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Polygamy and female labour supply in Senegal

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Abstract: In this paper, we explore the links between polygyny and female labour supply in Senegal using a nationally representative survey. In a reduced-form approach, we first measure the impact of polygyny on participation using a joint model of spouse participation. The identification of the impact of polygyny relies on the use of district-level variables as instruments. We find a positive impact of polygyny on female labour force participation. Turning to a structural approach based on the collective household model, we examine the possibility that men within couples use polygyny as a threat to influence the distribution of resources in their favour. The results are less conclusive regarding the role played by the risk of polygyny as an effective distribution factor.

Keywords: collective model, intrahousehold allocation, women's empowerment, polygyny, social norms
JEL classification: D13, J12, J16, J22

Tables: at the end of the paper.

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1 Introduction

If you annoy me, I will take a second wife!

Polygyny remains a well-established reality in Africa: in the 'polygyny belt' that extends from Senegal to Tanzania, it is common to find more than a third of married women in polygamous unions. While many economics papers have attempted to explain the rationality and persistence of this phenomenon through time since the pioneering work of Boserup (1970) and Becker (1974, 1991), less effort has been devoted to studying its effect on outcomes such as women's labour force participation and well-being. In this paper we empirically explore these effects using data from Senegal.

In line with Becker's view, economists generally consider the practice of polygamy to be efficient and mutually beneficial for men and women. Opposing this view, a number of works in the fields of social anthropology and feminist economics emphasize its oppressive nature for women (e.g., Bergmann 1995; Ickowitz and Mohanty 2015). Indeed, as Boyer et al. (1991) point out, women generally have no say in the decision over whether to enter into polygamy, and empirical evidence from qualitative interviews shows a widespread rejection of this practice among women. For example, in a survey among the Yoruba of Nigeria involving 2,000 respondents, Aluko and Aransiola (2003) show that about 80 per cent of women in the sample want polygamy to be eradicated. Meekers and Frankin (1995), who examine women's perceptions of polygyny among the Kaguru of Tanzania, also conclude that most women do not support polygyny, and link this rejection to the non-cooperative nature of relationships between co-wives. Women in polygamous unions have to compete for scarce resources, particularly for their children, and this competition is a source of conflict that weighs on their well-being. While there are examples of co-wife cooperation (e.g., Bastide 2012; Bledsoe 1980; Petsalis 1990), Jankowiak et al.'s (2005) ethnographic examination of 69 polygynous cultures finds evidence of pervasive co-wife conflict, hostility, and violence in polygamous unions (cf. Dauphin 2013).

Concerning men, as shown by Antoine et al. (1998), the option of monogamy is rarely final when polygyny is legal. For monogamous men polygyny is always an option, and the possibility of polygyny appears to be present even for men who declare themselves favourable to monogamy: 'today, it is preferable to take only one wife to be able to treat her well, but on condition that she is herself of good character' (a 30-year-old trader from Dakar, single) (Antoine et al. 1998: 168). Indeed, polygyny is declared by some men to be a means of control over their wives, a penalty against a 'disobedient' or 'disrespectful' wife: 'The monogamous woman seeing no rival forgets morality, she thinks she is a goddess, spends the husband's money without a second thought' (a 39-year-old technician from Bamako) (Antoine et al. 1998: 169); 'It is women, according to their character in the couple, who encourage men to remain monogamous or to choose polygyny. The husband of a bad wife will always marry another, who may be of good character and influence the first wife, who consequently adjusts' (a 51-year-old tailor from Bamako, divorced) (Antoine et al. 1998: 169). These quotes all suggest that men in monogamous unions can use the threat of polygyny to obtain satisfactory behaviour from their wives.

The empirical evidence presented above suggests two things. First, in countries where polygyny is legal, women in monogamous unions are subject to the risk of polygyny, and they are likely to respond to it. Indeed, given the likelihood of spouse conflict highlighted above, polygyny increases the risk of divorce. For instance, Antoine et al. (1998) show that in Dakar and Bamako, entry into polygyny dramatically increases the risk of divorcing the first wife (by 3.3 times in Dakar, and by 4.15 times in Bamako). Polygyny also has the immediate effect of reducing a woman's share of

inheritance in case of the husband's death. In both cases, women might try to enhance their financial autonomy by participating in the labour market in order to compensate for the income loss. Second, the threat of polygyny can be used by men as a way to influence the behaviour of their spouse, and it is likely that polygyny provides men with a means of pressure that can be used to gain power in the household bargaining process. This idea relates closely to the notion of 'threat points' in bargaining models, and to the notion of power effectively captured in the collective household model pioneered by Chiappori (1988, 1992). In this model the so-called sharing rule, which governs the intrahousehold distribution of household resources, provides a measure of each partner's power. This sharing rule is likely to depend both on preferences and economic variables and on the opportunity structure set by formal (e.g., legislation as laws governing divorce or protecting women against domestic violence) and informal institutions (norms).

With this empirical and theoretical background in mind, we analyse the impact of polygyny on labour supply, following two approaches and using quantitative household and individual data from Senegal. The first approach is based on a reduced-form model of labour force participation, jointly estimated for spouses. The identification of the impact of polygyny relies on the use of individual- and district-level variables that explain polygyny but can arguably be excluded from the participation equations. Following Chiappori's model, the objective of the second approach is to recover the parameters of the sharing rule from the estimation of a structural model of hours worked, using the risk of polygyny as a distribution factor.

