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Paying for gender?
The gender price gap in Central Kenyan vegetable markets

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Abstract

We analyze the gender price gap (*GPG*) in Central Kenyan vegetable markets. Exploiting differences in the combination of the gender of the household head, the person controlling production, and the seller, we control for other gender related influences. We cannot identify a significant GPG for the population as a whole but find an u-shaped relationship between the GPG and the sold quantities. Also, we observe that female control over marketing is negatively associated with the commercialization of vegetable trade. This indicates that besides the absence of an average GPG, women are disadvantaged in larger scale markets. These findings support recent experimental evidence that the GPG depends on the perceived competence and entitlement as women are traditionally active in small scale local vegetable trade but not in large scale trade in the survey region. Also, it is a warning that women might be left behind in an increasingly commercializing market, even though they traditionally controlled it.

Keywords: Gender, Gender Price Gap, Inequality, Agriculture, East Africa, Transaction costs

JEL Classification: D63, J16, O13, Q12, Q13

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1 Introduction

Income differences as a form of gender based discrimination are a well established topic. The gender wage gap is not only of interest for labor economists but also became an important factor in anti discrimination policies and the discussion of the latter. As early as 1951 the ILO passed convention 100, asking to enforce equal remuneration of men and women for work of equal value. The global gender pay gap was recently estimated to be around 23% and despite improvements the ILO does not expect equal pay to become reality before 2086 if the pace towards it does not improve (International Labour Office, 2016). Yet, this data captures only a quite small part of economic realities when it comes to developing countries. Missing data on self-employment is a serious obstacle in measuring gender equality. In Africa only around 30% of the labor force work for wages or salaries, compared to 90% of the labor force in developed countries (International Labour Office, 2016).

One major source of self-employment in these countries is smallholder-agriculture. Earlier research on gender inequalities in this area focused on the access to markets and inputs, labor division inside the family , and institutions regulating access to land (e.g. Bolwig (2012); Dolan (2001); House-Midamba (1995); Lodin (2012); Udry (1996)).[1] These studies point to strong evidence of disadvantages women face in producing a good and being able to sell it in some market. Our knowledge concerning the disadvantages that women might experience inside a given market is much smaller.

This blind spot is addressed by the concept of the gender price gap (GPG). The term was recently introduced by Kricheli-Katz and Regev (2016) to refer to the average difference in the price that women receive compared to men when selling the exactly same product. It is therefore comparable to the unexplained part of the wage gap that might be due to direct discrimination or to a yet unobserved factor as discussed in The World Bank (2011). By definition we cannot be sure what is driving the unobserved factor, though it is often seen as a form of unexplained discrimination. At the same time also explained differences are meaningful if they are based on other factors that are considered unjust, e.g. uneven access to means of transport.

To better understand the GPG we conducted a survey among Central Kenyan vegetable farmers in 2015. This region is specifically interesting due to its different grades of modernization in farming and the relatively high importance of women in vegetable production and trade. On the one hand, this allows us to find a sufficiently high number of women who are active in vegetables sales. On the other hand, it indicates that the extent of the GPG does not prohibit women's participation in the market. As our results show, on average women do not suffer from a significant GPG in these markets. However, we find a u-shaped relation between the GPG and handled quantities, resulting in lower prices for women compared to men at medium-high quantities. This pattern disappears as the quantities approach the upper end of the observed levels.

To overcome problems of endogeneity we exploit information on several plots owned by the same household. This allows us to observe differences based on the gender of the person selling the good while controlling for the gender of the persons heading the household and managing the production on the plot. We combine our econometric findings with insights from ethnological research to show that a GPG that increases with sold quantities coincides with women moving out of their traditional sphere of small scale vegetable trade into the traditionally male controlled large scale trade. Adding to this pattern we find a lower likelihood of female control over marketing where production is more commercialized in terms of the supply channel, used area, and the share of area committed to vegetable production. We argue that these findings support recent experimental evidence by Kricheli-Katz and Regev (2017) that a GPG only appears where women are not considered to be sufficiently competent or entitled.

[1] Some research could not find this link but this might be due to local circumstances or econometric problems. For example Zhang *et al.* (2006, p. 29, 32) do not find a significant difference in input use between male and female headed farms. They argue that the institutional setup in China is relatively non-discriminatory and input markets work well. Additionally, they do not control for endogeneity in respect to the household head's gender.

2 The gender price gap

To the best of our knowledge there are currently only four papers directly addressing the GPG. Three of these use observational data: Kricheli-Katz and Regev (2016) analyze price data from the online platform eBay in the United States. They find that when selling new, original articles women receive an on average 19.7% lower price. This is an extremely large difference, especially when considering that the authors can control for all information that the buyers receive and the quality of the new goods is by definition equal. To confirm this result, they also run an experiment where they auction off gift certificates and only change the name of the person who is selling the gift certificate to be male or female. Also in this case participants attached an on average lower value to the same certificate if the seller was thought to be female. Therefore, they argue that there is a lower willingness to pay for products sold by women. There might also be some other rationale behind this price gap because the price gap depends strongly on the product category. First, the gap shrinks drastically when looking at used goods, possibly due to a better expected state of products owned by women. Second, the direction of the gap even turns around in some product groups, e.g. in the category "Toys & Hobbies".

Handschuch and Wollni (2016) analyze the finger millet market in rural Kenya. They find that women get a significantly lower price than men when selling individually, while the price does not differ significantly when they sell collectively through a village group. At the same time households were 21% more likely to market finger millet when a women was in control of production, *ceteris paribus*. According to the authors, this shows that barriers to the market are not at the core of their finding.

Banerjee *et al.* (2014) find a gender price gap in the Cameroonian Cocoa market. This gap is strongly significant when comparing persons who are marketing individually but is not statistically significant for farmers selling through a collective marketing group. In contrast to Handschuch and Wollni (2016) they find a negative effect of the price gap on female Cocoa farmers' participation in marketing. They show that women shift the marketing to male family members to secure a higher price for their produce. The negative side-effect of this is that women lose control over revenues as the male who is selling has the power to keep a share of the income.

Other papers encountered the gender dimension of the price as a side effect in the survey data they use. As they are not focusing on the gender gap the methodology can be questionable for measuring the GPG and it is particularly hard to find these studies. For example Fulton *et al.* (2004) find a significant and large GPG when looking at sales of Senegalese cow pea traders in six markets. There are only few women in the market and the authors' method of buying the product themselves might influence the data. Overall they do not give much attention to the gender effect even though its size relates to 13 to 16 percent of the average price and 26 to 37 percent of the standard deviation in the markets where they can measure it. Among small scale bean farmers in Nicaragua, Ebata *et al.* (2017) find that women receive an about two percent lower average price. This effect is highly significant besides controlling for several variables, including the question if the person is the household head, two proxies for product quality, and transaction size.

One possible way to explain why women get a worse price for the exact same product is that the GPG is associated with the product they sell and culture dependent. Kricheli-Katz and Regev (2017) argue that this could happen via stereotypes which relate women to characteristics that are less favorable for transactions in a certain market. Buyers could use these stereotypes as a rule-of-thumb to deal with uncertainty in transactions. In a market for new, identical goods the price difference due to this stereotyping cannot be due to quality differences in the good but only due to transaction characteristics. Kricheli-Katz and Regev (2017) test this with an auction in a controlled experimental setting. They find that the gap in the willingness to pay disappears when giving the information that the women seller is competent or entitled. Information on the trustworthiness does not affect the gap. While the statement on competence leads to women getting a higher price compared to the baseline and thereby catching up, the merit treatment leads to both men and women getting a lower price that happens to be insignificantly different. The finding is supported by related experimental evidence of Fershtman and Gneezy (2001) that stereotypes can explain ethnic discrimination. They show that neither statistical discrimination (i.e. the different treatment of an individual, based on earlier experience with individuals from the same group), nor a "taste for discrimination" (associated with a willingness to pay for the ability to discriminate) can explain the phenomenon.

Given the potential scope of the issue the current literature is still small and at least two gaps sustain. First, Banerjee *et al.* (2014) and Handschuch and Wollni (2016) base their finding on the difference between prices in collective and individual sales. Parts of the difference could be associated with the transaction characteristics that particularly affect women outside of collective bargaining, e.g. an increased need for mobility. This would not disprove the results but point towards a specific problem. The paper by Kricheli-Katz and Regev (2016) might not be considered to be a good comparison to these papers as it refers to non-commercial transactions with considerably different characteristics. Second, earlier papers explained relatively little about the cultural background that might affect the transaction. Given the findings of Kricheli-Katz and Regev (2017) the GPG should relate to a predominant understanding of women's and men's competence in an economic area. We address the first issue by using the difference between the gender of the marketing person, the producing person, and the household head instead of different prices in collective marketing to identify price differences. To approach the second point, we identify a market that is affected by increasing commercialization. Based on the existing ethnological literature for our study area, we argue that at increasing levels of commercialization women's competence is likely to be judged lower. If the GPG depends on stereotypes, its size and (possibly) direction should react to the change in perceptions.

