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Global Value Chains, Large-Scale Farming, and Poverty: Long-Term Effects in Senegal

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Abstract

This paper is the first to present panel data evidence on the longer-term impact of expansion of global value chains and large-scale export-oriented farms in developing countries. Using panel data from two survey rounds covering a seven-year period and fixed effects regression, we estimate the longer-term income effects of wage employment on large-scale farms in the rapidly expanding horticultural export sector in Senegal. In addition to estimating average income effects, we estimate heterogeneous income effects using fixed effects quantile regression. We find that poverty and inequality reduced much faster in the research area than elsewhere in Senegal. Employment in the horticultural export sector significantly increases household income and the income effect is strongest for the poorest households. Expansion of the horticultural export sector in Senegal has been particularly pro-poor through creating employment that is accessible and creates substantial income gains for the poorest half of the rural population. These pro-poor employment effects contrast with insights in the literature on increased inequality from rural wage employment.

Key Words: globalisation, high-value supply chains, rural wage employment, quantile regression, panel data, long-term effects

JEL classification: F16, J14, O19, Q17, R23

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1 Introduction

The expansion and transformation of high-value food export chains, and the implications for rural households in developing countries and emerging markets remain highly debated (Beghin et al., 2015; Gómez et al., 2011; McCullough et al., 2008; Reardon et al., 2009; Swinnen, 2007; Van den Broeck and Maertens, 2016). Evidence shows that these value chains take on different forms and affect a large number of rural households. High-value export chains are often dominated by a limited number of export companies, and organized based on contract-farming with local farmers and/or on vertically integrated production on large-scale farms (Maertens et al., 2012; Swinnen, 2007). These chains can include thousands of smallholder farmers – e.g. the vegetable export sector in Madagascar (Minten et al., 2009) – and/or ten- or hundred-thousands of estate workers – e.g. the horticultural export sectors in Kenya, Peru and Ethiopia (Humphrey et al., 2004; Schuster and Maertens, 2016; Staelens et al., 2016).

The literature largely points to positive welfare effects for rural households, either through product markets and contract-farming (e.g. Asfaw et al., 2009; Dedehouanou et al., 2013; Kersting and Wollni, 2012; Minten et al., 2009; Dries et al., 2009) or through labor markets and wage employment (e.g. Herrmann and Grote, 2015; Maertens and Swinnen, 2009; Maertens et al., 2011; Mano et al., 2011). On the other hand, the available evidence suggests that contract-farming often excludes the poorest households (e.g. Dolan and Humphrey, 2000; Hernández et al., 2007; Maertens and Swinnen, 2009; Neven et al., 2009; Reardon et al., 2009). Employment in high-value export sectors is found to be more inclusive towards the poorest households (Maertens and Swinnen, 2009; Maertens et al., 2011). Yet, some studies point to low wages, insecure employment contracts and inferior working conditions; and expect expansion of high-value exports to lead to increased vulnerability of poor households

(Barrientos et al., 2000; Barron and Rello, 2000; Baumgartner et al., 2015; Patel-Campillo, 2010; Trifkovic, 2014; Ulrich, 2014; Staelens et al., 2016).

Despite a growing number of studies, empirical evidence still has shortcomings. First, most studies use cross-sectional household survey data to analyze productivity, income and poverty effects of the expansion of global value chains. Solving endogeneity problems is difficult with such data and estimates from existing studies are likely biased. Panel data evidence can help to control better for selection bias and better identify causality, and corroborate or fine-tune earlier findings from cross-sectional studies. Two recent studies use panel data to identify income and welfare effects of smallholder participation in supermarket supply chains (Michelson, 2013; Andersson et al., 2015) but no panel data evidence exists for high-value export chains.

Second, there is no evidence on the longer-term welfare effects of the expansion of global value chains. Existing studies mainly analyze short-term effects by analyzing income variation between households participating in global value chains, either as contract-farmers or as workers, and non-participating households. There is no evidence whether positive welfare effects persist over time – a limitation that arises from the lack of longitudinal data. Given that high-value exports from developing countries started to boom in the early 2000s, an urgent need for insights into the longer-term effects arises.

In this paper, we address both these shortcomings. We use panel data to estimate the long-term[3] income effects of wage employment in the horticultural export sector in Senegal. We use data from a balanced panel of 255 households and two survey rounds conducted in 2006 and 2013. Investments in horticultural exports in the research area, the Senegal River Delta, started in 2003 and the first exports were realized in 2005. Hence, our 7-year panel data covers

[3] The reference of long-term effects to a seven-year panel period is backed-up by other studies looking at similar time periods (e.g. Carter et al., 2007).

a period from the early export years up to a decade after the first investments started. During that period four new horticultural export companies established in the area; and wage employment in the sector expanded to include 42% of households in the area. We present descriptive evidence on the employment, income, poverty and inequality dynamics in the research area. We use a fixed effects regression approach to estimate the average income effect of wage employment in the horticultural export sector and eliminate bias from time-constant unobserved heterogeneity. In addition, we use a fixed effects quantile regression approach to reveal how effects differ along the income distribution[4] and we compare the impact of wage employment in the horticultural export sector with the impact of wage employment in other sectors.

The research area experienced a spectacular reduction in poverty of almost 20 percentage points over the panel period 2006-2013. Our analysis reveals that entry into wage employment in the horticultural export sector is a major source of poverty reduction, increasing household income on average with 36% and for the poorest decile of the population with 57%. A comparison with other employment sectors reinforces conclusions on the potential for pro-poor growth from the development of global agri-food value chains and large-scale farming.

2 Data and methods

2.1 Research area

Our research area is the area around the Senegal River Delta, located in the region of Saint-Louis in the northern Sahel part of Senegal, upstream of Saint-Louis town and the estuary of the Senegal River. The area stretches over two rural communities, Gandon and Diama, in two of the three departments in the region, Saint-Louis and Dagana. The region has become one of the two principal horticultural export areas in Senegal, besides the Niayes region north of Dakar.

[4] While the impact evaluation literature has moved beyond the estimation of average welfare effects and heterogeneous effects have been analyzed in studies on the impact of entrepreneurship, contract-farming, standards and cooperative membership (e.g. Fisher and Qaim, 2012; Hansen and Trifkovic, 2014; Verhofstadt and Maertens, 2015; Narayanan, 2014; Ramaswami et al., 2009; Vial and Hanoteau, 2015), evidence on heterogeneous effects is largely lacking in the literature on high-value exports.

