The Risk of Polygamy and Wives' Saving Behaviour*

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Abstract

In a polygamous society, all monogamous women are virtually at risk of polygamy. However, both the anthropological and economic literature are silent on the potential impact of the risk of polygamy on economic decisions of monogamous wives. We explore this issue for Senegal using individual panel data. We first estimate a Cox model for the probability of transition to polygamy. Second, we estimate the impact of the predicted risk of polygamy on monogamous wives' savings. We find a positive impact of the risk of polygamy on female savings entrusted to formal or informal institutions, consistent with self-insurance strategies.

JEL Classification: J12, D13, D14, J22, O12

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1 Introduction

Polygamy[1] is widespread in many developing countries, especially in Sub-Saharan Africa, and although it has been declining since the 1970s, it remains persistent, as documented by Fenske (2012, 2013). In the former study, in 2000, the overall prevalence of polygamy is 28% in the 34 countries, based on data from the Demographic and Health Surveys on ever-married women of childbearing age. Although in a polygamous society only a certain proportion of unions actually become polygamous, almost all monogamous women are faced with the risk that their union becomes polygamous. As noted by Antoine (2002), in Senegal, a majority of women will be in a polygamous union at some point in their life.

Socio-anthropological research suggests that polygamy is an undesirable outcome for women (Madhavan, 2002; Antoine, 2002). In particular, the arrival of a second wife is mostly viewed by women in a monogamous union as a threat. This threat may be exploited by the husband to monitor their wife, who have in general no say in this decision (Madhavan and Bledsoe, 2001). The extensive literature review provided by Bove and Valeggia (2009) substantiates this fear since it shows a negative correlation between polygamy and women's health. However, the economic literature is silent on the potential impact of the anticipation of polygamy on the allocation of resources within households. In particular, no paper, to our knowledge, has investigated the strategies that women in monogamous unions may implement in order to avoid the arrival of a co-wife or to protect themselves against such an event. Antoine (2002) mentions one of these strategies consisting in not sharing their income with their husband and driving him to spend more in order to decrease his saving capacity and impede the arrival of a co-wife. Marrying a second wife is indeed costly to the husband: savings are needed to pay for both the wedding and the bride price which has remained high and remarkably stable over time in Senegal, according to our survey data. As for women, they may have incentives to increase their own savings, so as to self-insure against the arrival of a co-wife, and potentially afford to divorce and leave the household. Depending on their capacity to protect their savings from their husband, we expect different strategies of monogamous wives in response to an increased risk of polygamy. This article thus intends to fill a gap in the literature on polygamy by exploring the impact of the threat of polygamy on monogamous spouses' saving behaviour, but also on

[1] In this article, we use the generic term polygamy for polygyny: polyandry does not exist in Senegal.

labour market participation, and resource allocation decisions, in the case of Senegal.

The case of Senegal is particularly interesting since previous studies have shown that the prevalence of polygamy is still high and declines at a slower pace than most other sub-Saharan countries. The share of young women (aged 20 to 24) in a polygamous union has even increased in rural areas from 1986 to 1997 (Antoine (2002), based on the *Enquêtes démographiques et de santé* (EDS)). We use original individual panel data from the two waves of a nationally representative survey (*Enquête Pauvreté et Structure Familiale* (EPSF)) conducted in 2006-2007 and 2010-2012. In our data, in the first wave, 22% of women aged 15 to 60 are in a polygamous union, while this is the case of 38% of married women in the same age category. Our data are unique, and particularly suitable for this analysis since they provide us with detailed information on consumption choices and savings at the individual level. Indeed, the vast majority of survey data in the developing world collect information on savings at the household level and cannot be used to investigate individual saving and consumption strategies. By contrast, we have information at each survey date on the stock of savings of each household member, which allows us to focus on wives saving and resource allocation decisions.

In the first step of our empirical analysis, we investigate the determinants of polygamy at the union level and estimate the probability of transition from a monogamous to a polygamous union using a survival analysis approach, with a semi-parametric Cox model. We then predict for each monogamous union, the risk of becoming polygamous at each survey date. In a second step, we exploit the panel structure of our data to identify the impact of the risk of polygamy on saving decisions of monogamous husbands and wives, controlling for union fixed-effects. We are thus able to control for time-invariant unobserved individual and union characteristics that correlate with both the probability of polygamy and individual economic decisions.

Our main results suggest that the risk of polygamy has a positive impact on wife savings but only on savings entrusted to formal or informal institutions, as opposed to savings kept at home. In addition, women facing a larger increase in their risk of polygamy are found to spend more on education and clothing while the household food consumption level is lower. These results suggest that the risk of polygamy leads monogamous wives to engage in self-insurance strategies. On the other hand, the risk of polygamy is not found to affect women's labour market participation. By contrast, the risk of polygamy is positively correlated with

monogamous husbands' labour market participation and income, and negatively correlated with their contribution to the personal expenditures of their spouse, consistent with an accumulation strategy to afford a second wife.

This paper first contributes to the empirical literature on polygamy initiated by Grossbard (1976). While the theoretical framework provided by Grossbard (1980), based on the theory of marriage developed by Becker (1974), accounts for the emergence and persistence of polygamy at the society level, little is known yet on the micro-determinants of polygamy. Indeed, most research in this area, following Grossbard (1976), is based on the comparison of two groups of individuals according to the type of their union and does not account for self-selection effects. Jacoby (1995) goes further by identifying the causal relationship between female agricultural productivity and polygamy. However, these findings cannot account for the persistence of polygamy in urban areas, as observed in Senegal (Antoine, 2002). Controlling for socio-economic characteristics of both spouses, we find evidence of the transmission of norms regarding polygamy from fathers to sons. In this strand of literature exploring the micro-determinants of polygamy, the approach of this paper is original since we focus on unions and explore the determinants of the transition from monogamy to polygamy based on a survival analysis. Indeed, even in countries where polygamy is the norm, a non negligible proportion of unions will remain monogamous. Note that since we choose to document the determinants of the transition of unions from monogamous to polygamous, single individuals and women marrying as second or higher rank wives are out of the scope of our study.

Second, to the best of our knowledge, this paper is the first to investigate the impact of the anticipation or threat of polygamy on economic decisions of monogamous spouses. The only studies on the effects of polygamy on household economic behaviour focus on polygamous households and do not study the impact of the risk of polygamy on non-polygamous households. Yet, papers analysing the economic impact polygamy are scarce, with the exception of the studies by Dauphin (2013) and Dauphin and Fortin (2001) which focus on the effect of polygamy on the efficiency of agricultural households. At the macroeconomic level, the relationship between polygamy and savings has been explored in a theoretical model by Tertilt (2005). In the author's model, polygamy leads in particular to high bride prices and high fertility, which crowd out other investments. Descriptive evidence of the relationship between polygamy and savings

at the micro level is provided by Laiglesia and Morrison (2008). Using household survey data from Ghana, Indonesia and Côte d'Ivoire, the authors find that polygamous households have lower assets per capita than monogamous ones, but they do not account for self-selection into polygamy. Our paper suggests and tests another channel for the impact of polygamy on saving decisions based on the strategic behaviors of monogamous wives "at risk" of polygamy.

The article is structured as follows. Section 2 discusses evidence of non-cooperative behaviors between spouses. In Section 3, we present our empirical model and identification strategy. The data are described in Section 4. Results on the determinants of polygamy and its impact on savings are presented and discussed in section 5. Finally, Section 6 concludes.

2 Spouses non-cooperative behaviors and savings

In contradiction with the predictions of the unitary model, several works have shown that spouses in developing countries do not necessarily behave cooperatively, especially in the presence of asymmetries of information (Udry (1996), Ashraf (2009), Castilla and Walker (2013), among others), and that spouses may have conflicting views on the use of household income. As regards savings in particular, based on a two-person household model best suited to the context of developed countries, yet, Browning (2000) shows that the age difference between spouses and the higher longevity of women generates different incentives to save for men and women. Different preferences for consumption may also lead to different preferences for savings, as modelled by Anderson and Baland (2002) who explain the higher participation of married women from a Kenyan slum to Rotative Savings and Credit Associations (ROSCAs) by a strategy aimed at preserving their savings from their husband.

Polygamy is of particular interest, since it is related to both aspects: first, polygamy creates asymmetries of information between spouses. Second, polygamy may give rise to opposite incentives for wife and husband savings. If household savings can be used by husbands to finance the cost of a second wife, men will have a higher preference for savings than women, as suggested by Antoine (2002).

As regards asymmetries of information first, there seems to be a consensus about the fact that men have the final say on whether to take a second wife (Madhavan and Bledsoe, 2001). Anecdotal evidence even suggest that, in some instances, the first wife is told about the second

marriage of her husband only after the ceremony. Husbands thus have private information on the probability and date of arrival of a co-wife in the household, while this event represents a risk for wives, which may then have an incentive to accumulate precautionary savings.

Note in addition that when faced with the arrival of a co-wife women have an outside option which is divorce (Antoine, 2002; Locoh and Thiriat, 1995). However this option is costly, since divorced women have to leave their former husband's household and either be taken in by a related household or earn their own living, which may give wives an incentive to increase her labour market participation and/or save. Two recent papers, in the very different context of Ireland and the US, indeed suggest that women who are faced with a higher risk of divorce both save (González and Özcan, 2013) and work more (Papps, 2006).

