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Socioeconomic dynamics resulting from structural transformation and agriculture transition in Ghana

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ABSTRACT

Since 1990 Ghana's economy has accelerated sharply and the level of overall poverty experienced a significant decrease. Agriculture is still playing an important role but is gradually replaced by the progressive expansion of the non-agricultural economy, in particular the services sector. Using nationally representative data from the Ghana Living Standards Surveys by the World Bank for 1991, 1998 and 2005, we examine recent trends in the reallocation of labour across sectors, agriculture production, input adoption and socio-economic characteristics of the households, both at national and regional levels. We attempt to advance the analysis of structural transformation in Ghana by investigating the determinants of household labour allocation via a micro-econometric approach based on synthetic panels (Dercon, 1985). This analysis shows that structural transformation is occurring at different speeds across the country leading to the development of a "north-south dualism". While northern regions' economies are still relying on low productive agriculture, the "Services revolution" is gradually shaping the southern regions economy. Regression-based results suggest that factors such as households' demographic composition, level of education, poverty status, migration flows, access of infrastructure and financial services are all factors contributing to labourers' occupation choices.

Keywords: Structural Transformation, Synthetic Cohort, Agriculture transition, Regional Development, Ghana

JEL Codes: E24; J62; O11; O40; O55; Q12; R11; R20

PAPER

1. Introduction

The debate on Sub-Saharan Africa's economic growth and poverty alleviation has recently seen a resurgence of interest by policy makers and the academic world on the role of structural transformation (AfDB, 2013, ACET, 2014). The structural transformation process that consists in the reallocation of labour from traditional agriculture sectors to industry and services[2], started in Europe with the industrial revolution (Kim, 2007, Allen, 2009) before spreading out in Africa, Asia and Latin America, where countries started a quicker and more mixed transition with respect to the rest of the world. This process evolved differently throughout the developing countries: while Asian economies rapidly evolved "from flying geese into leading dragons" (Lin, 2012) the African shape of structural transformation was radically different. Many countries experienced substantial amounts of labor reallocation across sectors and the sectoral composition of their economies generally shifted from mostly agrarian to a combination of agriculture, industry and services. A great movement of farmers away from rural areas led to a drop in the agricultural value added and employment since the 1960s. Industries lost ground since the mid-1970s and globalization did not realize the promise of growth. Inter-sectoral mobility of labour went in the wrong direction, shifting from more productive to less productive sectors, with services instead of manufacturing becoming the primary recipient of labour exiting from agriculture. Not much recovery seemed to take place, with African countries remaining under-industrialized at all levels of income (McMillan et al., 2012, Rodrik, 2014).

Since Fisher (1939) and Kuznets (1966), who included structural transformation as one of the six most relevant stylized facts of development, a vast macroeconomic literature stressed this topic in several ways. A useful review of this literature is provided by Herrendorf et al. (2011) who highlighted the importance of multi-sector models to control for the complexities and the two-way causality relationship between economic growth and structural change. Recent literature examined the relationship between structural transformation and productivity gaps (Caselli, 2005; Duarte and Restuccia, 2010), urbanization (Michaels, 2012; Gollin et al. 2013, Christiansen et al., 2013), demographic transitions (Beegle, Weerdt, and Dercon, 2011; de Brauw et al., 2014), land institutions (Deininger et al., 2014), farming systems (Jayne et al, 2014) and environmental externalities (Antoci et al. 2009, 2012). Despite the huge potential for structural change due to the high share of the labour force in agriculture in most

[1] Authors listed in alphabetical order.
[2] See Lewis, 1954, Kuznets, 1966, Maddison, 1980 and Chenery et al., 1986 among others.

of Sub-Saharan Africa (SSA), literature on structural transformation in Africa has been not investigated much. Only recently, contributions on this topic experienced an important improvement. Authors like de Brauw et al. (2014), Christiansen and Todo (2014), McMillan et al. (2014a) and De Vries et al. (2015)[3] started to fill this gap by analysing gains/losses and consequences for economic growth and poverty reduction objectives[4] of structural transformation in Africa.

Experiences from developing countries achieving such targets usually indicate that the drivers of growth and development differ not only between countries, but also within the same country. Labour reallocation itself changes, depending on cultural and environmental factors, often not modeled within macro-level analysis but yet representing the assumption on which these are based. It is thus hard to give a precise insight of the drivers affecting structural transformation and labour movements across sectors without controlling for the host of heterogeneity arising from differences at regional level or - better - at household level (Foster and Rosenzweig, 2007; Fox and Sohnesen, 2012). In this sense, the microeconomic perspective is quite relevant, since it better reflects individuals' occupational choices by looking specifically at their local heterogeneity. The availability of questionnaires on individuals' employment sector, time use, income, wage and other relevant labour-related indicators helps makes the construction of productivity measures easier. These, once paired with other relevant covariates can improve the understanding of labour allocation decisions.

