

# The World's Oldest Profession? Employment-Age Profiles from the Transactional Sex Market

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**Abstract:** Standard labor market models predict that the likelihood of employment increases, hours worked increase, and individuals transition from less-skilled and temporary jobs to more skilled and more stable employment as they age. I examine the association between age and transactional sex work using national household surveys from Zambia, one of the few settings with general population surveys asking women about transactional sex and a relatively high documented prevalence of employment in transactional sex. My results indicate that the likelihood of employment in transactional sex sharply falls with age. Increased employment opportunities outside of transactional sex do not appear to explain the transactional sex employment-age profile and marital status appears to explain only a portion of it. These findings are consistent with the hypothesis that clients prefer younger transactional sex workers and suggest that policymakers implement interventions designed to reduce client demand for younger females.

*Keywords:* age; employment; labor supply; transactional sex; Zambia

*JEL codes:* J10; J40; O10; R23

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## 1. Introduction

Standard economic models of labor market outcomes predict that as individuals age the likelihood of employment increases, hours worked increase, and individuals transition from less-skilled and temporary jobs to more skilled and more stable employment (e.g., Mincer 1974, Blinder and Weiss 1976, MaCurdy 1981, Weiss 1986, Rupert and Zanella 2015, Gervais et al. 2016). Research on labor market outcomes in the transactional sex market has examined labor supply on the intensive margin (e.g., Robinson and Yeh 2011, Dupas and Robinson 2012, Robinson and Yeh 2012, Cunningham and Kendall 2017) and earnings (e.g., Rao et al. 2003, Gertler et al. 2005, Arunachalam and Shah 2012, Dupas and Robinson 2012, Arunachalam and Shah 2013, Cunningham and Kendall 2017), yet there is little evidence on the relationship between age and employment in transactional sex.<sup>1</sup> This paper provides unique evidence from national household surveys on employment-age profiles in the transactional sex market.

A major barrier to measuring determinants of employment in transactional sex is the dearth of data on female participation in transactional sex from general population surveys. The Demographic and Health Surveys (DHS), collected in over 90 low-and middle-income countries and often used in economic analyses of risky sexual behavior including participation in the transactional sex market (e.g., see De Walque 2008, Fortson 2009, Friedman 2016, Lucas and Wilson 2017), typically only ask males about participation in the transactional sex market. Few general population surveys from middle-and high-income countries appear to ask women about participation in transactional sex markets. Where general population surveys do exist (e.g., see Dunkle et al. 2010), they generally are single cross-sections, without information across time on labor supply in transactional sex markets and often include behaviors such as exchanging sex for gifts or

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<sup>1</sup> There is evidence of a skill premium for more educated workers in transactional sex (e.g., Rao et al. 2003, Gertler et al. 2005), suggesting that wages may rise with age and experience.

favors in a single question about transactional sex.<sup>2,3</sup> Data from multiple points in time on labor supply in transactional sex markets are required to determine whether differences in labor supply across age groups are due to cohort differences or life cycle changes in labor supply.

To address these barriers, I use data from the Zambia Sexual Behavior Surveys (ZSBS), national household surveys that include information from female respondents on whether they exchanged sex for money in the past twelve months. In total, I use data for over 8,000 females age 15-49 from four rounds of the ZSBS. I conduct semi-parametric and parametric regression analyses to calculate employment-age profiles for transactional sex work. I use weighted local polynomial smoothing and the Epanechnikov kernel to explore nonlinearities in employment-age profiles. I use ordinary least squares (OLS) regression to estimate a single slope coefficient for the employment-age profile and to examine sensitivity to controlling for other socio-demographic characteristics.

My results suggest that younger females are more likely to engage in transactional sex work than are older females. For example, my point estimates suggest that women age 35-39 (age 40-49) are between 1 and 2 (2 and 4) percentage points less likely to engage in transactional sex in the twelve months leading up to the survey date than are females age 15-19. In relative terms, these are large differences, around 50 to 100% reductions relative to the mean likelihood of engaging in transactional sex.

I analyze possible mechanisms underlying the transactional sex employment-age profile, finding that two leading hypotheses appear to not fully explain this pattern. First, controlling for employment outside of transactional sex does not eliminate the negative and statistically significant association between age and transactional sex work, suggesting that employment outside of transactional sex increasing with age is not the mechanism underlying my main result. Second, controlling for being married somewhat

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<sup>2</sup> The DHS for Guinea (1999), Niger (1999), and Madagascar (2003) ask females about exchanging sex for money. Two rounds of the Kenya DHS – 1998 and 2003 – ask females about exchanging sex for “money, gifts, or favours”. In contrast, the surveys I use in the current analysis, the Zambia Sexual Behavior Surveys (ZSBS), ask respondents, “in the past 12 months, have you paid for sex or been paid to have sex?”.

<sup>3</sup> The 1991-2016 survey rounds of the General Social Survey (GSS) asks respondents, “Thinking about the time since your 18th birthday, have you ever had sex with a person you paid or who paid you for sex?” Fewer than 1% of females answer yes to this question.

attenuates the association between age and transactional sex work, although the general relationship remains. These results suggest that life-cycle changes in marital opportunities may be part of the explanation for my main result and are consistent with a third hypothesis – that client preference for younger females drives a substantial part of the observed (unconditional) transactional sex employment-age profile.

My results are robust to controlling for district fixed effects, survey year fixed effects, and individual-level covariates. Robustness of my results to survey year fixed effects suggests that the observed employment-age profiles reflect systematic life-cycle variation and not differences in birth cohorts.

