Maternal off-farm wage employment and primary school enrolment:

Evidence from a natural quasi-experiment in Senegal.

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1. Introduction

Education is a critical asset for rural people and in the process of agricultural growth and rural development (World Bank, 2008). As with many other productive assets, nowhere is the lack of education as large is in Sub-Saharan Africa (SSA). Adult literacy is only 62% in SSA – compared to more than 90% in East Asia and Latin America (World Bank, 2010). More anxiously, progress in education is slow. Primary school enrolment is only 76% in SSA while close to 100% in East Asia and Latin America. Currently still 69 million of primary school-age children are not in school worldwide, about half of them in SSA (United Nations, 2010). Moreover, specifically in Western Africa, there are huge disparities in primary schooling between rural and urban areas and between boys and girls (Bennell, 2002). For example in Senegal, primary school enrolment is estimated at 78% for boys and 73% for girls in urban areas versus 62% for boys and 51% for girls in rural areas (Montgomery and Hewett, 2005).

Government policies and development projects have aimed at increasing primary school enrolment by focussing on the supply side of schooling: for example through reducing or abolishing school fees, investing in teaching infrastructure and resources, and introducing mobile schools in remote areas (United Nations, 2010). Such programs are necessary but they are not sufficient to guarantee increases in school enrolment. A low demand for primary education among poor and rural households is the most critical factor in low primary school enrolment rates in SSA (Bennell, 2002). Empirical evidence indicates that household income is the main factor determining households' demand for schooling (Behrman and Knowles, 1999). These insights have lead to renewed policies that focus on the demand side of schooling: for example conditional cash transfer programs, and the provision of free meals at school (United Nations, 2010).

In this paper we argue that not only the level of household income matters but also how, and especially by whom, income is earned. We specifically analyze the effect of maternal off-farm wage employment on primary school enrolment. We use a conceptual framework, based on a household bargaining model and human capital theory, to theoretically derive how increases in maternal wage income affect schooling of children. We empirically address the question using original household survey data from the *Niayes* region in Senegal. In this area, female off-farm wage employment has increased tremendously since the early years 2000 as a result of a horticulture export boom and associated employment on the fields of large agro-industrial estates and in processing and packing units (Maertens and Swinnen, 2009). We can treat this case as a natural quasi-experiment in the sense that a treatment (maternal wage employment) has arisen serendipitously but where selection into treatment is likely not random (Rosenzweig and Wolpin, 2000). We use different econometric techniques to estimate the casual effect of maternal wage income on the propensity of children to be in school, controlling for individual, household and village characteristics. We find that maternal

wage employment has a significant positive effect on primary school enrolment for both boys and girls.

2. Conceptual framework[1]

We rely on insights from a farm-household bargaining model in which the bargaining power of women is a function of women's off-farm income, in which utility is derived from consumption and the schooling of children, and in which women have a higher preferences for child education. We additionally use insights from the human capital theory that regards education as an investment with a direct cost (school fees), an opportunity cost (availability of child labour on the farm and in the household) and net benefits (utility derived from child schooling). The model reveals that four different effects need to be considered in understanding the effect of female wage employment on child school enrolment. First, there is a general income effect arising from the fact that female wage income adds to total income, decreases the household budget constraint and increases child schooling. Second, there is an empowerment effect, arising from the fact that mothers have higher preferences for child education and access to off-farm wage income increases their intra-household bargaining power. Third, there is a labour substation effect. Female wage employment reduces the availability of labour for household productive and non-productive activities. This could be partially substituted with child labour and hence decrease their school enrolment. Fourth, female wage employment opportunities might alter preferences for schooling, especially for girls, and have either a positive or negative effect on child school enrolment.

3. Data collection

For the analysis in this paper we use original survey data from the *Niayes* region in Senegal, collected in 2007. Stratified random sampling was used to select 451 households in 36 villages in four rural communities in the region. The survey instrument included separate and specific sections for the household head and for the spouse (or in case of polygamist household for the spouse responsible for the housekeeping). The survey provides general data on household demographic characteristics, land and non-land asset holdings, agricultural production and marketing, off-farm employment and income, non-labor income, credit and savings. Specifically important for the analysis in this paper is that the survey data include detailed and gender disaggregated information on wage employment in the horticulture export industry and associated wage income. In addition the data allow calculating total household net income from different farm and non-farm

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[1] The conceptual model is derived and adapted from Emerson and Souza (2002), Glewwe (2002) and Tansel (1997)

sources. Also information on child schooling is available at the individual level for all children between the age of 6 and 18. This includes information on school enrolment during the past year, the years of schooling and the highest grade obtained. This data allows analyzing school enrolment but more detailed information on school attendance and performance is lacking.

