Are Happy Marriages Faithful Marriages? Addressing the Endogeneity Problem

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What makes a person more likely to engage in an extramarital affair, and are there systematic differences between men and women? These complex questions have been central to the empirical and theoretical literature on infidelity since its interception in economics with Fair (1978). One factor that is often found important is happiness and/or marital happiness. Men and women who are happy are less likely to have an affair. This intuitive and somewhat unsurprising result, however, is fraught with an endogeneity problem. This paper utilizes a recursive simultaneous-equations model that circumvents the endogeneity issue. Using data from the U.S. General Social Survey, we find that given equal 'prices' men and women choose differently when making decisions related to marital infidelity. Our estimates also show that happiness with marriage is the single most relevant factor explaining infidelity for both men and women. Social class, age, and divorced status also affect the likelihood of infidelity. Somewhat surprising, demographic factors including educational attainment seem to not affect infidelity.

Keywords: infidelity, happiness, marriage, bivariate probit, endogeneity

JEL Codes: J1, J10, J12

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Acknowledgements: We thank William Greene for his helpful feedback on model specification and Reagan Baughman for her valuable critique of an early version of this paper. We also thank Padmaja Ayyagri, Michael Baker, Shilpi Bhardwaj, Lewis Davis, and Ilyana Kuziemko for insightful comments that improved the paper

 http://dx.doi.org/10.26021/10834

I. Introduction

As an area of research within the economics of marriage literature, infidelity has become more popular lately. And for good reason: infidelity is a leading cause of divorce, spousal abuse, as well as other less visible marital issues such as decreased trust, security, and general happiness. While each of these issues represents personal adversity, they also imply externalities that affect children, relatives, and society at large (e.g. lower academic achievement of children from divorced families and increases in court costs). Thus, there are negative consequences of marital infidelity for society. While studies in psychology and sociology provide a myriad of explanations for infidelity, the empirical analysis of the determinants of infidelity is subject to significant limitations, including in studies conducted by economists (e.g. Fair, 1978; Cameron, 2002; Wells, 2003; Elmslie and Tebaldi, 2008; Potter, 2011; Brooks and Monaco, 2012; Smith, 2012; and Adamopoulou, 2013).

The two extant models of infidelity in the economics literature were developed by Fair (1978) and Elmslie and Tebaldi (2008). While both will be discussed below, it is fair to say that the existing empirical work on the economics of infidelity is loosely related to the extant theories (Fair, 1978; Elmslie and Tebaldi, 2008), focusing mainly on how socio-economic factors affect marital infidelity (Cameron, 2002; Potter, 2011). This study addresses several concerns with the existing economic literature on infidelity. Throughout the main literature, one result has remained consistently significant: men and women who are happier generally or within their marriage are less likely to have an affair. This consistency also highlights a major weakness in all of the literature on infidelity to date (Li and Racine, 2004; Elmslie and Tebaldi, 2008; Potter, 2011; and Adamopoulou, 2013). Each study fails to recognize the potential endogeneity of happiness as a regressor in the infidelity equation, which certainly deems this conclusion as unreliable as the estimated coefficients are biased. Additionally, Cheng and Smyth (2015) use Chinese data to examine the reverse effect of infidelity on happiness. They find that extramarital affairs negatively affect happiness but fail to control for endogeneity. There are also concerns regarding the measure of infidelity itself in these studies, as discussed below.

In this paper, we ask the questions: what are the key factors affecting a person's behavior with respect to infidelity, and are there gender-related differences linked to infidelity? We contribute to the economics of marriage literature by providing a robust empirical analysis of the

factors affecting a person's behavior toward infidelity. First, our empirical strategy circumvents the happiness-infidelity endogeneity problem that plagues previous analysis of infidelity. Endogeneity produces biased coefficient estimates, thus leading to unreliable conclusions. Our approach by-passes the search for an elusive instrument by relying on relationships among the joint, conditional, and marginal probabilities of a bivariate probit model as demonstrated in the work of Burnett (1997), Greene (1998; 2008), and Li, Poskitt and Zhao (2019). More precisely, we use an empirical approach that treats marital infidelity and happiness with marriage as jointly determined outcomes that can be estimated via a recursive bivariate probit model. This approach has recently been demonstrated to be a "resilient empirical tool for estimating the effect of an endogenous binary regressor on a binary outcome variable." (Li, Poskitt and Zhao, 2019, p. 112)

Second, we improve previous empirical analysis of infidelity by using comprehensive data from the General Social Survey (GSS) from 1991 to 2012 and better metrics that capture the complexity of both marital happiness and infidelity. We code a person as having had an extramarital affair if she/he is married and had more than one sex partner in the last year. This metric is significantly different from that used by Elmslie and Tebaldi (2008) and Smith (2012) using GSS data, or Potter (2011) using National Youth Survey (NYS) data. The former studies code a person as having had an extramarital affair if she/he had *ever* had sex with a person other than the spouse while married. The latter study measures infidelity in terms of the frequency with which a person, during a year, engages in extramarital sexual relationships. The major problem with Elmslie and Tebaldi (2008) and Smith (2012) is not the metric of infidelity itself, but how it is included in the empirical model because most covariates are measured contemporaneously while the measure of infidelity represents a long-run "stock" that was likely determined by factors other than the contemporaneous variables included in their regressions. Potter's (2011) proxy for infidelity, on the other hand, measures the intensity of the affair, rather than the likelihood that a married person may engage in an extramarital affair. Our study also employs a measure of happiness that focuses on happiness with the marriage instead of general happiness (used by Elmslie and Tebaldi, 2008).