Under the first approach, we find a positive impact of polygyny on female labour force participation. Two possible interpretations come to mind. On the one hand, higher labour force participation results from a strategic choice by women subjected to polygyny to increase their autonomy. This interpretation is consistent with Boltz and Chort (2016), who find a positive impact of the risk of polygyny on female savings, suggesting self-protective strategies. On the other hand, the higher labour force participation is also consistent with women benefiting from polygyny through domestic labour sharing, given the heavy domestic burden and the existence of economies of scale within the household. Under the second approach, the structural model proves more difficult to estimate, and the results are less conclusive regarding the role played by the risk of polygyny as an effective distribution factor in the collective model.

The rest of the paper is structured as follows. Section 2 describes the Senegalese context and our data. Section 3 discusses the choice of the empirical specifications used in our two different approaches. Section 4 presents empirical results, and Section 5 concludes. Chiappori's theoretical framework is presented in the Appendix.

2 Context and data

2.1 Context

A lower-middle-income country in sub-Saharan Africa, Senegal is a democracy and predominantly Muslim (95 per cent of the population). In 2014, Senegal scored 0.528 on the Gender Inequality Index,[1] which places it at 170 out of 188 countries. Data from the 2005 Demographic and Health Survey show that 65.2 per cent of women agreed with at least one 'reason' (from a list of five) for a man to beat his wife.

Despite its low international ranking, Senegal's constitution guarantees equality between women and men, and its legal framework protects women's bodily integrity in theory. However, family law continues to discriminate against women (Antoine et al. 1998). The Senegalese Family Code grants parental authority solely to the father, and women are unable to take legal responsibility for their children. The father handles administrative procedures affecting his children, chooses the family's place of residence, and receives any family allowances. In addition, while laws protecting women are generally respected in urban areas, rural areas are still dominated by custom, and few women are aware of the legal rights in place to protect them.

Marriage is a symbol of high social position in Senegal, and few women remain single. Polygamy is legal, and according to census data it was practised in 2002 by 50 per cent of married women and 25 per cent of married men. To be legally recognized, marriages must be performed in front of a civil registrar, and each spouse must give their full and free consent. Registered marriages can be either monogamous or polygamous; in the latter case the husband can marry up to four women. If the husband opts for neither, the marriage is considered polygamous by default. Before entering into civil marriage, the wife must give her consent if the marriage is to be polygamous; but once they are married under that regime, the husband is under no obligation to notify her or gain her consent if he chooses to take another wife (Antoine and Nanitelamio (1995).

Senegalese females' participation in the labour market is particularly low in the West African context (Nordman et al. 2011). The female paid employment rate in Dakar was 35.7 per cent in the early 2000s, while it was about—or up to—50 per cent in Bamako, Cotonou, Abidjan, and Lomé.

2.2 Data

The main source of data used in this study is the Enquête de Suivi de la Pauvreté au Sénégal (ESPS), conducted in 2011 by the National Agency of Statistics and Demographic Surveys. ESPS is a nationwide survey covering 14 administrative regions that uses a stratified two-stage cluster sampling design. The resulting sample of 17,890 households—corresponding to 168,201 individuals—is representative at the national, regional, and district levels. At the individual level, the survey collects detailed information on sociodemographic characteristics (age, sex, marital status), level of education, occupation and employment status, labour and non-labour income, and

[1] The Gender Inequality Index (GII) measures gender inequalities in three aspects of human development: reproductive health, empowerment, and economic status. See UNDP (2016) for details on how the GII is calculated.

transfers received and paid. At the household level, the survey provides information on housing characteristics, household assets, and consumption.

In order to reconstruct couples, individual data is processed using information on family links at the individual level. Indeed, all individuals declare the vital status of their parents and their own status ordering if they reside in the same household. Using this information for children aged zero to 15, this procedure enables the reconstruction of 16,068 pairs of spouses corresponding to 16,068 women and 13,660 men. The advantage of this procedure is that it is able to include not only household-head couples—which represent 70 per cent of the couples in the whole sample—but also couples formed by head's sons (16 per cent of couples) and head's brothers (eight per cent of couples).[2]

Tables 1 and 2 provide some summary statistics for all men and women in the sample of couples. A large majority of women in the sample (73.2 per cent in urban areas and 53.2 per cent in rural areas) declare themselves to be monogamous, while 13.9 per cent of urban women and 22.7 per cent of rural women are first wives in a polygamous union. Concerning female characteristics, the average age is slightly above 30 in both rural and urban areas and average fertility is high, with more than 2.5 children in both areas. Muslims represent more than 95 per cent of the sample, and one third of the women are Wolof. The figures also point to a very low educational level, with 64 per cent of urban women and 90 per cent of rural women having no education. Finally, 31.4 per cent of urban women are working, while the share reaches 50.8 per cent in rural areas. Concerning males, the average age is significantly higher (above 45 in both rural and urban areas) and the number of children is also higher, particularly in rural areas, with more than 3.5 on average per man. Muslims also represent more than 95 per cent of the sample, and one third of men are Wolof. The figures point again to low levels of education, with half of urban men and 83 per cent of rural men having no education. Finally, labour force participation is higher, with 75.8 per cent of urban and 81.7 per cent of rural men working. One last and important characteristic of the context in which married individuals operate is the size of the household in which they live. Figures from both tables indicate that households are very large, with average sizes ranging from 11.9 (married men in urban areas) to 13.8 (married women in rural areas).