Since the mid 2000s five horticultural export companies established in the region: a first multinational company started to invest in the area in 2003 and realized its first export season in 2005; four other companies followed with exports since 2007. Horticultural exports from the region are increasing rapidly; the cultivated area is expanding and product variety is increasing. Tomatoes, beans and mangoes are the main export crops, and are largely destined for the European market. Production mainly occurs from October to May, when horticultural production in Europe is less competitive. The companies are all vertically integrated and lease land from rural communities to establish large-scale estate farms and one or several conditioning units. Approximately 5,000 people are employed on the fields and in the conditioning units of the companies in 2013; of which 80% female workers. The employees have daily, seasonal or more permanent employment contracts and mainly come from the surrounding villages.

Households in the research area belong to Wolof, Peulh and Maure ethnic groups. The majority of them are Muslim and live in large extended families within one compound. Polygamy is common in the area, with members of polygamist households living in the same compound. Traditionally, households in the research area are farm-households deriving income from cropping, including irrigated rice production and rain-fed vegetable production, and livestock-rearing, including selling of meat and milk from cattle, goats and sheep. Households increasingly complement their farm income with wages earned in the horticultural export companies or in other jobs. Small business activities, such as petty trade, hairdressing and tailoring are also emerging in the area.

2.2 Data collection

We conducted fieldwork in this area in the period 2006 - 2013 and collected data and information from several sources. First, we conducted semi-structured interviews with all five

horticultural export companies – the oldest ones several times throughout the period – on production activities, sourcing strategies, employment strategies and working conditions. Second, we conducted a two-round household survey, with the first baseline round implemented in February - April 2006 and the second follow-up round in April - June 2013. The panel period covers seven years during which the first export company expanded activities and four additional companies started export activities. The first survey round covered 284 households in 17 villages across the two rural communities Gandon and Diama. We used a two-stage stratified sampling design. In the first stage, villages were stratified according to their distance to the road and randomly selected within the strata with an oversampling of villages closer to the road. In the second stage, households in the sampled villages were stratified according to whether or not members of the household are employed in the horticultural export industry and randomly selected within the strata with an oversampling of households with employment. To draw population inferences from descriptive statistics, we use sampling weights to correct for the oversampling of households close to the road and employed in the horticultural export sector. The weights are calculated with census information from the rural communities and villages.

For the second survey round, we tried to resurvey all the households from the original sample but 25 households moved out of the region, an attrition rate of 8.8%. We do not know the reasons for their resettlement, but attrition bias is deemed to be sufficiently low because the relocated households are not statistically different from other sampled households. Four observations were not retained for the analysis in this paper because of missing information. The final sample consists of a balanced panel data set of 255 households.

We used a structured quantitative questionnaire with different modules. We used the same questionnaire in both survey rounds but in the follow-up survey some less relevant modules were dropped while other modules were added. The survey data include information

on demographic characteristics, productive assets, living standards, and income from agricultural production (both crop and livestock production), off-farm wage employment and self-employment, and non-labour income (mainly remittances). We complemented the household survey with a village survey to collect information on geographic and institutional characteristics of the sampled villages.

2.3 Poverty, inequality and income calculations

We calculate income per adult equivalent for both survey rounds. We define total income as the income a household earned during the 12 months before the survey. We include different sources of income: on-farm self-employment (both crop and livestock production), off-farm self-employment, wage employment (in horticultural export sector and other sectors) and non-labour income, such as received remittances and state subsidies. We use real income data to compare income over time and inflate all income data to 2013 price levels using consumer price indices (IMF, 2015). We use the modified OECD adult-equivalence scale, which assigns a value of 1 to the household head, 0.5 to each additional adult member and 0.3 to each child. We define a household as all members who lived, slept and ate together in the same compound for at least six months during the past year.

We derive incidence of poverty and extreme poverty using the national rural poverty and extreme poverty line of 2011, which we adapt to 2013 price levels using consumer price indices (République du Sénégal, 2014). A household is poor if per adult equivalent income is lower than 225,909 FCFA per year and extremely poor if it is lower than 141,521 FCFA per year[5]. As robustness check, we calculate poverty based on the Multidimensional Poverty Index, which takes into account households' living standards, health and education (Alkire and Santos,

[5] The national currency FCFA stands for *Franc Communauté Financière d'Afrique* and has a fixed exchange rate to the Euro: €1 is 655.957 FCFA.

2010). We have these data only for 2013. We calculate income inequality using the Gini coefficient. We correct all population statistics using sampling weights.

2.4 Econometric analysis

We estimate the effect of wage employment in the horticultural export sector and in other employment sectors on household income. We estimate mean effects and heterogeneous effects to reveal if the income effect of wage employment is different for poorer households than for better-off households.

2.4.1 Estimation of mean impact

We estimate the mean impact of wage employment on household income according to the following model:

$$\mathbf{Y_{ijt} = \beta E_{ijt} + \gamma X_{ijt} + \alpha_{ij} + \upsilon_{jt} + \theta_t + \varepsilon_{it}}, \qquad (1)$$

where β and γ are coefficients to be estimated, α_{ij} is a set of time-constant unobservable household variables, υ_{jt} is a set of time-variant unobservable village variables, θ_t is a year dummy (taking the value of one for 2013) and ε_{it} is a set of time-variant unobservable household variables. The dependent variable Y_{ijt} is the logarithm of income per adult equivalent of household *i* in village *j* at time *t*. It is measured as explained in section 2.3.

The main variable of interest E_{ijt} is specified in two alternative ways. First, we specify E_{ijt} as a vector of two variables: 1/ a dummy variable for household *i* in village *j* at time *t* having at least one member being employed for a wage in the horticultural export industry during the 12 months periods before the survey and irrespective of the length of that employment; and 2/ a similar dummy variable for wage employment in another sector (which is not the horticultural export sector). Second, we specific E_{ijt} as a dummy variable for wage employment in any sector (the horticultural export sector or another sector). Employment in the horticultural export sector represents all jobs that are performed in one of the five horticultural export companies in the

Senegal River Delta, and other sectors represents all other job types whereby a person received a wage in exchange for labour[6]. The majority of the jobs in this sector entail low-skilled professions, such as domestic, garment and construction workers. A minority of these jobs are high-skilled professions, such as teachers and civil servants. Our data are not detailed enough to distinguish further between low-skilled and high-skilled employment in other sectors. We use the definitions of employment in the horticultural export sector and other sectors for the remainder of this paper.