3 Vegetable markets and the role of gender in Kiambu County

The Central Kenyan vegetable markets of Kiambu County are currently in a process of modernization. Traditional institutions are based on Kikuyu culture while the current situation is affected by growing demand from Nairobi and the modernization of supply chains, particularly through the growth of supermarkets' vegetable demand.

With 22 percent of the Kenyan population, Kikuyus are the largest ethnicity group in the country (Central Intelligence Agency, 2016). In Kiambu County they are the dominant ethnicity. This is also evident in our data, in which 98.99 percent of household heads self-identified as being Kikuyu.

House-Midamba (1995) argues that Kikuyu culture can best be described as horticultural and patrilineal. Horticulture is described to be dominated by women historically. Likewise, local trade in vegetables was controlled by women while trade overall and particularly long distance trade was controlled by men. This relatively high importance of women is contrasted by the prevailing patrilineality, which describes that descent and inheritance are determined by the husband's side of the family (House-Midamba, 1995). Still, historically the Kikuyu are described to once have been a matrilineal tribe (Wacker, 1994). It is assumed that this change occurred before the 17th century. After this shift men were clearing and purchasing land but women had individual land-user rights, acquired through lineage or marriage. Women's situation deteriorated during colonial times as land became limited through European settlement policies and the introduction of new cash crops. In the 20th century the *Law of Succession Act* of 1972 improved women's roles at least formally by providing equal access to the inheritance if no will exists. This improved the legal position of daughters and widows (House-Midamba, 1995). *De facto* women are reported to often lack the power to enforce their rights (Wacker, 1994). Furthermore, in the recent past the number of single, widowed and separated women increased, which often leaves these women alone in the care for their children (House-Midamba, 1995).

Besides the larger changes in women's situation, also recent transformations in vegetable production and trade showed to have gender related implications. The modernization of vegetable supply chains in the region is mostly driven by domestic demand, particularly from Nairobi which is directly bordering Kiambu County in the south. While traditionally vegetables were sold to independent traders at the farm gate or on local markets, supplies to companies and institutions (e.g. schools) and particularly to Supermarkets are a relatively new phenomenon. Research based on the first round of the panel data set we use shows gendered consequences of this process. Participation in supermarket supply chains was found not to be significantly affected by the gender of the farm operator when holding other factors stable. However, the likelihood to participate was affected by infrastructure as well as physical and human capital, as Rao and Qaim (2011) write. These factors were found to be unequally distributed

over gender which leads to a de facto lower participation of women in these high value supply chains. Therefore, women are more likely to be excluded from the substantial increases of about 48 percent in per capita income which Rao and Qaim (2011) find on average to be realized when farmers participate in the supermarket supply chain. These results are supported by the study of Chege *et al.* (2015) who find a negative relation between participation in the supermarket supply chain and female control over vegetable production in the second round of the survey. However, due to increased labor demand by supermarket suppliers also women who do not supply to them themselves were found to profit. The average likelihood to employ a women rises by 23 percent and the number of days for which women are hired is on average 72 percent higher where the farmer is supplying supermarkets according to Rao and Qaim (2013). Therefore, there seems to be a tendency for women to be less involved in more commercialized supply chains where they are in charge but it does not seem to affect their participation in production. Dominant male rule over commercialized supply chains fits with the traditional role of men in long distance trade while women are restricted to their traditional role in local vegetable trade. Hence, there is potential for a perceived lower competence of women in more commercialized segments of the market for vegetables.

4 Method

We measure the GPG by exploiting variation in the gender of the persons selling products from the different plots in the same household. The separate management of the plots allows to control not only for the gender of the household head but also for the gender of those responsible on the plot level. In this way we control for influences due to gender related differences in access to inputs, knowledge or other factors that might affect the price via differences in production or market access. The only major assumption we need to make is that the allocation of the person who sells the product is not due to stochastic realizations in the production process.

Our primary econometric method to exploit this panel structure is a model with random effects on the household level. We follow two arguments made by Rabe-Hesketh and Skrondal (2012) in choosing this method instead of a fixed effect model. First, we only have observations on one to three plots per household. Estimation of household fixed effects would return poor results under this circumstance. Second, we intend to refer to the entire population that was sampled and we consider the households to be random draws from this population. As the focus of this paper is not only on the causal link but also on the measurement of the existing gap we put emphasis on the latter argument. To prove the robustness of our results we will show that the results of the fixed effects regressions present the same outcomes.

To measure the average effect associated with the selling person's gender we estimate the model

$$\begin{aligned} P_{hi} =& \alpha + \beta_1 gender\ selling_{hi} + \gamma_1 q_{hi} + \gamma_2 buyer_{hi} + \gamma_3 gender\ production_{hi} + \\ & \gamma_4 gender\ hhh_h + \gamma_5 \mathbf{X}_h + \gamma_6 vegetable_{hi} + v_i + \epsilon_{hi}. \end{aligned} \tag{1}$$

where P_{hi} is the price received for the products of plot i in household h. We use the highest and the lowest price reported in the season as dependent variable in two separate regressions. This is preferential as most farmers in our sample do not keep books. Under these circumstances, estimating average prices is a harder task for farmers than remembering unique values. $gender\ selling_{hi}$ is the gender of the person who is mainly doing the marketing of the good (i.e. the person going to the market or talking with the trader). In the same line $gender\ production_{hi}$ and $gender\ hhh_h$ are the gender of the person controlling production on plot i and the gender of the household head. q_{hi} is the quantity usually sold from the plot after each harvest. $buyer_{hi}$ is a vector of dummies identifying the supply channel. The vector $\mathbf{X}_h$ contains a number of household level controls. These are the share of the cropped area under irrigation, the number of years the household is growing vegetables, the division the farm is located in, and the distances to the closest tarmac road, the closest local shopping center, the closest supermarket, and the closest place where to sell vegetables. The vegetable grown on the plot is indicated by the vector of dummies $vegetable_{hi}$. β_1 and γ_1 to γ_6 are the coefficients or vectors of coefficients to be estimated. v_i is the household specific error component and ϵ_{hi} the plot-specific error term.

We convert all continuous variables into their logarithms as we expect a multiplicative connection of these factors, i.e. we expect that the GPG does not have the form of a constant but a relative markup, dependent on other factors defining the price. Additionally, this transformation normalizes the distribution of the variables, particularly the price and the quantity sold per harvest.

In a further step, we analyze the heterogeneity of the GPG in different parts of the sample. We concentrate on the differentiation due to the quantity sold from each harvest. This variable is an indicator of the scope of vegetable sales from one plot. It relates to the ability to supply larger markets as well as to transaction costs related to harvest, handling, and transport. We introduce this step by adding the interaction $gender\ selling_{hi} \times q_{hi}$ to the model. In order to allow for a non-linear relation we also add the term $gender\ selling_{hi} \times q_{hi}^2$. Therefore, the advanced model is

$$\begin{aligned} P_{hi} =& \alpha + \beta_1 gender\ selling_{hi} + \beta_2 gender\ selling_{hi} \times q_{hi} + \beta_3 gender\ selling_{hi} \times q_{hi}^2 + \\ & \gamma_1 q_{hi} + \gamma_2 q_{hi}^2 + \gamma_3 buyer_{hi} + \gamma_4 gender\ production_{hi} + \gamma_5 gender\ hhh_h + \gamma_6 \mathbf{X}_h + \\ & \gamma_7 vegetable_{hi} + v_i + \epsilon_{hi}. \end{aligned} \tag{2}$$

Even though we reduce the potential endogneity by controlling for gender at two additional levels, these controls might not be perfect. One reason is the limited variability between the gender of the persons at the three different levels. We therefore try to decrease the threat from endogeneity further by using lagged values for all variables but those relating to gender and the vegetable type. As we cannot follow single plots over time, we cannot observe the sold quantities per harvest. Instead we use information on the previous year's income from vegetables sales and interact it with the gender of the marketing person. The two variables are similar in being an indicator of involvement in vegetable trade. Furthermore, we do not have information on the buyer on the plot level. Instead, we use information on the most important buyer in the past. Hence, we arrive at the following model with lagged controls:

$$\begin{aligned} P_{hit} =& \alpha + \beta_1 gender\ selling_{hit} + \beta_2 gender\ selling_{hit} \times income_{ht-1} + \\ & \beta_3 gender\ selling_{hit} \times income_{ht-1}^2 + \gamma_1 income_{ht-1} + \gamma_2 income_{ht-1}^2 + \\ & \gamma_3 major\ buyer_{ht-1} + \gamma_4 gender\ production_{hit} + \gamma_5 gender\ hhh_{ht} + \\ & \gamma_6 \mathbf{X}_{ht-1} + \gamma_7 vegetable_{hit} + v_i + \epsilon_{hi}. \end{aligned} \tag{3}$$

5 Dataset

We use the third round of a dataset of vegetable farmers from Kiambu County collected in 2015. For the original sampling in 2008 four of Kiambu District's divisions with strong vegetable production were chosen, based on information from the District Agricultural Office. Using the same source, 31 administrative locations were then purposefully selected in these divisions. In these locations respondents were randomly sampled. Therefore, the sample was designed to be representative of the major vegetable growing areas of what was Kiambu district in 2008. Between the survey rounds the national administration was restructured so that the survey areas are situated in what is now Kiambu County. Due to the local system of heritage we were able to replace households with the ones of the heirs where the household head deceased. Hence, the survey is still representative of the originally targeted population.