This household data is complemented with original data from a village survey in all selected villages and with secondary village-level data from ANSD (*Agence National de la Statistique et de la Demographie*). This includes information on institutional and infrastructure characteristics such as the presence of a primary school in the village and distances to markets, schools and agro-industrial export companies.

4. A natural quasi-experiment

Horticulture exports from Senegal increased sharply in the past 15 years; from less than 2.5 million US$ in 1994 to more than 30 million US$ in 2009 (Comtrade, 2010). Especially since the early years 2000 horticulture exports have increased sharply. The three main export crops are beans, mango and tomatoes of which the first two are mainly sourced from the *Niayes* region. Apart from some small volumes to neighbouring countries, exports are mainly destined for markets in the European Union (EU).

Figure 1: Gender disaggregated participation in wage employment in the horticulture export industry, *Niayes* region, 1995 - 2007

Source: calculated from survey data

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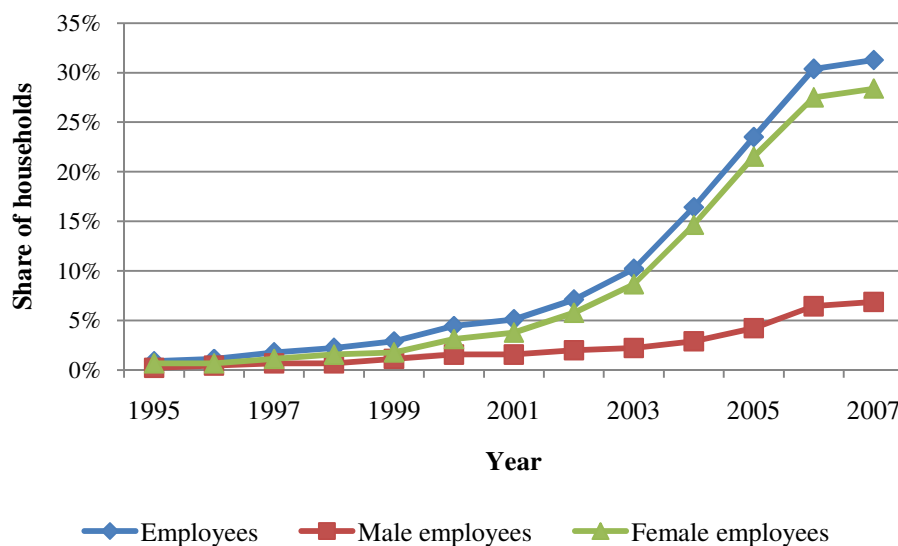
The horticulture export boom has been associated with increased wage employment on the fields and in the processing and packing units of agro-industrial export companies. Especially since the early years 2000 – when exports increased most sharply, when export chains shifted from smallholder contract-farming based on family labour to integrated estate production based on hired labour, and when high quality and safety standards in the EU increased the need for labour-intensive post-harvest handling – employment in these companies increased sharply. Importantly, mainly women are employed in the sector. Figure 1 shows that the share of households in the region with one or more members working for wages in the horticulture export industry increased sharply; from less than 5% of households in 2001 to more than 30% in 2007. For the large majority of these households it is specifically female household members who are employed in the agro-industry. Almost one third of rural households in the region have one or several female members working in the agro-industry.

The horticulture export boom and associated off-farm employment opportunities can be considered a natural quasi-experiment or an event that has emerged 'naturally' without researcher's intervention and control (Rosenzweig and Wolpin, 2000). The event has resulted in the existence of a treatment (female wage employment) but has been driven by factors that are exogenous to household characteristics (e.g. demand in EU markets, trade and investment liberalisation, food standards). Nevertheless, selection into treatment is influenced by household characteristics, which resembles a quasi-experimental design without random assignment.

5. Household endowments and child school enrolment

Before turning to an econometric analysis of the causal impact of maternal wage employment on primary school enrolment we present some descriptive statistics on households endowments and school enrolment across households with and without female off-farm wage employment.