We include a vector of other explanatory time-variant household variables X_{ijt} that are likely to influence income. We control for human capital by including age, education, and gender of the household head, household size (both number of members able to work[7] and number of dependents), and physical capital by including total land and total livestock units that a household possesses. Additionally, we include the variable $\theta_{t,}$ to capture all temporal variation in the region between 2006 and 2013, such as weather shocks and price variation. We cluster the standard errors at village level and report robust errors.

We use a fixed effects regression to reduce the bias caused by a non-random assignment of households into wage employment. This model focuses on the variation within households over time and removes all time-invariant observable and unobservable household characteristics. This approach solves the potential endogeneity related to unobserved time-invariant heterogeneity. Forty percent of the sampled households switched wage employment status over time, which renders sufficient within-household variation to use a fixed effects approach.

[6] It is possible that a household is employed both in the horticultural export sector and other sectors. This was the case for 15 households in 2006 and 28 in 2013; respectively 5.9% and 11.0% of the total number of observations. As this sample size is very small, we do not include this group as a separate employment category.

[7] This is defined as the number of people between 18 and 65 years old and who are no student.

The fixed effects estimator can still suffer from endogeneity bias when unobservable time-variant factors are correlated with both income and the decision to be wage employed. We therefore include $\upsilon_{jt,}$ which is a set of village-year dummies to control for all time-variant village characteristics, including a change in wage employment opportunities (e.g. through expansion of a horticultural export company), a reduction in transaction costs (e.g. through road construction), or project interventions (e.g. through investments by the Senegalese government to develop new rice irrigation perimeters in villages along the Senegal River).

2.4.2 Estimation of heterogeneous impact

In a second step, we estimate the heterogeneous impact of wage employment on household income by using quantile regressions. While ordinary least squares regressions estimate impacts at the mean, quantile regressions estimate treatment effects at different quantiles of the outcome distribution. We extend the model of equation (1) and estimate a fixed effects panel quantile regression:

$$\mathbf{q_\tau}(\mathbf{Y_{ijt}}|\mathbf{E_{ijt}}, \mathbf{X_{ijt}}) = \boldsymbol{\beta_\tau}\mathbf{E_{ijt}} + \boldsymbol{\gamma_\tau}\mathbf{X_{ijt}} + \boldsymbol{\alpha_{ij}} + \boldsymbol{\upsilon_{jt}} + \boldsymbol{\theta_t}\ , \qquad (2)$$

where $q_\tau(Y_{ijt} \mid E_{ijt}, X_{ijt})$ is the τ^{th} conditional quantile of the logarithm of income per adult equivalent and τ ranges between zero and one. The coefficient β_τ represents the estimated percentage change in income of a change in employment status over time at the τ^{th} quantile of the log income distribution.

We follow the approach proposed by Canay (2011) to estimate the panel quantile regressions. This approach has recently been used e.g. by Nguyen et al. (2013) who investigate the magnitude of earnings gaps between the informal and formal sector in Vietnam, and by Vial and Hanoteau (2015) who investigate the returns of micro-entrepreneurship in Indonesia. The estimation procedure consists of two steps. First, we run a standard fixed effects model at the conditional mean of the logarithm of income and get an estimator for the household specific

effects, α_{ij}. Canay (2011) assumes that α_{ij} has a pure location shift effect on the conditional quantiles of the dependent variable. In other words, α_{ij} is assumed to affect all quantiles in the same way. Second, we generate a new dependent variable by subtracting the estimator for α_{ij} from Y_{ijt} and run a quantile regression for different quantiles on this new dependent variable. We apply 100 bootstrap replications on this two-step estimation procedure to correct the standard errors.

3 Results

3.1 Employment and welfare dynamics

Our results show that economic development in the Senegal River Delta has been remarkably pro-poor. Between 2006 and 2013, there was a substantial poverty reduction and a slight decrease in income inequality region (figure 1). The rate at which poverty and inequality decreased is much higher than in (rural) Senegal in general. The incidence of poverty decreased with 19.2 percentage points from 54.1% in 2006 to 34.9% in 2013; and the incidence of extreme poverty with 6.7 percentage points from 30.6% to 23.9%. Over a similar time period (2005 - 2011) the incidence of rural poverty in Senegal in general decreased with only 1.7 percentage points while the incidence of extreme poverty even increased with 0.4 percentage points. The Gini coefficient for the Senegal River Delta decreased with 4.2 percentage points from 42.8% in 2006 to 38.6% in 2013 while the Gini coefficient in Senegal increased from 39.2% in 2005 to 40.3% in 2011.

Table 1 summarizes the labour market participation of rural households in the research area in 2006 and 2013. The horticultural export sector is the main source of wage employment in the area, providing jobs for 42% of the households in 2013. As the sector expanded after initial investments and exports, employment increased from 30% of households in 2006 to 42% in 2013. Also wage employment in other sectors increased, from 10% of households in 2006 to

25% of households. Overall labour market participation increased from 37% to 54%, implying that some households are employed in multiple sectors. The labour market participation rates along the income distribution reveal that for 2006 households in the upper income classes are more likely to be employed, while for 2013 labour market participation is more evenly distributed. This differs substantially across the sectors. For the horticultural export industry we find the highest employment rates in the lowest income classes while for other sectors we find the highest employment rates in the highest income classes. Expansion of employment in the horticultural export sector between 2006 and 2013 especially includes households below the median income quantile, while expansion of employment in other sector is highest for households in the highest income decile.

Table 2 presents poverty and income data for 2006 and 2013, distinguishing between self-employed households (these are households without wage employment who derive their income from self-employment in agriculture, livestock rearing and/or small businesses), and households with employees in the horticultural sector and in other sectors. In 2006, households with employees in the horticultural export sector have a significantly higher total income but are as likely to be poor as self-employed households. Households with employees in other sectors have a significantly higher total and per capita income and are less likely to be poor than self-employed households. In 2013, income levels are substantially higher and poverty incidences substantially lower for all households. Income increased more rapidly for households with employees and we observe significantly larger total and per capita incomes in 2013 for households with employees than for self-employed households. Poverty reduction is most sharp among households with employees in the horticultural export sector. The incidence of poverty and extreme poverty among these households reduced from 54% to 25% and from 30% to 15% respectively, resulting in significantly lower poverty rates than for self-employed households. These data on income poverty are corroborated by the data on multidimensional

poverty based on households' living standards, health and education. The figures in table 2 further reveal that wages earned in the horticultural export industry and other sectors contribute the major part of total household income for households with employees while self-employed households derive their income mainly from agricultural production and non-farm businesses.

