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The economic value of virtue *

Fabio Mariani†
PSE, Paris 1 and IZA

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Abstract

We model virtue as an asset on the marriage market: since men value virginity in prospective mates, preserving their virtue increases girls' chances of getting a "good" husband, and therefore allows for upward social mobility. Consistent with some historical and anthropological evidence, we find that the diffusion (and the social value) of virginity, across societies and over time, can be determined, among others, by income inequality, gender differences, social stratification and overall economic development. This is a further example of how cultural and moral values can be affected by economic factors.
JEL classification: D1; D31; J12; Z13.
Keywords: Mating; Marriage; Cultural values; Social classes; Inequality.

1 Introduction

Since Becker (1973, 1974), economic analysis has tried to explain several aspects of human mating, family formation, spouse selection and marriage, the basic question being: "who marries whom and why?". Therefore, we have now models that can help us understanding a variety of issues, ranging from assortative matching of partners (in terms of human capital, etc.), to inter-sex differences in the age at marriage (Bergstrom and Bagnoli, 1993) and even the so-called mystery of polygamy (Gould et al., 2008). All these contribution show that economic factors can also explain, at least partially, the historical evolution and cross-cultural differentiation of family patterns.

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†CES, Université Paris 1 Panthéon-Sorbonne; 106-112, bd. de l'Hôpital, F-75013 Paris (France). Ph.: +33 (0)1 44078350; fax: +33 (0)1 44078231. E-mail: fabio.mariani@univ-paris1.fr.

Our idea is that a simple model of marriage can also help explaining how the value of virtue changes over time and across societies. In first approximation we use a narrow definition of "virtue", identifying it with "female virginity at marriage" (premarital chastity); in a wider acception, it might be also defined as "sexual exclusiveness", meaning that a girl may have had premarital sex, but only with her future husband. Whatever the case, virtue may influence spouse selection.

The idea of explaining the diffusion of virginity (or chastity) and its social value with economic factors is, to the best of our knowledge, completely new. In fact, although the "sexual revolution" has represented a dramatic break in the history of the family in Western societies, the evolution of sexual morals and the way it can affect human mating has usually been regarded as a cultural, ethic, and religious phenomenon, neglecting possible interactions with economic factors.[1] Still, if we look at the contributions of the socio-anthropological and historical literature, we find a deep awareness that economic factors play an important role in defining the value that societies put on (female) virginity.

For instance, Goethals (1971) observes that virginity is highly valued in societies where women are looked upon as the property of their husbands: under these circumstances, virginity attains "market value" and parents, therefore, preserve their daughters' virginity as a means of protecting their own pocketbooks. In a similar fashion, Berger and Wenger (1973) defend the idea that virginity serves the interest of women, helping them to secure a better marriage, if they have little economic power. Broude (1975) shows that class stratification is correlated with premarital sexual norms: where a society has a fluid class structure as a result of achievable status, parents are expected to prohibit premarital sex to protect the social standing of their daughter. More recently, Schlegel (1991) claims that the cultural value put on the virginity of girls is, in large part, a function of the form of marriage transactions. Taking a sample of traditional societies, she provides some evidence that virginity is relatively more valued when marriage implies transfers of wealth between the families of the bride and the groom.

This view of virtue as an asset on the marriage market needs not to apply only to traditional societies. In a study of contemporary China, Zhou (1989) puts forward that virginity is regarded as a "marketable asset", often the only one future wives can hold. Ortner (1978) underlines that, in many (modern) societies, being a "good" girl increases the poten-

[1] See Scott (1998) for a cross-national study on the evolution of attitudes towards premarital sex.

tial for personal status mobility: in this respect, virginity plays the same role of dowries, enhancing the girl's value for a higher-status spouse. Finally, Gonzalez-Lopez (2004), after interviewing Mexican fathers living in Los Angeles, reports that, for them, "protecting their daughters from a sexually dangerous society and improving their socioeconomic future is of greater concern than preserving virginity per se".