The figures in table 1 reveal that there are not many differences in terms of asset ownership and household characteristics across the two types of households. Households with female wage employment have significantly more female workers, are somewhat older and mainly come from the major ethnic group (Wolof). There is however no difference between households in terms of ownership of land and non-land assets. Yet, households with female wage employment have significantly higher total and per capita incomes. The wage received by women constitute on average a quarter of the total income of households with female wage employment. This has important implications for intra-household bargaining power and 94% of women working as laborer in horticulture agro-industry indicate that the employment increased their decision-making power in the household (Maertens and Swinnen, 2010).

Table 1:   Household assets and income across households with and without female off-farm wage employment

	total sample	hh with female wage empl.	hh without female wage empl.	
Number of observations	449	185	264	
Number of female workers	4.34	5.05	3.84	***
Number of male workers	4.52	4.75	4.36	
Number of children age cohort 0 to 5	1.09	1.06	1.11	
Number of children age cohort 6 to 12	1.60	1.68	1.54	
Number of children age cohort 13 to 15	0.84	0.85	0.83	
Age of the household head	54.86	56.09	53.99	**
Number of spouses	1.68	1.76	1.62	*
Female headed households (share)	3.3%	2.7%	3.8%	
Ethnic Wolof households (share)[1]	67%	77%	59%	***
Years of education of the household head	1.34	1.46	1.26	
Years of education of the spouse[2]	0.16	0.23	0.10	*
Landholdings (ha)	3.77	3.99	3.62	
Livestock units[3]	2.59	2.36	2.74	
Value of non-land assets (1,000 FCFA)[4]	332	315	344	
Total household income (1,000 FCFA)	1,555.71	1,970.18	1,265.27	***
Per capita household income (1,000 FCFA)	222.27	261.63	194.69	***
Share of total household income from				
household farm businesses	58%	48%	66%	
household non-farm businesses	18%	15%	20%	
non-labor income	6%	5%	7%	
off-farm wages	18%	32%	7%	
off-farm wages earned by women	10%	26%	0%	

Characteristics of households with and without female off-farm wage employment are compared using t-test. Significant differences are indicated with *p < .15; **p < .10; ***p < .05.

[1] Wolof is the main ethnic group in Senegal

[2] For households with more than one spouse, the maximum years of education of all spouses is taken.

[3] One livestock unit equals 1 cow, 0.8 donkey, and 0.2 sheep/goat.

[4] Non-land assets include all equipment and machinery for farming as well as non-farm businesses and their value is revealed from the survey as the price the household would receive if selling an item.

Source: calculated from survey data

The figures in table reveal that 54% of primary school-age children in the sample are actually enrolled in school. This rate is higher among boys (57%) than among girls (50%) and higher in households with female off-farm wage employment (60%) than in other households (50%). In the next section we perform further econometric analysis to reveal whether the observed difference in primary school enrolment can actually be

attributed to the impact of access to female off-farm wage employment and associated increase in female intra-household bargaining power.

Table 2: **School enrolment rates and school expenditures across households with and without female off-farm wage employment**

		total sample	households with female wage empl.	households without female wage empl.	
Primary school enrolment	total	54.50	60.53	50.32	***
(age cohort 6-12)	boys	57.50	66.26	51.45	***
	girls	50.65	53.33	48.56	
Secondary school enrolment	total	49.81	60.11	42.36	***
(age cohort 13-15)	boys	50.22	64.72	40.66	***
	girls	49.21	54.87	44.78	
Secondary school enrolment	total	29.39	32.99	26.06	
(age cohort 16-18)	boys	40.85	45.88	36.47	
	girls	24.40	27.36	21.28	
expenditures for schooling		32.88	41.11	27.11	***
expenditures for schooling per child		10.24	11.92	8.94	**

Characteristics of households with and without female off-farm wage employment are compared using t-test. Significant differences are indicated with $*p < .15$; $**p < .10$; $***p < .05$.

Source: calculated from survey data

6. Regression analysis

6.1. Econometric methods

We want to estimate the effect of the share of female wage income in total household income on the propensity of children in the age cohort 6-12 to attend school. We control for a large set of individual, household and village factors. Unobserved heterogeneity, resulting from preferences for schooling being correlated with female wage employment, might lead to biased estimates. To correct for unobserved heterogeneity we use two different techniques. First we use a variable that can proxy for unobserved household preferences for schooling. This variable is defined as the share of children in the age cohort 13-18 that have attended at least one year of primary school during their primary school age period (which is considered exogenous to the decision of female off-farm wage employment as it concerns decision taken before the boom in horticulture exports and associated employment opportunities). In a second model, we use instrumental variable estimation using the distance to the nearest agro-industrial company as instrument for the share of female wage income. The instrument is highly correlated with the share of female wage income but has no direct effect on school enrolment. In addition, as the share of female wage income might be correlated with total household

income, we estimate the model with and without controlling for total household income. Finally, we estimate the model for all children and separately for boys and girls.