Key economic variables in the labour supply models include both wages and non-labour incomes. Wages are computed using individual earnings reported over the last month divided by the number of hours worked. Following Donni and Matteazzi (2010), we then estimate non-labour income as the difference between household spending and spouses' labour income (hours times wages) as well as household income outside the couple. As mentioned above, Senegalese households are large, and it is likely that the labour supply of spouses is influenced by the total income earned by other household members. This income is estimated directly as the sum of labour and non-labour income declared by all other household members. Table 3 presents summary statistics for weekly hours, wages, and incomes of working couples. The figures indicate that women work 40 hours per week on average in both rural and urban areas, while men work around 50 hours per week on average.

We also use data from the 2002 census Recensement Général de la Population et de l'Habitat to compute district-level characteristics.[3] The use of data from the 2002 census has some advantages. In particular, it captures district-level structural characteristics that are somewhat 'invariant', as

[2] Note that the procedure only allows the linking of spouses that reside in the same households. Non-co-resident spouses cannot be identified in the sample.

[3] Districts here correspond to the 34 Senegalese departments.

opposed to contemporaneous district-level data that can be more cyclically sensitive. These variables, presented in Table 4, are used for different purposes. The sex ratio and polygyny rates are used to identify the impact of polygyny on the labour force participation of males and females. The activity rates by gender at the district level are used to control for local-level characteristics likely to influence the level of labour force participation. Other district-level characteristics (water connection rate, share of jobs in agriculture, and share of secondary-school graduates) are also used as control variables.

3 Empirical strategy

The impact of polygyny on labour supply is analysed following two approaches, using the quantitative household and individual data from Senegal discussed above.

The first approach is based on a reduced-form model of labour force participation estimated jointly for spouses. We estimate the risk of polygyny together with labour participation equations. The resulting system includes three equations that are estimated using three-stage least squares (3SLS). The focus is on the impact of polygyny on spouses' participation in the labour market. The model is estimated on the sample of couples restricted to first wives and their husbands (either monogamous or polygamous), excluding second and third wives. This is because, as opposed to first wives, second and third wives enter polygamous unions knowingly. Hence it is the contrast between the labour market participation behaviour of monogamous wives and polygamous first wives that is used as the left-hand side source of variation to identify the effect of polygyny.

The following specifications are used:

$$work^f = \alpha_0 + \alpha_1 poly + \alpha_2 work^m + \alpha_3 z_f + \alpha_4 z_c + \alpha_5 z_h + \alpha_6 z_d \quad [1]$$

$$work^m = b_0 + b_1 poly + b_2 work^f + b_3 z_m + b_4 z_c + b_5 z_h + b_6 z_d \quad [2]$$

$$poly = c_0 + c_1 z_f + c_2 z_m + c_3 z_c + c_4 z_h + c_5 z_d + c_6 z_p \quad [3]$$

where $work^f$ (respectively $work^m$) is a dummy variable indicating whether the individual works, $poly$ is a dummy variable indicating whether the union is polygamous, z_f (respectively z_m) is the vector of wife (respectively husband) characteristics, z_c is the vector of couple characteristics, z_h is the vector of household characteristics, z_d is a vector of district-level variables including activity rate by sex, and z_p is the vector of variables used to identify the impact of polygyny. Descriptive statistics for the main variables of this model are presented in Tables 3 and 4.

Control variables for the participation equations include individual characteristics of both spouses (age, education, ethnic group, religious affiliation), couple characteristics (non-labour income, number of children under and over five, number of girls among children), household characteristics (household income outside the couple, household size), activity rates by gender at the district level, and other district-level controls (see above). The participation equations are estimated jointly for husbands and wives, and jointly with the polygyny equation. The identification of the impact of polygyny relies on the inclusion of individual-level variables in the polygyny equation (dummy if the husband's non-labour income is above median; vital status of husband's

parents), as well as district-level variables (sex ratios by ethnic group and religion in 2002; polygyny rate in 2002). These variables are likely to explain polygyny but can arguably be excluded from the participation equations. Indeed, because marriage is expensive (due to the payment of a bride price), both the wealth level of the husband and the vital status of his parents (from whom he will possibly inherit) are likely to explain the entry into polygyny. Furthermore, lagged variables capturing the local context in terms of both demography (sex ratios by ethnic group and religion) and norms (polygyny rate) can influence the probability of becoming polygamous, while it is unlikely that these variables determine labour force participation directly. Note that we control for demand-side factors influencing participation at the district level by including the lagged activity rate by sex.

Labour supply within households has most often been analysed for couples in Organization for Economic Cooperation and Development countries (e.g., Donni and Matteazzi 2010; Rapoport et al. 2011), where the majority of households are nuclear. This is not the case for Senegal. As already mentioned, Senegalese households are large, with average sizes of 11.8 in urban and 13 in rural areas (Table 2), as well as complex. Apart from the prevalence of polygyny, it is common for up to three generations to co-reside, or for brothers and their wives to share their livelihoods. When we examine the behaviour of couples it is therefore important to take this complexity into account to some extent, by controlling at least for the income that other household members bring into the household. This is referred to as 'outside-couple income'.