Most importantly, in a well-known study of the historical evolution of the family in Britain, Stone (1990, p. 401-402) claims that, in the 18th century, " ... the value attached to chastity is directly related to the degree of social hierarchy and the degree of property ownership. Pre-marital chastity is a bargaining chip in the marriage game, to be set off against male property and status right". The female has then "a powerful lever to obtain marriage". By consequence, as Stone suggests: (i) "the most sexually inhibited class in the population is likely to be the lower-middle class of small property owners"; (ii) "the rise of a class of landless rural labourers and urban workers without property or status meant the rise of a class to whom virginity was not important, and foresight, prudence and planning were irrelevant to their dismal economic future", (iii) "the developments of the 18th century, with the progress of enclosures, the amalgamations of farms, the development of cottage industries and the growth of towns, were causing a considerable increase in the size of such a class." Stone concludes saying that, therefore, "the principal cause of the rise of illegitimacy in England in the late 18th century was (...) a rise of the proportion of the propertyless with no economic stake in the value of their virginity". The change of attitudes towards premarital sex was then dictated by a change of economic circumstances.

As for contemporary society, in the Western World the revolution in sexual behaviour has been "anticipated" by some major socio-economic changes like, for instance, the increased participation of women to the labour market, and an overall reduction of income inequality and social stratification.

In this paper, we propose a theoretical model to explain that the incidence of virginity may depend on (i) income level, (ii) the relative economic position of women with respect to men, (iii) income inequality, (iv) the degree of social segregation, and (v) strategic interaction between social classes.

Central to our model is the marriage market. Potential partners belong to two different social classes: the rich and the poor. Women value prospective spouses only in terms of income, while men value also virginity, in girls. Mating is, to some extent, random: a rich

man can be matched, on the basis of true love, with a poor girl (although this is less likely than him falling in love with a girl of the same census). Income is split between spouses after marriage. Therefore, a poor girl can aspire to upward social mobility, if she is lucky enough to be matched with a rich husband. However, virginity matters: if the poor girl lacks virginity, love may not be enough to secure her marriage with a richer man, and her place may be eventually taken by a rich maiden. This defines the value of virginity, as the difference in expected after-marriage income between virgin and non-virgin girls, and introduces a strategic dependence between virginity choices of rich and poor girls. All results derive from this mechanism: in particular, all factors that lower the relative returns to a good marriage (such as a reduction in inter-gender and rich-poor inequality) may cause a reduction in the value of virginity, thus inducing less stiff sexual morals.

The paper is organized as follows. After this Introduction, Section 2 will describe the structure of basic model. Section 3 will solve for the equilibrium, showing how the diffusion of virtue depends on economic factors. Finally, a few concluding remarks will be presented in Section 4.

2 The model

The characterization of the marriage market is crucial for our model. Not differently from the existing literature, this market is based on a matching process.[2]

2.1 Population, preferences and individual characteristics

The population of the model economy is divided equally between females and males, and between rich and poor. This means that there are four group (rich women, rich men, poor women, poor men) of equal size, which we normalize to one. The premarital income of each individual is denoted by $w_{g,y}$, where $g = F, M$ and $y = R, P$.

For the sake of simplicity, we assume that everybody will end up married. Inside every newly formed family, income is equally split between the husband and the wife, so that the after-marriage income of the spouses is given by $(w_M + w_F)/2$.

As in Bergstrom and Bagnoli (1995), we make the stark simplification that men and women research different qualities in their prospective mates. The quality of potential

[2]See, for instance, Nosaka (2007), Peters and Siow (2002), and Engineer and Welling (1999).

husbands coincides essentially with their income: women prefer to marry rich men. This can be especially true in traditional societies. On the other hand, men value potential wives on the basis of three parameters: love, money and virtue:

$$U = \alpha L + \beta V + \gamma Y, \tag{1}$$

with $\alpha, \beta, \gamma > 0$.

The variable L denotes "love", it can take only the two values 0 and 1, and is assumed to be random: a man can fall in love with a girl regardless of her income and virtue. This looks like the "true love" hypothesis employed by Engineer and Welling (1999): it can encompass beauty, physical attraction, affinity, etc.