Conversely, the risk of polygamy may have a negative impact of savings if the wife anticipates that her savings may be seized by her husband: indeed, she has no incentive in saving in that case since her savings may facilitate her husband's second marriage. In Senegal, data from the PSF survey suggest that the cost of marrying a second wife is high: in addition to the wedding ceremony and the work to set up a room for the new co-wife, the husband has to pay a high bride price : from 2001 to 2006 the average bride price for the first wife was about 13.2% of the average yearly income of married men and 10.7% for the second wife.

Qualitative evidence in the case of Senegal suggests that husbands and wives do not pool their income, and that the expected contributions of husband and wife to the household budget are not symmetrical: men are expected to provide for their household while women are not (Boltz-Laemmel and Villar, 2014). Moreover, both qualitative and quantitative data suggest that the largest share of Senegalese spouses' savings are kept out of home and entrusted to formal of informal institutions institutions, suggesting that individuals prefer to rely on costly strategies to keep their own resources out of the reach of potential claimants (Boltz-Laemmel and Villar, 2014; Boltz, Marazyan, and Villar, 2015).

Depending on the possibility for each spouse to seize household savings or private savings of the other spouse, we may expect different strategic behaviour of monogamous wives "at risk" of polygamy. If wives cannot protect their own savings from being seized by their husband, they may have less incentives to save in response to an increase in the risk of their union to become polygamous. On the other hand, if wives can secure their savings by entrusting them

to formal of informal institutions, they may then want to insure against the arrival of a co-wife by increasing their savings.

3 Empirical Strategy

In the empirical analysis conducted in this section, we first aim at documenting the individual and union determinants of the transition of unions from monogamy to polygamy. Second, we investigate the impact of the risk for monogamous wives to become polygamous on their strategic savings decisions. The first methodological problem that we encounter is that the risk for a union to become polygamous is not observed. We thus adopt a two-step strategy consisting first in (1) estimating a duration model for transitions from monogamy to polygamy and recovering the predicted risk of turning polygamous, and (2) estimating the impact of this predicted risk of turning polygamous on saving behaviors of individuals in the population at risk, i.e. individuals in monogamous unions. Our two step approach to estimate probabilities for monogamous unions to become polygamous is related to the methodology used by Jacoby, Li, and Rozelle (2002) to study the impact of the risk of land expropriation on farmers' productive investments in rural China.

3.1 First step: estimation of the risk of polygamy

We discuss here the first step of the analysis. The second step is presented in the next subsection. First, in the vocabulary of survival analysis, individuals in monogamous unions at time t are at risk of turning polygamous: the survival function $S(t)$ refers to the probability of being still monogamous at time t, while the failure function $F(t) = 1 - S(t)$ represents the probability of having turned polygamous before time t. The hazard function θ_t refers to the transition rate to polygamy at time t, conditional on survival until time t (conditional on monogamy until time t).

In the first step of the analysis, we rely on a standard semi-parametric Cox proportional hazard model estimated at the union level to predict the risk of turning polygamous for individuals in monogamous unions. The model is estimated on the pooled sample of monogamous and polygamous unions made of a husband and his only or first-rank wife, in the first wave of

the survey. In this model, the hazard is assumed to be

$$\theta_t = \theta_0(t) \exp(\beta' X_i) \tag{1}$$

where X_i is a vector of spouse and union characteristics determined at the marriage and not affected by *ex post* marriage outcomes. In our baseline empirical specification, we control for both spouses' age at marriage, ethnicity, education, having been fostered before the age of 15, for the polygamy status of the husband's father, and for location (Dakar and other urban areas as opposed to rural areas). We additionally control for the education and activity of both spouses' parents.

$\theta_0(t)$ is the baseline hazard which is assumed to depend on survival time. The baseline hazard function is unspecified in the Cox model. We derive an estimate of the baseline survival function and obtain for each observation i the predicted survival $\widehat{S}_i(t) = \widehat{S_0}(t)^{exp(\widehat{\beta}' X_i)}$, which depends on the non-parametric baseline survival and the predicted hazard ratio depending on the characteristics X_i of union i. From the predicted survival, we calculate for each union, the predicted failure function $\widehat{F}_t$, representing the probability to become polygamous before time t. This predicted variable is used in the second step as a proxy for the risk of turning polygamous. More specifically, the second step of our estimation strategy uses the two waves of the survey collected five years apart, and focuses on the subsample of unions that have remained monogamous. We are interested in the difference between the predicted failure function at time t and $t+5$ (corresponding to the second survey wave) $(\widehat{F_{t+5}} - \widehat{F}_t)$, which represents the probability of becoming polygamous between t and $t+5$. The predicted failure function is preferred to the predicted hazard in this application: it is more easily interpreted and more adapted to the nature of the risk at stake. Indeed, we intend to estimate the risk of becoming polygamous, in order to assess the impact of such a risk on saving decisions of spouses at risk. In this specific application, we argue that the failure function which is a cumulative distribution function, better captures the relevant perception of the risk of becoming polygamous in the near future, than the hazard rate, which may be interpreted in a continuous setting as the instantaneous transition intensity to polygamy at time t. Indeed, economic decisions, and saving decisions in particular, are likely to be made with a medium to long time horizon, rather than be sensitive to instantaneous risks.

We choose to rely on a semi-parametric estimator in the first step of our analysis, no assumption is therefore needed on the functional form of the baseline hazard function. Note that the set of individual and union level characteristics X_i only contains variables that are predetermined at the time of marriage, so as to avoid reverse causality concerns.

Since we are only using time-invariant characteristics, both the predicted risk of becoming polygamous at time t (first survey wave) and time $t+5$ (second survey wave) are thus directly obtained from the Cox model estimated using the first survey wave only. More specifically, the predicted risk of becoming polygamous at time $t+5$ is obtained by combining the baseline survival, estimated using the first survey wave only, taken at $d+5$ (with d the observed marriage duration at time t) and the predicted exponentiated linear prediction depending on union and individual characteristics X_i. By using the data from the first survey wave only to estimate the risk of turning polygamous both at time t and $t+5$, we thus assume that the pattern of duration dependence and determinants of polygamy do not change between the two survey waves, which does not seem unrealistic given that the average period between the two waves is five years.

Since we use the predicted failure function as a proxy for the risk of polygamy, our predicted risk mechanically increases with marriage duration. However, capturing the impact of the length of marriage on the risk of polygamy through estimated failure rates rather than simply using marriage duration as observed in the data has three advantages. First, using observed marriage duration may lead to errors-in-variable problem as noted by Jacoby, Li, and Rozelle (2002). Indeed, the actual marriage duration is partly determined by a stochastic process and is subsequently a noisy indicator of the underlying uncertainty faced by the monogamous wives as regards a potential transition to polygamy. Second, survival analysis allows us to account for data censoring, corresponding to the fact that some of the observed monogamous unions will in fact become polygamous in the future but their transition is not observed yet, while we exploit the timing of the transition to polygamy of first-rank polygamous wives. In addition, this strategy allows for a flexible non-linear relationship between marriage duration and the probability for a union to turn polygamous, and accounts for the effect of observed individual and union characteristics on transition patterns.

Hence, the predicted failure $\widehat{F}_i(t)$ is used in the second step as a proxy for the risk of becoming polygamous, at the union level.

3.2 Second step: impact of the risk of polygamy on wives' resource allocation decisions

In the second step of our analysis we aim at identifying the impact of the risk of polygamy on resource allocation decisions of monogamous wives. We exploit the panel structure of our data by estimating an individual fixed-effect model and focus on the subsample of unions that remained monogamous between the two survey waves: we are then able to cancel out the effect of time-invariant unobserved union characteristics on our outcome variables.

We estimate several outcome equations of the following type:

$$Y_{jt} = \beta_0 + \beta_1 \widehat{F}_{ijt} + X'_{kt}\beta_2 + \alpha_{ij} + \epsilon_{ijt}, \quad k \in \{i, j, ij\} \tag{2}$$

Where the dependent variable and outcome of interest, Y_{jt}, is the outcome decision of the wife j considered –savings or consumption choices– and is measured at time t. The sets of explanatory variables X_{it}, X_{jt}, and X_{ijt} refer to husband i, wife j or union ij characteristics at time t, and α_{ij} are union fixed-effects. $\widehat{F}_{ijt}$ is the predicted failure, proxying for the risk of becoming polygamous before time t, obtained from the survival analysis conducted in the first step. Standard errors are clustered at the neighborhood level and bootstrapped to account for the extra-sampling variability induced by the inclusion of a predicted regressor in the model.

The use of panel data with union level fixed effects allows us to identify the impact of a change in the risk of turning polygamous, controlling for all time-invariant unobserved characteristics likely to affect both their polygamy status and spouses' saving decisions. We additionally control for some time-varying characteristics, namely, the wife's age to control for the individual differences in the time frame of the two survey waves, the death of each spouse's father, the household size and the share of dependants in the household. Identification relies on the implicit assumption that no other time-variant characteristic is correlated with both the risk of turning polygamous and savings decisions. As noted above, the set of individual and union level variables X_i used to predict the risk of turning polygamous only contains variables that are predetermined at the time of marriage, so as to avoid reverse causality concerns.