Using the collective household framework developed by Chiappori et al. (2002), the second approach aims first to analyse the impact of polygyny on hours worked, and second to recover the parameters of the sharing rule. For that purpose, we estimate a structural model of hours of labour supply, using polygyny as a distribution factor. Browning and Chiappori (1998) introduce the concept of 'distribution factor', defined as variables that can affect the intrahousehold decision process without influencing individual preferences or the joint consumption set. In the context of polygamous societies, the threat to take a second spouse may be used as a way of limiting the bargaining power of the first wife *ceteris paribus*, and the risk of polygyny could qualify as a distribution factor. In that case, we expect the impact of the risk of polygyny to be of opposite signs in the labour supply equations of women and men, reflecting the redistribution of resources within the household as a result of bargaining. Using the specifications of Chiappori et al. (2002) and Rapoport et al. (2011), we estimate the following labour supply equations derived from the collective model described in the Appendix for working women and men:

$$h^f = f_0 + f_1 \ln w_f + f_2 \ln w_m + f_3 y + f_4 poly + f_5 z + f_6 \ln w_f \ln w_m \quad [4]$$

$$h^m = m_0 + m_1 \ln w_f + m_2 \ln w_m + m_3 y + m_4 poly + m_5 z + m_6 \ln w_f \ln w_m \quad [5]$$

$$poly = g_0 + g_1 z_f + g_2 z_m + g_3 z_c + g_4 z_h + g_5 z_d + g_6 z_p \quad [6]$$

where h^f (respectively h^m) is female (respectively male) weekly hours worked, w_f (respectively w_m) is the female (respectively male) hourly wage rate, y is non-labour income, and z is a vector of individual, couple, and household characteristics, as well as job and district-level variables.

Men's and their spouses' labour supply functions are jointly estimated together with the polygyny equation using a 3SLS specification allowing residuals to be correlated. To implement this empirical strategy, we use the subsample of working women who are either in monogamous unions or first wives in polygamous unions and who are married to a working man. Weekly hours worked

respectively by each spouse are estimated controlling for each spouse's personal characteristics (ethnic group, religious affiliation, age group, and educational level), job characteristics (experience, sector, and professional category in this activity), and district variables that might capture the local labour market demand-side factors (water connection rate, share of jobs in agriculture, and share of secondary-school graduates).

The estimation of labour supply equations [4] and [5] raises a number of methodological issues. The first is related to the measurement of wages, since real wages are not observed directly. Instead, unit values—computed using earnings divided by the number of hours worked—are used in the estimation. Because unit values are derived from reported earnings and hours, measurement error in hours will be transmitted to measurement in the unit value, inducing a spurious negative correlation (Deaton 1997: 292). The second problem is the endogeneity of wages and non-labour income. Wages are endogenous not only because of the measurement error problem mentioned above, but also because they result from the equilibrium of labour supply and demand, while we only estimate the supply side. Non-labour income is endogenous because it results in part from past labour choices and bargaining within the household.

Our strategy to try to overcome these issues is to instrument wages and non-labour income. We instrument the distribution factor 'polygyny' by the same variables as those used in our reduced-form approach, i.e. dummy if the husband's non-labour income is above median, vital status of the husband's parents, and district-level variables (sex ratios by ethnic group and religion in 2002; polygyny rate in 2002). We also instrument wages, non-labour income, and the 'cross-term' of wife's and husband's wages by both male and female experience crossed with their educational level in order to capture productivity effects. While both experience and education are likely to influence the labour supply decision, the interaction of both variables is likely to condition only productivity.

Finally, given the specifications above and system [11] in the Appendix, we can compute the partial derivatives of the sharing rule:

$$\Phi y = \frac{f_3 m_4}{\Delta}; \Phi s = \frac{f_4 m_4}{\Delta}; \Phi w_m = \frac{(f_2 + f_6 \ln w_f) m_4}{w_m \Delta}; \Phi w_f = \frac{(m_1 + m_6 \ln w_m) f_4}{w_f \Delta}. \quad [6]$$

where s is a dummy that indicates polygyny, and Δ is equal to $f_3 m_4 - f_4 m_3$. All derivatives of the sharing rule are computed at sample means using these expressions.

4 Results

The results of the two approaches are presented sequentially.

4.1 Participation model

The focus of the reduced-form approach is on the identification of the impact of polygyny on labour participation. The model is estimated jointly, and we first comment on the estimation of the risk of polygyny.

Concerning urban areas, results in column 3 of Table 5 indicate that the risk of polygyny is negatively related to both the couple's non-labour income and outside-couple income. Also, as

expected, the risk of polygyny is positively correlated with the district-level polygyny rate in 2002; however, the sex ratio does not appear to play a role. The effect of the district-level rate of polygyny is relatively strong, since the point estimate indicates that when it increases by 10 per cent, the risk of polygyny at the couple level increases by 3.3 percentage points. Concerning husbands' variables excluded from participation equations, the risk of polygyny is positively related to the husband's non-labour income: when the husband's income is above the median, the risk increases by eight percentage points. However, the vital status of the husband's parents is not significant. Results for other control variables (not shown) suggest expected life cycle effects, since the risk of polygyny increases significantly with age. As regards education, results indicate that women's education decreases the risk of polygyny to some extent (not shown). In rural areas, results are similar as far as income variables (non-labour income and outside-couple income) are concerned. Figures in column 3 of Table 6 further indicate that the risk of polygyny is negatively related to the district-level sex ratio, and positively to the rate of polygyny. Also, when the husband's income is above the median, the risk increases by 2.5 percentage points. The vital status of the husband's father is also significant: when he is deceased, the risk of polygyny increases by 2.7 percentage points.