V stands for virginity (that can be generalized to "virtue"): it also can take only the values 0 and 1. An innate preference of men for virginity and/or sexual exclusiveness is well documented. According to Buss (1994), men characterized by a preference for female virginity enjoyed an evolutionary advantage, since premarital female chastity provides a cue to the future certainty of paternity.[3] Stone (1990) puts it in a more straightforward way: men value virginity in potential mates for it guarantees that they are "purchasing a new and not second-hand goods" on the marriage market, and because they value "exclusiveness" in the good they aim at buying. It also makes sense to assume that virtue is not equally important in defining the desirability of men as potential marriage partners for the simple reason that it cannot be assessed in males as easily as in females.

Money (relative income Y) refers to the fact that some of the after-marriage utility that accrues to the husband depends on the division of resources inside the family; equation 1 can be thus rewritten as:

$$U_i = \alpha L + \beta_i V + \gamma(w_F/w_M), \tag{2}$$

therefore Y can take in principle any positive value, but it would not be unrealistic to assume that $0 \leq Y \leq 1$. Notice also that here we have introduced heterogeneous preferences among male individuals: all men have the same preferences with respect to love and in-

[3]To corroborate his argument, Buss also cite contemporary studies showing that the single best predictor of extramarital sex is premarital sexual permissiveness. Not differently from the anthropologists, sociologists and historians we cited in the Introduction, he firmly believes that the cultural variability in the preference for virginity is heavily affected by economic factors, and namely the economic independence of women (and he makes the example of Sweden).

come, while each man attaches a different degree of importance to virginity. To keep things simple, we assume that β_i is uniformly distributed among rich men, over the interval $(0, \alpha)$.

We also assume that $\alpha > \gamma$: when choosing a mate for life, love is more important than virtue *or* money alone, although it cannot be enough if the potential bride lacks *both* virtue and money. We will come back on this assumption later.

U_i is then the total value of a girl, as a potential bride, from the point of view of the i-th man. It is important to underline that, while L and Y can be assessed before a man starts dating a girl, V becomes observable only after two potential partners engage in a relationship. However, for the sake of simplicity, we will assume that also V is observable before marriage. This kind of assumption can be justified saying that, for instance, girls cannot cheat (or decide not to cheat) about their virginity because cheating may eventually lead to rejection immediately after marriage (in the Appendix, we will show that the results we will obtain would not change if we assume that men can assess virtue only after dating girls for a while).

Men and women enter the marriage market as soon as their earning capacity is revealed.[4] At that point, all the relevant variables that determine the value of a potential wife - love, income and virtue - are perfectly observable.

However, differently from income and love, virtue is not exogenous in our model. Before entering the marriage market, girls can decide whether staying virgin or not. Chastity has a (utility) cost c_j, that we assume to be heterogeneous and uniformly distributed over $(0, C_y)$. However, preserving her virginity increases a girl's value on the marriage market. Every girl will therefore decide to remain chaste if the value of virginity exceeds the cost of chastity.

2.2 Mating

Our model admittedly confer an advantage to men, and namely to rich men, who are free to select their mates. This is not too unrealistic, especially in less developed countries and traditional societies. A marriage proposal made by a rich man will never be rejected since, by assumption, girls value potential husbands exclusively on income. Therefore, we describe

[4] In traditional societies, where women only engage in housekeeping activities and their resources are provided by the family, the bride is typically much younger than the groom. See also Bergstrom and Bagnoli (1993), whose model explains why women on average marry older men.

the mating process from the point of view of rich men.

We have already pointed out that love is random. That means, in our model, that there is an exogenous probability π that a rich guy falls in love with a poor girl; with a probability $(1-\pi)$ he will be attracted by a girl coming from his same social class, so that it looks sensible to assume $0 < \pi < 1/2$: since people of different social classes have less opportunities to meet each other, different tastes and levels of education, they have a lower probability to find some affinity and reciprocally fall in love. Symmetrically, this means that a poor girl has only a probability π to attract a rich guy. The parameter π can be interpreted as a measure of the stratification or social segregation that characterizes a given society: the lower π, the stronger is social segregation.