Note in addition that we focus in this second step on wives' economic decisions. Indeed, as mentioned in Section 2, strong asymmetries of information exist between spouses as regards the

potential arrival of a co-wife. Our approach in terms of risk of polygamy best applies to the wife, who has no say in her husband's decision to take a second wife, and is in general kept in the dark as regards the planning and timing of such an event. We thus focus our analysis on wives' economic decisions, in response to an increased risk of polygamy. The few results on male outcomes that we present in the last part of the following section should thus be interpreted with caution. However, we chose to show second-step results for male employment, savings and transfers as they help us to shed light on some mechanisms behind the results obtained for wives.

Sample selection

We are faced with a sample selection issue at the second stage of our analysis. Indeed, we focus in the second step of our empirical analysis on monogamous unions that have remained monogamous between the two survey waves. The obvious reason for this is that initially monogamous women whose union has become polygamous between the two waves, are not facing in the second wave the same incentives in terms of savings and resource allocation than still monogamous wives. We thus need to consider the selection issue that may result from the use that we make of our panel data. Indeed, unions that are at a higher risk of becoming polygamous before the second wave, may also be at a higher risk not to be included in our regression sample, since all unions that became polygamous between the two survey waves are mechanically dropped from our second step regression sample. This strategy implies that we are estimating the impact of the risk of polygamy on a sample of unions that are on average facing a lower risk than the population of interest, which we expect to downward bias our results. Note however that since we include union fixed effects, we control for sample selection driven by time-invariant union characteristics. In the following section, we document the composition of our sample at both stages and provide summary statistics on the observed characteristics of unions dropped either due to attrition or because they became polygamous between the two survey waves. Our results suggest that dropped unions and unions included in our second step regression sample are very similar as regards their observable characteristics.

4 Data

4.1 The PSF Individual Panel Survey

The data used in this paper come from an original household survey, "Poverty and Family Structure" (PSF), conducted in Senegal from 2006 to 2012[2]. The data were collected in two waves, in 2006 and 2007 for the first wave, and from late 2010 to mid 2012 for the second wave, constituting an individual panel. The data provide in particular detailed information on marital trajectories, savings and labour market participation at the individual level. The overall sample in the first wave is made of 1750 households and 14,450 individuals, in 150 randomly drawn census districts. In the whole sample, 57,1% of the individuals are living in a rural area, 48% are males and 95 % are Muslim. The average household size is between eight and nine members.

The PSF survey data are rich and unique in that they intend to account for the complexity of household structures in the Senegalese society. The questionnaire relies on the preliminary identification of household sub-structures, referred to as cells. Cells are defined as units that are semi-autonomous as regards resource allocation decisions, composed of a cell head and his or her direct dependants – and in particular children, foster children, or widowed mother or father. The average household is made of 2.4 cells of around 3 members each. Notably, expenditures data were collected at the cell level, with a particular attention to identify the expenditures that are specific to one cell, shared between two or more cells and shared by the whole household. This valuable and original feature of the data allows us to measure intra-household variations in consumption patterns and, in particular, differences between spouses.

The PSF data are also particularly suitable for this analysis since savings stock as well as the flows of transfers sent out and received from individuals out of the household in the past 12 months were collected at the individual level. Moreover, the survey collects detailed information on individual and household socio-demographic and economic characteristics and on family structure.

[2]The survey has been conducted by a team of French researchers and researchers from the National Statistical Agency of Senegal and is described in detail in DeVreyer et al. (2008). Momar Sylla and Matar Gueye of the Agence Nationale de la Statistique et de la Démographie of Senegal (ANSD) on the one hand and Philippe De Vreyer (Paris-Dauphine Dauphine, IRD-DIAL), Sylvie Lambert (PSE) and Abla Safir (World Bank) designed the survey. The data have been collected by the ANSD thanks to the funding of the IDRC (International Development Research Centre), INRA Paris and CEPREMAP.

4.2 Descriptive statistics

Sample description

Our sample of interest in the first step of our empirical analysis is composed of all co-resident monogamous and polygamous unions made of a husband and his only or first-rank wife.

We restrict our sample to unions in which women are between 15 and 60 years old. The 60 unions with the husband being Christian are dropped from our sample, since these unions are not expected to face the same probability of becoming polygamous as Muslim ones. Our final sample for the first step of the analysis is thus made of 1388 unions surveyed in the first wave of the PSF survey.

Figure 1 in Appendix plots the time interval between the first and second marriages, computed from the subsample of 457 men living in a polygamous union (434 once missing values on years of marriage are taken into account). This interval ranges from 0 to 50 years. The average interval is 12 years and the median 10 years. The risk of polygamy decreases after 10 years and 75% of second marriages occurred in the first 16 years of the first union. Mechanically, women in their first monogamous union are on average younger (32.2 years) than both women in a polygamous marriage and women in a monogamous union with at least one former union dissolved (40.5 years) (see Figure 2 in Appendix). The former have been married for 13.9 years, on average. The median duration of their union is 10 years. 75% of them have been married for less than 20 years.

Table 7 in Appendix provides descriptive statistics of socio-economic characteristics of our first-step sample made of monogamous and polygamous-first-rank unions.

Panel sample and attrition

Table 8 in Appendix presents our second step regression sample made of monogamous unions in wave one that have remained monogamous and were surveyed in wave two. The characteristics of the 782 unions in our regression sample are compared to those of the 333 monogamous unions at wave one which are dropped, either due to survey attrition or because they had become polygamous at wave two. 138 initially monogamous unions were not surveyed in the second wave, for multiple reasons including international migration, death of both partners, or failure of the tracking process. Almost 100 unions became polygamous between the two waves,

while the rest became widow or divorced in the interval. Investigating the difference in observed characteristics between the two samples we find only few notable differences: Pulaar unions as well as unions in larger households with more dependants are more likely to be part of the final sample, while unions from the region of Dakar are more likely to be dropped from the regression sample. We estimate a Probit model for the probability not to be part of the panel regression sample, on the sample of monogamous unions at wave 1, depending on our predicted risk of polygamy and individual and union characteristics. Results are shown in Table 9 in Appendix. We separately explore the determinants of the probability of survey attrition (in the first two columns), and the probability to be excluded from the final sample which also concerns unions becoming polygamous (last two columns). We find that the predicted risk is not significantly correlated with the probability to be excluded from the regression sample in all four specifications. Wife age and living in a rural area are negatively correlated with survey attrition, but not significantly correlated with the probability of exclusion from our panel regression sample. The only significant coefficients in the last column are those on the dummy for wives having been fostered before the age of 15, who are thus likely to be slightly over-represented in the panel sample, as well as wives whose father has some formal eduction. Overall, this analysis suggests that the sample selection due to attrition, based on individual and union characteristics, is likely to be negligible, which does not solve the issue of selection based on unobserved characteristics. Since the coefficient on our variable of interest, the predicted risk of polygamy, is not significant, we are reasonably confident that our second step results presented in the following section are not affected by severe selection biases.

5 Results

5.1 First step: estimation of the risk of polygamy

We first estimate a semi-parametric Cox proportional hazard model for the risk of polygamy using at the union level. Hazard ratios (exponentiated coefficients) are reported. Estimation results are presented in Table 1. A coefficient larger than one means that the corresponding variable accelerates the transition to polygamy, while a coefficient smaller than one means that the corresponding variable decelerates the transition to polygamy.

Table 1: First-step estimation results for the risk of polygamy

Hazard ratios from Cox proportional hazard model estimates for transitions to polygamy

Wife controls	
Age at marriage	0.980
	(0.018)
Serere ethnicity	0.625
	(0.248)
Pulaar ethnicity	1.028
	(0.357)
Minority ethnicity	1.061
Ref: Wolof ethnicity	(0.392)
Fostered before 15	0.662**
	(0.118)
No formal education	1.655**
	(0.418)
Secondary education or higher	1.315
Ref: Primary education	(0.457)
Husband controls	
Age at marriage	0.969***
	(0.012)
Serere ethnicity	0.975
	(0.411)
Pulaar ethnicity	0.650
	(0.240)
Minority ethnicity	0.733
Ref: Wolof ethnicity	(0.249)
Fostered before 15	1.563***
	(0.207)
No formal education	1.304
	(0.232)
Secondary education or higher	0.998
Ref: Primary education	(0.251)
Husband's father polygamous	1.493***
	(0.187)
Union controls	
Dakar region	0.821
	(0.152)
Other urban area	0.719*
Ref: Rural area	(0.127)
Additional controls†	*Yes*
Number of observations	1355

Semi-parametric Cox proportional hazard model ; exponentiated coefficients are presented (hazard ratios), Standard errors in parentheses are clustered at the neighborhood level;
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimation sample includes all monogamous unions and polygamous unions made of husband and first-rank wife aged 15 to 60, in the first wave of the PSF Survey.

† Additional controls include dummies for Koranic education of both spouses' parents, and for formal education and sectors of activity of both spouses' fathers.