Third, our empirical strategy and data set allow for an empirical test of the main implications of the extant models in the economics literature of Fair (1978) and Elmslie and Tebaldi (2008). More precisely, Fair (1978) proposes a theoretical model based on the preference for variety. Given such a preference, individuals divide their time between work and leisure time

that could be spent with either one's spouse or with a paramour. There are three major implications of this model. First, given that there is no *a priori* reason to assume that preferences are gender specific, men and women are expected to respond similarly to the various costs and benefits of infidelity. Second, given diminishing returns to time spent with one's spouse, time spent with a paramour is an increasing function of marital tenure. Finally, increased utility received from time spent with a spouse decreases time spent with a paramour. This leads to the prediction that increased marital happiness decreases infidelity equally for both genders. Other work has previously empirically evaluated Fair (1978). Pagan and Vella (1989) and Wells (2003) are not interested in the topic of infidelity as much as they are interested in applications of econometric techniques developed since Fair (1978). These studies use the *Psychology Today* data set used by Fair (1978). Pagan and Vella (1989) check for normality, heteroskedasticity and omitted variable bias in Fair's (1978) Tobit equation and find that the model fails all the tests, which caused them to cast serious doubt on the basic result that infidelity increases with time in marriage. Wells (2003) recompute the exact tests performed by Pagan and Vella (1989) and find that the original Fair model actually passes all of the tests, indicating a mistake in their econometric work. Thus, Wells (2003) re-establishes the results of Fair, with special emphasis on the marriage tenure and infidelity result. However, using nonparametric methods, Li and Racine (2004) find no relation between marital tenure and infidelity. Additionally, Chernozhukov and Hong (2002) find a negative relationship between tenure and infidelity. The preponderance of the evidence is that the relationship is weak and possibly negative in Fair's original data.

Elmslie and Tebaldi (2008) develop an expected utility model where the expectations are driven partly by biology. The evolutionary biology view suggests that the sex drive in both men and women comes from each individual's instinctive desire to pass one's own genes onto the next generation. Given this basic desire, men have an incentive to spread their seed widely because they do not face the direct costs and limitations of pregnancy. Their ability to do this will depend on their own gene quality. Women face more stringent costs related to sexual activity. If impregnated, they face nine months plus recovery time where they will not be able to be impregnated by another, perhaps superior, male. Therefore, a woman's incentive to stray is dependent on the quality of her spouse's genes relative to those of other available males. In short, the benefits of infidelity differ for men and women due to biological differences, while the costs are expected to differ for societal and other reasons (e.g. spousal abuse resulting from an affair being discovered). For a more

detailed description of differential behavior of men and women regarding infidelity from the evolutionary biology and psychology literature, see Trivers (1972; 1986) and Buss (1994).

Overall, the Elmslie and Tebaldi (2008) model makes three predictions. First, through the expected utility function, there is an inverse relation between marital happiness and the probability of an affair. Second, stemming from the biological benefits of an affair, there is a negative relation between age and the probability of an affair. Given that age and marital tenure are highly correlated, this relation also applies to marital tenure (Li and Rocine, 2004). Finally, biological differences between men and women in terms of the costs and benefits of pregnancy imply that men and women will respond differently to the costs and benefits (i.e. prices) of infidelity. Smith (2012) also develops an expected utility model of infidelity driven primarily by preferences and the expected costs associated with an affair. His predictions relate to both models of Fair (1978) and Elmslie and Tebaldi (2008) and suggest that infidelity propensity is an increasing function of an individual's quality (undefined in the paper), is indeterminate in terms of education, and decreasing in terms of expected costs. Utilizing some biological arguments of Elmslie and Tebaldi (2008), Smith's (2012) model allows the infidelity propensity to differ for men and women.

Our empirical strategy allows for testing the main implications of the extant models of Fair (1978) and Elmslie and Tebaldi (2008) and addressing concerns about the endogeneity between happiness and infidelity and the infidelity-gender bias that have plagued infidelity-related studies.

II. The Empirical Model

There is a large and growing literature studying methods to obtain robust and consistent estimates when endogenous variables are present in binary choice models (e.g. Burnett, 1997; Angrist, 2001; Blundell and Powell, 2004; Dong and Lewbel, 2015). The available methods include control functions, 2SLS with a linear probability model, and the special regressor estimator. However, these methods are subject to major limitations and require strong identifying assumptions (see Lewbel, Dong, and Yang, 2012; and Dong and Lewbel, 2015). More precisely, each of the alternatives above relies on a key requirement: find Z, a set of instruments, that satisfies the following conditions: $E(Z'\varepsilon)=0$ and $E(Z'X)$ has full rank (ε is the error term of the equation of interest and X are regressors). In addition, these alternative estimators rely on methods to address the endogeneity issue where the final step usually consists of estimating a probit-type model. This,

in turn, requires specifying the distribution of the model's error term as normal, which is similar to the assumption required in a bivariate probit specification.

The key problem in estimating a model with infidelity and marital happiness (both are binary variables) is the evident endogeneity between these two variables and the challenge to find an instrument that meets the requirements of any of the four estimation options above. The search for such an instrument is elusive, particularly when using information from datasets such as the GSS. Altonji *et al.* (2005) discuss an alternative approach where the amount of selection on the observed regressors provides an indication of the amount of selection on the unobservable. Their method, however, is highly dependent on a set of restrictive assumptions that are unlikely to be met with the set of regressors utilized in our study. In fact, the authors provide a word of caution against using their method and state that their method "is only the start of the methodological work that is needed. Priorities include a Monte Carlo analysis on how the methods perform in the context of real-word examples and systematic look at how the performance of our methods varies with the context of major data sets" (p. 182).