In each household we asked for information on up to three plots on which vegetables are grown. If households had more than three plots we recorded information on the three most important plots in terms of the quantity sold. In some cases no vegetables were sold or some data is missing. Therefore, we can only use observations on 884 of the 929 plots we have in our survey. In all but one of these cases the observation needed to be dropped because the household did not sell anything from the plot. The plots we include in the survey belong to 382 households which means that we observe on average 2.3 plots per household. 15 households did not sell any vegetables in the 2015 round of the survey.[2]

[2]Comparing the excluded observations with the subset used in the regressions (Table 5) shows that only very few variables show significant differences. If they are selling, they are more likely to sell their entire plot at once.

Table 1: Comparison of main characteristics and supply channels of plots with male and female seller.

	Difference/se	Male seller	Female seller
Woman controls production	-.6581419***	.0131868	.6713287
	.0227253		
Man controls production	.6581419***	.9868132	.3286713
	.0227253		
Female household head	-.2356976***	.0043956	.2400932
	.0203007		
Male household head	.2356976***	.9956044	.7599068
	.0203007		
Share irrigated	-30.03896	27.47129	57.51025
	27.34811		
Quantity sold per harvest	2036.221***	3385.039	1348.818
	732.1135		
Years growing vegetables	.1062937	20.55385	20.44755
	.7774764		
Last years vegetable income	286578.1***	471142	184563.9
	71359.52		
Buyers			
Supermarket	.0595405***	.0945055	.034965
	.0165606		
Trader to Supermarket	-.0245088**	.0197802	.044289
	.0117702		
Company/Institution	.0589411***	.0659341	.006993
	.0126167		
Independent Trader	-.0181152	.4527473	.4708625
	.033581		
Spot Market	-.1752914***	.1230769	.2983683
	.0267076		
Sold to trader at once	.0994339***	.243956	.1445221
	.0265189		
N	884		

Comparing the plots with female and male marketing (Table 1) shows that it is very unlikely for men to be selling the products grown on a plot where a women decides on production. In only 67 percent of the plots with female marketing a women controls the production on the plot, though. I.e. men are unlikely to sell what is produced on a women's plot but women often sell what was produced on a man's plot. The pattern is similar when looking at the gender of the household head. Extremely few men are in charge of marketing in a household with a female head while about 76 percent of cases with female marketing are observed in male headed households. This contrasts the findings by Banerjee *et al.* (2014), where women shifted the marketing to men to avoid the GPG. The different pattern indicates that women in our sample are not suffering under the same pressure to shift marketing to a male relative. This reflects the cultural given normality of women selling vegetables in the study area. Also, the values show that female marketing happens under male as well as female leadership at the different levels.

Under this arrangements the trader takes care of the plots harvest and the farmer is paid for all harvested crop on the plot at once. Where the farmer handles the harvest and sells to an independent trader it was less likely that the farmer was not selling from the plot. Hence, it appears that the excluded farmers are generally putting less labor into vegetable sales. Together with the much lower, yet insignificantly different, vegetable income this group reported for the last year, it appears that these households generally are less involved in vegetable trade. Still, only five of the excluded households did not report any vegetable income in the last year. With regard to gender there are no significant differences between the excluded and the used observations. Amongst the excluded observations more plots are under female control and more households are female headed than in the whole sample but less cases of female sellers are reported (which in this case describes the person who would sell in seasons in which something was sold).

Thereby, the data fulfills our method's prerequisite of variation of gender at different levels of decision making in the household.

Information on the transaction characteristics indicates that women are less likely to operate in highly commercialized vegetable trade. The quantities usually sold per harvest and the last year's vegetable income are significantly smaller where women do the marketing. Men are more often involved in sales to supermarkets and to companies and institutions (which are primarily schools). Women are more likely to supply supermarkets via a trader. This might be driven by the inability of women to directly supply supermarkets, e.g. due to the smaller quantities they sell. The higher likelihood to participate in this channel does not make up for the lower participation in direct supermarket supply. Men are also more likely to sell the entire plot at once. In this way the effort of harvest can be shifted to the trader. This might be caused by the higher quantities men sell, but it could also be connected to higher shadow wages of men, amongst other reasons. Women on the other hand are more likely to sell in the spot market. This is a traditional sphere of local vegetable trade and female commercial activity in the area. Also, it is a market channel with a relatively high labor input as selling in a local market can take a lot of time. It thereby contrasts the higher likelihood for men to sell the entire harvest at once.

The commercialization effect is also visible in the higher likelihood of male sellers to be situated in regions that are the closest to the markets of Nairobi, particularly Dagoretti and Westlands (Table 7). The same is true for the vegetables grown. While the number of crops with significant differences is relatively small, it is observable that female sellers are more likely to deal with Kales, a traditional and affordable food crop in the region, while male sellers are significantly more often dealing in cauliflower, broccoli, lettuce, celery and cucumber which are relatively expensive and normally not consumed in rural households (Table 7).

Simply comparing the average prices of vegetables with more than 25 observations reported for plots with male and female marketing we do not find significant differences. This is little surprising given the large price variation that is visible in the box plot diagrams of the prices of the 6 most frequently sold vegetables, presented in Figures 2 to 7.[3]

6 Results

We start by estimating Equation 1, reported in columns (1) and (2) of Table 2 with the lowest and the highest price being the dependent variable, respectively. The coefficients of the "Female seller" dummy are not only insignificant but also small and with opposite signs. This finding is unaffected by a reduction of the control variables. When just adding controls for gender of the person having control at the household and plot level but omitting other controls besides the vegetable type, a significant negative association between having a female household head and the lowest price is observable (not reported). This disappears when adding the additional controls, indicating that the disadvantage is due to an unequal distribution of other factors.

Even though we cannot observe a GPG on average, it might exist in some parts of the market. We therefore test if women somewhere along the distribution of sold quantities experience a GPG by estimating Equation 2. Table 2 reports the results in columns (3) and (4). We find a non linear relation but unless we add the full set of controls only the coefficients for the regression on the lowest price are significant on the 10% level and above. However, the direction of the coefficients is the same where they are insignificant.

The coefficients indicate that women start off with a higher price at low quantities. As the quantities increase they experience a u-shaped development of the difference to the price men receive when selling the same quantity. To better understand the non-linear effect we can first look at the regression for the lowest price with all controls. According to these coefficients, on average and when holding everything else constant, women producing very small quantities would receive a better price than men. When selling more than 851 units (e.g. bundles of ten leaves in the case of leafy greens, pieces in the case of

[3] A problem in the comparison of prices is the usage of non standardized measures in Kenyan agriculture. Especially in the case of leafy greens quantities are usually defined in bunches or bags. We solve this problem by asking for bundle and bag size. In this way we equalize the prices to be in the same unit for each kind of vegetable. E.g. all prices for leafy vegetables relate to bundles of 10 leaves or stems.