Figure 3 presents the cumulative income distribution for households with employees versus self-employed households. For employment in the horticultural export sector (right panel), we observe that for 2006 the income distribution is very similar to the one for self-employed households. For 2013 the income levels of households with employees are higher than those of self-employed households with the largest differences at lower income levels and convergence toward to highest income levels. The figures suggest that wage employment in the horticultural export industry is positively correlated with total income, especially for households at the lower end of the income distribution. For employment in other sectors, we observe a different pattern. Income levels of households with employees are consistently higher than those of self-employed households but the difference is highest for medium income levels in 2006 and for upper income levels in 2013. This suggest that employment in other sectors is correlated with higher total household income, and this correlation becomes stronger for relatively wealthier households.

3.2 Job and worker characteristics

To compare working conditions across sectors we present estimates of average wages and employment days (table 3) and kernel density distributions of these variables (figure 4). First, we observe that daily wages in the horticultural export sector are on average lower than in other sectors. This difference has become more pronounced over time as the average real wage in other sectors increased with 66% while in the horticultural export sector there is hardly an

increase. We need to note that wages in the export companies are on average 67% higher than the national minimum wage of 1,500 FCFA per day. The variability in wages is larger in other sectors – likely because of more variability in the type of jobs – and the distribution is skewed with a long tail towards higher wages but with a similar median value as for the horticultural export sector. Second, the average number of days worked per year is substantially smaller in the horticultural export sector than in other sectors. Workers are hired in export companies for on average 6.8 months in 2006 and 8.2 months in 2013 while employment in other sectors is almost full-time and year-round. This reflects the seasonal character of horticultural export activities that are concentrated in the off-season in Europe. The distribution of employed days in the horticultural export sector shows a bimodal pattern, which reflects the employment of day-to-day workers during peak labour times and the employment of seasonal workers with a contract of six to eight months. The increase in number of working days over time for employment in export companies is important. Companies have been able to expand their product variety and to prolong their export season, which results in longer employment periods for temporary workers.

Table 4 presents demographic household characteristics for 2013, distinguishing between self-employed households, households with employees in the horticultural export sector and households with employees in other sectors. We observe that households with employees in the horticultural export sector and in other sectors, have significantly more workers and more dependent household members, a higher likelihood to be ethnic Peulh, and live closer to Saint Louis town than self-employed households. The level of education is higher for households with employees than for self-employed but the level of education in general is very low with the large majority of household heads not having finished primary school. Households with employees in the horticultural export sector have significantly less agricultural

land – which might be an important push factor for employment – and live closer to export companies – which might be an important pull factor for employment.

3.3 The impact of wage employment on income

In this section we report the results of the fixed effects and quantile fixed effects regression estimations of the impact of wage employment in the horticultural export sector and in other sectors on household income – results are summarized in table 5. The full set of regression results are included in appendix; tables A1 and A2 report respectively the results of the regressions for wage employment in the horticultural export sector and in other sectors, and wage employment in any sector. We first report the mean effects from the fixed effects estimations and then turn to the heterogeneous effects from the quantile fixed effects estimations.

First, the results show that wage employment in the horticultural export sector does not have a significant mean effect on per capita income. While the estimated coefficient is quite large, showing an income increase of 37.5 %, the effect is statistically not significant due to a large standard error. For employment in other sectors we find a large positive effect on household income of 83%, which is significant at the 1% level. For overall wage employment in any sector the estimated coefficient is 75% but not significant. We control for overall variation over time by including a time dummy. The significant positive effect of this time dummy shows that ceteris paribus household income in the region increased with 56% between 2006 and 2013. The estimated coefficients for household characteristics are not significant, likely because of limited variation over time.

Second, the results from the quantile fixed effects regression show the heterogeneous impact of wage employment at the 10%, 25%, 50%, 75% and 90% quantiles of the income distribution. The results for labour market participation in general show large and statistically

significant effects of employment on income per capita at all quantiles. The point estimates are largest for the lower quantiles – for example, employment increases income per capita with 89% at the 10% quantile – and they decline towards the higher quantiles – for example, employment increases income per capita with 40% at the 90% quantile. The impact of employment differs significantly across quantiles, justifying the use of quantile regressions. The estimated effects of employment in the horticultural export industry are strongest for the poorest income groups, at the 10 to 50% quantiles of the income distribution. Wage employment in the horticultural export sector increases income per capita with 53% at the 10% quantile, with 49% at the 25% quantile, and with 30% at the 50% quantile. The effect reduces to less than 15% and is not significant at the 75 to 90% quantiles, implying that wage employment in horticultural export sector does not benefit relatively wealthier households in the region. The estimated effects of employment in other sectors are similar in magnitude and statistically significant across the income quantiles. Employment in other sectors increases income per capita with 74% at the 10% quantile, and this effect increases slightly for the higher income quantiles to 84% at the 90% quantile.

4 Discussion

The results reveal that expansion of the horticultural export sector in the Senegal River Delta has brought about substantial positive welfare effects by increasing the incomes of the poorest half of the rural population through employment on the fields and in the conditioning centers of the export companies. The sector has created employment that is accessible for poorer and better-off households, and that increases the incomes of wage workers in the poorest half of the population with 30% and in the poorest 10% of the population with 53%. A decade after the first investments were made, the horticultural export sector has contributed substantially to poverty reduction in the region.

Our results corroborate and nuance the findings from cross-sectional studies on the impact of employment in high-value export sectors. Maertens and Swinnen (2009) and Maertens et al. (2011) previously documented average income effects of 47% to 60% for employment in the horticultural export industry in the Niayes region and the Senegal River Delta region. The evidence in this paper corroborates this earlier finding and additionally shows that the income effect persists over time and that specifically for the poorest quantiles the impact of employment on income is high. Evidence from cross-sectional studies on other sectors and countries is very limited. One study points to slightly larger income effects; Herrmann and Grote (2015) find that employment in the Malawi sugarcane export industry doubles rural incomes. Another study indicates that employment in high-value export sectors has no impact; Trifkovic (2014) finds no significant effect of employment in the Vietnamese catfish export sector on household income. Cross-sectional studies are likely more prone to over- or underestimation of impacts but results on the magnitude of income effects likely remain country- and sector-specific. Our study documents the importance of looking beyond mean income effects and analysing heterogeneous effects across the population. The more nuanced effect that especially poorer households benefit – as we show for the horticultural export sector in Senegal and as has been indicated by Barron and Rello (2000) based on qualitative evidence for the tomato industry in Mexico – might remain hidden in the estimation of mean effects.

