$$

Hence, conditional on being a sex buyer, exogenous changes in B, T_{work} and p produce the following effect on the intensive and extensive margin of the demand for paid sex:

Intensive margin	Extensive margin	
$\frac{\mathrm{d}t_d^*}{\mathrm{d}p_d} = \frac{U_q - t_d^* p_d U_{qq}}{V_{dd}} = \frac{U_q}{V_{dd}} - t_d^* \frac{\mathrm{d}t_d^*}{\mathrm{d}B} < 0$		(20)
$\frac{\mathrm{d}t_d^*}{\mathrm{d}B} = \frac{p_d U_{qq}}{V_{dd}} > 0$	$\frac{\mathrm{d}\bar{p}_d}{\mathrm{d}B} = \frac{\mathrm{d}t_d^*}{\mathrm{d}B} > 0$	(21)
$\frac{\mathrm{d}t_d^*}{\mathrm{d}T_{work}} = w\frac{p_d U_{qq}}{V_{dd}} = w\frac{\mathrm{d}t_d^*}{\mathrm{d}B} > 0$	$\frac{\mathrm{d}\bar{p}_d}{\mathrm{d}T_{work}} = 0$	(22)

Moreover:

$\frac{\mathrm{d}t_d^*}{\mathrm{d}w} = T_{work}\frac{p_d U_{qq}}{V_{dd}} = T_{work}\frac{\mathrm{d}t_d^*}{\mathrm{d}B} > 0$	$\frac{\mathrm{d}\bar{p}_d}{\mathrm{d}w} = -\left(\frac{\mathrm{d}t_d^*}{\mathrm{d}p_d}\right)^{-1}\frac{\mathrm{d}t_d^*}{\mathrm{d}w} > 0$	(23)
$\frac{\mathrm{d}t_d^*}{\mathrm{d}\sigma} = \frac{U_x + (\alpha - \pi)\, t_d^* U_{xx}}{-V_{dd}}\alpha'$	$\frac{\mathrm{d}\bar{p}_d}{\mathrm{d}\sigma} = -\left(\frac{\mathrm{d}t_d^*}{\mathrm{d}p_d}\right)^{-1}\frac{\mathrm{d}t_d^*}{\mathrm{d}\sigma}$	(24)
$\frac{\mathrm{d}t_d^*}{\mathrm{d}\pi} = \frac{U_x - (\alpha - \pi)\, t_m^* U_{xx}}{V_{dd}} < 0$	$\frac{\mathrm{d}\bar{p}_d}{\mathrm{d}\pi} = -\left(\frac{\mathrm{d}t_d^*}{\mathrm{d}p}\right)^{-1}\frac{\mathrm{d}t_d^*}{\mathrm{d}\pi} < 0$	(25)

The effect of an increase in relational skills r on the intensive and extensive margin of the demand for paid sex is, respectively,

$$\frac{\mathrm{d}t_d}{\mathrm{d}r} = \frac{\mathrm{d}t_d}{\mathrm{d}B}T_{work}\cdot w' + \frac{\mathrm{d}t_d}{\mathrm{d}\pi}\cdot\pi', \qquad \frac{\mathrm{d}\bar{p}_d}{\mathrm{d}r} = \frac{\mathrm{d}\bar{p}_d}{\mathrm{d}B}T_{work}\cdot w' + \frac{\mathrm{d}p_d}{\mathrm{d}\pi}\cdot\pi' \tag{26}$$

Sex workers

For the comparative statics exercises on the supply of sex for individuals that do not buy sex, we apply the implicit function theorem using the first order condition (17). Recall that,

by concavity,

$$V_{ss} := U_{ss} + (p_s - w)\, U_{qq} < 0 \tag{27}$$

The effects on the intensive and extensive margin of the supply of paid sex are as follows:

Intensive margin	Extensive margin	
$\frac{\mathrm{d}t_s^*}{\mathrm{d}p_s} = \frac{U_q + t_s^*\,(p_s - w)\, U_{qq}}{-V_{ss}} = \left(\frac{U_q}{-V_{ss}} + t_s^* \frac{\mathrm{d}t_s^*}{\mathrm{d}B}\right)$		(28)
$\frac{\mathrm{d}t_s^*}{\mathrm{d}B} = \frac{(p_s - w)\; U_{qq}}{-V_{ss}} < 0$	$\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}B} = -\frac{\mathrm{d}t_s^*}{\mathrm{d}B}\left(\frac{\mathrm{d}t_s^*}{\mathrm{d}p}\right)^{-1}$	(29)
$\frac{\mathrm{d}t_s^*}{\mathrm{d}T_{work}} = w\frac{\mathrm{d}t_s^*}{\mathrm{d}B} < 0$	$\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}T_{work}} = w\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}B}$	(30)

Moreover

$\frac{\mathrm{d}t_s^*}{\mathrm{d}w} = \frac{U_q - t_w^*\,(p_s - w)\, U_{qq}}{V_{ss}} = \frac{U_q}{V_{ss}} + t_w^* \frac{\mathrm{d}t_s^*}{\mathrm{d}B} < 0$	$\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}w} = -\left(\frac{\mathrm{d}t_s^*}{\mathrm{d}p}\right)^{-1} \frac{\mathrm{d}t_s^*}{\mathrm{d}w}$	(31)
$\frac{\mathrm{d}t_s^*}{\mathrm{d}\sigma} = 0$	$\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}\sigma} = 0$	(32)
$\frac{\mathrm{d}t_s^*}{\mathrm{d}\pi} = 0$	$\frac{\mathrm{d}\bar{p}_s}{\mathrm{d}\pi} = 0$	(33)

The effect of r on the intensive of the supply of sex work is

$$\frac{\mathrm{d}t_s^*}{\mathrm{d}r} = \frac{\mathrm{d}t_s^*}{\mathrm{d}\sigma}\sigma' + \frac{\mathrm{d}t_s^*}{\mathrm{d}w}w' \tag{34}$$

Equation (34) can be equivalently written as:

$$\frac{\mathrm{d}t_s^*}{\mathrm{d}r} = \left(p\sigma' - w'\right)\frac{U_q}{-V_{ss}} + \left(t_w^* w' + p t_s^* \sigma'\right)\frac{\mathrm{d}t_s^*}{\mathrm{d}B} \tag{35}$$

Formulation (35) emphasizes that an increase in relational skills determine higher labor income, as shown by $\mathrm{d}t_s^*/\mathrm{d}B$, which would produce a reduction in labor supply. Hence, the sign of $\mathrm{d}t_s^*/\mathrm{d}r$ depends on the trade-off between the effect of relational skills on the marginal income gap $(p\sigma' - w')$ and on the income effect $(\mathrm{d}t_s^*/\mathrm{d}B)$. Since the latter is negative, a sufficient condition for sex workers with stronger relational skills to supply less paid sex is that the change in the marginal income gap between sex and non-sex work is negative $(p\sigma' - w' < 0)$. If, instead, the overall increase in the marginal income gap is large enough to overcome the negative income effect, the overall effect is positive.

At the extensive margin, the following holds:

$$\frac{\mathrm{d}p_s}{\mathrm{d}r} = -\frac{\mathrm{d}t_s^*}{\mathrm{d}r}\left(\frac{\mathrm{d}t_s^*}{\mathrm{d}p}\right)^{-1} \tag{36}$$

If (t_s^*, p) is on the increasing tract of the sex work supply schedule and $\mathrm{d}t_s^*/\mathrm{d}r > 0$, then the reservation price p_s decreases and participation in the sex market as a sex worker becomes more likely.