At the moment, research at micro-level on structural transformation is scant, in particular if considering its microeconomic dimensions in a context of labour reallocation. To the best of our knowledge only recently authors like Christiansen and Kaminski (2015) and McCullough (2015) focused on micro-level empirical research on structural transformation. The first looked deeply into the distribution of productivity levels within sectors by proposing a micro-level decomposition approach of consumption growth and poverty reduction in Uganda. The second provided a descriptive overview of the key features of structural transformation in four different African economies.

Country level studies on Ghana's structural transformation (Breisinger et al. 2009; Kolavalli 2010, Jedwab 2011, Jedwab and Osei, 2012) often concentrate on the evolution of demographic, employment and productivity indicators at the national level, leaving very little space for micro-level scale considerations. The contribution of this study lies in filling this gap by providing, on the one hand, a descriptive review of changes in the structure of the workforce and the evolution of agricultural and socio-economic characteristics of households living in rural areas over a period of 20 years; on the other hand, a micro-level empirical assessment using Weighted Least Squares to identify the determinants and the key correlates that can explain the likelihood of households changing the distribution of labour across the different occupational sectors. Ghana is of particular relevance to our purposes for two reasons. The first is related to its enormous structural transformation potential: its average GDP growth rates increased in the last decades, the number of poor reduced, and – most importantly – according to WDI (2014) the number of people employed in agriculture decreased by 18% in the last 20 years, with the sector still employing 44% (in 2013) of the economically active population. The second is the availability of data over a 25 year time span, which is long enough to capture structural variation in the country's economy. We base our analysis on the Ghana Living Standards Surveys from 1991/92, 1998/99 and 2005/06 designed by The World Bank. The GLSS data include detailed information on households' social and economic characteristics, as well as a detailed section on agriculture activity. From this we have drawn variables related to farm activity, agriculture inputs and farming equipment and livestock. However, in both developed and developing countries, long-running panel datasets are rare, whereas cross sectional household surveys are often conducted on a regular basis. Although such surveys do not allow following individuals over time, to overcome the unavailability of panel data, groups of people may be tracked from one wave to another by the use of cohort clusters (Deaton, 1985) rather than observations at the individual or household level in a "pseudo-panel" framework.

The rest of the paper is organized in two parts. The first part begins with section 2 by providing some stylized facts of Ghana's economic growth, poverty reduction and structural transformation, and ends up with a descriptive analysis of the process of structural transformation both at national and regional scales. The second part of the paper focuses on the econometric analysis: section 4 describes the econometric model and section 5 provides the econometric results. A final section concludes.

2. Economic growth and structural transformation in Ghana: aggregate stylized facts

By African standards, Ghana has done reasonably well in recent years, representing a success story of noteworthy poverty reduction and significant economic growth. In relation to poverty reduction, the level of overall poverty among the Ghanaian population fell from 52% in 1991/92 to 29% in 2005/06, and lingered at 24% in 2012/13. The Ghana is one of the few African countries to achieve the first MDG target of halving poverty[5], although four out of its ten regions are lagging behind with people still living in extreme poverty. Regarding economic growth, since 1990 the country's economy expanded, with average GDP growth rates

[3] Among others, we do not report all the literature.
[4] See, for instance, McMillan and Headey (2014) for a comprehensive review in a World Development special issue.
[5] In Africa and Eastern Asia, only 63 countries have reached the MDG-1 hunger target between 1990 and 2015 (FAO, 2014).

ranging between 4% to 5% during the 90s and early 2000s and thereafter increasing to 8% on average (WDI, 2014). This impressive growth performance – which reached a peak of +14% in 2011 – is quite unusual at world level. In fact, in the last 20 years only a few developed and developing countries achieved these levels over such a period.

In the last decades, agriculture has been the backbone of Ghana's economy contributing between 40 and 50% of total GDP between 1965 and 1975 and rising up to 60% in the 80s. Even though it experienced a constant decline, agriculture still plays an important role in ensuring food security by representing the 22% of the GDP in 2014 (Figure 1) with 44% of the economically active population employed in the sector in 2013 (down from 62% in 1992).