Table 2: Random effects results

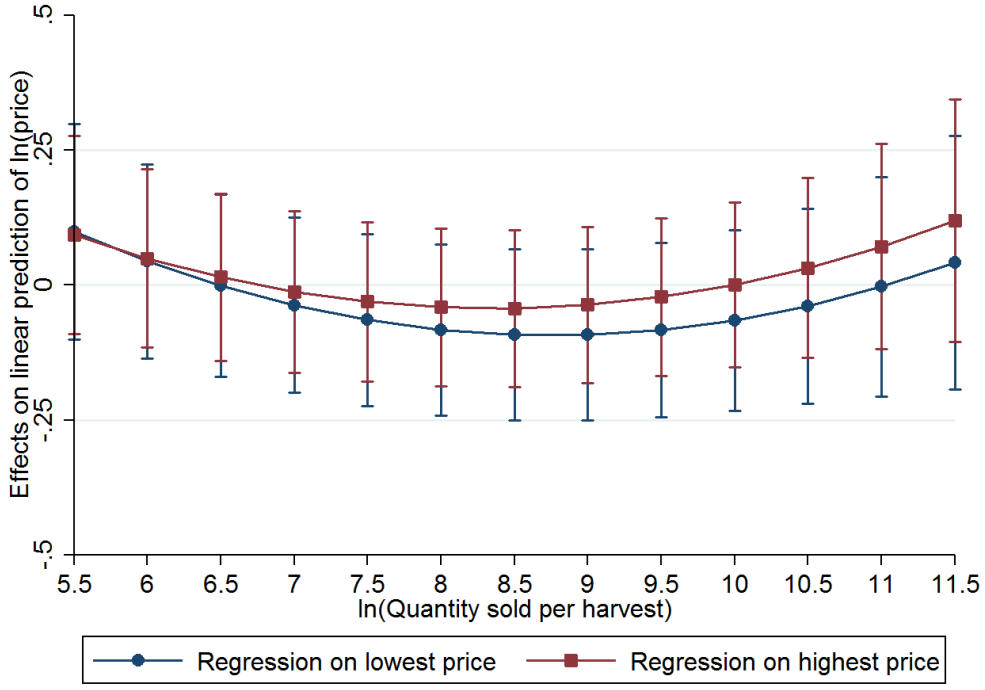
	(1) ln(L. price)	(2) ln(H. price)	(3) ln(L. price)	(4) ln(H. price)	(5) ln(L. price)	(6) ln(H. price)
Female household head	-0.107	0.0000670	-0.0999	0.00669	-0.0969	0.0174
	(0.101)	(0.0853)	(0.101)	(0.0855)	(0.103)	(0.0869)
Woman controls production	0.0573	0.00511	0.0642	0.0108	0.0655	0.0139
	(0.0924)	(0.0822)	(0.0931)	(0.0823)	(0.0936)	(0.0832)
Female seller	-0.0340	0.00846	1.291**	1.120*	1.440***	1.191**
	(0.0904)	(0.0828)	(0.625)	(0.607)	(0.541)	(0.599)
Quantity sold p.h.	-0.212***	-0.159***	-0.0321	-0.00745	-0.0418	0.0134
	(0.0231)	(0.0190)	(0.110)	(0.0991)	(0.112)	(0.114)
Quantity sold p.h.^{2}			-0.0102	-0.00891	-0.0106	-0.0111
			(0.00648)	(0.00602)	(0.00727)	(0.00727)
Female seller∗Quantity sold			-0.316**	-0.278*	-0.345**	-0.291*
			(0.152)	(0.150)	(0.138)	(0.151)
Female seller∗Quantity sold ^{2}			0.0180**	0.0166*	0.0193**	0.0171*
			(0.00912)	(0.00915)	(0.00865)	(0.00940)
Supply channel, base group are suppliers to independent traders:						
Supermarkets	0.586***	0.332***	0.578***	0.328***	1.565	2.674**
	(0.116)	(0.112)	(0.115)	(0.112)	(1.728)	(1.166)
Trader/Broker to SM	0.108	-0.123	0.0934	-0.134	-1.842	-2.713*
	(0.172)	(0.158)	(0.172)	(0.156)	(1.337)	(1.647)
Companies/Institutions	0.105	-0.0746	0.0947	-0.0825	-0.291	-1.175
	(0.170)	(0.140)	(0.169)	(0.139)	(3.287)	(2.629)
Spot market	0.0757	0.0656	0.0723	0.0645	-1.499*	-0.258
	(0.0684)	(0.0634)	(0.0683)	(0.0635)	(0.906)	(0.977)
Sold to trader at once	0.166**	-0.404***	0.152*	-0.418***	0.0880	-0.109
	(0.0843)	(0.0777)	(0.0848)	(0.0780)	(2.208)	(2.215)
Distances in Km:						
To tarred road	-0.0180	-0.0125	-0.0181	-0.0123	-0.0198	-0.0148
	(0.0297)	(0.0258)	(0.0295)	(0.0256)	(0.0301)	(0.0260)
To local shopping center	-0.0718*	-0.0554*	-0.0726*	-0.0564*	-0.0697*	-0.0573*
	(0.0383)	(0.0326)	(0.0384)	(0.0326)	(0.0396)	(0.0335)
To supermarket	-0.148***	-0.0451	-0.148***	-0.0453	-0.148***	-0.0449
	(0.0341)	(0.0284)	(0.0340)	(0.0283)	(0.0345)	(0.0288)
To nearest sales place	0.0469	0.0303	0.0484	0.0311	0.0469	0.0298
	(0.0307)	(0.0241)	(0.0306)	(0.0240)	(0.0309)	(0.0243)
Experience & investment in vegetable production:						
Share of veg. area irrigated	-0.0215	-0.0197*	-0.0225	-0.0203*	-0.0236	-0.0206*
	(0.0189)	(0.0113)	(0.0184)	(0.0109)	(0.0193)	(0.0113)
Years growing vegetables	-0.0393	-0.0583	-0.0387	-0.0583	-0.0329	-0.0539
	(0.0398)	(0.0373)	(0.0397)	(0.0372)	(0.0401)	(0.0378)
Constant	4.117***	4.007***	3.380***	3.407***	3.455***	3.384***
	(0.310)	(0.293)	(0.524)	(0.467)	(0.508)	(0.512)
Vegetable dummies	Y	Y	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y	Y	Y
Buyer∗Quanti/Quanti.^{2}	N	N	N	N	Y	Y
Observations	884	884	884	884	884	884

Robust standard errors in parentheses. * $p < 0.1$,** $p < 0.05$,*** $p < 0.01$. Columns (1) and (2) relate to Equation 1, columns (3) and (4) relate to Equation 2. Columns (5) and (6) add an interaction between dummies for the different supply channels and the quantity as well as the square of the quantity as additional controls.

cabbage, and kg in the case of broccoli) per harvest women would start to receive a worse price, reaching the turning point at 4,331 units. Only for women selling more than 22,026 units we would expect them to earn more than their male counterparts. Setting these values into relation we need to consider that only for a bit more than ten percent of plots the reported quantities are so small that we expect women

to receive a better price. At the upper end of the distribution of quantities the number of observations is of similar size. Therefore, we would expect that given the current observations most women would receive a worse price. In the regression on the highest price the results are very similar.

In order to take into account the confidence interval of our estimation and the distribution of the control variables, we estimate the average marginal effects of the selling person being female given increasing quantities sold from each harvest. We combine these estimates for the regressions in columns (3) and (4) in Figure 1. The quantities on the x-axis are given in their logarithmic value. The area of the axis relates to the central 90 percent of the distribution of the reported quantities. While the form of the estimated GPG is as described above, we cannot identify an area of the distribution where the marginal effects are significant. Yet, the point estimates relate to an on average about nine percent lower lowest price at the turning point, an economically significant effect size. The difference estimated for the highest price is more favorable, but also in this case the price is about four percent lower at the turning point.



Calculated from Table 2 column (3) and (4) with 90% confidence intervals. Robust 90 percent confidence interval. X axis relates to variables distribution with 5th percentile at 5.7 and 95th percentile at 11.3.

Figure 1: Average marginal effects

At least in theory, farmers in Central Kenya could sell their produce through a number of channels. As described, the likelihood to participate in each of the supply channels differs between male and female sellers. Therefore, it might be that the quantity dependent GPG is actually due to different price elasticities with regard to the quantity in the different sales channels. We test this hypothesis by adding interactions between the buyer dummies and the sold quantity and its squared term. The results show that the coefficient on the seller being female and its interactions with the quantity and its squared term are still significant. The size of the coefficients changes only slightly. Hence, the u-shaped GPG cannot be explained with the gender specific likelihood to use different marketing channels.

6.1 Regression using lagged controls

While the regressions with purely cross-sectional data profit from good data availability on the plot level, they are prone to some problems of endogeneity. Particularly, short term shocks could be correlated with the gender of the selling person and reverse causality could be an issue. To reduce the potential influence of these problems we use several controls from the 2012 round of the survey. As we cannot follow plots over time we cannot control for the quantity sold from each harvest and we have to rely on the aggregate description of the main supply channel for the household's vegetable sales.