Our approach models infidelity (*I*) and marriage (un)happiness (*U*) as jointly determined outcomes:

$$I^* = x_1'\beta_1 + \gamma U + \varepsilon\,, \quad I = 1 \text{ if } I^* > 0, \quad 0 \text{ otherwise} \tag{1}$$

$$U^* = x_2'\beta_2 + \upsilon, \qquad U = 1 \text{ if } U^* > 0, \quad 0 \text{ otherwise} \tag{2}$$

$$Cov[\varepsilon, \upsilon | x_1, x_2] = \rho, \tag{3}$$

where I^* and U^* are the unobserved latent variables, *I* is a dummy variable equal to one if the person had an extramarital affair *last year*, *U* is a dummy variable equal to one if the person is not very happy with marriage, x_1 and x_2 are vectors of explanatory variables, β_1 and β_2 are parameter vectors, and ρ measures the covariance between the error terms of the infidelity and happiness status equations. The vectors x_1 and x_2 include covariates that measure both individual's characteristics as well as his/her spouse's characteristics. A simplified version of this model can also be written as follows:

$$Prob[I = 1, U = 1 | x_1, x_2] = \phi(x_1'\beta_1 + \gamma U, \qquad x_2'\beta_2, \rho),$$

where ϕ is the bivariate normal cumulative density function. See Greene (2008: 817-826) for details about this specification.

The specification above assumes that Equations 1 and 2 are related via their error terms (Equation 3), which implies that the probability that a person is not very happy with marriage (*pr(U=1))* and the probability of infidelity (*pr(I=1))* are not independent, thus these probabilities cannot be calculated by just estimating any one of these equations separately. In other words, studies that ignore the simultaneity between happiness status and infidelity may produce unreliable estimates and, possibly, wrong conclusions. The fact that *I* does not directly appear in the happiness (*U*) equation is an identification requirement, but it does not imply that happiness does not affect infidelity. For instance, the bivariate probit specification implies that *pr(U=1 , I=1)=pr(U=1)*Pr(I=1|U=1).* Thus, under ρ different from zero, happiness has an indirect influence on infidelity.

Greene (1998, 2008) shows that using a recursive simultaneous-equations model allows one to ignore endogeneity in formulating the log-likelihood function while still accounting for the fact that the probability of either infidelity or marital happiness is dependent on the probability of the other. More precisely, "[W]e can ignore the simultaneity in this model and we cannot in the linear regression model because, in this instance, we are maximizing the log-likelihood, whereas in the linear regression case, we are manipulating certain sample moments that do not converge to the necessary population parameters in the presence of simultaneity." (Greene, 2008: 823). This statistical property produces the "counterintuitive result … that in the bivariate probit model, unlike in the linear simultaneous equations model, if the two dependent variables are jointly determined, we just put each on the right hand side of the other equation (or, in our case, one of them) and proceed as if there were no simultaneity problem." (Greene, 1998: 295). Furthermore, Li, Poskitt and Zhao (2019) also demonstrate that the bivariate probit specification produces robust estimates of the effects of an endogenous binary regressor.

Moreover, the Lagrange multiplier or Wald tests can be used for testing whether the correlation between the error terms (ρ) is zero. If ρ equals zero, then the bivariate probit model can be specified as two independent univariate probit models. However, if ρ is different from zero, then infidelity (happiness) also has an indirect influence on happiness (infidelity) causing the univariate probit model to produce unreliable estimates. In this case, the bivariate probit model is preferable. We estimate the recursive bivariate probit model above using maximum-likelihood with Huber/White robust standard errors. This approach has been utilized in several recent articles

including Appelt (2015), Chen *et al.* (2014), Zanin *et al*. (2013), and Magnani (2012), suggesting that our approach is being utilized and recognized as a viable and robust option in dealing with endogeneity problems when the variables of interest are binary.

III. Data

This study uses U.S. data from the General Social Survey. The GSS is the only nationally representative survey of attitudes and intergroup relations that monitors trends in attitudes and behaviors in the United States. Our dataset pools GSS data from all annual surveys containing questions regarding extramarital infidelity and happiness (1991, 1993, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, and 2012). As discussed in the introduction of the paper, we code a person as having had an extramarital affair if she/he is married and had more than one sex partner in the last year. The data contains a three-category question regarding marital happiness specifically. It asks respondents if they are: *very happy*, *pretty happy*, or *not too happy*. Within these categories, only 2.9 percent of respondents reported being *not too happy* in their marriage, so we combined *pretty happy* with *not too happy* into a category we call *not very happy*. In coding the dummy variable *not very happy*, responses are given a *0* if the individual answered *very happy* and *1* otherwise. The sample used in this study only includes married people who are between 18 and 60 (see Table 1 for descriptive statistics). The sample is comprised of 4,607 women and 3,796 men, from which 2.3 and 4.6 percent, respectively, reported having had sex with more than one partner last year.

IV. Results

Our empirical analysis addresses endogeneity concerns and demonstrates that single-equation models of infidelity and happiness produce unreliable results. It also provides evidence that men and women respond differently to the costs and benefits of infidelity and that happiness with marriage is the single most important relevant factor explaining infidelity for both men and women. The results pertaining to the equation *not very happy with marriage* are not discussed in detail here because the focus of this study is on infidelity. Our results, however, are somewhat consistent with the literature on this subject (see Elmslie and Tebaldi, 2014; Eyunni, 2011; Easterlin, 2003; Cheng and Smyth, 2015).