Our results suggest that employment in the horticultural export sector is more pro-poor and inequality reducing than employment in other sectors in the research area. Employment in the horticultural export sector has the highest impact on income for the poorest households and is also most inclusive towards these households. Contrary, employment in other sectors has the largest impact on income for households at the upper end of the income distribution and is not inclusive towards the poorest households. Employment participation rates for the horticultural export sector are higher than for other employment sectors along the whole income distribution

(apart from the upper 10% of the income distribution) and much higher among the poorest 10% of the population. This documents the importance of the sector and its impact on pro-poor development in the research area.

Yet, the estimated income effect of employment in other sectors is higher than the estimated income effect of employment in the horticultural export sector, along the whole income distribution. This likely relates to longer employment periods in other sectors, where jobs are more year-round and full-time, and the seasonality of horticultural export activities that are confined to a specific export window and result in temporary jobs. It is less likely that the higher income effect of employment in other sectors relates to wages. Apart from a few households with access to highly remunerative jobs, there is not much difference in the distribution of wages between the two sectors. Our results do not at all confirm the assertions in the literature that high-value export sectors provide inferior and insecure jobs for which wages are too low to get people out of poverty (Barrientos et al., 2000; Barron and Rello, 2000; Ortiz and Aparicio, 2007; Patel-Campillo, 2010; Ulrich, 2014). With panel data we are able to show substantial long-term income effects of employment in the horticultural export sector in Senegal and with quantile regressions we are pointing to strong poverty-reducing effects. More nuanced findings would be possible if the heterogeneity in other employment sectors could be taken into account. This is difficult with our data because of the relatively low number of observations involved in wage employment outside the horticultural export sector and because more detailed information on other employment sectors is lacking.

We find large and positive effects of participation in the labour market on household income. This is consistent with the idea in the broader development literature that labour market development and off-farm employment is important for rural development (Barrett et al., 2001; Haggblade et al., 2010; Lanjouw and Lanjouw, 2001). Empirical studies from various countries have shown that off-farm income in general, and wages in particular, increase rural incomes

(Cramer et al., 2008; Oya, 2013; Rizzo et al., 2015); and that non-farm work has a positive effect on nutrition and food security (Babatunde and Qaim, 2010; Owusu et al., 2011). Our study adds to this evidence but also contradicts it to some extent. Much of the evidence suggests that the poorest segment of the rural population is either excluded from off-farm employment opportunities or ends up in insecure and low-paid jobs that do not make major contributions towards improving welfare (Oya, 2013; Loison, 2015). There is ample evidence that upper income groups benefit more from rural wage employment than lower income groups; for example for Ghana and Uganda (Canagarajah et al., 2001), for Ethiopia (Bezu et al., 2012), for Honduras (Ruben and van den Berg, 2001), for India (Scharf and Rahut, 2014), and for Bangladesh (Mishra et al., 2015). This implies that rural labour markets are inequality increasing. This is consistent with our results for employment in other sectors in the research area, which are found to be most inclusive towards better-off households and have the largest income effect for those households. In contrast, the horticultural export sector is found to be most inclusive towards the poorest households and to have the largest relative impact for these households, which implies that these value chains contribute disproportionately to reducing inequality.

5 Conclusion

This paper is the first to present panel data evidence on the longer-term impact of expansion of global value chains and large-scale export-oriented farms in developing countries. We estimate long-term income effects of wage employment in the horticultural export sector in the Senegal River delta. We use panel data from two survey rounds and fixed effects quantile regressions to control for selection bias and estimate heterogeneous effects; and compare the horticultural export sector with other employment sectors in the research area. In the seven-year period since the first horticultural exports were realized, exports increased rapidly, employment in the sector

expanded substantially and poverty in the region reduced much faster than elsewhere in the country. The horticultural export sector has created employment that is accessible for poorer and better-off households, and that significantly increases household income. The income effect of employment in the horticultural export sector is strongest for the poorest households. We conclude that expansion of the horticultural export sector in Senegal has been particularly pro-poor and increased the incomes of workers in the poorest half of the rural population with 30 to 60% through employment on the fields and in the conditioning centers of the export companies.

Employment in the horticultural export sector is more pro-poor than employment in other sectors in the research area as it has the highest impact on income for the poorest households and is also more inclusive towards these households. This finding contradicts much of the literature on rural labour markets that points to better-off households gaining most from wage employment and off-farm income. Possible reasons why the horticultural export sector in Senegal is more pro-poor and inequality-reducing than other employment sectors, may relate to the combined effect of the size of the sector and its rapid expansion in an area where very few employment opportunities existed; the intensity of low-skilled labour in the sector; and the relative high return to that labour from selling a high-value product in high-value markets. Our results do not support the assertions in the literature that high-value export sectors provide inferior and insecure jobs for which wages are too low to get people out of poverty.

Using panel data we were able to corroborate the findings from earlier cross-sectional studies on the labor market and income effects of high-value exports; and using quantile regressions we were able to point to strong heterogeneity in the income effects and show a strong poverty-reducing impact. While panel data allow to better deal with selection bias, estimation of heterogeneous impacts can lead to more nuanced findings than average welfare effects.

Our findings provide evidence in the debate on globalization and development; particularly in the discussion whether or not the integration of developing countries in global trade stimulates pro-poor growth and reduces inequality, and in the discussion on large land-lease deals in these countries (Deininger and Byerlee, 2012; Pieters et al., 2016; Wade, 2004; Ezcurra and Rodríguez-Pose, 2013). For Senegal in specific, further expansion of horticultural exports is likely to further improve rural incomes and reduce poverty but might have a superior welfare effect if product and/or destination variety could increase in such a way that export activities become less seasonal (which is possible in the Senegal River Delta where irrigation water is well accessible) and more year-round employment can be created.