Therefore, on the basis of pure love, there would be π marriages involving a rich man and a poor girl, and $1-\pi$ marriages in which both spouses come from the upper class. Similarly, π low-income men should end up married with a rich girl, while $1-\pi$ poor-poor marriages would be celebrated.

However, when deciding whom they are going to marry, rich men will also take money and virtue into account. If for instance, one rich man falls in love with a poor girl who is not virgin any more (call her $L\overline{VY}$), he could consider to marry a rich girl he doesn't love, provided that: (i) she is virgin ($\overline{L}VY$), and (ii) he has strong preferences for virginity, i.e. if $\beta_i + \gamma(w_{F,R}/w_{M,R}) > \alpha + \gamma(w_{F,P}/w_{M,R})$. If instead he loves a rich girl who turns out to be non-virgin (call her $L\overline{V}Y$), he will still marry her because it would not be possible to find a better match: given men's preferences, and namely $\alpha > \beta$, she will be preferred to a girl of the $\overline{L}VY$ type.

Therefore, all wealthy girls who are lucky enough to be loved by a rich guy will end up married with him, while only poor girls that are also virgin ($LV\overline{Y}$) can secure a "good" marriage. On the other hand, poor girls that are not loved by a rich guy have no chance of upward social mobility, while a rich girl in the same situation still has a chance to obtain a rich marriage, provided that she preserved her virginity.

The role of virtue as an instrument for (upwards) social mobility is then clear: virginity is an asset on the marriage market. The value of this asset can be defined in expected terms; it will depend, among others, on male preferences over virtue, and on the competing choices of other girls. Let us see how.

2.3 The value of virtue

For the time being, let us consider the shares of maidens among poor and rich girls (v_P and v_R, respectively) as given. Let us also define $w_{M,R} \equiv w$ and assume that $w_{F,P} = \rho w$, $w_{F,R} = \mu w$ and $w_{M,P} = \lambda w$, with $0 \leq \rho, \mu, \lambda \leq 1$, $\rho < \lambda$ and $\rho < \mu$.

2.3.1 The poor

Consider now the perspective of the π poor girls, who happen to be loved by rich men. Among them, the less virtuous ones ($(1 - v_P)\pi$) can *potentially* be eliminated as marriage partners. The number of the *actually* dismissed ones depends on men preferences. In fact, as we have seen above, rich men can decide to replace a loved, poor and non-virgin girl (type $L\overline{VY}$) with a girl who, although not loved, is both wealthy and virtuous ($\overline{L}VY$), if and only if $\beta_i > \alpha + \gamma(\rho - 1)$.

In particular, there will be a "threshold" male individual, characterized by $\beta_i = \hat{\beta} = \alpha - \gamma(1 - \rho)$, who is indifferent between $L\overline{VY}$ and $\overline{L}VY$. Men with $\beta_i < \hat{\beta}$ will prefer to marry the poor girl they love, regardless of her virtue; while those characterized by $\beta_i < \hat{\beta}$ will prefer a $\overline{L}VY$-type wife (provided that there are any).

By consequence, the number of loved but poor girls, who are "at risk" is given by:

$$(1 - v_P)\frac{\gamma(1-\rho)}{\alpha}\pi. \tag{3}$$

Of course, how many of them will be actually replaced by rich, yet unloved, maidens depends on the relative availability of this kind of marriage partners. For instance, all of them will be replaced if $v_R \geq (1 - v_P)\gamma(1 - \rho)/\alpha$.

Taking this into account, the probability for a poor, non-virgin girl to marry a rich man, is given by:

$$\pi\left\{\left(1 - \frac{\gamma(1-\rho)}{\alpha}\right) + \frac{\gamma(1-\rho)}{\alpha}\left(1 - \min\left[1, \frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\right)\right\}, \tag{4}$$

while her probability to end up married with a poor husband is:

$$(1 - \pi) + \pi\left\{\frac{\gamma(1-\rho)}{\alpha}\min\left[1, \frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\right\}. \tag{5}$$

Losing her virtue exposes a poor girls who has been lucky enough to be loved by a rich man to a double risk. First, he might be willing to replace her if he cares enough about

virginity. Second, she may be actually replaced by a rich maiden, if there are enough girls of this kind on the marriage market.