We test for a GPG by applying Equation 3. As explained, we use lagged information on the previous year's vegetable income as alternative to data on harvested quantities. Clearly these variables are not exchangeable, which is visible in their limited correlation ($\rho = 0.14$). Taking this into account, we first run a regression without interacting the sellers gender and the lagged income. The results are reported in column (1) and (2) of Table 3, followed by the full model in columns(3) and (4). The dummy for the sellers gender and its interactions are insignificant in all specifications.

While the results cannot support our earlier findings, we can also use the model to look into indications of a GPG with regard to the choice of the supply channels. To accomplish this we add an interaction between the sellers gender and the dummies for the supply channels in column (5) and (6). The interactions of the sellers gender with supermarket supply and supply to companies and institutions are negative and significant. Yet, interpretation of these coefficients is problematic as dropping out of these channels is associated with a higher likelihood for women to be in control over marketing in 2015. Of 21 observations from households that sold to supermarkets in 2012 and got a women in control over marketing in 2015 only six still report sales to supermarkets in 2015. Instead, these households sell to independent traders, in spot markets, or they sell the entire harvest at once to a trader who takes care of the harvest. As these supply chains on average provide lower prices than supermarkets, this pattern explains the negative coefficients. Furthermore, adding the same interaction between the sellers gender and the supply to supermarkets to the main cross-sectional model does not show a negative coefficient. Hence, the lower price associated with a lagged use of the supermarket supply channel and current female control just reflect the lower price received in the new marketing channel and this change of channels is also associated with control over marketing going to a women. This might be the case as men do not want to be involved in marketing if it is not sufficiently lucrative. This observation supports the finding of Chege *et al.* (2015) who find that supplying supermarkets leads to a higher likelihood of male control. Our results show that men not only take over control when the household starts selling to supermarkets, but that the effect works similarly in the opposite direction (even though we cannot compare the effect size). Without such shifts we would not expect large price differences between men and women selling to supermarkets as many supermarkets in our sample follow a strategy where they fix prices over longer time, no matter who supplies the good. Of course, this would not exclude differences due to men and women selling to different supermarkets but we would expect them to be much smaller. For sales to companies and institutions also in the cross-sectional regression the coefficients are significantly negative. Also here, not for a single plot that is under female control in 2015 supply through this channel is reported at that point. The pattern shows the prevailing obstacles that keep women from using several supply channels. Surprisingly, sales in the spot market do not yield an on average better price than sales to independent traders, neither for men nor for women. This is unexpected as these transactions involve larger efforts compared to sales to independent traders.

As expected, distances to different points of sale show a tendency to have a negative effect on the price. The effect is only significant for the lowest price and the distance to the next supermarket. This shows an overall small effect of the distances on prices. And this does not change when reducing the sample to households that sold to a trader supplying supermarkets, an independent trader, or sold their entire plot at once in 2015. Hence, even where the transactions costs would be effect to have a major influence on the price, the effect is still small. This indicates that transportation costs of the traders are small compared to the product value.

The fact that larger land holdings correlate with a lower price might be explained with the land-holdings correlation with the harvested quantities and the lower prices we find for larger quantities. The same argument works for the irrigated share of the area.

Overall we cannot directly support our theory using lagged data. Yet, the results support earlier

Table 3: Random effects results using lagged controls

	(1) ln(L. price)	(2) ln(H. price)	(3) ln(L. price)	(4) ln(H. price)	(5) ln(L. price)	(6) ln(H. price)
Female household head	-0.211*	-0.0552	-0.209*	-0.0576	-0.242**	-0.0804
	(0.111)	(0.0986)	(0.110)	(0.0986)	(0.110)	(0.0993)
Woman controls production	0.191*	0.0915	0.190*	0.0920	0.192**	0.0926
	(0.1000)	(0.0943)	(0.0999)	(0.0943)	(0.0952)	(0.0902)
Female seller	-0.0104	0.0514	-0.356	-0.200	-0.348	-0.208
	(0.0932)	(0.0976)	(0.327)	(0.262)	(0.319)	(0.261)
Vegetable income $_{t-1}$	-0.0268	0.00518	-0.0655	-0.0517	-0.0249	-0.0198
	(0.0498)	(0.0401)	(0.0553)	(0.0508)	(0.0493)	(0.0464)
Vegetable income $_{t-1}{}^2$	0.00216	-0.000179	0.00363	0.00329	0.000179	0.000495
	(0.00324)	(0.00272)	(0.00413)	(0.00379)	(0.00368)	(0.00348)
Female seller∗Vegetable income $_{t-1}$			0.0502	0.0891	0.00363	0.0556
			(0.0815)	(0.0691)	(0.0800)	(0.0663)
Female seller∗Vegetable income $_{t-1}{}^2$			-0.00174	-0.00567	0.00276	-0.00221
			(0.00555)	(0.00482)	(0.00548)	(0.00463)
Supply channel, base group are suppliers to independent traders:						
Supermarkets$_{t-1}$	0.302	0.287**	0.301	0.265*	0.669***	0.553***
	(0.186)	(0.143)	(0.192)	(0.145)	(0.141)	(0.123)
Trader/Broker to SM$_{t-1}$	-0.151	-0.209*	-0.150	-0.218*	0.0237	-0.0199
	(0.129)	(0.123)	(0.129)	(0.124)	(0.139)	(0.148)
Companies/Institutions$_{t-1}$	0.196	0.260*	0.200	0.249*	0.312*	0.374***
	(0.167)	(0.149)	(0.171)	(0.148)	(0.184)	(0.142)
Spot market$_{t-1}$	-0.0263	-0.00314	-0.0256	-0.00287	-0.0264	-0.00225
	(0.0755)	(0.0727)	(0.0755)	(0.0728)	(0.105)	(0.105)
Female seller∗Supply channel, base group are suppliers to independent traders:						
Female seller × Supermarkets$_{t-1}$					-0.897***	-0.683**
					(0.347)	(0.276)
Female seller × Trader/Broker to SM$_{t-1}$					-0.362	-0.460*
					(0.267)	(0.243)
Female seller × Companies/Institutions$_{t-1}$					-0.568**	-0.751***
					(0.233)	(0.172)
Female seller × Spot market$_{t-1}$					0.000505	-0.00460
					(0.146)	(0.140)
Distances in Km:						
To tarred road	-0.0137	-0.0232	-0.0127	-0.0226	-0.00973	-0.0207
	(0.0197)	(0.0159)	(0.0199)	(0.0161)	(0.0189)	(0.0163)
To local shopping center	-0.0366	-0.0409	-0.0374	-0.0397	-0.0348	-0.0369
	(0.0406)	(0.0346)	(0.0413)	(0.0345)	(0.0390)	(0.0319)
To supermarket	-0.0125***	-0.00165	-0.0126***	-0.00154	-0.0123***	-0.00127
	(0.00411)	(0.00347)	(0.00411)	(0.00350)	(0.00403)	(0.00341)
To nearest sales place	0.00886	0.00852	0.00888	0.00852	0.00785	0.00833
	(0.00648)	(0.00581)	(0.00653)	(0.00576)	(0.00651)	(0.00547)
Farm land characteristics:						
Area owned $_{t-1}$	-0.0679***	-0.0436	-0.0682***	-0.0465*	-0.0726***	-0.0496*
	(0.0259)	(0.0269)	(0.0262)	(0.0267)	(0.0270)	(0.0275)
Share under vegetables $_{t-1}$	0.0613	0.0336	0.0584	0.0274	0.0474	0.0174
	(0.0516)	(0.0477)	(0.0526)	(0.0484)	(0.0513)	(0.0471)
Share of veg. irrigated $_{t-1}$	-0.232***	-0.179***	-0.232***	-0.179***	-0.209***	-0.163**
	(0.0721)	(0.0683)	(0.0719)	(0.0688)	(0.0711)	(0.0700)
Constant	2.884***	2.762***	3.151***	2.960***	3.180***	2.998***
	(0.370)	(0.339)	(0.363)	(0.363)	(0.358)	(0.360)
Vegetable dummies	Y	Y	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y	Y	Y
Observations	806	806	806	806	806	806

Robust standard errors in parentheses. * $p < 0.1$,** $p < 0.05$,*** $p < 0.01$. Random effects results for the regression of the prices received in 2015 on the lagged controls from 2012 besides the variables identifying gender and vegetables.

findings that the GPG is not the only problem women might face when selling vegetables in the study area.

6.2 Robustness checks

Using a random effects model comes at the risk of receiving biased results due to the correlation of cluster specific characteristics with the variables of interest. Fixed effects models do not suffer from this issue, though they are less efficient. We test for systematic differences in the coefficients obtained by the two models using the Hausman test. We cannot reject the hypotheses of systematic differences when applying the model with all interactions to the lowest prices. Applying the same model to the highest prices we can reject the same hypotheses. Hence, the Hausman test indicates that the random effects model is adequate to estimate the regressions on the highest price but not on the lowest price. Referring to the Section 4, we still prefer the application of the random effect model in the latter case for theoretical reasons.