By providing large-scale evidence on labor market outcomes for a major sector of economic activity in many countries – transactional sex work (Shah 2014) – I contribute to the literature on labor markets and age (e.g., Mincer 1974, Blinder and Weiss 1976, Lazear 1981, MaCurdy 1981, Hanoch and Honig 1985, Weiss 1986, Murphy and Welch 1990, Kotlikoff and Gokhale 1992, Hellerstein and Neumark 1995, Thornton et al. 1997, Robinson 2003, Lahey 2008, Rodenberg and Stone 2011, Göbel and Zwick 2013, Schnalzenberger et al. 2014, Atalay and Barrett 2015, Bande and López-Mourelo 2015, Rupert and Zanella 2015, Banerjee and Blau 2015, Debrulle 2016, Gervais et al. 2016, Vermeer et al. 2016, Anderson et al. 2017).<sup>4</sup> Existing economic analyses of transactional sex markets primarily use data from surveys of transactional sex workers (e.g., Rao et al. 2003, Gertler et al. 2005, Cunningham and Kendall 2011a, Robinson and Yeh 2011, Arunachalam and Shah 2012, Dupas and Robinson 2012, Robinson and Yeh 2012, Arunachalam and Shah 2013, Logan and Shah 2013, Cunningham and Kendall 2017) or use indirect measures such as population STI incidence (e.g., Cunningham and Shah 2015), precluding analysis of how employment in transactional sex varies with age. I overcome this barrier by using general population surveys to provide the first economic analysis of transactional sex employment-age profiles.<sup>5</sup> In studying labor supply in the market for transactional sex, this paper complements the large body of economic

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<sup>4</sup> Part of this literature studies earnings-age (and earnings-experience) profiles (e.g., Mincer 1974, Lazear 1981, Murphy and Welch 1990, Hellerstein and Neumark 1995, Thornton et al. 1997). The ZSBS do not include data on earnings, so I am not able to provide evidence on transactional sex earnings-age profiles.

<sup>5</sup> Arunachalam and Shah (2008) pool two different datasets: (i) surveys of transactional sex workers, asking about transactional sex work and, (ii) surveys of all women, asking about employment outside of transactional sex work.

literature on demand for transactional sex (e.g., Gertler et al. 2005, Della Giusta et al. 2009a, Cunningham and Kendall 2011b, Arunachalam and Shah 2012).

The rest of the analysis is organized as follows. Section 2 provides a conceptual framework for examining employment-age profiles and outlines existing evidence on age and labor market outcomes and on age and transactional sex markets. Section 3 describes the data and statistical methods. Section 4 presents the results. Section 5 discusses these results and concludes.

## **2. Conceptual Framework and Existing Evidence**

Standard economic models of labor market outcomes predict that the likelihood of employment increases, hours worked increase<sup>6</sup>, and individuals transition from less-skilled and temporary jobs to more skilled and more stable employment as they age (e.g., Mincer 1974, Blinder and Weiss 1976, MaCurdy 1981, Weiss 1986, Rupert and Zanella 2015, Gervais et al. 2016).<sup>7</sup> One main mechanism underlying these predictions is that individuals acquire more skills as they age, increasing their productivity and employability.<sup>8</sup>

Economic models of transactional sex work have not explored employment-age profiles for transactional sex work. These models have focused on labor supply on the intensive margin (e.g., Robinson and Yeh 2011, Dupas and Robinson 2012, Robinson and Yeh 2012) and on earnings (e.g., Edlund and Korn 2002, Rao et al. 2003, Gertler et al. 2005, Arunachalam and Shah 2012, Dupas and Robinson 2012, Arunachalam and Shah 2013). These studies find that transactional sex workers engage in riskier sex with clients in response to economic shocks (Robinson and Yeh 2011, Dupas and Robinson 2012, Robinson and Yeh 2012) and are compensated for engaging in riskier sex (Rao et al. 2003, Gertler et al. 2005, Arunachalam and Shah 2013). At least one study (Edlund and Korn 2002) argues that transactional sex workers are compensated for forgone marriage market opportunities. Other studies (Della Giusta et al.

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<sup>6</sup> At higher ages, hours worked begin to decrease with age (Weiss 1986, Rupert and Zanella 2015).

<sup>7</sup> In high income countries, women of childbearing age often (at least temporarily) exit the labor force in association with taking care of child. This is not the case in my study setting, as suggested by Figure 2.

<sup>8</sup> In some occupations, productivity actually may decrease with age over age ranges typically considered to be prime working age. For example, Castellucci et al. (2011) found that the productivity of Grand Prix Formula One drivers peaks at age 30-32.

2009a, Della Giusta 2009b, Immordino and Russo 2015) emphasize that transactional sex makes employment outside of transactional sex more difficult because of stigma costs.

Connecting these two sets of theories yields three insights about relationship between transactional sex employment and age. First, if the return to skill is greater (lower) outside of transactional sex work than in transactional sex work<sup>9</sup>, then transactional sex employment may decrease (increase) with age. Second, if marriage or employment outside of transactional sex raises the cost of engaging in transactional sex, then transactional sex employment may decrease with age. Third, client preferences for sex worker age may affect transactional sex employment outcomes.

There is limited empirical evidence on these predictions. Arunachalam and Shah (2008) pooled data from surveys of transactional sex workers asking about transactional sex work and data from surveys of all women asking about employment outside of transactional sex work. They found that earnings decline with age, both among transactional sex workers and among women employed outside of transactional sex. Wilson (2012) provided a simple analysis of group means by age without including any controls. In a study of 248 transactional sex workers in The Gambia, Pickering et al. (1992) found that younger transactional sex workers (e.g., under age 25) charged higher prices on average than did older transactional sex workers, yet was not able to examine how the likelihood of employment in transactional sex work varied with age. In a study of 70 clients of transactional sex workers in Glasgow, Scotland, McKeganey (1994) found evidence of a stated preference for younger females (e.g., age 16-25).