The baseline regression results for women and men are reported in Tables 2 and 3,

Table 1: Descriptive Statistics

	Women (4,607 obs.)		Men (3,796 obs.)	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Extramarital affair	2.3%	0.151	4.6%	0.209
Not very happy with marriage	38.9%	0.487	36.4%	0.481
BA or graduate degree	29.9%	0.458	34.1%	0.474
Spouse - BA or graduate degree	30.9%	0.462	30.3%	0.460
Spouse's labor force participation	86.4%	0.343	69.4%	0.461
Protestant	56.7%	0.496	53.0%	0.499
Catholic	25.7%	0.437	24.2%	0.428
Other religion	7.6%	0.264	8.0%	0.271
Age	40.00	9.871	41.53	9.581
White	85.3%	0.354	85.1%	0.356
Black	7.8%	0.268	8.0%	0.271
Log population in city-town of residence	3.24	1.922	3.31	1.923
Unemployed	4.2%	0.200	5.6%	0.229
Housekeeper	24.4%	0.430	1.2%	0.111
Divorced in the past	24.1%	0.428	24.2%	0.428
Has child(ren)	84.5%	0.362	82.5%	0.380
Middle-class	47.4%	0.499	48.4%	0.500
Upper-class	3.2%	0.177	3.8%	0.192
Republican party affiliation	30.6%	0.461	35.4%	0.478
Democratic party affiliation	31.5%	0.464	25.4%	0.436

Source: Authors' calculations using data from the General Social Survey, 1991-2012. Sample includes married people who are 18 to 60 years old.

respectively. The estimates of ρ are relatively large (above 0.44 in absolute value) and are statistically significant in all bivariate probit models. These results imply that the error terms of the "not very happy" with marriage and marital infidelity equations are correlated, and a single-equation model is inappropriate in examining the relationship between marital infidelity and happiness status. The results also imply that marginal effects using a single-equation model are incorrect. We do not include goodness-of-fit statistics in these tables due to the inherent difficulties in obtaining meaningful goodness-of-fit metrics for bivariate probit models. However, all models were tested using the log-likelihood test and, in all regressions, the null hypothesis that all coefficients in the model are statistically equal to zero was rejected at conventional levels of significance.

Similar to a univariate probit model, the coefficients of a bivariate probit model only show the direction of the relationship between the dependent and explanatory variables. Calculations of marginal effects for a bivariate probit model are cumbersome but possible for several different

Table 2: Coefficient Estimates of Recursive Bivariate Probit Models, Women

Variables	**(1)**	**(2)**	**(3)**	**(4)**
Dependent Variable: Infidelity				
Not very happy with marriage	1.231***	1.079***	1.178***	1.192***
	[3.95]	[3.14]	[3.59]	[3.84]
Spouse has BA or graduate degree	-0.00147		-0.00836	-0.0199
	[-0.01]		[-0.08]	[-0.18]
Spouse's labor force participation	-0.251**	-0.278**	-0.255**	-0.252**
	[-2.35]	[-2.37]	[-2.36]	[-2.37]
Log size of population in city/town of residence	0.0225	0.0224	0.0236	0.0230
	[1.03]	[0.98]	[1.08]	[1.06]
House keeping	-0.175*	-0.120	-0.177*	-0.179*
	[-1.72]	[-1.13]	[-1.73]	[-1.77]
Divorced in the past	0.333***	0.286***	0.334***	0.332***
	[3.64]	[2.91]	[3.63]	[3.66]
Age of respondent	-0.0346***	-0.0345***	-0.0347***	-0.0348***
	[-6.87]	[-6.35]	[-6.89]	[-7.01]
Spouse's occupational prestige score		-0.00515		
		[-1.27]		
Middle-class				-0.00248
				[-0.03]
Upper-class				0.168
				[0.66]
Constant	-0.984***	-0.737**	-0.973***	-0.972***
	[-4.24]	[-2.34]	[-4.14]	[-4.12]
Dependent Variable: Not Very Happy with Marriage				
Spouse has BA or graduate degree	-0.185***		-0.178***	-0.148***
	[-3.78]		[-3.63]	[-2.94]
Spouse's labor force participation	-0.0974*	-0.0827	-0.0950*	-0.0875 [d]
	[-1.76]	[-1.38]	[-1.71]	[-1.57]
Log size of population in city/town of residence	0.00841	0.00840	0.00792	0.00949
	[0.82]	[0.78]	[0.77]	[0.92]
House keeping	-0.0796*	-0.100**	-0.0780*	-0.0736 [d]
	[-1.77]	[-2.13]	[-1.73]	[-1.63]
Divorced in the past	-0.0838*	-0.0677 [d]	-0.0895*	-0.0920**
	[-1.81]	[-1.41]	[-1.93]	[-1.98]
Age of respondent	0.00301	0.00292	0.00311	0.00384*
	[1.47]	[1.35]	[1.52]	[1.86]
College or graduate degree	-0.0993**	-0.136***	-0.0918*	-0.0665
	[-2.04]	[-2.86]	[-1.87]	[-1.34]
Protestant	-0.175***	-0.183***	-0.145**	-0.171***
	[-2.68]	[-2.64]	[-2.18]	[-2.60]
Catholic	-0.110	-0.121	-0.0935	-0.0995
	[-1.53]	[-1.61]	[-1.30]	[-1.38]
Other religions	-0.222**	-0.249**	-0.211**	-0.208**
	[-2.44]	[-2.51]	[-2.31]	[-2.28]
White	-0.200***	-0.248***	-0.187**	-0.189**
	[-2.69]	[-3.11]	[-2.51]	[-2.54]
Black	0.257***	0.146	0.256**	0.248**
	[2.61]	[1.38]	[2.56]	[2.51]
Has child(ren)	0.449***	0.447***	0.454***	0.445***
	[7.80]	[7.44]	[7.88]	[7.71]
Spouse's occupational prestige score		-0.00612***		
		[-3.79]		
Republican party affiliation			-0.133***	
			[-2.78]	
Democratic party affiliation			-0.0616	
			[-1.33]	
Middle-class				-0.164***
				[-3.90]
Upper-class				-0.0874
				[-0.75]
Constant	-0.314**	-0.0221	-0.299**	-0.312**
	[-2.30]	[-0.14]	[-2.19]	[-2.28]
Observations	4,607	4,199	4,607	4,607
ρ	-0.515***	-0.435**	-0.486**	-0.494**
Wald Test of ρ=0 (Chi-squared)	6.280	3.825	5.098	5.960

t statistics in brackets, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, [d] $p< 0.15$. The matrix of variance-covariance is calculated

using the Huber/White Robust estimator.