Let us now look at the expected income of a "poor" girl.

If she is virgin, her expected income (which depends on the random variable π) is given by:

$$\pi\left(\frac{w_{M,R}+w_{F,P}}{2}\right)+(1-\pi)\left(\frac{w_{M,P}+w_{F,P}}{2}\right), \tag{6}$$

that is:

$$[(\lambda+\rho)+\pi(1-\lambda)]\frac{w}{2}. \tag{7}$$

The above expression means that, with probability π, a poor girl who manages to preserve her virtue is able to raise her after-marriage income by the quantity $(1-\lambda)w/2$.

In case she is not virgin, her expected income is affected by the possibility of missing a rich husband because of her premarital sexual behaviour, and amounts to the following:

$$\begin{array}{l}\left\{(1-\pi)+\pi\frac{\gamma(1-\rho)}{\alpha}\min\left[1,\frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\right\}\left(\frac{w_{M,R}+w_{F,P}}{2}\right)+\\ +\pi\left\{1-\frac{\gamma(1-\rho)}{\alpha}\min\left[1,\frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\right\}\left(\frac{w_{M,P}+w_{F,P}}{2}\right),\end{array} \tag{8}$$

which, after substituting, becomes:

$$\left\{(\lambda+\rho)+\pi(1-\lambda)\left[1-\frac{\gamma(1-\rho)}{\alpha}\right]\min\left[1,\frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\right\}\frac{w}{2}. \tag{9}$$

Therefore, we can define the "value of virginity" (for the poor) as being the difference between (7) and (9), that is the expected income gain attached to the choice of remaining virgin:

$$\Omega_P \equiv \pi\frac{\gamma(1-\rho)(1-\lambda)}{\alpha}\min\left[1,\frac{\alpha v_R}{\gamma(1-\rho)(1-v_P)}\right]\frac{w}{2}. \tag{10}$$

Notice that the economic value of virginity for the poor increases with π (it is higher if there is less social segregation and then a higher - *ceteris paribus* - chance of social mobility), w (the absolute level of income) and γ (that, defining men's preferences for income, determines the probability of rejection). It is instead decreasing in ρ and λ: the higher the relative income of the poor (women and men, respectively), the smaller the cost associated to missing a rich husband. Finally, Ω_P depends positively on the aggregate behaviour of poor and rich girls (v_P and v_R, respectively): a relatively high number of virgins, in both social classes, increases the probability of rejection for poor and non-virgin girls, thus determining a higher return to virginity.

2.3.2 The rich

We can now follow the same procedure to compute the value of virginity for the rich (Ω_R).

If she stays virgin, a rich girl can secure a good marriage with a probability $(1-\pi)$ (the probability that a rich man falls in love with her); moreover, she gets also a chance to marry a rich man who does not love her, replacing a $L\overline{VY}$-type girl. Therefore, the expected income for a virtuous rich girl writes as:

$$\begin{array}{l}(1-\pi)\left(\frac{w_{M,R}+w_{F,R}}{2}\right)+\pi\min\left[1,\frac{\gamma(1-\rho)(1-v_P)}{\alpha v_R}\right]\left(\frac{w_{M,R}+w_{F,R}}{2}\right)+\\ +\pi\left(1-\min\left[1,\frac{\gamma(1-\rho)(1-v_P)}{\alpha v_R}\right]\right)\left(\frac{w_{M,P}+w_{F,R}}{2}\right);\end{array} \tag{11}$$

this expression, once we use $w_{M,R}\equiv w$, $w_{F,P}=\rho w$, $w_{F,R}=\mu w$ and $w_{M,P}=\lambda w$, becomes:

$$\left[(1+\mu)-\pi(1-\lambda)\left(1-\min\left[1,\frac{\gamma(1-\rho)(1-v_P)}{\alpha v_R}\right]\right)\right]\frac{w}{2}. \tag{12}$$