### **3. Data and Methods**

#### **3.1 Data**

Data for this analysis come from the Zambia Sexual Behavior Surveys (ZSBS). These are repeated, cross-sectional national household surveys. I use the 2000, 2003, 2005, and 2009 survey rounds, the rounds that

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<sup>9</sup> Edlund and Korn (2002) note that transactional sex work is relatively low-skilled compared to other employment.

include information on female participation in the transactional sex market. All of these rounds survey females age 15-49 and yield a combined total of 8,359 females age 15-49.

I construct two main measures of labor market outcomes. First, I construct a measure of employment in transactional sex that is equal to one if the respondent reported engaging in transactional sex in the twelve months leading up to the survey date and zero otherwise. All four rounds of the ZSBS ask respondents “in the last 12 months have you paid for sex or been paid to have sex?” and I interpret female respondents who answer “yes” to this question as reporting having been paid to have sex. Second, I construct a measure of employment outside of transactional sex that is equal to one if the respondent was employed outside of transactional sex and zero otherwise. All four rounds of the ZSBS ask respondents “what kind of work do you mainly do?” and I use this question to construct the measure of employment outside of transactional sex.<sup>10</sup> The household surveys include individual-level information on marital status and educational attainment and I use these as control variables.

Reporting bias is a key concern for the question about transactional sex. Gersovitz et al. (1998) demonstrates that females in knowledge and behavior surveys (e.g., the DHS or the ZSBS) under-report risky sexual behavior and/or males over-report risky sexual behavior. If the probability of under-reporting risky sexual behavior (e.g., employment in transactional sex) is not correlated with respondent age, then under-reporting should bias me against finding a large and statistically significant association between age and transactional sex employment. However, reporting bias may be correlated with age (or marriage), raising additional concerns about how to interpret the response to this survey question. Three factors suggest that reporting bias may be low. First, the survey enumerators emphasized to respondents at the beginning of the entire survey and again at the beginning of the section on risky sexual behavior (including transactional sex) that their responses were completely confidential.<sup>11</sup> Second, for each survey round,

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<sup>10</sup> In a study of the association between neighborhood characteristics and pre-marital sex, Kayeyi et al. (2013) also uses employment data from the ZSBS.

<sup>11</sup> At the beginning of the survey, enumerators stated, “I am working with the Central Statistical Office in collaboration with the Ministry of Health, collection information pertaining to your health. Please be assured that everything we discuss will be strictly confidential and no information will be shared or leaked.” (Central Statistical Office et al. 2010). At the beginning of the risky behavior section the enumerators stated, “I am going to ask some specific

approximately 10 enumerator teams conducted all of the survey interviews (Central Statistical Office et al. 2010), meaning that enumerators were highly unlikely to be from the local community and hence unlikely to raise undue concerns among respondents about enumerators sharing their responses with other community members. Third, anecdotal evidence from fieldwork at the Central Statistical Office indicates that enumerators followed procedures similar to those in the DHS, that are also collected with technical advice from Measure Evaluation, which directed enumerators when asking sensitive questions to assess who else is present in the interview location and whether they were listening (Central Statistical Office et al. 2009).<sup>12</sup>

Table 1 presents descriptive statistics for female respondents age 15-49 in the pooled 2000-2009 ZSBS. The average age is almost thirty years old, approximately two-thirds of the respondents are married, slightly more than one-half have completed primary school, 3% have exchanged sex for money in the twelve months leading up to the survey date, and approximately two-thirds are employed outside of transactional sex. The prevalence of exchanging sex for money is consistent with evidence from elsewhere in sub-Saharan Africa as collected in national general population surveys and in sub-national studies (Vandepitte et al. 2006, Konstant et al. 2015).

### **3.2 Methods**

My main methodology is regression analysis. First, I use weighted local polynomial smoothing and the Epachenikov kernel to estimate semi-parametric employment-age profiles. This approach allows for a very flexible non-linear relationship between employment and age by imposing minimal parametric

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questions about sex and your sexual partner(s) in the last 12 months. I know it may be difficult to remember exactly, but I would like you to answer the questions to the best of your knowledge, as this information is very important for the survey. Again, this information is all completely private and anonymous and cannot be linked to you or any partner in any way.” (Central Statistical Office et al. 2010).

<sup>12</sup> As an additional check for reporting bias, I examine robustness to including a control for household size in each of the specifications that appear in Tables 2 and 3. If misreporting was correlated with privacy concerns and larger household have less privacy, then my results should be sensitive to controlling for household size. Throughout, I find that the estimated transactional sex-age profile is robust to controlling for household size.



assumptions. Second, I use ordinary least squares (OLS) regression to estimate the parameters of the following equation:

$$employed_{idt} = \alpha + \beta_1 age_{idt} + X'_{idt}\Pi + \gamma_d + \delta_m + \mu_t + \varepsilon_{idt} \quad (1)$$

where  $employed_{idt}$  is an indicator variable for employment in transactional sex,  $age_{idt}$  is the respondent's age in years, and  $X'_{idt}$  is a vector of covariates (including indicator variables for primary school completion and for secondary school completion). To account for time invariant unobserved heterogeneity in the determinants of employment across district, I include district fixed effects<sup>13</sup>, denoted by  $\gamma_d$ .  $\delta_m$  are survey month fixed effects, which account for potential seasonality in employment.  $\mu_t$  are survey year fixed effects, which address concerns about unobserved heterogeneity across survey rounds.  $\varepsilon_{idt}$  is an idiosyncratic error term. In all OLS regression analyses, I estimate heteroskedasticity-robust standard errors and cluster the standard errors at the district level to account for unobserved determinants of employment potentially being correlated at the district level.<sup>14</sup> I also explore using indicator variables for five-year age group instead of  $age_{idt}$ . In all OLS regression analyses, to facilitate comparison of coefficient estimates that would otherwise be small in absolute terms I rescale  $employed_{idt}$  such that it equals 100 if employed and 0 otherwise. Thus, the point estimates in the OLS regressions should be interpreted directly as percentage point effects.