Table 3: Estimates of Recursive Bivariate Probit Models, Men

	(1)	(2)	(3)	(4)
Dependent Variable: Infidelity				
Not very happy with marriage	1.491***	1.561***	1.200***	1.566***
	[5.34]	[6.38]	[2.81]	[5.60]
Spouse has BA or graduate degree	-0.00614		-0.0341	-0.0738
	[-0.08]		[-0.39]	[-0.87]
Spouse's labor force participation	-0.107[d]	-0.0980	-0.110[d]	-0.0962
	[-1.51]	[-1.24]	[-1.48]	[-1.38]
Log size of population in city/town of residence	0.0193	0.0241	0.0226	0.0168
	[1.15]	[1.34]	[1.27]	[1.00]
Unemployed	0.0617	0.0778	0.0887	0.0763
	[0.45]	[0.56]	[0.63]	[0.56]
Divorced in the past	0.235***	0.249***	0.249***	0.241***
	[2.92]	[2.93]	[2.95]	[3.01]
Age of respondent	-0.0168***	-0.0173***	-0.0174***	-0.0186***
	[-4.42]	[-4.23]	[-4.39]	[-4.88]
Spouse's occupational prestige score		0.00177		
		[0.65]		
Middle-class				0.198***
				[2.72]
Upper-class				0.313*
				[1.68]
Constant	-1.479***	-1.572***	-1.440***	-1.505***
	[-8.68]	[-7.16]	[-7.61]	[-8.71]
Dependent Variable: Not Very Happy with Marriage				
Spouse has BA or graduate degree	-0.102*		-0.0966*	-0.0517
	[-1.94]		[-1.82]	[-0.96]
Spouse's labor force participation	-0.00223	0.0346	-0.00406	-0.00987
	[-0.05]	[0.67]	[-0.09]	[-0.21]
Log size of population in city/town of residence	0.000748	0.00376	0.000186	0.00294
	[0.07]	[0.31]	[0.02]	[0.26]
Unemployed	0.159*	0.165*	0.153*	0.133
	[1.74]	[1.70]	[1.68]	[1.45]
Divorced in the past	-0.00509	-0.00836	-0.0109	-0.00836
	[-0.10]	[-0.15]	[-0.21]	[-0.16]
Age of respondent	0.00304	0.00334	0.00311	0.00470**
	[1.30]	[1.32]	[1.32]	[1.99]
College or graduate degree	-0.175***	-0.208***	-0.160***	-0.0975*
	[-3.47]	[-4.11]	[-3.11]	[-1.84]
Protestant	-0.290***	-0.287***	-0.254***	-0.286***
	[-4.80]	[-4.42]	[-4.08]	[-4.73]
Catholic	-0.128*	-0.113[d]	-0.103[d]	-0.123*
	[-1.93]	[-1.59]	[-1.50]	[-1.87]
Other religions	-0.108	-0.0686	-0.117	-0.100
	[-1.17]	[-0.69]	[-1.25]	[-1.09]
White	0.00524	-0.0506	0.0247	0.0387
	[0.06]	[-0.52]	[0.29]	[0.46]
Black	0.382***	0.370***	0.366***	0.391***
	[3.54]	[3.04]	[3.21]	[3.64]
Has child(ren)	0.147**	0.162***	0.163***	0.145**
	[2.50]	[2.59]	[2.69]	[2.47]
Spouse's occupational prestige score		-0.00498***		
		[-2.89]		
Republican party affiliation			-0.181***	
			[-3.27]	
Democratic party affiliation			-0.0694	
			[-1.28]	
Middle-class				-0.238***
				[-5.03]
Upper-class				-0.361***
				[-2.92]
Constant	-0.363***	-0.166	-0.339**	-0.378***
	[-2.59]	[-0.97]	[-2.38]	[-2.69]
Observations	3,796	3,309	3,796	3,796
ρ	-0.608***	-0.649***	-0.443[d]	-0.639***
Wald Test of ρ=0 (Chi-squared)	9.138	12.87	2.338	9.746

t statistics in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, [d] *p< 0.15.* The matrix of variance-covariance is calculated using the Huber/White Robust estimator.

Table 4: Marginal Effects from Column 1 of Tables 2 and 3

	Women		Men	
	Pr(I=1|U=1)	**Pr(I=1)**	**Pr(I=1|U=1)**	**Pr(I=1)**
Not very happy with marriage	0.0416***	0.1084*	0.0926***	0.2164***
	[3.44]	[1.95]	[3.79]	[3.17]
Spouse has BA or graduate degree	-0.0025	-0.0001	-0.0034	-0.0009
	[0.73]	[0.01]	[0.70]	[0.08]
Spouse's labor force participation	-0.0098***	-0.0221**	-0.0067[d]	-0.0155[d]
	[2.75]	[2.31]	[1.56]	[1.52]
Log size of population in city/town of residence	0.0009	0.0020	0.0012	0.0028
	[1.22]	[1.07]	[1.21]	[1.16]
House keeping	-0.0069**	-0.0154*	-	-
	[2.05]	[1.71]	-	-
Unemployed	-	-	0.0085	0.0089
	-	-	[1.10]	[0.46]
Divorced in the past	0.0102***	0.0293***	0.0144**	0.0341***
	[3.18]	[2.81]	[2.99]	[2.99]
Age of respondent	-0.0011***	-0.0030***	-0.0010***	-0.0024***
	[5.76]	[3.80]	[4.11]	[4.38]
College or graduate degree	-0.0013		-0.0051**	
	[1.60]		[2.30]	
Protestant	-0.0023*		-0.0085***	
	[1.75]		[2.63]	
Catholic	-0.0014		-0.0037	
	[1.20]		[1.58]	
Other religion	-0.0029*		-0.0032	
	[1.73]		[1.18]	
White	-0.0026*		0.0002	
	[1.95]		[0.06]	
Black	0.0034*		0.0112**	
	[1.92]		[2.21]	
Has child(ren)	0.0059**		0.0043**	
	[2.47]		[2.11]	
Observations	4,607	4,607	3,796	3,796

z statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%; [d] significant at 15%.
dy/dx is for discrete change of dummy variable from 0 to 1. Standard errors are calculated using the Delta method.