Data source: PSF Survey, wave 1 (2006-2007)

We find that the dummy variable which is equal to one when the husband's father is polygamous is a significant predictor of the risk of polygamy, consistent with the transmission of preferences for polygamy from father to son. An alternative mechanism is that the polygamy of the father captures a transmission of wealth, as polygamous men are on average richer, since they are able to afford more than one wife[3] All else equal, the husband's father being polygamous increases the risk for the union of becoming polygamous by 50%. Moreover, when the wife has been fostered in childhood, the risk for the union to become polygamous is about 30% lower, whereas when the husband has been fostered in childhood, the risk of polygamy increases by 56% for men. A possible explanation is that girls are often fostered in the household of their future husband and therefore develop strong ties with their mother-in-law, which may help to delay or avoid the arrival of a second wife. In addition, having no education is found to accelerate transitions to polygamy especially for wives.

Alternative specifications are presented in Table 10 in Appendix. Results show that coefficients are remarkably stable across specifications. In column (4), we include additional controls, though some of them may be endogenous since contrary to the main set of controls included in in Table 1, they are not determined before marriage. We find that men who are the head of their household or work in the formal sector have an accelerated transition to polygamy. For wives, having a deceased father is also associated with a higher risk of polygamy. By contrast, the ratio of the number of dependants of the wife, mostly her children, to the household size, is associated with a lower risk of polygamy.

5.2 Second step: Impact of the risk of polygamy on wives' saving decisions

In the second step of our empirical analysis, we estimate the risk for each monogamous union to become polygamous, based on the Cox estimates obtained at step 1. More specifically, we predict for each union, the value of the failure function, depending on the union duration and other observed characteristics, that are excluded in the second step estimation, such as the polygamy of the husband's father, based on the specification shown in Table 1. We consider that the predicted failure is a proxy for the risk of a union to become polygamous. In order to assess the impact of the risk of polygamy, we focus on the panel of unions which are present in

[3]Note that our second estimation will not suffer from this *ex ante* difference in wealth since we identify our effects through individual fixed effects, as long as this does not affect differently accross time both the risk of polygamy and the saving behavior of wives.

both survey waves and remain monogamous. We include union fixed-effects to control for time invariant unobserved individual and union characteristics that may affect both the probability of polygamy and resource allocation decisions.

Estimation results of the impact of the risk of polygamy on wife savings are presented in Table 2. We first explore the impact of polygamy on the stock of total savings (in log), in columns (1) to (3). Columns (4) to (6) investigate the extensive margin, and the dependent variable is a dummy equal to one if the wife has savings of any kind (column (4)), entrusted to institutions, including both formal savings and participation in ROSCAs or other informal savings associations (column (5)), and kept at home (column (6)). By looking separately at different kinds of savings, we intend to investigate the potential impact of the risk of polygamy on wives' strategic behaviors, especially whether wives try to keep their savings out of the reach of their husband when facing a higher risk of polygamy. In the last column (7), the dependent variable is the share of total savings entrusted to institutions, as opposed to savings kept at home. Our main variable of interest is the estimated failure probability $\widehat{F}_t$, which is assumed to capture the risk for a union to become polygamous at different marriage durations (i.e. at each survey date).

Table 2: Impact of the risk of polygamy on wife savings - Panel fixed effect estimation

	(a) Wife savings stock (in log)			(b) Wife has savings (dummy)			(c) Share of savings
	Total	In institutions	At home	Total	In institutions	At home	In institutions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\widehat{F}_t$	13.458**	14.628***	1.685	1.298**	1.404**	0.316	1.345**
	(5.611)	(5.518)	(2.592)	(0.568)	(0.552)	(0.314)	(0.530)
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls†	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1422	1422	1422	1442	1442	1442	1422
Number of unions	711	711	711	721	721	721	711
Within R2	0.026	0.022	0.056	0.031	0.025	0.061	0.020
Unconditional mean Wave 1	4.017	3.858	0.441	0.386	0.370	0.046	0.362

Panel union fixed effect model estimates. P-values in parentheses. Standard errors are clustered at the neighborhood level and bootstrapped (300 replications); * p<0.10, ** p<0.05,*** p<0.01.
Dependent variables: col (a): stock of savings of the wife (in log); col. (b): whether the wife holds savings (dummy), col. (2), (5) and (7) correspond to savings entrusted to informal or formal institutions, while col (3) and (6) to savings kept at home. In col. (7): Share of the total stock of savings entrusted to informal or formal institutions.
Sample: monogamous unions in the two waves.
$\widehat{F}_t$: predicted failure probability estimated by a Cox survival model (see Table 1).
† Controls not shown: age of the wife and a dummy for deceased father of each spouse ; household size ; relative cell size ; share of dependants.
Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

We find that a higher risk of polygamy has a positive impact on both wives' stock of savings and their probability to save. The predicted risk of polygamy lies between 0 and 1, hence an increase of 1 percentage point in the predicted risk of polygamy leads to an increase in the stock

of savings of 13.5%, this represents an increase of 9,059 FCFA out of an average stock of 67,102 FCFA. A one-percent increase in the predicted risk induces an increase in the propensity to save of 1.3 percentage points, representing a 3.3% increase in the baseline saving propensity for monogamous wives. Notably, we observe that this increase in savings is totally driven by savings kept not at home but in informal or formal institutions, since no effect is found on savings kept at home and the share of savings held in institutions is increasing with the risk. This finding is consistent with the hypothesis that wives facing a higher risk of polygamy choose to save more and to keep these savings out of the reach of their husband.

5.3 Mechanisms

Going one step further, we are interested in understanding the mechanisms behind saving decisions in response to a higher risk of polygamy. We intend to investigate the following questions: how are wife and husband consumption choices affected ? How do wives afford to save more ? What is the correlation between wives' saving behaviors and husbands' saving and work decisions ? Do wives prepare their exit option and invest more on social capital out of the household through larger interpersonal transfers?

5.3.1 Wives' consumption decisions

As noted above, a unique feature of the PSF data is that information on consumption is available at the cell level. The definition of cells used in the survey implies that household head and their spouse(s) are in different cells. However, a husband who is not the household head and has a single wife, with or without children, will be part of the same cell as his wife, meaning we will not separately observe the consumption decisions of the two spouses. Therefore, to be able to observe private consumption of the wives, we focus our analysis on wives of the household head who are systematically in a separate cell from their husband. Note that the definition of cells has no impact on the measurement of savings, nor on labor or income, since information on consumption only is collected at the cell level, while all other information is obtained at the individual level.

We thus additionally analyse the impact of the risk of polygamy on the level of household food consumption per capita for all monogamous unions and on private consumption decisions

of monogamous wives of the household head[4]. Note that since household heads are on average more likely to become polygamous, our results on the wives consumptions are therefore upper bound estimates.

Table 3: The risk of polygamy and spouses' consumption and contributions

	Household food consumption	*Wife of household head non-food consumption*				
		Level (in log)			Contributors (dummy)	
	Level (in log)	Total	Clothing	Education	Wife	Husband
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{F_t}$	−1.080*	−1.823	10.974**	11.477**	−0.907	−4.090***
	(0.626)	(1.314)	(4.504)	(5.715)	(0.930)	(0.557)
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls†	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1430	898	902	902	906	906
Number of unions	715	449	451	451	453	453
Within R2	0.092	0.065	0.042	0.100	0.16	0.39
Unconditional mean						
Wave 1	11.80	11.10	8.60	4.64	0.59	0.83

Panel union fixed effect model estimates. Standard errors in parentheses are clustered at the neighborhood level and bootstrapped (300 replications); $^{+}$ p<0.12 * p<0.10, ** p<0.05, *** p<0.01.
Sample: col.1 all unions
Dependent variables: col. (1) total food expenditure of household per capita (in log), col. (2) to (6) non-food consumption of the wife of the household head and her direct dependents: col. (2) total non-food expenditures of the wife's cell per capita (in log), col. (3) total expenditures in clothing per capita, col. (4). total expenditures in education per capita, col. (5) a dummy equal to one if the wife contributes to her own personal expenditures, col. (6) a dummy equal to one if husband contributes to his wife personal expenditures.
Sample: col. (1) all monogamous unions in the two waves; col. (2) to (6) monogamous unions in the two waves *where the husband is the household head.*
$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).
Controls not shown: age and a dummy for deceased father of each spouse ; household size ; share of dependents.
Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 3 presents the effect of the predicted risk of polygamy on the level of household food expenditures per capita (column (1)) for all monogamous unions and on non-food expenditures of household heads' wives and her direct dependants (columns (2) to (6)). We find that a higher risk of polygamy decreases the level of household food consumption per capita. Being more at risk does not significantly affect the level of the wife's personal expenditures, however the sign of the coefficient is negative (column (2)).

The rare anthropological findings Antoine (2002) on *ex ante* strategies of monogamous anticipating the arrival of co-wife document an increase in expenditures of wives on clothing. We thus investigate the impact of the risk of polygamy on the wives' private spending choices on clothing and education. We find that women facing a higher risk of becoming polygamous

[4]We provide the results on savings for the subsample of wives of the household head in Appendix (see 13): results are similar in significance and sign, the magnitude being slightly increased, which is not surprising since household head are also more likely to become polygamous.

are spending more both on education and clothing expenditures (adjusting for the number of direct dependents in her "cell"). The magnitude of the effect is large: the one percentage point increase of the risk of polygamy[5] leads to an increase in the level of spending in education per capita by 11.5%, meaning 1361 FCFA spent more out of the annual average 11842 FCFA. For spending in clothing, we find an effect of 11%, accounting for an increase of 2887 FCFA out of the annual average 26248 FCFA expenditures per capita. Column (5) show results for the impact of the risk of polygamy on women's propensity to contribute to her own private consumption. We observe no significant effect, the sign being negative. In column (6), we investigate whether an increase in the risk of polygamy is correlated with the propensity of the household head to contribute to his wife's personal consumption [6]. We find a strong negative correlation, meaning that husbands who are more likely to take a second wife soon are less likely to contribute to his wife's personal expenditures.