During the 80s, the Ghanaian economy underwent an important change with the implementation of the Structural Adjustment Program (SAP)[6]. Since the launch of the SAP, which that rescued Ghana from the economic collapse, the country experienced strong improvements in the industrial sector, whose contribution to total GDP increased to 27% in about 20 years. The same happened to the manufacturing sector, which grew by seven percentage points right after the SAP implementation, but its value added never went beyond the 10% of the total GDP. Looking at Figure 1, between 1981 and 2005 the service sector became increasingly relevant for the entire Ghanaian economy, reaching an average value of about one-third of the total GDP. The "regime switch" registered in 2006 (-10% agriculture, -6% industry, +1% manufacturing, +16% services) is mainly due to the rebasing of the series[7], with the number of subsectors under services being increased from six to eleven in the new series. The reorganization of the services sector led the way accounting for almost half of Ghanaian GDP, overtaking the agricultural sector as the most prominent sector of Ghanaian economy.

3. The Process of Economic and Social Development in Ghana

3.1 The dataset

In the present study we provide a descriptive analysis of change in households' characteristics, the structure of the workforce among agricultural and non-agricultural households and an analytic assessment of the determinants of time allocation using three waves from the Ghana Living Standards Surveys (GLSS), a comprehensive dataset modeled after the Living Standards Measurement Surveys (LSMS) and designed by The World Bank. The surveys were conducted in 1991/92, 1998/99 and 2005/06 (i.e., GLSS3, GLSS4 and GLSS5), adopting almost identical questionnaires with positive synergies in the analysis of economic transformation, agricultural transition and its contribution to poverty and hunger alleviation.

Among the variables included in the sample, we consider household demographic variables, variables related to participation in labor activities, land owning, annual household income and consumption, as well as durables owned by the household and information on access to credit. The entire sample includes 4,523 observations from GLSS3, 5,998 from GLSS4, and 8,688 from GLSS5, representing respectively 3.3, 4.2, and 5.5 millions of households at national level. Furthermore, we define a subgroup of agricultural households as households operating land and earning income from crop sales. For each round, we estimate an amount of agricultural households of around 60% percent out of the total sample. In particular, the sample sizes of agricultural households are 2,958, 3,698, and 4,755, for 1991, 1998 and 2005 respectively. Finally, we define three geographic groups according to the geographic location of the different regions. We group the ten regions in three different clusters, the northern macro-region, characterized by a semi-arid tropical climate (rural savannah), the central macro-region and the southern one, the coastal area[8].

The three clusters consist of 2782, 6098 and 2528 observations respectively. We report the evolution of the different variables over time at national and regional scales for the overall sample and the agricultural households.

3.2 National level

Table 1 in the Appendix reports summary statistics of main variables for the overall sample at national level. Education seems to have expanded during the 1990s in the country, which has resulted in a rise in the average years of school, from 2.7 in 1991/92, to 4.0 in 1998/99, to 5.3 in 2005/06, and an increase in the highest years of education in the household from 4.7 to 8.2 over the whole period. Figures show a decline in the share of household heads employed in agriculture from 53% in 1991 to 45% in 2005 although the agriculture sector is the major source of income in Ghana, whereas the share of household

[6] As reported by Konadu-Agyemang (2000) the most relevant measures behind the SAP implementation (1983) consisted in cuts in social services, devaluation of the cedi, abolishing the domestic price control, broadening the tax base, strengthening the tax administration, divesting state owned enterprises and encouragement of cocoa and other traditional exports.

[7] The rebasing exercise has been performed by the Ghana Statistical service using the International Standard Industrial Classification (ISIC). More information available at: http://www.statsghana.gov.gh/docfiles/news/gdp_newsletter_rebased_gdp_nov_2010.pdf.

[8] North includes: "Northern", "Upper East" and "Upper West" regions; Center includes "Volta", "Eastern", "Ashanti", "Brong Ahafo" regions and finally South includes "Western", "Central", "Gt Accra".

heads employed in transport, storage and communication increases over the whole period. On the other hand, the employment shares in manufacturing, and wholesale and retail trade increase from 1991 to 1998 (i.e., from 7.7 to 8.9 for the former, and from 11.4 to 13 for the latter), and slightly decrease from 1998 to 2006 (i.e., from 8.9 to 8.7 for the former, and from 13 to 12.7 for the latter).

Figures on annual consumption describe an increasing trend over the whole period both for food and non-food expenditure per adult equivalent expressed in 2005 Ghanaian cedis and appropriately deflated for price variation. This kind of variable is commonly used in the literature as a welfare indicator in measuring poverty and inequality (Ravallion and van de Walle, 2008). Figure 2 depicts the distribution of log consumption per adult equivalent for the three rounds of the GLSS showing higher densities towards the right side of the graph for non-farm households, while farmers have more density towards the left side. Following the consumption path, total household income (in 2005 Ghanaian cedis), as well as its sources show an increase over time.