Concerning participation in the labour force, results indicate that polygyny has a positive and significant impact on female labour participation in both rural and urban areas. The impact is quite large, since the point estimates reported in Tables 5 and 6 indicate that polygyny increases female labour force participation by 24.9 percentage points in urban areas and 34.4 percentage points in rural areas. Husbands' labour force participation choices appear to negatively affect the participation of women, although the effect is only significant in rural areas. On the other hand, women's participation does not significantly influence the participation of their husbands. Couples' non-labour income and outside-couple income both decrease the probability of work consistently with pure income effects. However, the effect of outside-couple income is not significant in the case of women. District-level activity rates in 2002 are positively related to participation in both rural and urban areas, but not significantly for urban men.

How can the positive impact of polygyny on female labour force participation be interpreted? Two possible interpretations come to mind. On the one hand, higher labour force participation might be the result of a strategic choice by women subjected to polygyny to increase their autonomy. This interpretation is consistent with Boltz and Chort (2016), who find a positive impact of the risk of polygyny on female savings, suggesting self-protective strategies. On the other hand, the higher labour force participation is also consistent with women benefiting from polygyny through domestic labour sharing, given the heavy domestic burden and the existence of economies of scale within the household. Indeed, polygamous wives spend less time doing domestic work than monogamous ones: ESPS data show that the housework burden of first and second wives in polygamous unions is 12.5 hours a week, compared with 16.6 hours a week for women in monogamous couples.

4.2 Labour supply model and the sharing rule

As presented above, labour supply models are estimated within the framework of the collective household model with the objective of recovering the parameters of the sharing rule and checking whether the threat of polygyny influences the allocation of resources within the household.

The model is estimated jointly for men and women, and separately for urban and rural areas, on the subsample of couples where both husband and wife work. Table 7 shows results from the joint 3SLS estimations. Columns 1 and 2 of Table 7 show estimations of hours worked for urban couples, while columns 3 and 4 show estimations of hours worked for rural couples. Given that the labour supply equations include an interaction term of male and female wages, own- and cross-

wage elasticities of labour supply need to be computed at sample mean. The resulting partial derivatives are presented in Table 8. We present and focus on the main model variables: male and female wages, non-labour income, and the risk of polygyny. Additional control variables include husband and wife individual characteristics, couple characteristics, and district-level characteristics (not shown).

Concerning partial derivatives, results presented in Table 8 suggest that the impact of wages on hours worked is very small, while non-labour income has the expected negative impact for all, but is only precisely estimated for women in urban areas and men in rural areas.

The risk of polygyny appears to be of opposite signs for men and women in both urban and rural areas, which is consistent with the interpretation of the risk of polygyny as a distribution factor. The interpretation goes as follows: an increase in the risk of polygyny by 10 percentage points increases the weekly hours worked by women by 0.39, while it decreases the weekly hours worked by men by 0.35 hours. This is reversed in rural areas, where a 10 percentage points increase in the risk of polygyny decreases the weekly hours worked by women by 0.53, while it increases the weekly hours worked by men by 0.28. In both rural and urban areas, however, the impact of polygyny is not estimated precisely, and coefficients are not significantly different from zero.

Table 9 presents the partial derivatives of the sharing rule with respect to key model variables using estimation results above and systems [11] and [12] in the Appendix for rural and urban couples. These partial derivatives represent the change in the non-labour income share that the wife can claim, as a function of changes in the male wage, the female wage, non-labour income, and the risk of polygyny. Unfortunately, the precision of these coefficients depends on that of the labour supply equations above, and none of our partial derivatives is significantly different from zero.

5 Conclusion

In this paper, we explore the links between polygyny and female labour supply in Senegal. The analysis uses a nationally representative survey of individuals that can be matched into couples, providing a sample of more than 16,000 observations. We then take two approaches to analyse this issue. In the first approach, we try to measure the impact of polygyny on participation using a joint reduced-form model of spouse participation. The identification of the impact of polygyny relies on the use of individual- and district-level variables that explain polygyny but can arguably be excluded from the participation equations. We find a positive impact of polygyny on female labour force participation. This might be explained as a self-protective strategy and/or a result of the sharing of domestic work in polygamous households.

In the second approach, we make use of the collective household model to analyse the impact of polygyny on hours worked and bargaining power within the household. In this framework, the husband's threat of taking a second spouse may influence the distribution of resources between spouses through its impact on the decision process. Consistently with this interpretation, we find opposite signs of the impact of polygyny on hours worked by men and women. Interestingly, while the risk of polygyny increases female hours in the urban sector, it appears to decrease female hours in the rural sector. Accordingly, the impact of polygyny on the sharing rule has opposite signs in urban and rural areas. This would suggest that women's bargaining power is reduced by the risk of polygamy in urban areas while the converse is true in rural areas. However, theses impacts are not estimated with precision, and the results are therefore less conclusive regarding the role played by the risk of polygyny as an effective distribution factor in the collective model.