Our results are consistent with self-insurance strategies of women faced with a higher risk of polygamy, through savings and investment in the education of their children. Our results are robust to changes in specifications and to the estimation of an alternative survival model in the first step, such as a flexible parametric model (Royston and Parmar, 2002)[7].

5.3.2 Labour and transfers

In Table 4, we study the link between the risk of polygamy and the amount of labour supplied by both spouses, more specifically the number of weeks worked in the past 12 months. The coefficient on the risk variable is negative but not significant for women. We find a positive correlation for men : an increase of 6 percentage point in the risk of polygamy is associated with 2.9 more weeks worked (significant at the 5% level), i.e. an increase of 9.5% of the average male labour supply. Similar results are observed for total income earned over the past 12 months for husbands and wives. We find a negative but not statistically significant coefficient on the risk variable for women, while men who are more likely to become polygamous earn significantly more.

[5] Note that the estimated risk variable is a probability taking value between 0 and 1.

[6] As noted above, results on husband outcomes should be interpreted cautiously since the husband takes the decision of the potential arrival of a second wife.

[7] Results are available upon request.

Table 4: The risk of polygamy and spouses' labour supply

	Wife		Husband	
	Number of weeks worked	Total income (in log)	Number of weeks worked	Total income (in log)
$\widehat{F_t}$	-19.395	-2.620	48.793**	7.093*
(p-values in parentheses)	(0.373)	(0.366)	(0.011)	(0.001)
Controls†	Yes	Yes	Yes	Yes
Number of observations	1376	1350	1350	1344
Number of unions	688	675	675	672
Within R2	0.031	0.049	0.022	0.019
Unconditional mean				
Wave 1	14.795	2.047	30.392	5.505

Panel union fixed effect model estimates. P-values in parentheses. Standard errors are clustered at the neighborhood level and bootstrapped (300 replications); $^{+}$ p<0.12 * p<0.10, ** p<0.05, *** p<0.01.
Dependent variables: Col (1) and (3): number of weeks worked in the past 12 months. Col. (2) and (4): total earnings over the past 12 months (in log).
Sample: monogamous unions in the two waves.
$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).
† Controls not shown: age and a dummy for deceased father of each spouse ; household size ; share of dependants.
Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 5: The risk of polygamy and husband savings - Panel fixed effect estimation

	(a) Husband savings stock (in log)			(b) Husband has savings (dummy)			(c) Share of savings
	Total	In institutions	At home	Total	In institutions	At home	In institutions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\widehat{F_t}$	4.252	−1.328	5.381	0.624	−0.024	0.626∗	−0.031
(p-values in parentheses)	(0.376)	(0.707)	(0.160)	(0.174)	(0.943)	(0.091)	(0.923)
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls†	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1366	1368	1384	1386	1386	1386	1366
Number of unions	683	684	692	693	693	693	683
Within R2	0.034	0.0069	0.043	0.048	0.011	0.051	0.0077
Unconditional mean							
Wave 1	2.445	1.886	0.748	0.216	0.163	0.071	0.156

Panel union fixed effect model estimates. P-values in parentheses. Standard errors are clustered at the neighborhood level and bootstrapped (300 replications); * p<0.10, ** p<0.05,*** p<0.01.
Dependent variables: col (a): stock of savings of the husband (in log); col. (b): whether the husband holds savings (dummy), col. (2), (5) and (7) correspond to savings entrusted to informal or formal institutions, while col (3) and (6) to savings kept at home. In col. (7): Share of the total stock of savings entrusted to informal or formal institutions.
Sample: monogamous unions in the two waves.
$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).
† Controls not shown: age of the husband and a dummy for deceased father of each spouse ; household size ; relative cell size ; share of dependants.
Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 6: The risk of polygamy risk and spouses' transfers, received and sent, out of the household

	Wife						Husband	
	Transfers sent			Transfers received			Transfers sent	
	Dummy	Amount (in log)	To kin (dummy)	Dummy	Amount (in log)	From kin (dummy)	Dummy	Amount (in log)
$\widehat{F_t}$	0.747	7.268	0.636	0.720	5.832	0.547	2.095***	19.232***
(p-values in parentheses)	(0.252)	(0.210)	(0.265)	(0.171)	(0.282)	(0.276)	(0.000)	(0.001)
Controls†	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1416	1416	1414	1416	1412	1414	1386	1386
Number of unions	708	708	707	708	706	707	693	693
Within R2	0.084	0.070	0.052	0.065	0.073	0.060	0.11	0.094
Unconditional mean								
Wave 1	0.370	3.585	0.293	0.228	2.324	0.207	0.398	4.072

Panel union fixed effect model estimates. P-values in parentheses. Standard errors are clustered at the neighborhood level and bootstrapped (300 replications); $^{+}$ p<0.12 * p<0.10, ** p<0.05, *** p<0.01.

Dependent variables: transfers sent and received from individuals out of the household over the past 12 months.

Sample: monogamous unions in the two waves.

$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).

† Controls not shown: age and a dummy for deceased father of each spouse ; household size ; share of dependants.

Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 5 explore the correlation between husband saving decisions and the risk of polygamy. We find no significant correlation between the total stock of male savings and the risk of polygamy. However, men with a higher probability to take a second wife soon are more likely to keep part of their savings at home: an average variation in the predicted probability to become polygamous of 6 percentage points is correlated with a probability to have savings at home of 3.8 percentage points higher, i.e. an increase of 53.4% (significant at the 10% level).

Finally, we investigate in Table 6 whether spouses who are more at risk of polygamy rely more on their social network outside the household. We focus in the first 6 columns on transfers received and sent by monogamous women, over the past 12 months. We do not find any significant effect of the risk of polygamy on both types of transfers, neither at the extensive nor the intensive margins. Similar results are obtained for transfers from or to wives' kin : coefficients on the risk variable are positive but not statistically significant at conventional levels. As for husbands, we find in the last two columns a positive and significant correlation between the risk of polygamy and both the probability to send transfers and amounts transferred.

Results on male outcome are consistent with a strategy aiming at accumulating more resources through an increase in the labour supply, and subsequently in income, and increased savings (though not significant) when planning to take a second wife. Men are also found to transfer more out of their household, possibly as a way to accumulate resources out of the household or alternatively, the husband already transfers to the future second wife, although transfers prior to the wedding are not common in Senegal.As for monogamous wives, we do not find any significant impact of the risk of polygamy on labour supply and transfers.

6 Conclusion

This paper is the first to investigate the impact of the anticipation or threat of polygamy on economic decisions of monogamous women. This paper thus contributes to the scarce economic literature on polygamy by exploring a new channel for the impact of polygamy on saving decisions based on the strategic insurance behaviors of monogamous wives at risk of polygamy.

In the first step of our empirical strategy, we estimate a standard semi-parametric Cox model and predict the risk of a monogamous union to become polygamous. We then use this prediction to estimate the impact of the risk of polygamy on saving behaviors of monogamous

wives. The use of panel data with union level fixed effects allows us to identify the impact of a change in the risk of becoming polygamous, controlling for all time-invariant characteristics likely to affect both the risk of polygamy and wives' saving decisions.

We find that wives with a higher risk of polygamy save more but only out of the household. Wives more at risk of polygamy are also found to spend a larger share of their non-food expenditures on education of their children or clothing. A negative correlation is found between the level of food consumption at the household level and the risk of polygamy. While no effect of the risk of polygamy is found on monogamous wives' labour supply, a positive correlation is found for husbands: those facing a higher risk work and earn more. Husband are also less likely to contribute the wife's personal expenditures when they are more likely to take a second wife. These results are consistent with male accumulation strategies to afford taking a second wife. These findings suggest that monogamous wives anticipate the risk of polygamy by engaging in self-insurance strategies.