marginal effects. Table 4 reports *i)* the marginal success probability for the infidelity equation *Pr(I=1)* and *ii)* the conditional predicted probability of infidelity given that one is not very happy in marriage *Pr(I=1 | U=1)*. All marginal effect calculations are based on model estimates reported in Column 1 of Tables 2 and 3, utilizing the Delta-method. Table A2 in the Appendix provides comparable marginal effects using a single-equation probit model and shows that ignoring the simultaneity between infidelity and happiness greatly biases marginal effect estimates. This result

together with the finding that ρ is statistically different from zero implies that single-equation probit estimates significantly underestimate the impact of happiness on the likelihood of marital infidelity.

Are there gender-related differences linked to infidelity? To answer this question, we first perform a Wald Test to assess whether men and women should be pooled together. The null hypothesis that there is no difference in the coefficients for men and women is rejected at all standard levels of significance. The Wald Test is conducted by running a bivariate probit model including all covariates plus interaction terms of these covariates with a gender dummy (female). Then we conduct a joint test of significance for all interaction terms. In addition, marginal effects reported in Table 4 clearly demonstrate that the covariates considered in this study affect the probability of infidelity differently for both men and women. These findings provide evidence that the samples of men and women should not be pooled together. They also reject Fair's (1978) prediction that men and women respond similarly to the costs and benefits of infidelity in favor of the differential behavioral prediction of Elmslie and Tebaldi (2008). For example, either conditional or not on marital happiness status, the impact of being not very happy in marriage is about twice as predictive of infidelity for men than for women.

A. Happiness with Marriage

Consistent with the theoretical expectations of Fair (1978) and Elmslie and Tebaldi (2008), and empirical work of Li and Racine (2004), Potter (2011), and Adamopoulou (2013), Tables 2 and 3 show that the coefficient on the dummy variable "not very happy with marriage" is positive and statistically different from zero in all model specifications for both men and women. This result implies that happiness with marriage affects a person's likelihood to seek relationships outside of his/her marriage.

Columns 2 and 4 of Table 4 show the marginal effect of happiness with marriage on infidelity. Our estimates show that the probability that a woman has an affair increases about 11 percent if she is not very happy with her marriage while the probability of a man having an affair increases about 22 percent. Columns 1 and 3 of Table 4 report the *conditional* predicted probability of infidelity given that a person is not very happy with his/her marriage *[Pr(I=1 | U=1)]*. These marginal effects show the effect of happiness with marriage on infidelity netting out of the indirect influence of the variables included in the *not very happy with marriage* equation. Under this

condition, the probability of a woman having an affair increases about 4 percent if she is not very happy with her marriage while the probability of a man having an affair increases about 9 percent. These results are consistent across regressions and in both the conditional and unconditional cases; the effect of being not very happy with marriage is twice as large for men as it is for women. These results mirror the overall infidelity differential between men and women from Table 1. Married men are twice as likely to have an affair even though women are 2.5 percent more likely to report being not very happy in their marriage. Since men are twice as likely as women to respond to being not very happy with a marriage by having an affair, the results favor the differential response prediction of Elmslie and Tebaldi (2008) over the gender neutral prediction of Fair (1978). This result holds when controlling for other factors such as marital tenure, proxied by age (Li and Racine, 1994), in Fair's theoretical model.

It is possible that our results derive from a tendency of women to under-report infidelity relative to men (Andrews *et al.*, 2008). The result that men are more likely to have an affair is well established in both the economics and psychology literature (Brewer *et al*., 2000; Cameron, 2002; Elmslie and Tebaldi, 2008; Smith, 2012; Johnson, 1973; Thompson, 1983; Waite and Gallagher, 2000; Hansen, 1987; McAlister *et al.*, 2005; and Lalasz and Weigel, 2011). While consistent across a number of studies, the problem of under-reporting may be behind all of the results. To consider this possibility, we investigated several studies (e.g. Lalasz and Weigel, 2011; Hansen, 1987; Ajzen, 1985, 1989; McAlister *et al.*, 1985;) that had general questions regarding sexual behavior as well as questions involving infidelity, those studies dealing with intent to commit infidelity, and a study that controls for the effect of female prostitution and male clients (Brewer *et al.*, 2000). All studies find evidence consistent with the hypothesis that both genders answer surveys regarding sexual behavior similarly, if not truthfully, and that men are more likely to enter an extramarital affair than women. For example, Brewer *et al*. (2000) utilize the GSS and find that after controlling for the differential use of prostitutes by men versus women, the differential in infidelity disappears.

Finally, we break our sample into 10-year age cohorts and show the means of those reporting an affair by group in Table A1 in the Appendix. For the group 20 to 29, 5.7% of women and 7.1% of men report having sex with more than one person in the previous year. This difference is not statistically significant. For the 30 - 39 (40 - 49) age cohort, 2.1% (2.1%) of women and 5.0% (4.8%) of men report multiple sex partners in the previous year. For the 50 to 59-year age

group, the percentages are 0.5% and 2.8%, respectively. Infidelity declines much more rapidly for women than men, which is consistent with biological factors discussed above.