If instead a rich girl has lost her virtue, she does not run the risk to be replaced if she is "loved", but she loses the chance to replace a non-virgin poor girl, so that her expected income is:

$$(1-\pi)\left(\frac{w_{M,R}+w_{F,R}}{2}\right)+\pi\left(\frac{w_{M,P}+w_{F,R}}{2}\right), \tag{13}$$

which can be easily simplified into:

$$[(1+\mu)-\pi(1-\lambda)]\frac{w}{2}. \tag{14}$$

Therefore, the difference between (12) and (14) defines the value of virginity for rich girls, that is:

$$\Omega_R\equiv\pi(1-\lambda)\min\left[1,\frac{\gamma(1-\rho)(1-v_P)}{\alpha v_R}\right]\frac{w}{2}. \tag{15}$$

It should be noticed, among others, that Ω_R is a negative function of both v_P and v_R: with relatively high aggregate "virginity rates", there will be less opportunities for the rich, yet unloved girls to replace $L\overline{VY}$-type girls, thus decreasing the premium on virtue.

3 Equilibrium

We have just seen that the economic value of virtue, from the female point of view, depends on the behaviour of other girls on the marriage market. Therefore, premarital (virginity) choices will be strategic in nature.

3.1 Virginity choices

Let us now recall that there also exist a utility cost associated to virtue. This cost is individual specific; for the sake of simplicity, it is assumed to be uniformly distributed over the intervals $[0, C_P]$ for the poor, and $[0, C_R]$ for the rich. These distribution are known to female agents. A girl will decide to preserve her virginity if its value (Ω_j) exceeds its cost. Therefore we can identify the endogenous shares of virgins inside the poor and the rich female population, as being, respectively, $v_P = \Omega_P / C_P$ and $v_R = \Omega_R / C_R$.

3.2 Reaction functions

Let us assume that $C_R = \phi C_P$ and $C_P \equiv A$, with $\phi, A \geq 0$.

Since Ω_P and Ω_R both depend on v_P and v_R, virginity choices of rich and poor girls are mutually dependent: every girl decides her premarital behaviour taking into account how many maidens there can be among girls from both social class. We can therefore write the following aggregate reaction functions:

$$v_P = \frac{\pi w \gamma (1-\lambda)(1-\rho)}{2\alpha A} \min \left[1, \frac{\alpha v_R}{\gamma (1-\rho)(1-v_P)} \right], \tag{16}$$

and

$$v_R = \frac{\pi w (1-\lambda)}{2\phi A} \min \left[1, \frac{\gamma (1-\rho)(1-v_P)}{\alpha v_R} \right]. \tag{17}$$

Alternatively, we can say that the reaction function for poor girls ($v_P \equiv v_P(v_R)$) is given by:

$$v_P(v_R) = \begin{cases} (1/2)(1 \pm \sqrt{[A - 2\pi w (1-\lambda) v_R]/A}) & \text{if} \quad v_R < \gamma (1-\rho)(1-v_P)/\alpha \\ \pi w \gamma (1-\lambda)(1-\rho)/(2\alpha A) & \text{if} \quad v_R \geq \gamma (1-\rho)(1-v_P)/\alpha \end{cases}, \tag{18}$$

while the aggregate behaviour of rich girls can be expressed as:

$$v_R(v_P) = \begin{cases} \pi w (1-\lambda)/(2\phi A) & \text{if} \quad v_R < \gamma (1-\rho)(1-v_P)/\alpha \\ \sqrt{\pi w \gamma (1-\lambda)(1-\rho)(1-v_P)/(2\phi \alpha A)} & \text{if} \quad v_R \geq \gamma (1-\rho)(1-v_P)/\alpha \end{cases}. \tag{19}$$

3.3 Equilibrium solutions

In this framework, we define a (Nash) equilibrium as a pair $(v_R^*; v_P^*)$, such that no girl has an incentive to revise her virginity choice (because otherwise her expected after-marriage income would decrease).