Obviously, our findings are specific for our case study. Land and water are relatively well accessible in our research area and effects might be different in other regions where the conditions for the expansion of high-value export chains differ, e.g. where access to land is more problematic. Our study implies that it is important to pay attention to labor market issues for policy-makers concerned with channeling the implications of trade and foreign direct investments, and for researchers evaluating the impact of globalization on development.

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Figures

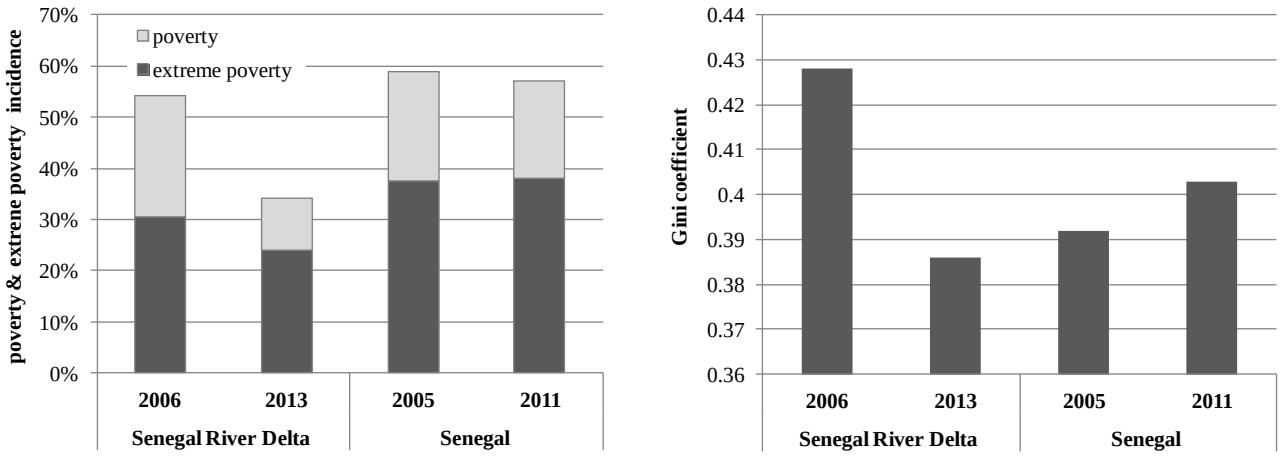

Figure 1: Poverty headcount ratio (left panel) **and Gini coefficient** (right panel) **for Senegal and the Senegal River Delta.** Poverty measures are based on national rural poverty and extreme poverty lines. *Source*: République du Sénégal (2014), World Development Indicators (2016), and own calculations based on survey data.

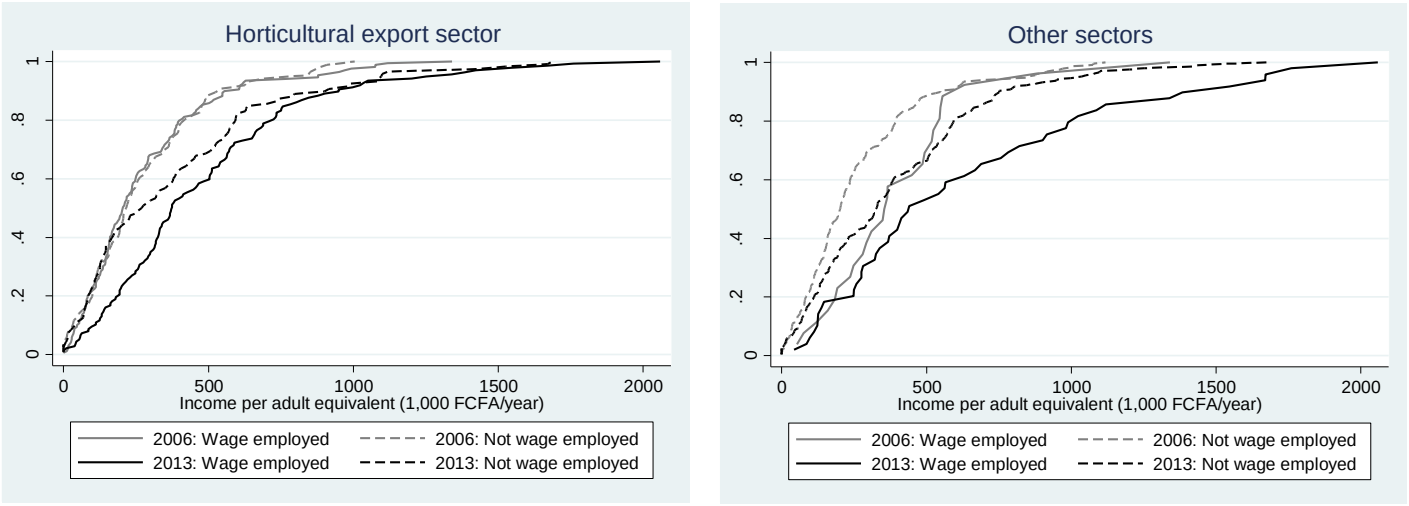

Figure 2: Cumulative real income distribution in 2006 and 2013 for households with employees in the horticultural export industry versus households without employees (left panel) **and for households with employees in other sectors versus households without employees** (right panel). *Source:* derived from survey data.