B. Spousal characteristics

Elmslie and Tebaldi (2008) suggest that spousal characteristics determine the potential costs (e.g. forgone income) of an affair. Thus, we include spouse's labor force participation and educational attainment in the infidelity equation. We also consider spouse's occupational prestige. In all regressions of Tables 2 and 3, the coefficients on spouse's educational attainment in the infidelity equation are statistically insignificant for both men and women. This implies that a spouse's educational attainment has no *direct* effect on the probability that men will have affairs. Spousal occupational prestige also has no significant effect for men or women. However, spouse's educational attainment as well as occupational prestige are inversely related to the probability that a person will not be very happy in his/her marriage. Thus, the effect of spousal education and occupational prestige on infidelity is captured through its effect on marital happiness.

Controlling for spouse's educational attainment, Columns 2 and 4 of Table 4 show that the probability that a woman or man has an affair decreases if his/her partner is in the labor force. This effect is only marginally significant for men. This implies that for women, the potential costs of infidelity rise -- thus reducing the likelihood of marital infidelity -- when the spouse participates in the labor market. It also supports the evolutionary biology argument that women marry for resources. Spousal labor force participation also affects marital happiness and, thus, has an indirect effect on infidelity via its positive impact on marriage happiness.

C. Place of residence and employment status

Tables 2 and 3 show that the coefficients on the population of the city/town of residence are statistically insignificant in all regressions for both men and women. Hence, we find very little evidence that increased anonymity and access to a larger pool of potential partners increases the likelihood that an individual will have an extramarital affair. This result differs from Elmslie and Tebaldi (2008) as they find evidence that increased anonymity increased the likelihood that a woman has an affair.

Columns 1 and 2 of Table 4 show that a woman who is a full-time homemaker is less likely to have an affair, but about half of the overall effect is due to the differential in marital happiness.

This result suggests that women who stay at home are less likely to have an affair either because they are happier with their marriages or because they have limited access to potential extramarital partners (e.g. coworkers). For men, we replace the homemaking variable with unemployment, but this variable is insignificant in all regressions.

D. Divorce

Our results provide strong evidence that married people who went through divorce in the past are more likely to have sexual partners outside the marriage. This finding is consistent with the sociological literature. Since infidelity is a major cause of divorce, the result may come from two possible sources. First, people who had an affair in a previous marriage are more likely to continue this behavior in a subsequent marriage, and second, people whose current spouse had an affair in a previous marriage are more likely to have an affair in a subsequent marriage (Knopp, *et al.* 2017). Columns 2 and 4 of Table 4 show that married men and women who were divorced are more likely to have an extramarital affair. It is important to notice that the *marginal* effect of divorce (columns 2 and 4 of Table 4) on infidelity is significantly larger than the *conditional* effect (columns 1 and 3 of Table 4). This implies that divorce has both a negative effect on marital happiness as well as a positive effect on the likelihood of extramarital affairs. Given the personal costs of divorce and because infidelity is a major cause of divorce, this result is not surprising.

E. Age

We find evidence that a person's age is negatively correlated with infidelity (Columns 2 and 4 of Table 4), but the effect is smaller for men. This result is consistent with expectations and suggests that the likelihood of infidelity decreases as a person settles in life or because of biological factors that decrease the benefits of infidelity as a person ages. Our results are consistent with Elmslie and Tebaldi (2008) and the biological explanation that age has a differentiated effect for men and women. Since men stay fertile longer into their lives than women do, the biological prediction is that men will continue having affairs longer into their lives.

The results have additional implications for the extant models. Assuming diminishing returns to a spouse's company, Fair (1978) links marital tenure positively to the probability of a man or woman having an affair. Our recursive bivariate probit model allows for a new test of this prediction. Controlling for marital happiness, Fair (1978) implies no independent relation between age and infidelity given that infidelity is modeled only through marital happiness. We find that,

after controlling for marital happiness, there is a negative relationship between age and infidelity. The existence of an independent age effect, along with its direction are implications of the Elmslie and Tebaldi (2008) expected utility model.

F. Children

Now we come to the dreaded *C* word in the marital happiness literature: children. Several studies have shown that having children has a negative effect on marital happiness for women (e.g. Elmslie and Tebaldi, 2014, Tao, 2005; Tsang *et al.,* 2003; White, *et al.,* 1986; and Feldman, 1971). The only counter example in the literature is Marini (1980). Using the GSS, for example, Elmslie and Tebaldi (2014) find that each additional child decreases a woman's probability of being very happy by about 2 percent. Most of the literature has found no effect on male marital happiness. These results are consistent with arguments that most of the burden of child rearing falls on mothers.

Our results from Tables 2 and 3 consistently show a negative effect of children on both genders. Having children increases the probability of being not very happy in marriage across the board. There may be endogeneity concerns with this result. It could be that people in unhappy marriages are more likely to have children and/or the presence of children causes people to stay in unhappy marriages. Elmslie and Tebaldi (2014), however, find no evidence that generally unhappy people are more likely to have children. Moreover, evidence from psychology (Feldman, 1971; Miller, 1976; and White *et al.*, 1986) show that the causality goes primarily in the direction from children to lower marital happiness as the presence of children leads to decreased communication and increased conflicts between spouses. Additionally, Grossbard and Mukhopadhyay (2013) find that children have a negative impact on feelings of love between spouses, which is likely to be associated with decreased marital happiness. Also from psychology, however, Glenn and McLanahan (1982) find that spouses are more likely to stay in an unhappy marriage if children are present. Given this general result, however, children increase the probability of an affair due to their impact on happiness for men and women. Table 4 also shows that a man or a woman with children is more likely to have an affair. These results imply that children make marriages less happy and less likely to be monogamous.