Depending on parameters, we may have two different cases. Let us define:

$$\hat{\pi} \equiv \frac{2\gamma\phi\alpha A(1-\rho)}{w(1-\lambda)[\alpha^2+\phi\gamma^2(1-\rho)^2]}. \tag{20}$$

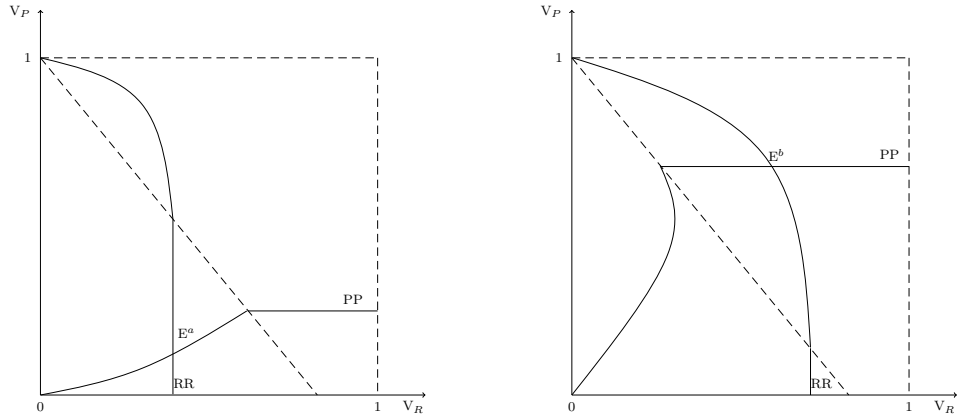
If $\pi > \hat{\pi}$ (case (a)), the equilibrium is given by:

$$(v_R^{*a}; v_P^{*a}) = \left(\frac{\pi w(1-\lambda)}{2\phi A}; \frac{1}{2}\left[1 - \sqrt{1 - \frac{\pi^2 w^2 (1-\lambda)^2}{\phi A^2}}\right] \right); \tag{21}$$

if instead $\pi \leq \hat{\pi}$ (case (b)), we have:

$$(v_R^{*b}; v_P^{*b}) = \left(\frac{1}{2\alpha A}\sqrt{\frac{\pi w\gamma(1-\lambda)(1-\rho)[2\alpha A + \pi w\gamma(1-\lambda)(1-\rho)]}{\phi}}; \frac{\pi w\gamma(1-\lambda)(1-\rho)}{2\alpha A} \right). \tag{22}$$

The situation is depicted in Figure 1.



(a) $\pi > \hat{\pi}$ (b) $\pi < \hat{\pi}$

Figure 1: Equilibrium

Notice that $v_P^{*a} < v_R^{*a}$ if $\pi < \overline{\pi}^a$, where $\overline{\pi}^a \equiv 2\phi A/[w(1-\lambda)(1+\phi)]$. If for instance we make the parsimonious assumption that $\phi = 1$, we have that the latter is automatically verified since $\hat{\pi} < \overline{\pi}^a$. Therefore, if π is relatively low, the diffusion of virtue will be

positively related to income, as historical evidence suggests (see Stone (1990), for the British case).

Moreover, $v_P^{*b} < v_R^{*b}$ if $\pi < \overline{\pi}^b$, where $\overline{\pi}^b \equiv 2\alpha A/[w\gamma(1-\lambda)(1-\rho)(1+\phi)]$. In general, we have $\hat{\pi} < \pi < \overline{\pi}^b$, so that we cannot exclude, in this case, that there will be more virgins among poor girls than among rich ones.

Let us now see how the equilibrium values of v_P and v_R are affected by the parameters of our model.