Comparing the results of a fixed effects estimation in line with Equation 2 to the random effects results it is observable that the dummy for female sellers and its interactions with the sold quantities are not significant when all controls are added. The coefficients are mostly similar though, with exception of the regression on the highest price with all controls where they are much smaller. We cannot say with certainty if the drops in significance levels are due to the lower efficiency of the fixed effects or due to omitted variables at the household level which are not controlled for in the random effects model. Based on the stable coefficient size, the latter seems less likely.

One main concern unaffected by the fixed effects is that the task of selling vegetables is given to a person after the household realizes some states of the world that affects the product price. First, we test if there is an association between the gender of the person selling the goods and the usage of pesticides and fungicides. These inputs do not only affect the size of the harvest but also quality characteristics like color and nutritional traces of insects. Hence, they are likely to affect the price. We do not find a statistically significant association between the quantities of these substances applied per square meter and the gender of the seller. This is the case with and without controls for plot characteristics. Second, we add interactions of the gender of the marketing person with the gender of the household head and with the gender of the person controlling the production to the model specified in Equation 2. These interactions would identify if the effect was due to men shifting the sales to women when they expect a bad price. The results show that women selling in a female controlled household or on a plot controlled by a women do not get a different price as those selling in male controlled households or plots respectively. Furthermore, the interactions between the gender of the seller and the quantity stay significant, supporting the earlier finding.

We also estimate the full model while excluding observations of the sale of vegetables which have been reported less than 25 times to avoid too small sub-populations. The coefficients of the regression on the lowest price change little and stay highly significant using this sample. In the regression on the highest price the dummy variable for the seller's gender becomes insignificant as do its interactions with the sold quantities. This is mostly due to increased standard errors while the coefficients lose little in size. Running the model separately for the three vegetables with most observations, we find the variables of interest only to be significant in the regressions on the price of black nightshade. In the regression on sales of spinach and kales the coefficients have the expected sign but are not significant. The sample size for these regressions lies between 118 plots for black nightshade and 223 plots for kales.

As described, some households' decision not to sell any vegetables is correlated with some observables. Therefore, we follow the strategy presented by Wooldridge (2010) and construct inverse probability weights to control for a possible bias due to non-random attrition. The significant estimators of attrition in our analysis are the vegetable income, the distance to the nearest sales point, and a set of enumerator dummies as proxy of interview quality. Using a maximum likelihood random effects model with the calculated weights we re-estimate columns (1) to (4) of Table 2. As before we do not find indication of an average GPG. Likewise the finding of a u-shaped relation between GPG and the sold quantities per harvest still holds.[4]

[4]We try an instrumental variable approach to control for endogeneity of the choice of the selling person and

6.3 Explaining the choice of the sellers gender

Considering the pattern we find in Section 6, it needs to be asked under which circumstances women actually get control over marketing. To answer this question we run a logistic regression and add controls for the average labor supply by family and hired workers, the area of cropped land, and the share of it used for growing vegetables to the usual controls. We do not control for the vegetable as the decision what to plant could be made well after the decision on who is doing the marketing. We run the regression once with and once without controls for the buyer as it is unclear if the selling person is chosen before or after the supply chain for the current harvest has been defined. The results of these regressions are reported in columns (1) and (2) of Table 4 respectively. Column (3) shows the results when adding controls for household demographics, the last years vegetable income, and an interaction between the area under crops and the share of it used for vegetable production. As the estimates are based on the natural logarithm of the variables, the odds ratios relate to the change of the likelihood of a women being in charge when the variable increases by the factor e, which is roughly 2.72.

Table 4: Logistic regression regarding control over marketing in a household

	(1) Female seller	(2) Female seller	(3) Female seller
Female household head	16.55***	15.80***	31.94***
	(16.14)	(16.21)	(42.67)
Woman controls production	253.4***	330.6***	402.9***
	(122.3)	(171.7)	(222.1)
Quantity sold p.h.	1.608	1.513	1.730
	(0.695)	(0.657)	(0.787)
Quantity sold p.h.^{2}	0.972	0.979	0.972
	(0.0253)	(0.0256)	(0.0263)
Area owned	0.857	0.917	0.879
	(0.192)	(0.219)	(0.215)
Total area under crops	0.430***	0.400***	0.472**
	(0.118)	(0.122)	(0.168)
Share under vegetables	0.448***	0.456***	0.0673*
	(0.0944)	(0.100)	(0.0992)
Total area under crops × Share under vegetables			1.246
			(0.220)
Share of veg. area irrigated	0.945	0.967	1.007
	(0.0739)	(0.0774)	(0.0913)
Years growing vegetables	1.270	1.258	1.120
	(0.300)	(0.324)	(0.271)
Last years vegetable income			1.243*
			(0.142)
Distances:			
Km to tarred road	1.335**	1.468**	1.473**
	(0.187)	(0.220)	(0.228)
Km to local shopping center	0.997	0.935	0.974
	(0.167)	(0.176)	(0.184)
Km to supermarket	0.924	0.761*	0.758*
	(0.129)	(0.112)	(0.109)
Km to nearest sales place	1.033	1.048	0.963
	(0.131)	(0.137)	(0.134)
Labor supply:			
Weekly labor hours high season	0.989	1.024	1.005
	(0.0990)	(0.110)	(0.108)
Weekly labor hours low season	1.225**	1.261**	1.281**
	(0.111)	(0.116)	(0.124)

the choice of the supply chain but our instruments turn out to be too weak. Therefore, we cannot technically exclude biases in our results due to self selection into supply channels. However, our model design should reduce the influence of endogeneity sufficiently.

Months permanent workers employed	1.247*	1.244*	1.182
	(0.150)	(0.157)	(0.154)
HH members primarily farming	2.118**	1.835*	1.671
	(0.707)	(0.665)	(0.593)
HH members participating in farming	2.203***	2.595***	3.093***
	(0.609)	(0.766)	(1.120)
Supply channels - Reference are sales to indep. traders:			
Supermarkets		0.181***	0.174***
		(0.0809)	(0.0826)
Trader/Broker to SM		1.983	1.908
		(1.243)	(1.287)
Companies/Institutions		0.255	0.201
		(0.474)	(0.346)
Spot market		3.141***	3.405***
		(0.952)	(1.079)
Sold to trader at once		0.704	0.711
		(0.254)	(0.247)
HH demographics:			
HH size			0.606
			(0.216)
Men aged 17 to 85 in HH			1.577
			(0.499)
Women aged 17 to 85 in HH			0.736
			(0.242)
Constant	9.337	21.50	0.533
	(24.26)	(61.96)	(1.818)
Observations	867	867	867

Robust standard errors in parentheses. * $p < 0.1$,** $p < 0.05$,*** $p < 0.01$. Logistic regression results on the question who is doing the marketing in a household. Results are given as odds ratios.

We find that female control at the household level, but even more at the plot level is associated with an increased likelihood of a women being in charge of sales. Therefore, our results do not resemble the findings of Banerjee *et al.* (2014), who found that women who control Cocoa production shift the marketing to a male relative to avoid the GPG they face. Given that on average we do not observe a GPG and that a shift of marketing would imply lower control over the income, this is little surprising. We do not find that the quantity sold per harvest got a significant effect. Therefore, the dynamic affecting the GPG at increasing sold quantities, does not significantly affect the choice of the marketing person's gender. Yet, a closely correlated size shows exactly that effect: Looking at the variables describing the landholdings and their usage we find indication that an increase in the production of vegetables is associated with a smaller likelihood of women being in control of the marketing. Additionally, we find a higher likelihood for women to be in control where the next tarred road is further away. This might be explained with the worse market access of these households. Due to this, men might shift their focus to activities that are less dependent on transport infrastructure and leave the vegetables to a woman. Only when controlling for the marketing channel the negative coefficient associated with the distance to the closest supermarket becomes significant. We would expect that the distance to supermarkets is only important where vegetables are sold to a supermarket. When controlling for sales to supermarkets, the distance to supermarkets might therefore be a proxy for the distance to urban centers. Where households are further away from cities men are likely to have less alternative income sources available to them. In this case they would be more likely to compete with women for control over marketing if market access is hold stable. The latter is likely to be the case as distance to tarred roads is a better indicator of market access given the study areas hilly landscape and often poor quality mud roads.