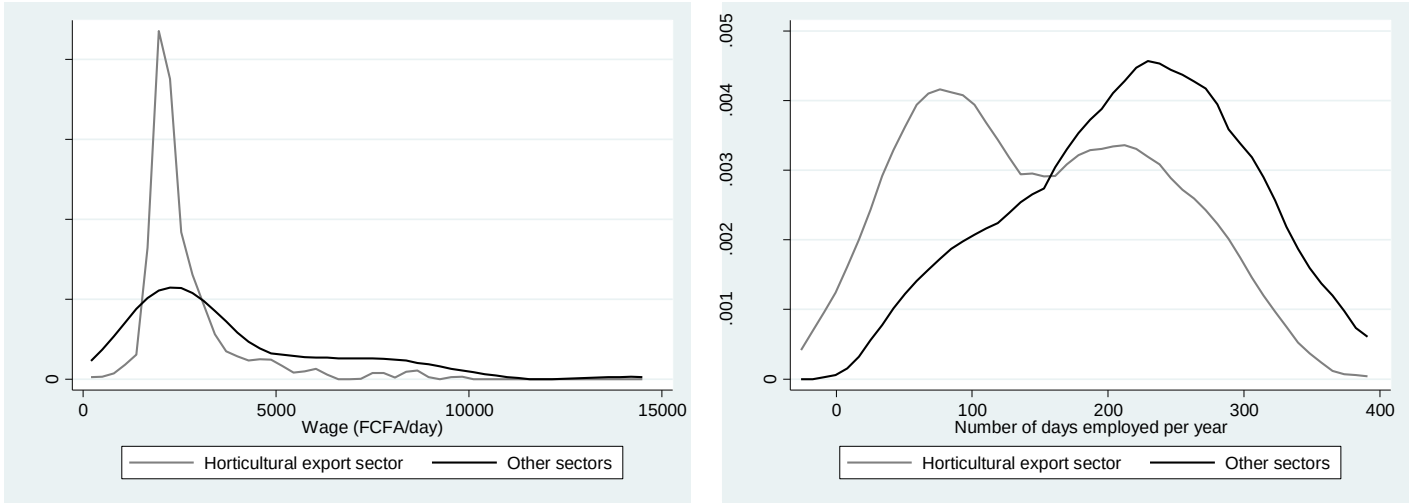

Figure 3: Kernel density distribution for wages (left panel) **and employment days** (right panel) **in the horticultural export sector and in other sectors.** Data are pooled for 2006 and 2013. *Source:* derived from survey data.

Tables

Table 1. Labour market participation rates in the Senegal River Delta in 2006 and 2013

	Total population	Income distribution (from low to high income)					
		0-10 %	10-25%	25-50%	50-75%	75-90%	90-100%
2006							
Employment in horticultural sector	0.30	0.06	0.13	0.26	0.53	0.30	0.53
Employment in other sectors	0.10	0.00	0.03	0.02	0.13	0.31	0.10
Employment in any sector	0.37	0.06	0.15	0.27	0.60	0.54	0.55
2013							
Employment in horticultural sector	0.42	0.63	0.30	0.45	0.34	0.46	0.56
Employment in other sectors	0.25	0.00	0.28	0.24	0.11	0.33	0.63
Employment in any sector	0.54	0.63	0.38	0.65	0.38	0.55	0.85

Source: Calculated from survey data.

Table 2. Poverty incidence and income levels for households with and without employees for 2006 and 2013

	2006			2013		
	Self-employed households	Households with employees in horticultural export sector	Households with employees in other sectors	Self-employed households	Households with employees in horticultural export sector	Households with employees in other sectors
Number of observations	75	169	26	97	137	49
Share of poor households[a] (%)	58.67	54.44	23.08***	50.52	25.55***	18.37***
	(5.72)	(3.84)	(8.43)	(5.10)	(3.74)	(5.59)
Share of extremely poor households[a] (%)	34.67	30.18	11.54**	37.11	15.33***	16.33***
	(5.53)	(3.54)	(6.39)	(4.93)	(3.09)	(5.33)
Share of multidimensionally poor households[b] (%)	*NA*	*NA*	*NA*	36.34	31.69**	25.21***
				(1.68)	(1.53)	(2.19)
Total household income (1,000 FCFA/year)	1,222	1,953***	2,006***	1,408	2,487***	3,491***
	(136)	(141)	(219)	(135)	(180)	(380)
Income per adult equivalent (1,000 FCFA/year)	261	279	406***	349	484***	640***
	(26)	(19)	(53)	(35)	(32)	(73)
Average share of income (%) from						
wage employment	0.00	54.39***	63.00***	0.00	56.34***	68.26***
	(0.00)	(2.17)	(3.89)	(0.00)	(2.74)	(4.24)
self-employment in agriculture	41.49	27.31***	19.27***	42.35	15.40***	11.90***
	(4.46)	(2.07)	(4.15)	(4.35)	(2.00)	(3.07)
non-farm self-employment	41.76	11.40***	11.25***	31.03	19.86***	14.77***
	(4.36)	(1.42)	(3.62)	(3.87)	(2.28)	(3.20)
non-labour	19.72	8.00***	6.48**	27.07	11.30***	8.93***
	(3.76)	(1.23)	(2.40)	(3.78)	(1.64)	(2.22)

We used one-sided t-tests to compare households without employees and households with employees in the horticultural export/other sectors. Significant differences are indicated with * p<0.1, ** p<0.05 or *** p<0.01. Standard errors are reported between parentheses. Households with employees in the horticultural export sector and households with employees in other sectors are not mutually exclusive classes.

[a] Poverty measure based on the national rural (extreme) poverty lines (République du Sénégal, 2014).

[b] Poverty measure based on the Multidimensional Poverty Index, calculated according to the guidelines by the UNDP (Alkire and Santos, 2010).

Table 3. Wages and employment duration in different employment sectors in 2006 and 2013

	Employment in horticultural export companies			Employment in other sectors		
	2006	2013		2006	2013	
Number of observations	169	137		26	49	
Daily wage (FCFA/day)	2,537	2,550		3,002	4,982	**
	(1,135)	(1,061)		(2,087)	(3,890)	
Number of working days per employee	135	163	***	215	245	
	(93)	(79)		(98)	(91)	

Standard deviations are reported in parentheses. Comparisons are made over time within employment sectors using t-tests. Significant differences are indicated with * $p<0.1$, ** $p<0.05$ or *** $p<0.01$.

Table 4. Demographic characteristics of households by employment status for 2013

	Self-employed households	Households with employees in horticultural export sector		other sectors	
Number of observations	97	137		49	
Age of HH head (years)	58.05	59.31		59.37	
	(1.40)	(1.13)		(2.31)	
Female HH head (%)	9.28	8.76		16.33	
	(2.96)	(2.42)		(5.33)	
Education of HH head (years)	1.46	2.65	***	3.18	***
	(0.29)	(0.32)		(0.55)	
Number of workers[a]	4.45	5.70	***	6.33	***
	(0.30)	(0.27)		(0.46)	
Number of dependents[a]	5.20	5.86	*	6.65	***
	(0.28)	(0.32)		(0.55)	
Total land (ha)	5.20	1.93	**	3.54	
	(1.57)	(0.25)		(0.79)	
Livestock units[b]	8.18	8.89		7.80	
	(1.78)	(1.67)		(3.37)	
Wolof ethnicity (%)	59.79	37.96	***	42.86	**
	(5.00)	(4.16)		(7.14)	
Peulh ethnicity (%)	15.46	35.04	***	38.78	***
	(3.69)	(4.09)		(7.03)	
Distance to Saint-Louis (km)	30.98	24.51	***	22.98	**
	(0.98)	(1.00)		(1.58)	
Distance to closest company (km)	4.29	2.60	***	3.37	
	(0.32)	(0.20)		(0.43)	
Lives next to road (%)	64.95	62.77		73.47	
	(4.87)	(4.15)		(6.37)	

We used one-sided t-tests to compare households with and without employees in the horticultural export / other sector. Significant differences are indicated with * p<0.1, ** p<0.05 or *** p<0.01. Standard errors are reported between parentheses. Households with employees in horticultural export sector and in other sectors are not mutually exclusive.