Concerning case (a), it can be easily seen that, for $j = P, R$: $\partial v_j^{*a}/\partial\pi > 0$, $\partial v_j^{*a}/\partial w > 0$, $\partial v_j^{*a}/\partial\lambda < 0$, $\partial v_j^{*a}/\partial\phi < 0$ and $\partial v_j^{*a}/\partial A < 0$. In case (b), instead, we have that, for $j = P, R$: $\partial v_j^{*b}/\partial\pi > 0$, $\partial v_j^{*b}/\partial w > 0$, $\partial v_j^{*b}/\partial\gamma > 0$, $\partial v_j^{*b}/\partial\lambda < 0$, $\partial v_j^{*b}/\partial\rho < 0$, $\partial v_j^{*b}/\partial\alpha < 0$ and $\partial v_j^{*b}/\partial A < 0$. Moreover: $\partial v_R^{*b}/\partial\phi < 0$.

Therefore, the diffusion of virginity is positively linked to π, meaning that stronger social segregation, implying a smaller chance of upward mobility through marriage, determines a weaker incentive to preserve virginity and use it as an asset on the marriage market. In addition, virginity rates are decreasing in ρ and λ: both higher female income and less income inequality imply a smaller value of virginity (because marrying a rich man would not make a big difference), thus reducing the incentive to stay virgin. Finally, all other things being equal, overall economic development (w) induces more chastity, since it increases the absolute value of a good marriage. These results are fully consistent with the historical and cross-cultural evidence discussed in the Introduction.

Men's preferences also affect women's choices, but only if π is sufficiently low, i.e. if social segregation is strong enough. In particular, a stronger preference for "love", as well as a weaker preference for "money", imply a lower risk of being rejected for a poor girl who lost her virginity; by consequence they determine lower virginity rates.

Finally, the effect of women's preferences (A and ϕ) is trivial: a higher cost of virtue reduces virginity rates.[5]

[5]In this regard, notice that the cost of virginity might be affected, among others, by the effectiveness of contraception. If the perceived risk of an undesired pregnancy after premarital sex decreases, the relative cost of chastity becomes larger. Therefore, "technological" improvements in contraception, increasing A, would encourage more promiscuity: this could be a complementary explanation for the sexual revolution, although it cannot explain differences across traditional societies.

4 Conclusions

In this paper we have shown how the diffusion of female virginity can be affected by economic variables. Using a very parsimonious mating model of the marriage market, where preserving her virtue helps a girl to improve her odds of gaining a "good" marriage, we have obtained results that are fairly consistent with historical and cross-cultural evidence. In particular, increased female participation on the labour market, decreasing inequality and stronger social stratification might be responsible for the decline of virginity as a social value.

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A An alternative setting

In Section 2 of the main text we have made the simplifying assumption that virginity (V or $\overline{V}$), as a characteristic of potential brides, can be observed before mating, just like income, for instance. We justified this assumption saying that the cost of cheating on one's own virginity might be very high (it could even determine repudiation after marriage).

In this Appendix we want to show that an alternative, more complicated, but more realistic "timing of events" would be compatible with our model. Everything is based on the hypothesis that, differently from income and beauty (that can affect love), virtue is not immediately observable, and can be assessed only after the two potential spouses know each other.

Therefore, since $\alpha > \gamma$ and V is unobservable, as soon as the marriage market opens, rich men will start dating the girls they are in love with, regardless of their income. If these girls display virtue (turn out to be virgin) they will decide to marry them. If they are not, disappointed rich men will start looking for a better match, i.e. rich maidens, even if they wouldn't have selected them on the basis of "true love". Therefore, some (or all) $L\overline{V}Y$-type girls will be replaced with $\overline{L}VY$-type girls, depending on the relative size of these two groups.

On the other hand, a rich girl who is loved by a rich guy, even if she is not virgin ($L\overline{V}Y$-type), will get married because it would not be possible to find a better match (given men's preferences, namely $\alpha > \beta$, she will be still preferred to a girl of the $\overline{L}VY$ type).

Once all rich men have found their best possible wives, the remaining girls will marry poor men.

It is then clear that, also in this framework, virtue (premarital sexual behaviour) is an instrument to secure a good marriage and eventually gain access to upward social mobility: although the reason is different, both poor and rich girls who have defended their virtue before the opening of the marriage market, can spend this asset to earn an advantageous marriage.