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7 Tables and figures

Figure 1: Number of years between first and second marriage for 20-60 year-old polygamous men

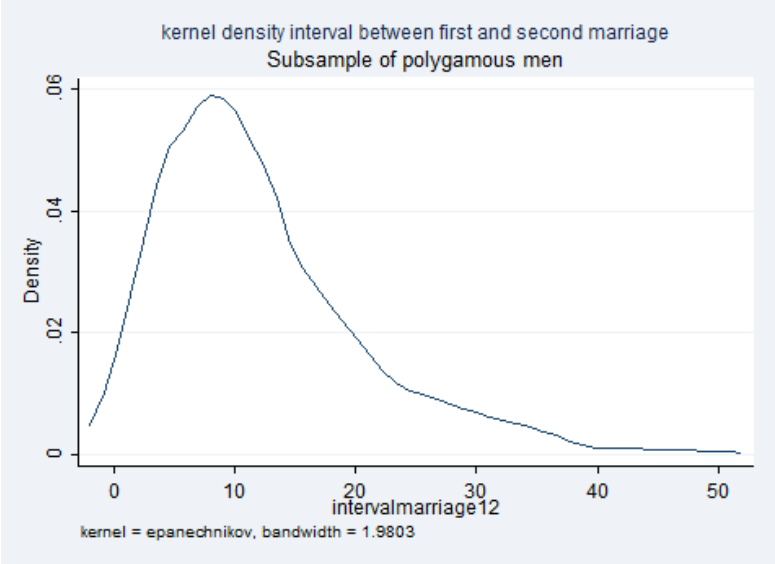

Figure 2: Age of the mongamous and first-rank polygamous women

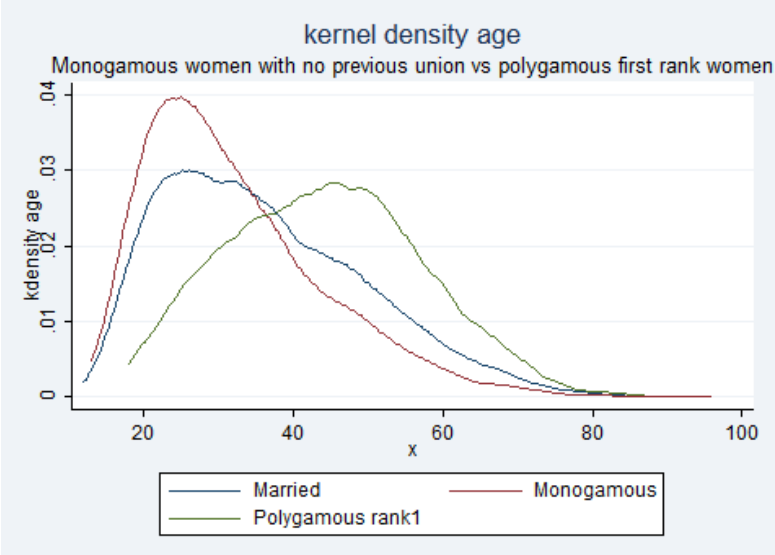

Figure 3: Non-parametric Kaplan-Meier survival and hazard estimates

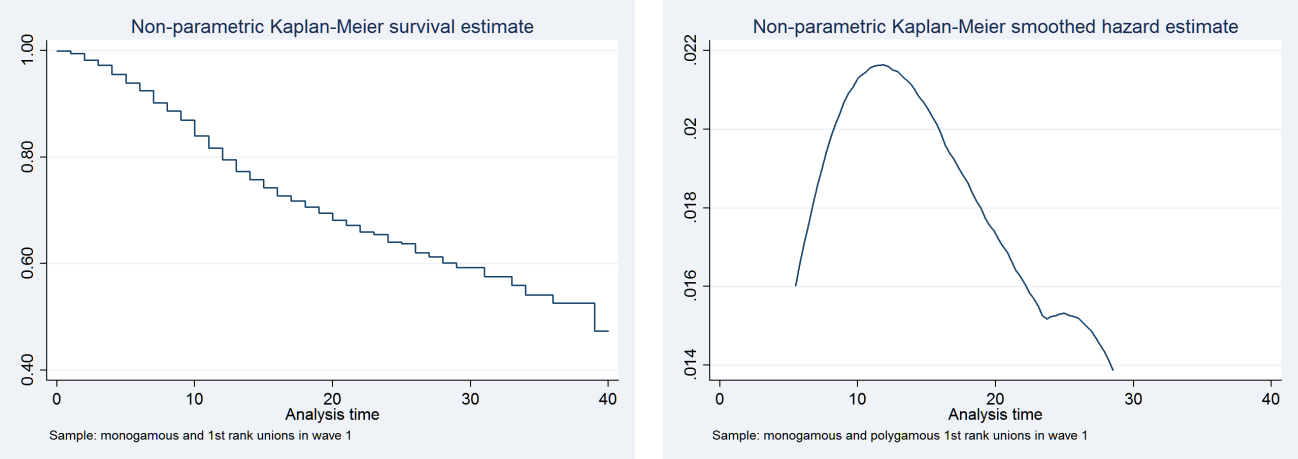

Figure 4: Variation of the estimated failure probability between the two waves

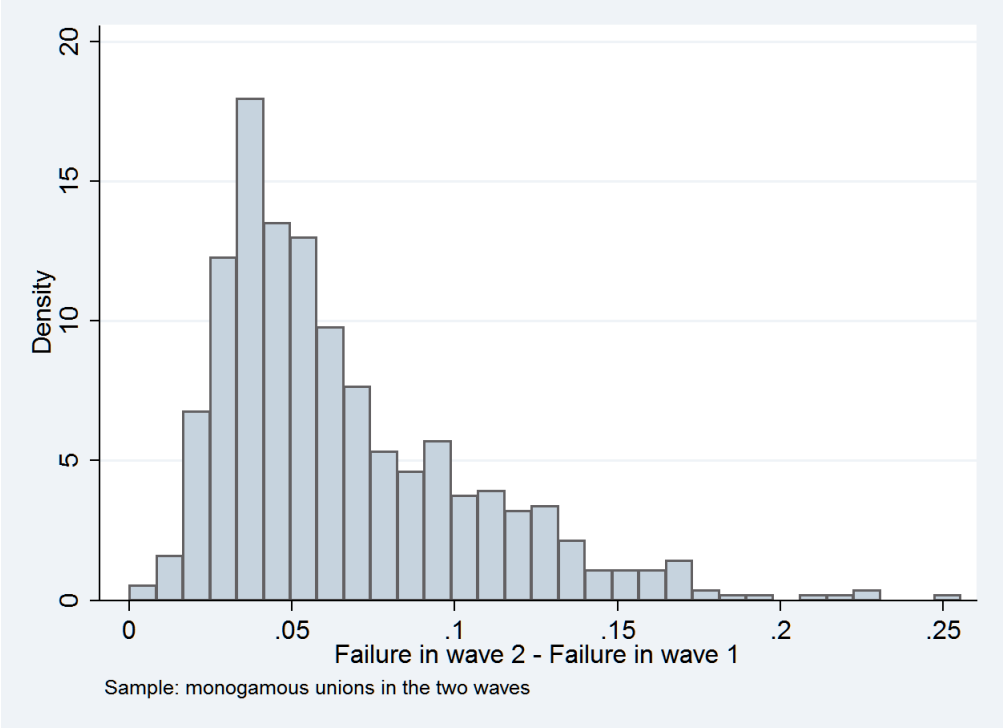

Table 7: Summary statistics (first stage sample made of monogamous unions and polygamous unions made of husband and first-rank wife)

Variables	N	Mean	Std. Dev.	Min	Max
Wife controls					
Age in years	1440	34.63403	11.34585	15	60
Age at marriage	1431	18.41929	4.34994	6	38
Serere ethnicity	1436	.1128134	.3164747	0	1
Pulaar ethnicity	1436	.3231198	.467831	0	1
Minority ethnicity	1436	.1573816	.3642871	0	1
Wolof ethnicity	1436	.4066852	.4913863	0	1
Fostered before 15	1436	.1504178	.357605	0	1
No education	1440	.7472222	.4347556	0	1
Secondary education or higher	1440	.0902778	.2866789	0	1
Primary education	1440	.1625	.369037	0	1
Works in non-agri. informal sector	1440	.2729167	.4456131	0	1
Works in non-agri. formal sector	1440	.0444444	.206152	0	1
Works in other/missing sector	1440	.1486111	.3558283	0	1
Works in agricultural sector	1440	.2479167	.4319532	0	1
Father: any formal edu.	1440	.1479167	.3551407	0	1
Father: Koranic education	1440	.40625	.4913029	0	1
Mother: any formal edu.	1440	.0673611	.2507334	0	1
Mother: Koranic education	1440	.1805556	.3847831	0	1
Father: non-agri. informal sect.	1440	.1993056	.399617	0	1
Father: non-agri. formal sect.	1440	.1444444	.3516619	0	1
Father: other activity	1440	.3118056	.4633918	0	1
Father: agricultural activity	1440	.3444444	.4753519	0	1
Wife is cell head	1440	.7243056	.4470188	0	1
Husband controls					
Age in years	1440	45.42708	13.29095	18	83
Age at marriage	1423	27.31413	5.771102	15	56
Serere ethnicity	1433	.1165387	.3209819	0	1
Pulaar ethnicity	1433	.3126308	.4637271	0	1
Minority ethnicity	1433	.1479414	.3551658	0	1
Wolof ethnicity	1433	.422889	.4941906	0	1
Fostered before 15	1430	.1678322	.3738479	0	1
No education	1440	.6756944	.4682774	0	1
Secondary education or higher	1440	.1645833	.3709329	0	1
Primary education	1440	.1597222	.3664755	0	1
Works in agricultural sector	1440	.2479167	.4319532	0	1
Works in non-agri. formal sector	1440	.1951389	.3964453	0	1
Works in other sector	1440	.1423611	.3495415	0	1
Owns the residence	1440	.4388889	.4964238	0	1
Father: any formal edu.	1440	.1215278	.3268531	0	1
Father: Koranic education	1440	.4375	.4962507	0	1
Mother: any formal edu.	1440	.0486111	.2151284	0	1
Mother: Koranic education	1440	.1986111	.3990932	0	1
Father: non-agri. informal sect.	1440	.1833333	.387074	0	1
Father: non-agri. formal sect.	1440	.1236111	.3292517	0	1
Father: other activity	1440	.3645833	.4814803	0	1
Father: agricultural activity	1440	.3284722	.4698207	0	1
Husband's father polygamous	1393	.6310122	.4827039	0	1
Husband is the household head	1440	0.70625	0.455637	0	1
Union controls					
Monogamous union	1440	.7743056	.4181841	0	1
Dakar region	1440	.3131944	.4639538	0	1
Other urban area	1440	.1708333	.376494	0	1
Rural area	1440	.5159722	.4999184	0	1
Household size	1440	11.02986	6.721074	2	44
Relative cell size	1440	.4850444	.2426905	0.0294118	0.9230769
% < 17 and > 60 yr-olds in hh	1440	51.47099	16.49042	0	87.5
Wife's father deceased	1428	.535014	.4989472	0	1
Husband's father deceased	1432	.7423184	.4375105	0	1