The failure to obtain meaningful sharing rule estimates might stem from various problems. First, from an empirical perspective, accurately measuring labour supply is difficult, particularly when the distinction between domestic and productive work in the context of farm households is blurred. Indeed, it would probably be more relevant to consider both domestic work and production. Also, as already mentioned, domestic work represents an important burden for females, with potential economies of scale likely to be shared in polygamous households. Also, while we estimate participation and hours separately, a more satisfactory approach, albeit not immune from estimation difficulties, would be to deal with participation and hours in a joint collective household model, following the strategy implemented by Donni and Matteazzi (2010) on US data. Second, from a theoretical perspective, using Chiappori's two-person model to fit Senegalese data is problematic, not only because Senegalese households are large and complex—possibly with multiple decision makers—but also because the efficiency assumption implicit in Chiappori's model is less credible in a context where market imperfections prevail. Finally, the difficulties in interpreting our results come from the fact that the link between female participation and empowerment is not straightforward. While Chiappori's model considers labour supply from the perspective of utility maximization, assuming that more work means less leisure and hence reflects a loss of bargaining power, labour force participation has also been associated with female empowerment in developed countries (Goldin 2006). Whether a woman has some agency in work-related decisions—from the perspective both of effort and of control over what she earns—has very different consequences in terms of empowerment.

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Appendix: Chiappori's model

The collective model developed by Chiappori (1988, 1992) and his numerous co-authors (Browning and Chiappori (1998);Chiappori et al. (2002);Bourguignon et al. (2009); Chiappori and Ekeland (2006)) provides an appealing theoretical framework to analyze household behavior and explore the effect of environmental variables, such as the risk of polygyny, on the distribution of intrahousehold power and welfare. The collective approach contrasts with the conventional unitary approach by acknowledging the multiplicity of decisions makers within the household, and is based on the only assumption that household bargaining results in Pareto efficient allocations. Remarkable results have been derived in this framework, notably the fact that the observation of individual labor supplies, as functions of wages, non-labor income and distribution factors, allows to identify the way in which the sharing rule varies in response to changes in price, household income and distribution factors.

Formally, let us consider a household consisting of two individuals i, a woman (f) and a man (m), and let L^i and C^i denote, respectively, member i's leisure time ($0 \leq L^i \leq T$) and consumption of a private Hicksian composite good whose price is set to unity. We assume that member i's has egoistic preferences represented by some utility function $U^i(C^i, L^i, z)$.[1] Here, z is a vector of preference factors, such as age and education of the two agents. Also, let w_f and w_m denote respective wage rates and y the household nonlabor income. Finally, let s denote a vector of distribution factors.

Under the collective framework, intrahousehold decisions are Pareto efficient and thus, for any given (w_f, w_m, y, z, s), there exists a weighting factor $\mu(w_f, w_m, y, z, s)$ belonging to

[1]This framework generalizes to Beckerian caring preferences (Becker (1991)).

$[0,1]$ such that (L^i, C^i) solves the following program:

$$\begin{cases} \max\limits_{C^f, C^m, L^f, L^m} \mu U_1 + (1-\mu) U_2 \\ \text{s.t.} \quad w_f(T - L^f) + w_m(T - L^m) + y \geq C^f + C^m \\ 0 \leq L^i \leq 1, \quad i = (f, m) \end{cases} \tag{7}$$

The particular location of the solution on the Pareto frontier depends on all relevant parameters, since the value of the Pareto weight μ depends on w_f, w_m, y, z and s. Furthermore, since the vector of distribution factors, s, appears only in μ, a change in s does not affect the Pareto frontier but only the final location on it.

In an economy of this kind, from the second fundamental welfare theorem, any Pareto optimum can be decentralized. Specifically, Chiappori (1992) shows that program (7) is equivalent to the existence of some function $\phi(w_f, w_m, y, z, s)$ such that each member i ($i = f, m$) solves the following program:

$$\begin{cases} \max\limits_{C^i, L^i} U^i(C^i, L^i, z) \\ \text{s.t.} \quad w_i(T - L^i) + \phi^i \geq C^i \\ 0 \leq L^i \leq T, \quad i = (f, m) \end{cases} \tag{8}$$

where $\phi^f = \phi$ and $\phi^m = y - \phi$ (Proof, see Chiappori (1992)). The interpretation is that the decision process can always be considered as a two-stage process: first, non-labor income is allocated between household members, and then each member separately chooses a labor supply and private consumption, subject to the corresponding budget constraint. The function ϕ is called the sharing rule. It describes the way non-labor income is divided up, as a function of wages, non-labor income, distribution factors, and other observable characteristics, and is an indicator of the wife's "weight" in the decision process: any change in, say, a distribution factor that increases ϕ makes the wife better off.

The collective framework imposes certain restrictions on the labor supply functions. From (8), with interior solutions assumed, labor supply functions $h^i = T - L^i$ $(i = f, m)$ can be written as:

$$h^f(w_f, w_m, y, z, s) = H^f(w_f, \phi(w_f, w_m, y, z, s), z) \quad (9)$$

$$h^m(w_f, w_m, y, z, s) = H^m(w_m, y - \phi(w_f, w_m, y, z, s), z) \quad (10)$$

where H^i is member i's Marshallian labor supply function.