G. Social Class

Column 4 of Tables 2 and 3 shows that social class affects the likelihood of infidelity. In the infidelity equation, the coefficients on middle-class and upper-class are statistically insignificant for women but significant for men. In addition, in the marital happiness equation, the coefficient on middle-class is statistically significant for women and the coefficients on both middle- and upper-classes are significant for men. Interestingly, these findings suggest that social class is an important predictor for male infidelity but not for female. The differential strength of the impact of class on infidelity appears to be due to men having a direct and indirect effect via marital happiness while women only see an indirect effect of class on the probability of having an affair, and only for middle-class women. This indicates that social class as perceived by the man himself is a strong determinant of infidelity. While there is a potential endogeneity issue with this result, it is consistent with the Elmslie and Tebaldi (2008) expected utility model which is based partly on evolutionary biology in that men with more resources have a larger supply of potential mates, and that they are likely to act on the looser constraint. These results are also consistent with the Pongou and Serrano (2009) model in that the costs of developing an infidelity network will be lower if a wife is less likely to divorce a higher-class male due to the expectation of lost resources.

H. Findings' Robustness

We tested several alternative model specifications not reported in the paper. In particular, the following variables were tested in both the infidelity and "not very happy" equations: a dummy variable indicating whether the person works full or part time, how often a person attends religious services, a dummy identifying if the person is religious or not, and time-trend dummies. In all regressions, the coefficients on these variables were neither significant at the standard levels nor affected the size or the significance of the coefficients of other variables included in the model, so we do not include them in our parsimonious specification here. Additional regression analysis (available upon request) shows that our results are not affected by religiosity and a person's own education.

V. Conclusions

This study contributes to the understanding of marital infidelity by providing a comprehensive and robust empirical analysis of the factors affecting a person's behavior in respect to infidelity. The empirical strategy employed in this paper corrects for endogeneity between

marital happiness and infidelity, which allows this result to be confidently asserted for in the literature. We find that happiness with marriage is the single most relevant factor explaining infidelity for both men and. While this result is intuitive and unsurprising, some results stand out in our analysis.

Contradicting Fair (1978), we find that men and women respond differently to the costs and benefits of infidelity. This study also provides evidence that age, which has a strong link to biology and the implicit benefits of infidelity, has a noticeable impact on marital infidelity. Divorced men and women are more likely to have an affair. Spousal labor force participation reduces the likelihood of an affair for women and has a small impact for men. Educational attainment has stronger effects on infidelity for men than for women. Social class also plays an important role in infidelity and affects the likelihood of infidelity for both men and women, even though the effect of social class on infidelity is only through marital happiness for women while it has both a direct and indirect effect for men.

In general, this study shows that men and women respond differently to the costs and benefits of infidelity, which is consistent with the theoretical predictions of Elmslie and Tebaldi (2008) and counter to those of Fair (1978). This finding, however, calls for further theoretical and empirical research on the subject because it is unclear if the infidelity-utility functions of men and women are fundamentally different (as with biology-related theories) or if unobservable factors might be driving the results and biasing the estimated coefficients. With this proviso stated, our results are clearly pointing in the direction that, given equal 'prices', men and women will choose differently when making decisions related to marital infidelity. Additionally, our results on the effects of both martial happiness and age on infidelity are consistent with the model by Elmslie and Tebaldi (2008), but not with Fair (1978).

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Appendix

Table A1: Proportion of Married Individuals who Reported an Affair

Age Cohort	**Women**	**Men**	**t-test for equal mean** ***Pr(|T| > |t|)***
20 -29 yrs (n=1,355)	5.7%	7.1%	0.3204
30 - 39 yrs (n=3,039	2.1%	5.0%	0
40 - 49 yrs (n=2,914)	2.1%	4.8%	0
50 - 59 yrs(n=2,064)	0.5%	2.8%	0
60 + years (n=2,115)	0.0%	1.7%	0
All ages (n=11,486)	2.3%	4.6%	0

Source: Authors' calculations using pooled data (1991-2012) from the General Social Survey.
Note: The sample size considered here is slightly larger than that in the rest of the paper. For the regression analysis, observations for which data on marital infidelity were available, but required covariates were missing were dropped from the analysis. The proportions reported above, however, are statistically the same as those calculated using the restricted sample.

Table A2: Single-Equation Probit Model: Marginal Effects

	Women		Men	
	(1)	**(2)**	**(3)**	**(4)**
Not very happy with marriage	0.0172***	0.0198***	0.0430***	0.0440***
	[3.75]	[4.26]	[6.17]	[6.25]
Spouse has BA or graduate degree	-0.00118	-0.00528	-0.00614	-0.00915
	[-0.19]	[-0.99]	[-0.73]	[-1.18]
Spouse's labor force participation	-0.0151***	-0.0159***	-0.0126*	-0.0102
	[-2.69]	[-2.80]	[-1.77]	[-1.44]
Log size of population in city/town of residence	0.00186	0.00171	0.000486	0.00258
	[1.62]	[1.47]	[0.29]	[1.53]
House keeping	-0.0123**	-0.0102*		
	[-2.23]	[-1.85]		
Unemployed			0.0129	0.0136
			[1.01]	[1.05]
Divorced in the past	0.0150***	0.0171***	0.0248***	0.0242***
	[3.04]	[3.37]	[3.11]	[3.06]
Age of respondent	-0.00186***	-0.00181***	-0.00152***	-0.00162***
	[-6.25]	[-6.23]	[-3.91]	[-4.30]
College or graduate degree	-0.00637		-0.00101	
	[-1.02]		[-0.13]	
Protestant	-0.00871		-0.00586	
	[-1.33]		[-0.61]	
Catholic	-0.0159**		-0.0104	
	[-2.10]		[-0.96]	
Other religion	-0.0133		0.00674	
	[-1.36]		[0.51]	
White	-0.00297		-0.0184	
	[-0.38]		[-1.47]	
Black	0.00251		0.0287*	
	[0.25]		[1.90]	
Has child(ren)	0.0156**		-0.0127	
	[2.17]		[-1.45]	
Observations	4,607	4,607	3,796	3,796

z statistics in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%; [d] significant at 15%.
dy/dx is for discrete change of dummy variable from 0 to 1. Robust standard errors.