## 4. Results

### 4.1 Transactional Sex Employment-Age Profiles

Figure 1 displays the results of a locally-weighted semi-parametric regression of employed in transactional sex on age. The relationship between the likelihood of employment in transactional sex and age is

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<sup>13</sup> There are 72 districts in Zambia.

<sup>14</sup> An alternative view is that the standard errors should not be clustered because there is no "treatment" whose effect I am estimating. My results are robust to not clustering my standard errors.

approximately linear, although the profile flattens out somewhat around age 40. The peak ages for transactional sex work are around 15 years to 20 years old and the likelihood of transactional sex work declines monotonically with age. Between the youngest age (i.e. 15 years old) to the oldest age (i.e. 49 years old), the likelihood of employment in transactional sex falls from over to 4% to 1%.

Table 2 presents ordinary least squares (OLS) estimates of transactional sex employment-age profiles.<sup>15</sup> In Columns (1)-(3), I measure age in years. Column (1) includes no controls, Column (2) controls for district, survey month, and survey year fixed effects, and Column (3) adds individual-level controls (i.e., indicator variables for primary school completion and secondary school completion). The results reveal a large, negative and statistically significant association between age and the likelihood of employment in transactional sex. In the linear specifications, the coefficient estimates of approximately 0.140 (p-value<0.01) indicate that a one-year increase in age is associated with an approximately 0.14 percentage point reduction in the likelihood of employment in transactional sex. Controlling for district and year fixed effects and for individual-level characteristics (i.e., indicator variables for primary school completion and for secondary school completion) does not affect the association between age and employment in transactional sex.

Columns (4)-(6) repeat this analysis using indicator variables for five-year age group instead of a single age variable. The specifications that use indicator variables for five-year age group suggest some non-linearity in the association between age and the likelihood of employment in transactional sex, with females age 35-39, age 40-44, and age 45-49 all approximately equally less likely than the excluded age group (i.e. females age 15-19) to be employed in transactional sex. Controlling for district and year fixed effects and for individual-level characteristics (i.e., indicator variables for primary school completion and for secondary school completion) does not affect the association between age and employment in transactional sex.

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<sup>15</sup> Recall that in all OLS regressions, I rescale *employed<sub>idt</sub>* such that it equals 100 if employed and 0 otherwise. Thus, the point estimates in the OLS regressions should be interpreted directly as percentage point effects.

## 4.2 Mechanisms

Table 3 explores possible mechanisms underlying the observed transactional sex employment-age profile: (i) employment opportunities outside of transactional sex increase with age leading to substitution of labor supply away from transactional sex and toward other employment, and (ii) marital opportunities increase with age which raises the cost of supplying labor in transactional sex. In Column (1), I control for employment outside of transactional sex, in Column (2) I control for being married, and in Column (3) I include both of these controls. Columns (4)-(6) repeat this analysis using indicator variables for five-year age group instead of the linear specification in Columns (1)-(3).

The results from the linear specifications in Table 3 suggest that neither outside employment opportunities nor marriage are the main mechanisms underlying the transactional sex employment-age profile. For example, the coefficient estimate for age in Column (1), is -0.138 (p-value<0.01), virtually the same as in Table 2. As shown in Columns (2) and (3), controlling for marriage attenuates the linear relationship between age and employment in transactional sex, yet the point estimate in each regression is still more than half of the point estimate from specifications that do not control for marriage and it remains statistically significant at the 1% level.

The results from the semi-parametric specifications in Table 3 indicate that marriage may be driving part, but not all, of the decline in the (unconditional) likelihood of employment in transactional sex with age. In the specifications that control for being married (i.e. Columns (5) and (6)), the coefficient estimates for Age 20-24 are close to zero and statistically insignificant. Furthermore, the coefficient estimates for Age 25-29 and Age 30-34 are approximately one-third of the magnitude when not controlling for being married and are not statistically significant at conventional levels. For older ages (e.g., Age 35-39), the coefficient estimates are approximately one-half of the magnitude when not controlling for being married and are statistically significant at the 5% (or, in many cases, the 1%) level.

## 4.3 Employment-Age Profiles Outside of Transactional Sex

Figure 2 displays the results of a locally-weighted semi-parametric regression of employment outside of transactional sex on age. The relationship between employment outside of transactional sex and age is approximately linear, although the rate of increase in the probability of employment decreases somewhat at older ages. Between the youngest age (i.e. 15 years old) to the oldest age (i.e. 49 years old), the likelihood of employment outside of transactional sex rises from approximately 30% to roughly 80%.

Table 4 presents OLS estimates of employment-age profiles for employment outside of transactional sex. Columns (1)-(6) use age in years and Columns (7)-(12) use indicator variables for five-year age group. Throughout Table 4, the coefficient estimates indicate a large, positive and statistically significant association between age and employment outside of transactional sex. For example, the coefficient estimate in Column (1), 1.529 (p-value<0.01), indicates that a one year increase in age is associated with a 1.529 percentage point increase in the likelihood of employment outside of transactional sex.

These findings on the employment-age profile outside of transactional sex confirm that the stylized fact from other settings that overall employment outcomes improve with age also applies to the Zambia Sexual Behavior Surveys. Older women have higher employment outside of transactional sex than do younger women. Thus, the negative gradient in the employment-age profile for transactional sex documented in Section 4.1 is not an artifact of these data and is not present in all employment-age profiles invariant of occupational category.

#### **4.4 Mean Age by Occupation**

Table 5 presents mean age and standard deviation of age (in years) by occupation. I list transactional sex work, the four specific occupations with employment shares (outside of transactional sex work) of at least 2%, and aggregate the remaining occupations into “other”. These calculations confirm that transactional sex work is the youngest major occupation, approximately 6 years younger than the next youngest occupation, and has the lowest variance in age.