The particular structure of equations (9) and (10) imposes testable restrictions on labor supply behavior and allows us to recover the partial derivatives of the sharing rule. The intuition goes as follows. Consider a change in, say, the woman's wage rate. This can have an income effect on her husband's behavior only through its effect on the sharing rule, just as nonlabor income and the distribution factor. Thus the impact of these variables on the labor supply behavior of the woman allows us to estimate the marginal rate of substitution between w_m and y as well as between s and y in the sharing rule. Technically, it generates two equations involving the corresponding partial derivatives of the sharing rule. The same argument applies to the man's behavior, which leads to two other equations. These four equations allow us to directly identify the four partial derivatives of the sharing rule: $\phi_j = \partial\phi/\partial j$ $(j = w_f, w_m, y, s)$

To be more precise, start from:

$$h^f(w_f, w_m, y, z, s) = H^f(w_f, \phi(w_f, w_m, y, z, s), z)$$

$$h^m(w_f, w_m, y, z, s) = H^m(w_m, y - \phi(w_f, w_m, y, z, s), z)$$

Then:

$$\begin{cases} \dfrac{h^f_{w_m}}{h^f_y}(\equiv A) = \dfrac{\phi_{w_m}}{\phi_y} \\ \dfrac{h^m_{w_f}}{h^m_y}(\equiv B) = -\dfrac{\phi_{w_f}}{(1-\phi_y)} \\ \dfrac{h^f_s}{h^f_y}(\equiv C) = \dfrac{\phi_s}{\phi_y} \\ \dfrac{h^m_s}{h^m_y}(\equiv D) = -\dfrac{\phi_s}{(1-\phi_y)} \end{cases} \tag{11}$$

where A, B, C and D are observable. From these 4 equations, assuming $C \neq D$, the partial derivatives of the sharing rule with respect to non-labor income, the distribution factor and wages are given by:

$$\begin{cases} \phi_y = \dfrac{D}{D-C} \\ \phi_s = \dfrac{CD}{D-C} \\ \phi_{w_m} = \dfrac{AD}{D-C} \\ \phi_{w_f} = \dfrac{BC}{D-C} \end{cases} \tag{12}$$

Table 1: Summary statistics for Married Women

Urban	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Age	33.768	9.477	15	59	6405
Number of children	2.578	1.431	0	10	6405
Muslim	0.963	0.188	0	1	6405
Wolof	0.365	0.481	0	1	6405
Monogamous	0.723	0.448	0	1	6405
First wife	0.139	0.346	0	1	6405
Second wife or more	0.135	0.342	0	1	6405
No education	0.644	0.479	0	1	6405
Primary education	0.226	0.418	0	1	6405
Higher education	0.130	0.336	0	1	6405
Working	0.314	0.464	0	1	6405
Household size	12.275	6.869	2	45	6405
Rural	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Age	31.955	9.424	15	59	9663
Number of children	2.878	1.531	0	15	9663
Muslim	0.969	0.173	0	1	9663
Wolof	0.293	0.455	0	1	9663
Monogamous	0.532	0.499	0	1	9663
First wife	0.227	0.419	0	1	9663
Second wife or more	0.235	0.424	0	1	9663
No education	0.908	0.289	0	1	9663
Primary education	0.073	0.261	0	1	9663
Higher education	0.019	0.135	0	1	9663
Working	0.508	0.500	0	1	9663
Household size	13.786	7.333	2	69	9663

Source: ESPS 2011. Sample of married women aged 15 to 70 years old.

Table 2: Summary statistics for Married Men

Urban	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Age	45.863	12.135	20	96	5852
Number of children	2.834	1.759	0	17	5852
Muslim	0.961	0.193	0	1	5852
Wolof	0.375	0.484	0	1	5852
Monogamous	0.772	0.42	0	1	5852
Polygamous - One wife	0.037	0.189	0	1	5852
Polygamous - Two wives or more	0.191	0.393	0	1	5852
No education	0.493	0.5	0	1	5852
Primary education	0.239	0.426	0	1	5852
High education	0.268	0.443	0	1	5852
Working	0.758	0.429	0	1	5852
Household size	11.882	6.75	2	45	5852
Rural	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Age	44.823	13.158	18	95	7808
Number of children	3.571	2.236	0	18	7808
Muslim	0.966	0.182	0	1	7808
Wolof	0.280	0.449	0	1	7808
Monogamous	0.671	0.47	0	1	7808
Polygamous - One wife	0.017	0.129	0	1	7808
Polygamous - Two wives or more	0.312	0.463	0	1	7808
No education	0.831	0.374	0	1	7808
Primary education	0.101	0.301	0	1	7808
High education	0.068	0.251	0	1	7808
Working	0.817	0.387	0	1	7808
Household size	13.083	7.197	2	69	7808

Source: ESPS 2011. Sample of married men aged 15 to 70 years old.

Table 3: Summary Statistics for Working Couples

Urban	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Weekly market hours worked by women	39.242	17.337	1	98	1505
Weekly market hours worked by men	51.884	16.059	2	98	1505
Women wage rate	502.732	981.847	3.663	17307.691	1505
Men wage rate	877.108	1734.655	11.058	46153.848	1505
Non labor income (couple)*	-40.078	138.011	-2467.723	113.023	1489
Household income (outside couple)*	39.721	93.434	0	1742.346	1505
Polygamous	0.322	0.467	0	1	1505
Rural	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Weekly market hours worked by women	41.984	13.844	2	97	4349
Weekly market hours worked by men	52.598	14.082	1	98	4349
Women wage rate	137.512	436.903	0.962	16711.539	4349
Men wage rate	388.782	1071.972	0.916	37450.551	4349
Non labor income (couple)*	-10.714	58.439	-821.190	79.899	4321
Household income (outside couple)*	23.737	39.282	0	660.496	4349
Polygamous	0.508	0.5	0	1	4349

* in thousands of CFA Francs

Source: ESPS 2011. Sample of couples where both members work.