The indicators of labor supply show a positive association between labor supply and female

control over marketing, holding everything else -including land size- stable. The effects are not due to the household demographics as we test by controlling for the household size and the number of men and women of age 17 to 85.[5] Therefore, households seem to prefer shifting the marketing to women if they have sufficient labor available. Possibly this is preferred as it allows them to follow traditional gender roles. This has to be seen in conjunction with the very strong opposite effect of the total crop area and the share of it under vegetables. Households might only prefer to give the task to a woman as long as the scope of vegetable production falls into the traditionally female small scale vegetable trade.

In line with earlier findings by Chege *et al.* (2015) we find a decreased likelihood for women to be in control of marketing where supermarkets are supplied. Where sales take place in the spot market the likelihood for a women to do the marketing is considerably larger, holding every thing else stable. This pattern fits the traditional gender roles, in which local vegetable sales are considered to be a job for women.

7 Conclusion

We do not find an average GPG in the central Kenyan vegetable market. Instead we find that the price women receive compared to men first declines and then rises again as the quantities per harvest surpass the mean of the distribution. While there is an indication that women who sell very small quantities get a better price than men, growing quantities are associated with a falling price compared to what men receive. Close to the center of the distribution of quantities this dynamic turns around. However, only for the top ten percent of the distribution the point estimates indicate that women would get a better price than men again. We cannot show average marginal effects that are different from zero, though. For the lowest price received in the season the u-shaped pattern is observable even when ignoring every thing but the quantity and the vegetable type. Regressions on the highest price provide smaller coefficients which follow the same pattern.

We can explain the pattern of the GPG using the experimental evidence of Kricheli-Katz and Regev (2017). Their experimental findings show that the GPG disappears when the buyer considers the seller to be of high competence with regard to the sold product or having an entitlement to a good price. We argue that the better price women get in our data when selling small quantities is grounded in the traditional position women take in local vegetable trade in the Kikuyu culture. Being active in this area they are likely to be considered as entitled and competent. If they start selling larger quantities they do not get this bonus and potentially a penalty might be put on the price, relating to the missing competence and entitlement in this market segment. Women selling even higher quantities do not suffer from this problem anymore, according to our data. This might be due to self-selection of certain women into this predominantly male section of the market: While at smaller quantities about half of the sellers are women, in the upper ten percent of the distribution of sold quantities this share drops to about 30 percent.

Using controls from an earlier survey round in 2012 we are not able to test the same relation between sold quantities and the GPG. It becomes observable that not higher vegetable incomes as such can be associated with the GPG but that different household characteristics like larger land size and the supplied markets are closer correlates of the GPG. Past participation of a household in supermarket supply chains is associated with a higher GPG but this is due to observations where farms stopped supplying to supermarkets between 2012 and 2015. Therefore,

[5]The age limitation is based on the information of the households on who is having an employment, including work on the own farm.

the associated GPG shows that women are at least partially excluded from the benefits of modern supply channels in the study area. This is in line with our finding that women are more likely to be in charge of marketing where vegetable trade is not as strongly commercialized and therefore offers smaller potential incomes. We thereby support findings by Chege *et al.* (2015); Rao and Qaim (2011) in the same context. Interestingly, also a larger labor supply on a given farm is associated with a higher likelihood of women to have control over marketing. Potentially, this could point towards a general preference for women to do the marketing if the household has sufficient labor available, holding every thing else stable.

Research gaps persist in our understanding of the source of the GPG. Particularly, insights into the hypothesized connection to the cultural expectations of buyers in other markets are of high interest. The same applies to our understanding of the GPG at large as knowledge on the size of the GPG is still limited to few case studies. The application of the concept in more and larger surveys appears to be a necessary endeavor to get a better understanding of gender based economic disadvantages, particularly in developing economies. With larger sample sizes also differences between the GPG in traditional and commercialized supply chains could be investigated in more detail.

At the current stage our results indicate that the GPG is rooted in culture and therefore hard to overcome. Furthermore, the GPG might act as a deterrent for women to grow their commercial activities over a certain size. Under these circumstances an increase in transaction volumes might go along with women being left behind in a shrinking part of the market. To overcome the GPG two routes might be considered. First, following Deutsch (2007) gender stereotyping could lose its detrimental effects in a specific situation, if the counterpart in an interaction does not see gender as a characteristic in that moment. In the context of markets this could be accomplished through a cautious design of supply chains. In the given context professionalized supermarket supply channels would be a solution for women as prices are fixed in these. Furthermore, the quantities the farmers sell are defined by the share of their production that is actually bought by supermarket customers, who are unaware of the suppliers gender. Yet, our results also indicate that switching to this supply channel is likely to go along with women losing control over marketing. Therefore, the current system is insufficient to deal with the issue. Another option are collective sales as shown by Handschuch and Wollni (2016); Banerjee *et al.* (2014). These come at the risk of lower average prices though, and depend on the efficient solution of the collective action problem. Second, the long run solution to dissolve the GPG would be to gradually dismantle stereotypes. One possible set of policies to do this was presented in The World Bank (2011) with regard to gender inequality over all. While the need for such policies is not new, the presented research underlines the importance of this lengthy process.

References

Banerjee, D., Klasen, S., and Wollni, M., 2014. Market discrimination, market participation, and control over revenue: A gendered analysis of Cameroon's cocoa producers, *GlobalFood Discussion Papers*, No. 43.

Bolwig, S., 2012. Poverty and Gender Effects of Smallholder Organic Contract Farming in Uganda, *USSP Working Paper*, No. 8.

Central Intelligence Agency, 2016. *The World Factbook 2016-17*, Washington, DC: https://www.cia.gov/library/publications/resources/the-world-factbook/ (accessed July 2016).

Chege, C.G., Andersson, C.I., and Qaim, M., 2015. Impacts of Supermarkets on Farm Household Nutrition in Kenya, *World Development*, 72, 394–407.

Deutsch, F.M., 2007. Undoing Gender, *Gender & society*, 21 (1), 106–127.

Dolan, C.S., 2001. The 'Good Wife': Struggles over Resources in the Kenyan Horticultural Sector, *Journal of development studies*, 37 (3), 39–70.

Ebata, A., Velasco Pacheco, P.A., and von Cramon-Taubadel, S., 2017. The influence of proximity to market on bean producer prices in Nicaragua, *Agricultural Economics*, 78 (3), 1–9.

Fershtman, C. and Gneezy, U., 2001. Discrimination in a Segmented Society: An Experimental Approach, *The Quarterly Journal of Economics*, 116 (1), 351–377.

Fulton, J.R., Lowenberg-DeBoer, J., Jooste, A., and Faye, M.D., 2004. The influence of cowpea characteristics on cowpea prices in Senegal, *Agrekon*, 43 (4), 418–429.

Handschuch, C. and Wollni, M., 2016. Traditional Food Crop Marketing in Sub-Saharan Africa: Does Gender Matter?, *Journal of development studies*, 52 (3), 343–359.

House-Midamba, B., 1995. Kikuyu Market Women Traders and the Struggle for Economic Empowerment in Kenya, *in:* B. House-Midamba and F.K. Ekechi, eds., *African market women and economic power*, Westport, Conneticut: Greenwood Press, 81–97.

International Labour Office, 2016. *Women at Work: Trends 2016*, Geneva: ILO.

Kricheli-Katz, T. and Regev, T., 2016. How many cents on the dollar? Women and men in product markets, *Science Advances*, 2 (2), e1500599.

Kricheli-Katz, T. and Regev, T., 2017. Competence, Desert and Trust—Why Are Women Penalized in Online Product Market Interactions?, *Theoretical Inquiries in Law*, 18 (1), 83–95.

Lodin, J.B., 2012. Intrahousehold Bargaining and Distributional Outcomes Regarding NERICA Upland Rice Proceeds in Hoima District, Uganda, *Gender, technology and development*, 16 (3), 253–278.

Rabe-Hesketh, S. and Skrondal, A., 2012. *Multilevel and longitudinal modeling using Stata*, College Station, Texas: Stata Press, 3rd ed.

Rao, E.J. and Qaim, M., 2011. Supermarkets, Farm Household Income, and Poverty: Insights from Kenya, *World Development*, 39 (5), 784–796.

Rao, E.J. and Qaim, M., 2013. Supermarkets and agricultural labor demand in Kenya: A gendered perspective, *Food Policy*, 38, 165–176.

The World Bank, 2011. *Gender equality and development: World development report 2012*, Washington. DC: The World Bank.

Udry, C.R., 1996. Gender, Agricultural Production, and the Theory of the Household, *Journal of political economy*, 104 (5), 1010–1046.

Wacker, C., 1994. Sustainable Development Through Women's Groups: A Cultural Approach to Sustainable Development, *in:* W. Harcourt, ed., *Feminist perspectives on sustainable development*, London and Atlantic Highlands, N.J.: Zed Books, in association with Society for International Development, Rome, 128–142.