The mean age of individuals employed in transactional sex work in this sample – 23 years – is substantially lower than in previous economic research on transactional sex work. For example, Arunachalam and Shah (2013), Robinson and Yeh (2011), Ghosal et al. (2015) and Manian (2018), report mean ages of 27, 29, 32, and 37, respectively. One key difference between my analysis and these studies is that I use data from a general population survey whereas these studies typically used small, convenience-based samples.

## **5. Discussion and Conclusion**

Four stylized facts emerge from my empirical analysis. First, the likelihood of engaging in transactional sex declines sharply with age. Second, controlling for employment outside of transactional sex does not substantially affect the transactional sex employment-age profile, and controlling for being married somewhat attenuates the transactional sex employment-age profile. Third, these patterns are robust to including geographic, temporal, and other individual-level controls. Fourth, for all of the occupation categories outside of transactional sex work, the likelihood of employment increases sharply with age (at least in the younger age range), making transactional sex the youngest occupation.

These results are consistent with the hypothesis that client preference for younger females may be driving much of the observed (unconditional) transactional sex employment-age profile.<sup>16</sup> Although controlling for being married somewhat attenuates the transactional sex employment-age profile, the general relationship of declining likelihood of transactional sex employment with age remains. Data limitations preclude me from testing whether another alternative hypothesis – that differential mortality selection by transactional sex workers and the associated survivor bias – is at least partly underlying my main result.

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<sup>16</sup> An economic literature, primarily from high-income countries, has documented that individuals tend to marry individuals of roughly similar age (e.g., Choo and Siow 2006, Belot and Francesconi 2013). The conclusion that my findings are consistent with client preference for younger transactional sex workers (e.g., age 15-19) cannot be directly compared with the assortative matching finding in the existing economic literature on marriage because my study does not analyze client age.

At least three main policy implications follow from these findings. One main implication is that policymakers should consider interventions designed to reduce demand for transactional sex with younger females, such as (increased) penalties levied on the clients of younger transactional sex workers. A second implication is that policymakers should continue targeting younger women (e.g., age 15-24) for risk reduction programs associated with transactional sex work. My results add to the growing body of economic evidence that transactional sex work is a central cause of the HIV pandemic in adolescent girls. Third, as the age structure in sub-Saharan African countries shifts toward older ages, the population prevalence of transactional sex may decline.

Future research should examine these questions in more detail, including by estimating the elasticities of demand and supply for transactional sex disaggregated by age group. Furthermore, future research should continue to study transactional sex using general population surveys. Previous research on transactional sex work typically has used small, convenience-based samples and the median age in these studies (i.e. around 30 years old) is consistently higher than in my analysis. My findings suggest that these studies may be systematically missing younger women, women who are disproportionately likely to be employed in transactional sex.

## **List of Abbreviations**

DHS Demographic and Health Survey  
OLS Ordinary Least Squares  
ZSBS Zambia Sexual Behavior Survey

## **Declarations**

### *Availability of data and material*

The data used in this analysis are available directly from the Zambia Central Statistical Office (<http://www.zamstats.gov.zm/>).

### *Competing interests*

The author declares that they have no competing interests.

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This study did not use external funding.

### *Authors' contributions*

NW performed all analyses and wrote the manuscript.

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## References

- Andersen, T.M., Maibom, J., Svarer, M. and Sørensen, A., 2017. Do business cycles have long-term impact for particular cohorts? *Labour*, 31(3): 309-336.
- Arunachalam, R. and Shah, M. 2008. Prostitutes and brides? *The American Economic Review Papers and Proceedings*, 98(2): 516-522.
- Arunachalam, R. and Shah, M. 2012. The prostitute's allure: The return to beauty in commercial sex work. *The BE Journal of Economic Analysis & Policy*, 12(1): 1-25.
- Arunachalam, R. and Shah, M. 2013. Compensated for life: Sex work and disease risk. *Journal of Human Resources*, 48(2): 345-369.
- Atalay, K. and Barrett, G.F. 2015. The impact of age pension eligibility age on retirement and program dependence: Evidence from an Australian experiment. *Review of Economics and Statistics*, 97(1): 71-87.
- Bande, R. and López-Mourelo, E., 2015. The impact of worker's age on the consequences of occupational accidents: empirical evidence using Spanish data. *Journal of Labor Research*, 36(2): 129-174.
- Banerjee, S. and Blau, D. 2016. Employment trends by age in the United States: Why are older workers different?. *Journal of Human Resources*, 51(1):163-199.
- Belot, M. and Francesconi, M. 2013. Dating preferences and meeting opportunities in mate choice decisions. *Journal of Human Resources*, 48(2): 474-508.
- Blinder, A.S. and Weiss, Y., 1976. Human capital and labor supply: A synthesis. *Journal of Political Economy*, 84(3): 449-472.
- Castellucci, F., Padula, M. and Pica, G. 2011. The age-productivity gradient: Evidence from a sample of F1 drivers. *Labour Economics*, 18(4): 464-473.
- Central Statistical Office, Ministry of Health, Tropical Diseases Research Centre, University of Zambia, and Macro International Inc. 2009. *Zambia Demographic and Health Survey 2007*. Calverton, Maryland, USA: CSO and Macro International Inc.
- Central Statistical Office, Ministry of Health, University of Zambia, and MEASURE Evaluation. 2010. *Zambia Sexual Behaviour Survey 2009*. Lusaka, Zambia: CSO and MEASURE Evaluation.
- Choo, Eugene, and Aloysius Siow. 2006. Who marries whom and why. *Journal of Political Economy* 114(1): 175-201.
- Cunningham, S. and Kendall, T.D. 2011a. Prostitution 2.0: The changing face of sex work. *Journal of Urban Economics*, 69(3): 273-287.
- Cunningham, S. and Kendall, T.D. 2011b. Men in transit and prostitution: Using political conventions as a natural experiment. *The BE Journal of Economic Analysis & Policy*, 11(1).
- Cunningham, S. and Kendall, T.D. 2017. Prostitution, hours, job amenities and education. *Review of Economics of the Household*, forthcoming