Data source: PSF Survey, wave 1 (2006-2007)

Table 8: Summary statistics (second stage panel sample made of monogamous unions in the two waves) and attrition

Variables	Number of observations	Mean on attrited sample (1)	Mean on panel sample (0)	Diff (1)-(0)	P-Value	
Number of observations	1115	333	782			
Wife controls						
Age in years	1115	32.9610	32.4949	0.466	0.5119	
Age at marriage	1108	18.9667	18.7095	0.257	0.3882	
Serere ethnicity	1112	0.1261	0.1091	0.017	0.4144	
Pulaar ethnicity	1112	0.3003	0.3504	-0.050	0.1049	
Minority ethnicity	1112	0.1502	0.1643	-0.014	0.5556	
Wolof ethnicity	1112	0.4234	0.3761	0.047	0.1389	
Fostered before 15	1111	0.1394	0.1639	-0.024	0.3050	
No education	1115	0.7117	0.7097	0.002	0.9465	
Secondary education or higher	1115	0.1171	0.0959	0.021	0.2851	
Primary education	1115	0.1712	0.1944	-0.023	0.3640	
Father: any formal edu.	1115	0.1562	0.1701	-0.014	0.5678	
Father: Koranic education	1115	0.3784	0.4066	-0.028	0.3779	
Mother: any formal edu.	1115	0.0751	0.0703	0.005	0.7791	
Mother: Koranic education	1115	0.1712	0.1841	-0.013	0.6064	
Father: non-agri. informal sect.	1115	0.2282	0.2136	0.015	0.5874	
Father: non-agri. formal sect.	1115	0.1471	0.1662	-0.019	0.4272	
Father: other activity	1115	0.3183	0.2839	0.034	0.2486	
Father: agricultural activity	1115	0.3063	0.3363	-0.030	0.3288	
Wife's relative cell size	1115	0.5230	0.4916	0.031	0.0552	*
Wife's father deceased	1104	0.4697	0.4845	-0.015	0.6527	
Wife is cell head	1115	0.6757	0.6509	0.025	0.4250	
Wife works in non-agri. informal sect.	1115	0.2462	0.2928	-0.047	0.1126	
Wife works in non-agri. formal sect.	1115	0.0450	0.0422	0.003	0.8305	
Wife works in other sect.	1115	0.1381	0.1458	-0.008	0.7393	
Wife works in agricultural sector	1115	0.1471	0.1586	-0.011	0.6301	
Husband controls						
Age in years	1115	43.7237	43.2110	0.513	0.5499	
Age at marriage	1101	27.8537	27.6675	0.186	0.6330	
Serere ethnicity	1109	0.1235	0.1145	0.009	0.6716	
Pulaar ethnicity	1109	0.2831	0.3449	-0.062	0.0445	**
Minority ethnicity	1109	0.1566	0.1480	0.009	0.7134	
Fostered before 15	1106	0.1424	0.1430	-0.001	0.9786	
No education	1115	0.6246	0.6419	-0.017	0.5825	
Secondary education or higher	1115	0.2162	0.1777	0.038	0.1336	
Father: any formal edu.	1115	0.1471	0.1292	0.018	0.4208	
Father: Koranic education	1115	0.4204	0.4246	-0.004	0.8984	
Mother: Koranic education	1115	0.1982	0.1944	0.004	0.8830	
Father: non-agri. informal sect.	1115	0.2042	0.1905	0.014	0.5982	
Father: non-agri. formal sect.	1115	0.1441	0.1458	-0.002	0.9435	
Father: no/other activity	1115	0.3544	0.3465	0.008	0.8025	
Wolof ethnicity	1109	0.4367	0.3925	0.044	0.1700	
Primary education	1115	0.1592	0.1803	-0.021	0.3944	
Mother: any formal edu.	1115	0.0751	0.0499	0.025	0.0979	*
Father: agricultural activity	1115	0.2973	0.3171	-0.020	0.5130	
Husband's father polygamous	1076	0.6258	0.5963	0.029	0.3672	
Husband's father deceased	1109	0.7173	0.7051	0.012	0.6833	
Husband is the household head	1115	0.6697	0.6419	0.028	0.3747	
Husband works in other activity	1115	0.1231	0.1560	-0.033	0.1551	
Husband works in agricultural sector	1115	0.2012	0.2494	-0.048	0.0827	
Husband works in non-agri. formal sect.	1115	0.2132	0.1905	0.023	0.3843	*
Husband owns the residence	1115	0.3423	0.3913	-0.049	0.1228	
Union controls						
Dakar region	1115	0.3814	0.3197	0.062	0.0463	**
Other urban area	1115	0.1772	0.1829	-0.006	0.8217	
Household size	1115	9.7447	11.0077	-1.263	0.0042	***
% $<$ 17 and $>$ 60 yr-olds in hh	1115	48.6877	51.9090	-3.221	0.0031	***

Data source: PSF Survey, wave 1 (2006-2007)

Table 9: Attrition between the two waves - Probit model

	Survey attrition		Final attrition	
	(a)	(b)	(c)	(d)
$\widehat{F_t}$	0.201	0.091	−0.019	−0.334
	(0.697)	(0.882)	(0.958)	(0.517)
Wife controls				
Age in years	−0.018**	−0.027**	−0.000	−0.004
	(0.021)	(0.032)	(0.931)	(0.701)
Serere ethnicity		0.059		0.103
		(0.864)		(0.699)
Pulaar ethnicity		0.061		−0.073
		(0.811)		(0.745)
Minority ethnicity		0.011		−0.260
Ref: Wolof ethnicity		(0.969)		(0.217)
Fostered before 15		−0.131		−0.227*
		(0.427)		(0.073)
No education		0.152		0.158
		(0.373)		(0.254)
Secondary education or higher		−0.041		0.141
Ref: Primary education		(0.855)		(0.410)
Mother: Koranic education		−0.336**		−0.043
		(0.040)		(0.751)
Father: any formal edu.		−0.427**		−0.222+
		(0.024)		(0.118)
Father: Koranic education		0.022		−0.101
		(0.887)		(0.399)
Husband controls				
Age in years		0.012		0.002
		(0.198)		(0.780)
Serere ethnicity		0.123		−0.056
		(0.733)		(0.838)
Pulaar ethnicity		0.141		−0.146
		(0.609)		(0.528)
Minority ethnicity		0.368		0.172
Ref: Wolof ethnicity		(0.142)		(0.406)
Fostered before 15		−0.139		0.039
		(0.427)		(0.749)
No education		−0.154		−0.013
		(0.379)		(0.928)
Secondary education or higher		0.183		0.187
Ref: Primary education		(0.387)		(0.266)
Mother: Koranic education		0.002		0.021
		(0.992)		(0.880)
Father: any formal edu.		−0.052		0.055
		(0.795)		(0.712)
Father: Koranic education		−0.067		0.055
		(0.672)		(0.622)
Union controls				
Dakar region	0.644***	0.585***	0.153	0.115
	(0.000)	(0.001)	(0.129)	(0.408)
Other urban area	0.415***	0.324∗	0.056	−0.002
Ref: rural area	(0.010)	(0.063)	(0.645)	(0.988)
Household size		−0.018		−0.000
		(0.306)		(0.978)
% < 17 and > 60 yr-olds in hh		−0.005		−0.006**
		(0.268)		(0.041)
Additional controls†	No	Yes	No	Yes
Number of observations	1035	1019	1035	1019
Number of attrited obs.	138		333	

Probit model; Standard errors are bootstrapped (300 replications), p-value in parentheses; $^{+}$ $p < 0.12$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimation sample is composed of all monogamous unions in which wife is aged 15 to 60, in the first wave of the PSF Survey. The dependent variable in columns (a) and (b) is a dummy variable equal to 1 for unions that were not surveyed in the second wave (i.e. was not found or had migrated abroad or is deceased). In columns (c) and (d), a dummy variable equal to 1 for unions not included in the second step panel sample, either because of survey attrition, or change in marital status (dissolved union, became polygamous).

$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).