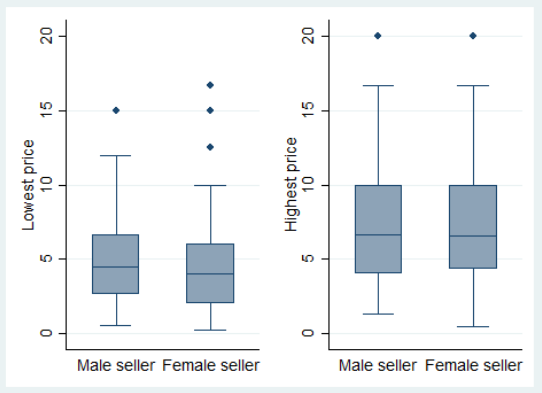
Wooldridge, J.M., 2010. *Econometric analysis of cross section and panel data*, Cambridge, Mass.: MIT press.

Zhang, L., Rozelle, S., Liu, C., Olivia, S., de Brauw, A., and li, Q., 2006. *Feminization of Agriculture in China: Debunking the Myth and Measuring the Consequence of Women Participation in Agriculture*, Washington, D.C.: World Bank.

Appendices

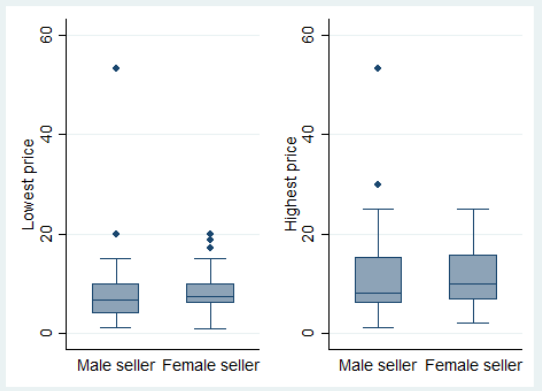
A Appendix of figures

Figure 2: Comparison of kale prices



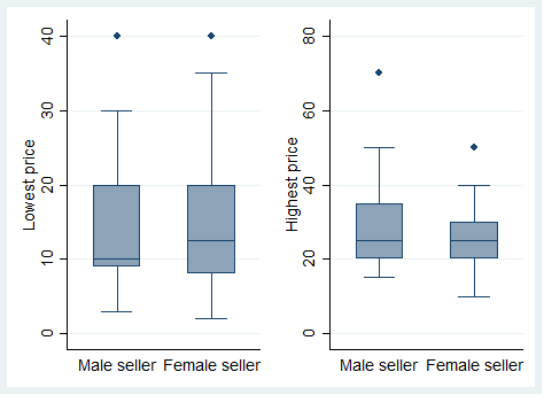
Box plot of the highest and lowest price male and female farmers received for kales (sukuma wiki) in the season.

Figure 3: Comparison of black nightshade prices



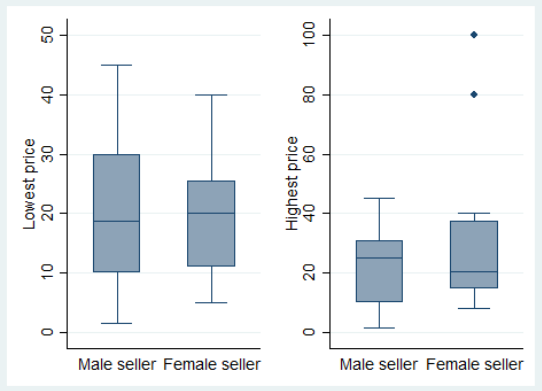
Box plot of the highest and lowest price male and female farmers received for black nightshade in the season.

Figure 4: Comparison of cabbage prices



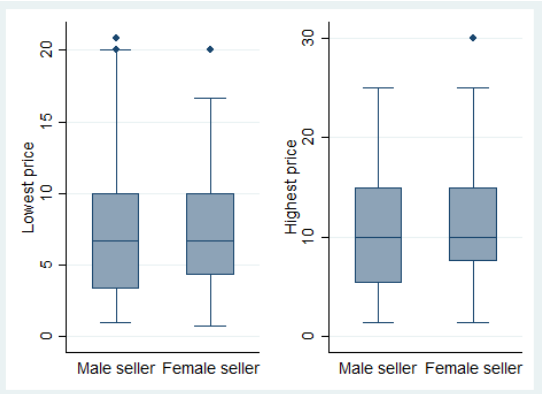
Box plot of the highest and lowest price male and female farmers received for cabbage in the season.

Figure 5: Comparison of lettuce prices



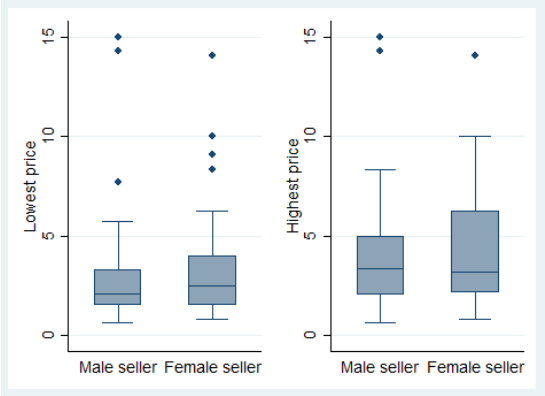
Box plot of the highest and lowest price male and female farmers received for lettuce in the season.

Figure 6: Comparison of spinach prices



Box plot of the highest and lowest price male and female farmers received for spinach in the season.

Figure 7: Comparison of coriander prices



Box plot of the highest and lowest price male and female farmers received for coriander in the season.

B Appendix of tables

Table 5: Comparison of excluded and used observations

	Difference/se	Excluded obs.	Used obs.
Female seller	-.0778867	.4074074	.4852941
	.0977001		
Woman controls production	.1118653	.4444444	.3325792
	.0722719		
Female household head	.0145551	.1333333	.1187783
	.0496187		
Share irrigated	-41.63582	.4132071	42.04902
	60.61809		
Quantity sold per harvest	-1330.681	1066.192	2396.873
	3155.525		
Years growing vegetables	1.164404	21.66667	20.50226
	1.756889		
Last years vegetable income	-106921.3	224513.9	331435.2
	163151.7		
Buyers			
Supermarket	-.0656109	0	.0656109
	.0477032		
Trader to Supermarket	.0053628	.037037	.0316742
	.034335		
Company/Institution	-.0002933	.037037	.0373303
	.0370723		
Independent Trader	-.1652422*	.2962963	.4615385
	.0972682		
Spot Market	-.0970337	.1111111	.2081448
	.0789295		
Sold to trader at once	.3228172***	.5185185	.1957014
	.0782661		
Region			
Lower Lari	.0018602	.0222222	.020362
	.0216533		
Githunguri	-.0095274	.0888889	.0984163
	.0454737		
Kabete/Kikuyu	.0710659	.5111111	.4400452
	.0759656		
Limuru	.043816	.2666667	.2228507
	.0638641		
Lari	-.063097	.1111111	.1742081
	.0575825		
Dagoretti	-.0248869	0	.0248869
	.0232474		
Westlands	-.0192308	0	.0192308
	.0204948		
N	929		

* $p < 0.1$,** $p < 0.05$,*** $p < 0.01$.

Table 7: Comparison of region and vegetables of plots with male and female seller

	Difference/se	Male seller	Female seller
Region			
Lower Lari	-.0011988	.0197802	.020979
	.0095153		
Githunguri	-.0714619***	.0637363	.1351981
	.019924		
Kabete/Kikuyu	.1710956***	.5230769	.3519814
	.0329433		
Limuru	-.0380286	.2043956	.2424242
	.0280085		
Lari	-.1280053***	.1120879	.2400932
	.0251875		
Dagoretti	.0438228***	.0461538	.002331
	.0103911		
Westlands	.0237762**	.0307692	.006993
	.0092179		
Vegetable type			
Kales	-.1122211***	.1978022	.3100233
	.0290157		
Spinach	-.011322	.1868132	.1981352
	.0265497		
Black Nightshade	-.0123876	.1274725	.1398601
	.0229095		
Corriander	.0082584	.0945055	.0862471
	.0193268		
Cabbage	.0003996	.0703297	.0699301
	.0172053		
Lettuce	.0423576***	.0703297	.027972
	.0145824		
Cauliflower	.0277722**	.0417582	.013986
	.0111294		
Brocolli	.0214452**	.0307692	.009324
	.009488		
N	884		

* $p < 0.1$,** $p < 0.05$,*** $p < 0.01$. The list of vegetables has been reduced to the six most common ones and those with differences that are significant on the five percent confidence level).