Table 4: Summary statistics at the District Level

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Activity Rate of Females	0.31	0.091	0.07	0.495	16068
Activity Rate of Males	0.776	0.063	0.618	0.918	16068
Polygamy Rate of Married Women	0.265	0.064	0.081	0.337	16068
Share of Access to Tap Water	0.375	0.268	0.046	0.948	16068
Share of Jobs in Agriculture	0.584	0.222	0.008	0.821	16068
Share of High School Graduates	0.029	0.028	0.005	0.187	16068

Source: RGPH 2002.

Table 5: Labor Force Participation Model Estimations - Urban

	(1)	(2)	(3)
	3SLS	3SLS	3SLS
VARIABLES	Women	Men	Poly
Polygamous	0.249**	-0.497***	
	(0.120)	(0.126)	
Working husband	-0.105		
	(0.0675)		
Working wife		0.104	
		(0.0695)	
Non labor income (couple)	-0.000308***	-0.000653***	-0.000205***
	(9.29e-05)	(7.50e-05)	(5.91e-05)
Household income (outside couple)	-0.000210	-0.000928***	-0.000457***
	(0.000137)	(0.000113)	(8.43e-05)
2002 district level female activity rate	0.431***		
	(0.0945)		
2002 district level male activity rate		0.127	
		(0.118)	
2002 district level sex ratio			-0.000504
			(0.00928)
2002 district level polygamy rate			0.328***
			(0.117)
Husband's non labor income above median			0.0808***
			(0.00936)
Husband's father deceased			0.0130
			(0.0102)
Husband's mother deceased			-0.000253
			(0.0100)
Constant	.1484	.4429	-.1437
	(.0847)	(.1120)	(.0735)
Observations	5,181	5,181	5,181
R-squared	0.099	-0.085	0.126

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Additional control variables not shown.

Table 6: Labor Force Participation Model Estimations - Rural

	(1)	(2)	(3)
	3SLS	3SLS	3SLS
VARIABLES	Women	Men	Poly
Polygamous	0.344***	-0.0570	
	(0.0972)	(0.0590)	
Working husband	-0.239***		
	(0.0814)		
Working wife		0.0670	
		(0.0439)	
Non labor income (couple)	-0.000458***	-0.000720***	-0.000690***
	(0.000166)	(9.46e-05)	(0.000119)
Household income (outside couple)	-0.000327	-0.00105***	-0.00106***
	(0.000237)	(0.000134)	(0.000163)
2002 district level female activity rate	1.136***		
	(0.0874)		
2002 district level male activity rate		0.209**	
		(0.0857)	
2002 district level sex ratio			-0.0688***
			(0.0228)
2002 district level polygamy rate			1.076***
			(0.153)
Husband's non labor income above median			0.0250**
			(0.0101)
Husband's father deceased			0.0276**
			(0.0117)
Husband's mother deceased			0.00801
			(0.0114)
Constant	.2743	.5904	-.5724
	(.1047)	(.0858)	(.0918)
Observations	6,888	6,888	6,888
R-squared	-0.031	0.108	0.194

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Additional control variables not shown.

Table 7: Labor Supply Model Estimations

	(1)	(2)	(3)	(4)
	Urban	Urban	Rural	Rural
VARIABLES	h_f	h_m	h_f	h_m
Polygamous (s)	3.966	-3.558	-5.269	2.781
	(5.154)	(4.686)	(3.239)	(3.443)
Log of female wage (w_f)	14.12	3.217	6.134	15.60***
	(9.544)	(8.982)	(5.386)	(5.188)
Log of male wage (w_m)	13.23	0.614	7.708*	12.82***
	(9.063)	(7.206)	(4.000)	(3.252)
Couple non labor income (y)	-0.0516*	-0.0416	-0.0336	-0.189***
	(0.0267)	(0.0297)	(0.0453)	(0.0552)
Log(w_f)*Log(w_m)	-2.967*	-0.709	-1.851*	-3.057***
	(1.556)	(1.364)	(0.998)	(0.862)
Observations	1,238	1,238	3,183	3,183
R-squared	0.108	0.166	0.133	-0.161

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Additional control variables not shown.

Table 8: Partial Derivatives of Labor Supply

	Urban	Urban	Rural	Rural
	Women	Men	Women	Men
s	3.9658	-3.5581	-5.2694	2.7812
$\ln w_f$	-0.0082	-0.0023	-0.0216	0.0018
$\ln w_m$	-0.0036	-0.0039	-0.0002	-0.0001
y	-0.0516	-0.0416	-0.0336	-0.1892

Table 9: Partial Derivatives of the Sharing Rule

Urban	coeff	se	t
ϕ_s	-40.490	40.348	-1.004
ϕ_{w_f}	-0.026	0.049	-0.528
ϕ_{w_m}	0.037	0.037	0.993
ϕ_y	0.526	0.516	1.021
Rural	coeff	se	t
ϕ_s	13.441	14.235	0.944
ϕ_{w_f}	0.009	0.049	0.183
ϕ_{w_m}	0.000	0.007	0.066
ϕ_y	0.086	0.151	0.567