- Cunningham, S. and Shah, M. 2014. Decriminalizing indoor prostitution: Implications for sexual violence and public health. NBER, Working Paper 20281.
- De Walque, D. 2009. Does education affect HIV status? Evidence from five African Countries. *The World Bank Economic Review*, 23(2): 209-233.
- Debrulle, J. 2016. The role of entrepreneurship in the context of career trajectories: Moving back into wage employment or into unemployment? *Labour*, 30(2):180-197.
- Della Giusta, M., Di Tommaso, M.L., Shima, I. and Strøm, S. 2009a. What money buys: Clients of street sex workers in the US. *Applied Economics*, 41(18):2261-2277.
- Della Giusta, M., Di Tommaso, M.L. and Strøm, S. 2009b. Who is watching? The market for prostitution services. *Journal of Population Economics*, 22(2): 501-516.
- Dunkle, K.L., Wingood, G.M., Camp, C.M. and DiClemente, R.J., 2010. Economically motivated relationships and transactional sex among unmarried African American and white women: Results from a US national telephone survey. *Public Health Reports*, 125(S4):90-100.
- Dupas, P. and Robinson, J. 2012. The (hidden) costs of political instability: Evidence from Kenya's 2007 election crisis. *Journal of Development Economics*, 99(2):314-329.
- Edlund, L. and Korn, E. 2002. A theory of prostitution. *Journal of Political Economy*, 110(1): 181-214.
- Fortson, J. 2008. The gradient in sub-Saharan Africa: Socioeconomic status and HIV/AIDS. *Demography*, 45(2): 303-322.
- Friedman, W. 2016. Antiretroviral drug access and behavior change. University of California, Berkeley working paper.
- Gersovitz, M., Jacoby, H.G., Seri Dedy, F., Goze Tape, A. 1998. The balance of self-reported heterosexual activity in KAP surveys and the AIDS epidemic in Africa. *Journal of the American Statistical Association*, 93(443), 875-883.
- Gertler, P., Shah, M. and Bertozzi, S.M. 2005. Risky business: The market for unprotected commercial sex. *Journal of Political Economy*, 113(3):518-550.
- Gertler, P. and Shah, M. 2009. Sex work and infection: What's law enforcement got to do with it? *Journal of Law and Economics*, 54(4): 811-840.
- Gervais, M., Jaimovich, N., Siu, H.E. and Yedid-Levi, Y. 2016. What should I be when I grow up? Occupations and unemployment over the life cycle. *Journal of Monetary Economics*, 83: 54-70.
- Ghosal, Sayantan, Smarajit Jana, Anandi Mani, Sandip Mitra, and Sanchari Roy. 2015. Sex workers, self-image and stigma: Evidence from Kolkata brothels. University of Glasgow working paper.
- Göbel, C. and Zwick, T. 2013. Are personnel measures effective in increasing productivity of old workers?. *Labour Economics*, 22: 80-93.
- Hanoch, G. and Honig, M. 1985. "True" age profiles of earnings: Adjusting for censoring and for period and cohort effects. *The Review of Economics and Statistics*, 383-394.

- Hellerstein, J.K. and Neumark, D. 1995. Are earnings profiles steeper than productivity profiles? Evidence from Israeli firm-level data. *Journal of Human Resources*, 89-112.
- Immordino, G. and Russo, F.F. 2015. Regulating prostitution: A health risk approach. *Journal of Public Economics*, 121: 14-31.
- Kayeyi, N., Fylkesnes, K., Wiium, N. and Sandøy, I.F. 2013. Decline in sexual risk behaviours among young people in Zambia (2000–2009): Do neighbourhood contextual effects play a role?. *PloS One*, 8(5): e64881.
- Konstant, T.L., Rangasami, J., Stacey, M.J., Stewart, M.L. and Nogoduka, C. 2015. Estimating the number of sex workers in South Africa: Rapid population size estimation. *AIDS and Behavior*, 19(1): 3-15.
- Kotlikoff, L.J. and Gokhale, J. 1992. Estimating a firm's age-productivity profile using the present value of workers' earnings. *The Quarterly Journal of Economics*, 107(4): 1215-1242.
- Lahey, J.N. 2008. Age, women, and hiring: An experimental study. *Journal of Human Resources*, 43(1): 30-56.
- Lazear, E.P., 1981. Agency, earnings profiles, productivity, and hours restrictions. *The American Economic Review*, 71(4): 606-620.
- Logan, T. and Shah, M. 2013. Face value: Information and signaling in an illegal market. *Southern Economic Journal*, 79(3): 529-564.
- Lucas, A. and Wilson, N. 2017. Schooling, wealth, risky sexual behavior, and HIV/AIDS in sub-Saharan Africa. University of Delaware working paper.
- MaCurdy, T.E. 1981. An empirical model of labor supply in a life-cycle setting. *Journal of Political Economy*, 89(6): 1059-1085.
- Manian, Shanthi. 2018. Health certification in the market for sex work: A field experiment in Dakar, Senegal. Washington State University working paper.
- McKeganey, N. 1994. Why do men buy sex and what are their assessments of the HIV-related risks when they do?. *AIDS Care*, 6(3): 289-301.
- Mincer, J. 1974. Schooling, experience, and earnings. New York: National Bureau of Economic Research.
- Murphy, K.M. and Welch, F. 1990. Empirical age-earnings profiles. *Journal of Labor Economics*, 8(2): 202-229.
- Pickering, H., Todd, J., Dunn, D., Pepin, J. and Wilkins, A. 1992. Prostitutes and their clients: A Gambian survey. *Social Science & Medicine*, 34(1): 75-88.
- Rao, V., Gupta, I., Lokshin, M. and Jana, S. 2003. Sex workers and the cost of safe sex: The compensating differential for condom use among Calcutta prostitutes. *Journal of Development Economics*, 71(2): 585-603.