6.2. Results and discussion

The regression results are summarized in table 3. The results show that the share of female wage income in total household income has a positive and highly significant effect on primary school enrolment, for boys as well as for girls. This result is robust across different models. The estimated coefficient from the first model (in which a proxy is used to correct for unobserved differences in preferences for schooling) is smaller than the estimated coefficient in the instrumental variable models. This could indicate that bias remains in the first model.

Table 3: Regression results[1]

	Probit[2] (control for preferences)		IV-regression		IV_regression (control for income)		IV_regression boys		IV_regression girls	
% female wage income	0.2976	**	4.3595	***	4.5826	***	4.2460	***	5.8453	***
Child age	0.6861	***	0.6905	***	0.7079	***	0.6560	***	0.8656	***
Child age _ square	-0.0343	***	-0.0348	***	-0.0357	***	-0.0318	***	-0.0457	***
Child gender (1=girl)	-0.1541	***	-0.1421	***	-0.1480	***				
Female head	-0.3037	**	0.1707		0.2360		-0.0480		0.3700	**
Ethnicity (1=Wolof)	0.1828	***	0.0760		0.0297		0.0567		0.1430	
Age of the head	0.0028		0.0042		0.0049		0.0038		0.0023	
Years of education head	0.0217	***	0.0268	***	0.0246	***	0.0004		0.0521	***
Years of education spouse	0.0103		0.0324		0.0283		0.0444		0.0383	
Number of male workers	-0.0023		-0.0724	***	-0.0829	***	-0.0677		-0.1296	***
Number of fem. workers	0.0146		0.0562	***	0.0553	***	0.0681	***	0.0735	***
Number of boys	-0.0407	***	-0.0281	**	-0.0316	**	-0.0095		-0.0559	**
Number of girls	0.0062		0.0306	**	0.0279	**	0.0360	*	0.0403	*
Landholdings	-0.0483	***	-0.0715	***	-0.0797	***	-0.0769	***	-0.0990	***
Landholdings _ square	0.0027	***	0.0040	***	0.0042	***	0.0040	***	0.0059	***
Livestock units	0.0063	*	0.0034		0.0019		-0.0074		0.0330	***
Productive assets (log)	-0.0045		0.0195	*	0.0200	*	0.0105		0.0273	
Household income (log)					0.0919	***				
Preference for schooling	0.2993	***								
School in the village	0.2503	***	0.1834	***	0.1828	***	0.0379		0.3511	***

[1] Marginal effects are reported

[2] The variable 'share of children in the age cohort 13-18 with at least one year of primary education' which is used as a proxy for preferences for schooling is unobserved for households who do not have children in this age cohort. We use a Heckman selection model to correct for the potential bias arising from this selection, with 'age of the oldest spouse', 'age square of the head', ' number of spouses' as additional variables for selection in the first stage.

Significant effects are indicated with *p < .15; **p < .10; ***p < .05.

Source: Estimated from survey data

The regression results further indicate that the age of the child matters and that girls have a lower propensity to be in school. A higher education of the household head has a positive impact on child school enrolment but the education of the spouse does not have a significant impact. Household landholdings have a negative effect on child schooling which is consistent with a higher opportunity cost of child schooling in households with more landholdings. The effect is increasing, indicating that school enrolment increases again if households' landholdings reach a certain size (and when labour can be hired in). Household wealth in terms of livestock holdings and the presence of a school in the village increase the likelihood of girls to be in school but have no impact on the schooling of boys, Finally, total household income significantly increases child school enrolment.

7.   Conclusion

In this paper we have shown that off-farm wage income earned by women has a huge and positive impact on the school enrolment of primary school-age children, both for boys and girls. Therefore the boom in horticulture exports in Senegal and associated rural off-farm employment has contributed to reaching MDG (Millenium Development Goal) 2 of universal primary education and MDG 3 of eliminating gender disparity in primary education.

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