[a] HH members who are able to work are all members between 18 and 65 who are no student, while the dependent HH members are the remaining people in the HH.
[b] One tropical livestock unit (TLU) equals 1 cow/horse, 0.8 donkey, and 0.2 sheep/goat.

Table 5. Results of fixed effects and quantile fixed effects estimations of the impact of wage employment on the logarithm of income per adult equivalent

	Mean effect	Quantile fixed effects regression				
		Q10	Q25	Q50	Q75	Q90
Wage employment in the horticultural export sector	0.375 (0.411)	0.527 *** (0.202)	0.494 *** (0.131)	0.297 *** (0.105)	0.142 (0.141)	0.146 (0.107)
Wage employment in other sectors	0.831 *** (0.269)	0.742 *** (0.128)	0.566 *** (0.133)	0.625 *** (0.114)	0.824 *** (0.137)	0.842 * (0.139)
Wage employment in any sector	0.750 (0.406)	0.891 *** (0.226)	0.658 *** (0.130)	0.519 *** (0.087)	0.490 *** (0.135)	0.400 * (0.167)

The reported results are summary results from two full regression models that are presented in Tables A1 and A2 in appendix. In the first model employment is specified as a vector of two variables (a dummy for employment in horticultural export sector and a dummy for employment in other sectors), while in the second model employment is specified as a dummy for wage employment in any sector. The first column reports the average effect of a change in employment status on the logarithm of income per adult equivalent using the fixed effects panel approach. The other columns report the effect of a change in employment status on the logarithm of income per adult equivalent estimated at different quantiles of the income distribution using the fixed effects quantile panel approach. Bootstrapped standard errors clustered at village level are reported in parentheses. Significant coefficients are indicated with * $p<0.1$, ** $p<0.05$ or *** $p<0.01$.

Appendix

Table A1. Full regression results of determinants of the logarithm of income per adult equivalent using fixed effects panel regressions and panel quantile regressions.

Variables	Average impact	Q10	Q25	Q5
Wage employment in horticultural sector	0.375	0.527 ***	0.494 ***	0.29
	(0.411)	(0.202)	(0.131)	(0.10
Wage employment in other sector	0.831 ***	0.742 ***	0.566 ***	0.62
	(0.269)	(0.128)	(0.133)	(0.11
Age of HH head	-0.022	-0.019 ***	-0.018 ***	-0.01
	(0.016)	(0.004)	(0.003)	(0.00
Female HH head	-0.210	-0.160	-0.183	-0.24
	(0.491)	(0.172)	(0.122)	(0.13
Education of HH head	-0.034	-0.036 **	-0.027 **	-0.02
	(0.057)	(0.016)	(0.013)	(0.01
Number of HH members able to work	-0.039	-0.032 *	-0.028 **	-0.03
	(0.065)	(0.017)	(0.014)	(0.01
Number of dependent HH members	-0.052	-0.048 ***	-0.046 ***	-0.03
	(0.047)	(0.016)	(0.011)	(0.01
Total land	-0.023	-0.021 **	-0.025 ***	-0.02
	(0.016)	(0.009)	(0.007)	(0.00
Livestock units	0.008	0.007 *	0.007	0.01
	(0.012)	(0.004)	(0.004)	(0.00
2013 dummy	0.274 *	0.245	0.783 **	0.48
	(0.154)	(0.525)	(0.393)	(0.28
Constant	13.751 ***	12.687 ***	12.683 ***	13.40
	(1.228)	(0.330)	(0.331)	(0.28
Village fixed effects	Included	Included	Included	Include
Number of observations	507	507	507	50
R^2 - between	0.003	/	/	
R^2 - within	0.139	/	/	

Variables are specified in Table 4. Standard errors are reported in parentheses. Significant coefficients are indicated with * p<0.1,

Table A2. Full regression results of determinants of the logarithm of income per adult equivalent using fixed effects panel regressions and panel quantile regressions.

Variables	Average impact	Q10	Q25	Q5
Wage employment in any sector	0.750	0.891 ***	0.658 ***	0.51
	(0.460)	(0.226)	(0.130)	(0.087
Age of HH head	-0.023	-0.017 ***	-0.017 ***	-0.02
	(0.016)	(0.004)	(0.004)	(0.003
Female HH head	-0.270	-0.150	-0.238 *	-0.29
	(0.526)	(0.158)	(0.130)	(0.144
Education of HH head	-0.033	-0.021	-0.023 **	-0.02
	(0.056)	(0.016)	(0.009)	(0.009
Number of HH members able to work	-0.045	-0.055 ***	-0.032 **	-0.03
	(0.065)	(0.019)	(0.013)	(0.013

Number of dependent HH members	-0.055		-0.034	**	-0.043	***	-0.04
	(0.046)		(0.015)		(0.012)		(0.012
Total land	-0.021		-0.016	*	-0.021	***	-0.02
	(0.016)		(0.009)		(0.005)		(0.007
Livestock units	0.009		0.011	**	0.008		0.01
	(0.009)		(0.005)		(0.005)		(0.005
2013 dummy	0.556	***	0.458		0.983	**	0.74
	(0.147)		(0.442)		(0.399)		(0.312
Constant	13.622	***	12.342	***	12.484	***	13.48
	(1.199)		(0.396)		(0.363)		(0.274
Village fixed effects	Included		Included		Included		Include
Number of observations	507		507		507		50
R^2 - between	0.003		/		/		
R^2 - within	0.156		/		/		

Variables are specified in Table 4. Standard errors are reported in parentheses. Significant coefficients are indicated with * p<0.1,