- Robinson, H. 2003. Are you experienced? British evidence on age-earnings profiles. *Applied Economics*, 35(9): 1101-1115.
- Robinson, J. and Yeh, E. 2011. Transactional sex as a response to risk in Western Kenya. *American Economic Journal: Applied Economics*, 3(1): 35-64.
- Robinson, J. and Yeh, E. 2012. Risk-coping through sexual networks evidence from client transfers in Kenya. *Journal of Human Resources*, 47(1): 107-145.
- Rodenberg, R.M. and Stone, D.F. 2011. The short and long-run labor market effects of age eligibility rules: Evidence from women's professional tennis. *Journal of Labor Research*, 32(2): 181.
- Rupert, P. and Zanella, G. 2015. Revisiting wage, earnings, and hours profiles. *Journal of Monetary Economics*, 72, pp.114-130.
- Schnalzenberger, M., Schneeweis, N., Winter-Ebmer, R. and Zweimüller, M. 2014. Job quality and employment of older people in Europe. *Labour*, 28(2): 141-162.
- Shah, M. 2014. Sex work and risky sex in developing countries. In: *Encyclopedia of Health Economics*, Vol 3. Anthony J. Culyer, ed. San Diego: Elsevier Science Publishers.
- Thornton, R.J., Rodgers, J.D. and Brookshire, M.L. 1997. On the interpretation of age-earnings profiles. *Journal of Labor Research*, 18(2): 351-365.
- Weiss, T. 1986. The determinants of life cycle earnings: A survey. In: *Handbook of Labor Economics*, Volume I, O. Ashenfelter and R. Layard, eds. Elsevier Science Publishers.
- Wilson, N. 2012. Economic booms and risky sexual behavior: Evidence from Zambian copper mining cities. *Journal of Health Economics*, 31(5): 797-812.
- Vandepitte, J., Lyerla, R., Dallabetta, G., Crabbé, F., Alary, M. and Buvé, A. 2006. Estimates of the number of female sex workers in different regions of the world. *Sexually Transmitted Infections*, 82(S3): iii18-iii25.
- Vermeer, N., Mastrogiacomo, M. and Van Soest, A. 2016. Demanding occupations and the retirement age. *Labour Economics*, 43: 159-170.

**Table 1: Descriptive Statistics**

	Mean	Standard deviation
	(1)	(2)
<b>Panel A: Demographic characteristics</b>		
Age	27.94	9.16
Age 15-19	0.22	0.41
Age 20-24	0.21	0.41
Age 25-29	0.18	0.39
Age 30-34	0.14	0.35
Age 35-39	0.11	0.31
Age 40-44	0.08	0.28
Age 45-49	0.06	0.24
Married	0.60	0.49
Primary school completion	0.52	0.50
Secondary school completion	0.12	0.32
<b>Panel B: Employment outcomes</b>		
Employed in transactional sex	0.03	0.16
Employed outside of transactional sex	0.60	0.49
<i>Employed in agriculture</i>	0.36	0.48
<i>Employed in sales</i>	0.15	0.35
<i>Employed in crafts</i>	0.02	0.14
<i>Employed in protective services</i>	0.02	0.13
<i>Employed, other</i>	0.06	0.25
Observations	8,359	

Notes: Standard deviations are in parentheses. All variables except "Age" are indicator variables.

\*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

**Table 2: Employment-Age Profiles, Employment in Transactional Sex**

Dependent variable:	Employed in transactional sex (Yes=100, No=0)					
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.140*** (0.023)	-0.136*** (0.022)	-0.137*** (0.023)			
Age 20-24				-1.470* (0.813)	-1.387* (0.754)	-1.294* (0.743)
Age 25-29				-3.116*** (0.746)	-2.824*** (0.678)	-2.787*** (0.674)
Age 30-34				-3.063*** (0.758)	-2.909*** (0.716)	-2.879*** (0.715)
Age 35-39				-3.766*** (0.804)	-3.407*** (0.739)	-3.416*** (0.741)
Age 40-44				-3.874*** (0.798)	-3.835*** (0.766)	-3.833*** (0.774)
Age 45-49				-3.919*** (0.861)	-3.795*** (0.789)	-3.765*** (0.789)
District and survey year/month fixed effects	NO	YES	YES	NO	YES	YES
Individual-level controls	NO	NO	YES	NO	NO	YES
Observations	8,359	8,359	8,359	8,359	8,359	8,359

Notes: Parameters estimated using ordinary least squares (OLS) regression. Robust standard errors are in parentheses. "Employed in transactional sex" is an indicator variable equal to 100 if the respondent reported exchanged sex for money in the past twelve months and 0 otherwise. In Columns (4)-(6), excluded age category is "Age 15-19". Individual-level controls are indicator variables for primary school completion and secondary school completion.