† Additional controls include dummies for deceased father of both spouses and for sectors of activity of both spouses' fathers.

Table 10: First-step estimation results for the risk of polygamy

Hazard ratios from Cox proportional hazard model estimates for transitions to polygamy

Wife controls				
Age at marriage	0.980	0.980	0.990	1.001
	(0.018)	(0.017)	(0.018)	(0.019)
Serere ethnicity	0.626		0.692	0.941
	(0.248)		(0.283)	(0.490)
Pulaar ethnicity	1.030		0.953	1.158
	(0.358)		(0.331)	(0.413)
Minority ethnicity	1.063		0.938	1.128
Ref: Wolof ethnicity	(0.393)		(0.328)	(0.367)
Fostered before 15	0.661**		0.651**	0.742
	(0.118)		(0.115)	(0.148)
No education	1.649**		1.696**	1.528*
	(0.417)		(0.427)	(0.378)
Secondary education or higher	1.312		1.226	1.079
Ref: Primary education	(0.456)		(0.434)	(0.400)
Wife's father deceased				1.133
				(0.176)
Relative cell size				0.102***
				(0.034)
Husband controls				
Age at marriage	0.969***	0.969**	0.975**	0.982
	(0.012)	(0.012)	(0.011)	(0.012)
Serere ethnicity	0.972		1.032	0.876
	(0.410)		(0.440)	(0.467)
Pulaar ethnicity	0.650		0.683	0.522*
	(0.240)		(0.237)	(0.180)
Minority ethnicity	0.734		0.726	0.485**
Ref: Wolof ethnicity	(0.249)		(0.251)	(0.157)
Fostered before 15	1.564***		1.354**	1.287*
	(0.208)		(0.176)	(0.181)
No education	1.304		1.451**	1.299
	(0.232)		(0.275)	(0.268)
Secondary education or higher	0.998		1.032	0.877
Ref: Primary education	(0.251)		(0.270)	(0.237)
Husband's father polygamous	1.493***	1.583***	1.439***	1.446***
	(0.187)	(0.198)	(0.174)	(0.198)
Husband's father deceased				0.698*
				(0.128)
Household head				0.378***
				(0.096)
Husband owns the residence				0.983
				(0.156)
Union controls				
Dakar region	0.819	0.681**		0.430***
	(0.152)	(0.107)		(0.117)
Other urban area	0.720*	0.636***		
Ref: rural area	(0.127)	(0.096)		
Household size				1.024*
				(0.013)
% < 17 and > 60 yr-olds in hh				1.001
				(0.004)
Additional controls 1†	Yes	No	Yes	Yes
Additional controls 2‡	No	No	No	Yes
Region fixed effects	No	No	Yes	Yes
Number of observations	1356	1371	1356	1347

Semi-parametric Cox proportional hazard model ; exponentiated coefficients are presented (hazard ratios), Standard errors in parentheses are clustered at the neighborhood level; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimation sample includes all monogamous unions and polygamous unions made of husband and first-rank wife aged 15 to 60, in the first wave of the PSF Survey.

† Additional controls include dummies for Koranic education of both spouses' parents, and for formal education and sectors of activity of both spouses' fathers.

‡ Additional controls include dummies for spouses' current sector of activity

Data source: PSF Survey, wave 1 (2006-2007)

Table 11: Impact of the risk of polygamy on wife savings stock

Wife savings stock (in log) (p-values in parentheses)	Total savings			Savings entrusted to formal/informal institutions			Savings at home		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
$\widehat{F_t}$	10.209***	12.378**	13.458**	8.019***	12.362**	14.628***	6.849***	3.804	1.685
	(2.609)	(4.934)	(5.611)	(2.586)	(4.851)	(5.518)	(1.529)	(2.629)	(2.592)
Wife's age in years		-0.041	-0.068		-0.082	-0.108		0.058	0.041
		(0.081)	(0.088)		(0.080)	(0.087)		(0.044)	(0.043)
Household size			-0.019			-0.069			0.124***
			(0.072)			(0.072)			(0.046)
Relative cell size			0.933			-0.545			3.286***
			(1.846)			(1.905)			(1.073)
% $<$ 17 and $>$ 60 yr-olds in hh			0.004			-0.005			0.008
			(0.017)			(0.017)			(0.008)
Wife's father deceased			1.457**			1.429**			0.869*
			(0.731)			(0.708)			(0.469)
Husband's father deceased			-2.326**			-2.104**			-0.324
			(1.056)			(1.003)			(0.482)
Constant	2.232***	3.211+	4.439	2.424***	4.384**	6.978**	-0.715**	-2.090*	-4.783***
	(0.546)	(2.033)	(2.863)	(0.544)	(2.014)	(2.824)	(0.303)	(1.132)	(1.393)
Number of observations	1482	1482	1422	1482	1482	1422	1482	1482	1422
Number of unions	741	741	711	741	741	711	741	741	711
Within R2	0.014	0.014	0.026	0.0089	0.010	0.022	0.022	0.025	0.056
Unconditional mean									
Wave 1	3.948			3.796			0.422		

Panel union fixed effect model estimates. Standard errors in parentheses are clustered at the neighborhood level and bootstrapped (300 replications); $^{+}$ p<0.12 * p<0.10, ** p<0.05, *** p<0.01.
Dependent variable: stock of wife savings (in log)
Sample: monogamous unions in the two waves.
$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).
Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 12: Impact of the risk of polygamy on wife decision to save

Wife savings stock (in log) (p-values in parentheses)	Total savings			Savings entrusted to formal/informal institutions			Savings at home		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
$\widehat{F}_t$	0.943***	1.181**	1.220**	0.708***	1.164**	1.323**	0.796***	0.511*	0.310
	(0.262)	(0.480)	(0.527)	(0.258)	(0.472)	(0.534)	(0.169)	(0.283)	(0.275)
Wife's age in years		-0.005	-0.007		-0.009	-0.011		0.005	0.004
		(0.008)	(0.008)		(0.008)	(0.008)		(0.005)	(0.004)
Household size			-0.000			-0.005			0.012***
			(0.007)			(0.007)			(0.004)
Relative cell size			0.121			-0.023			0.326***
			(0.185)			(0.181)			(0.108)
% < 17 and > 60 yr-olds in hh			0.001			-0.000			0.001
			(0.002)			(0.002)			(0.001)
Wife's father deceased			0.136**			0.139**			0.092**
			(0.068)			(0.065)			(0.046)
Husband's father deceased			-0.233**			-0.214**			-0.043
			(0.096)			(0.094)			(0.052)
Constant	0.220***	0.328*	0.400+	0.242***	0.448**	0.664**	-0.090***	-0.219*	-0.497***
	(0.055)	(0.191)	(0.250)	(0.054)	(0.189)	(0.261)	(0.033)	(0.117)	(0.146)
Number of observations	1482	1482	1422	1482	1482	1422	1482	1482	1422
Number of unions	741	741	711	741	741	711	741	741	711
Within R2	0.013	0.013	0.025	0.0078	0.0094	0.022	0.028	0.029	0.060
Unconditional mean									
Wave 1	0.379			0.365			0.044		

Panel union fixed effect model estimates. Standard errors in parentheses are clustered at the neighborhood level and bootstrapped (300 replications); $^{+}$ p<0.12 * p<0.10, ** p<0.05, *** p<0.01.

Dependent variables: col. (1) to (3) dummy equal to one if the wife has any form of savings; col (4) to (6) dummy for wife savings entrusted to formal/informal institution ; col (7) to (9): for wife savings kept at home.

Sample: monogamous unions in the two waves.

$\widehat{F_t}$: predicted failure probability estimated by a Cox survival model (see Table 1).

Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)

Table 13: Impact of the risk of polygamy on savings of household head's wives - Panel fixed effect estimation

	(a) Wife savings stock (in log)			(b) Wife has savings (dummy)			(c) Share of savings
	Total	In institutions	At home	Total	In institutions	At home	In institutions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\widehat{F}_t$	16.326**	18.447**	2.134	1.626**	1.851***	0.353	1.593**
	(7.275)	(7.259)	(4.394)	(0.678)	(0.687)	(0.439)	(0.736)
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls†	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	888	888	888	906	906	906	888
Number of unions	444	444	444	453	453	453	444
Within R2	0.028	0.028	0.080	0.029	0.028	0.084	0.021
Unconditional mean							
Wave 1	4.341	4.185	0.385	0.416	0.401	0.0419	0.396

Panel union fixed effect model estimates. Standard errors in parentheses are clustered at the neighborhood level and bootstrapped (300 replications); * p<0.10, ** p<0.05,*** p<0.01.

Dependent variables: col (a): stock of savings of the wife (in log); col. (b): whether the wife holds savings (dummy), col. (2), (5) and (7) correspond to savings entrusted to informal or formal institutions, while col (3) and (6) to savings kept at home. In col. (7): Share of the total stock of savings entrusted to informal or formal institutions.

Sample: monogamous unions in the two waves whose husband is the household head

$\widehat{F}_t$: predicted failure probability estimated by a Cox survival model (see Table 1).

† Controls not shown: age of the wife and a dummy for deceased father of each spouse ; household size ; relative cell size ; share of dependants.

Data source: PSF Survey, waves 1 and 2 (2006-2007 and 2010-2012)