\*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

**Table 3: Possible Mechanisms Underlying Transactional Sex Employment-Age Profiles**

Dependent variable:	Employed in transactional sex (Yes=100, No=0)					
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.138*** (0.023)	-0.081*** (0.019)	-0.086*** (0.020)			
Age 20-24				-1.379* (0.758)	0.205 (0.727)	0.105 (0.728)
Age 25-29				-2.906*** (0.707)	-0.903 (0.626)	-1.044 (0.638)
Age 30-34				-3.001*** (0.725)	-0.923 (0.708)	-1.066 (0.691)
Age 35-39				-3.551*** (0.791)	-1.550** (0.637)	-1.710** (0.671)
Age 40-44				-3.976*** (0.798)	-2.112*** (0.682)	-2.281*** (0.687)
Age 45-49				-3.899*** (0.828)	-2.080*** (0.701)	-2.238*** (0.728)
Employed outside of transactional sex	0.001 (0.003)		0.004 (0.004)	0.003 (0.003)		0.003 (0.004)
Married		-3.489*** (0.819)	-3.518*** (0.834)		-3.554*** (0.858)	-3.560*** (0.863)
District and survey year/month fixed effects	YES	YES	YES	YES	YES	YES
Additional individual-level controls	YES	YES	YES	YES	YES	YES
Observations	8,359	8,359	8,359	8,359	8,359	8,359

Notes: Parameters estimated using ordinary least squares (OLS) regression. Robust standard errors are in parentheses. "Employed in (outside of) transactional sex" is an indicator variable equal to 100 if the respondent reported employment in (outside of) transactional sex and 0 otherwise. In Columns (4)-(6), excluded age category is "Age 15-19". Additional individual-level controls are indicator variables for primary school completion and secondary school completion.

\*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

**Table 4: Employment-Age Profiles, Employment Outside of Transactional Sex**

Dependent variable:	Employed (Yes=100, No=0):											
	Outside of transactional sex						Protective					
	sex	Agriculture	Sales	Crafts	services	Other	sex	Agriculture	Sales	Crafts	services	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Age	1.529*** (0.122)	0.584*** (0.073)	0.496*** (0.101)	0.083*** -0.02	0.035* (0.0180)	0.331*** (0.065)						
Age 20-24							28.636*** (1.716)	12.083*** (1.958)	11.204*** (1.743)	1.287*** (0.433)	1.742*** (0.466)	2.319*** (0.869)
Age 25-29							40.145*** (2.726)	13.553*** (2.229)	16.029*** (2.618)	2.027*** (0.423)	1.742*** (0.607)	6.794*** (1.188)
Age 30-34							41.089*** (3.216)	13.598*** (2.179)	14.849*** (2.734)	2.467*** (0.623)	2.422*** (0.631)	7.754*** (1.645)
Age 35-39							45.576*** (3.197)	14.079*** (2.303)	17.825*** (2.784)	2.385*** (0.586)	1.351** (0.527)	9.937*** (1.815)
Age 40-44							48.366*** (3.826)	20.192*** (2.804)	17.745*** (3.729)	1.815*** (0.624)	1.448*** (0.538)	7.165*** (1.822)
Age 45-49							45.371*** (2.695)	18.837*** (2.903)	12.946*** (2.654)	3.091*** (0.837)	1.657** (0.768)	8.839*** (1.528)
District and survey year/month fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual-level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	8,359	8,359	8,359	8,359	8,359	8,359	8,359	8,359	8,359	8,359	8,359	8,359

Notes: Parameters estimated using ordinary least squares (OLS) regression. Robust standard errors are in parentheses. "Outside of transactional sex" is an indicator variable equal to 100 if the respondent reported employment outside of transactional sex and 0 otherwise. "Agriculture", "Sales", etc. defined similarly. "Other" refers to other occupation outside of transactional sex. In Columns (7)-(12), excluded age category is "Age 15-19". Individual-level controls are indicator variables for married, primary school completion, and secondary school completion.

\*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.



**Table 5: Age Distribution by Occupation**

	Standard deviation		Observations
	Mean age (1)	of age (2)	
Transactional sex	23.41	7.67	218
Protective services	29.37	8.02	142
Agriculture	30.01	9.09	2,977
Sales	30.53	8.28	1,223
Crafts	31.25	8.74	166
Other	31.42	8.06	543

Figure 1: Employment in Transactional Sex and Age

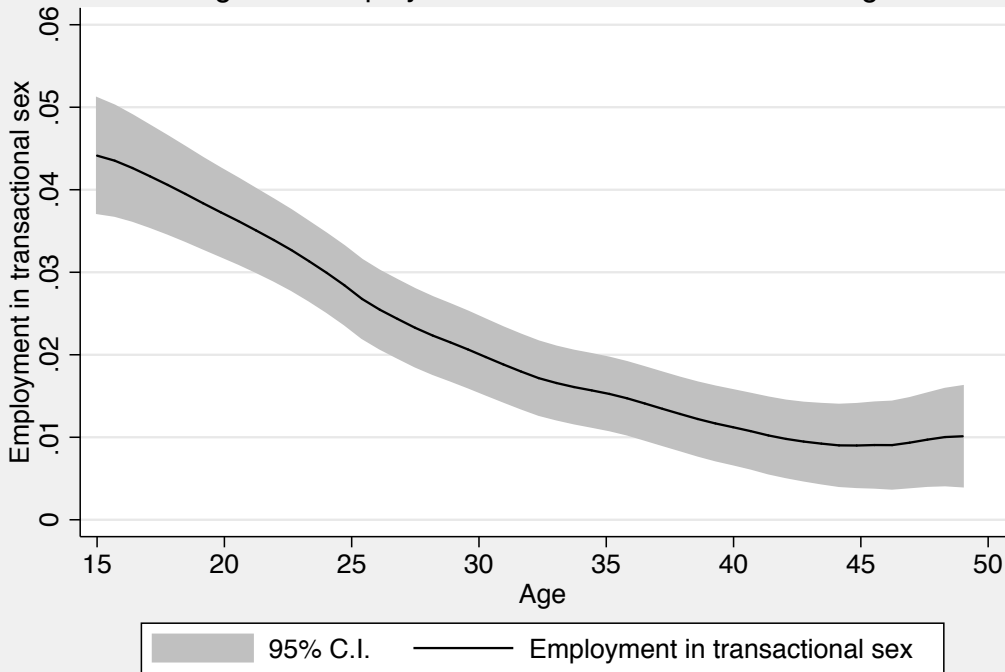


Figure 2: Employment Outside of Transactional Sex and Age