Descriptive statistics show a limited access to credit in the country with higher shares of informal sources with respect to formal ones, and loans mainly allocated for agricultural activities, as well as for business purposes. Some studies highlight that among others, age and gender of the household head and political affiliations are the main determinants of credit demand by farmers (Kimuyu and Omiti, 2000; Akudugu, 2012). On the other hand, other analyses reveal that extension services, education level and saving habits influence household access to formal credit (Dzadze et al., 2012; Hananu et al., 2015), with loans mostly used for agricultural and non-agricultural production, and consumption purposes.

Table 2 (see Appendix 1) provides summary statistics for the subsample of agricultural households only. Descriptive statistics show that among others, the household size, the gender of the head and the level of education are also important components also for the restricted sample of agricultural households. The share of female-headed households as well as the household size decrease (from 26 to 23% in the former and from 4.9 to 4.7% in the latter) in 14 years, whereas the average years of education in the household increase from 2.2 in 1991/92, to 3.1 in 1998/99, to 3.9 in 2005/06.

Figure 3 shows the distribution of the amount of land operated for the three waves of the survey. Operated land is defined as the sum of the agricultural land owned-and-operated by the household plus the difference between the amount of land rented/sharecropped in and rented/sharecropped out. The majority of the distribution falls below two hectares of land, and more than 75% of farmers operating operate less than the average farm size each year. The resulting figures show an expansion from the 1990s with a rise in the average farm size, from 2.3 hectares in 1991/92, to 2.5 in 1998/99, to 3.3 in 2005/06[9]. The increase may also be seen also for land owned, that includes operated land, land sharecropped out and rented out by agricultural households; that grows from 3.1 hectares in GLSS3 to 3.9 hectares in GLSS5. In this regard, Figure 4 presents basic information on land ownership by land size for agricultural households. It is interesting to note that the percentage of households owning less than 0.5 hectares of land shrank by 9% between the first and the last wave. This reduction has been partly compensated by the growth (+6%) of the large landowners (→4 ha). Furthermore, the share of farmers owning land with deed exponentially increases over time from 5.9% in 1991/92, to 16.6% in 2005/06.

Moving towards the variables related to farm activity, Figure 5 depicts the use of agricultural inputs by classes of land endowment per year. Overall, the purchase of seeds and seedlings is the most important agricultural input, with the exception of households owning more than two hectares of land in 2005/06. We find evidence of a negative variation in the share of seeds and an increase of the amount of fertilizer and pesticides adopted over time for all classes of land endowment. Smaller farmers tend to use more seeds rather than other agricultural inputs, whereas households cultivating more than two hectares of land purchase pesticides and fertilizer more frequently, especially in the 2005/06 round.

In this context, among agriculture inputs, it is worth taking into consideration the labour variable, revealing a decreasing but still high share of rural households (namely, 66% in 1991, 73% in 1998, and 57% in 2005) hiring workers during land preparation, weeding and harvest. On the other hand, the value of agricultural assets decreases over time, from 336 Ghanaian cedis in 1991/92, to 149 in 2005/06, with very low shares of households owning different assets, such as tractor, plough, cart, and sprayer.

3.3 Regional dynamics

Development economics literature largely documented the process of structural transformation over time at national level. However, responsiveness to change at national level is the result of different changes at local level. Factors like tradition, different levels of development or environmental and geopolitical acute disparities largely influence households' decision making processes. This is why, in order to assess the phenomenon of structural transformation in Ghana it is also crucial to thoroughly understand the patterns of change also at sub-national level. We proceed by clustering the ten regions in three macro-regions according to their geographic position, namely North, Centre and South, which represent respectively the rural savannah, the centre and the coastal area. For each group we analyse

[9] It is worth noting that these values do not include landholders not selling crops.

the evolution of society, economy, agriculture and technology in a descriptive framework. We place particular emphasis on the reallocation of labour across the different sectors by focusing on the ten regions separately through the adoption of choropleth maps.

Table 3 in the appendix compares the full sample and the agricultural households, featuring their most relevant socio-economic characteristics. Looking at the full sample, the first line shows the share of farmers over the total. Farmers are predominantly located in the northern area, which is less urbanised and where agricultural households are almost the double with respect to the southern macro-region. It is worth noting that the share of agricultural households decreases in all the three macro-regions (-10% in the north, -15% in the centre, -13% in the south). This reduction coincides with a migration from rural to urban areas. In fact, figures on the share of rural households over the total clearly show an important drain out towards urban areas in the centre (-12%) and coastal regions (-7%), while in the rural savannah it is pretty much constant over time.

In northern regions, households are on average slightly bigger and much less educated with respect to the rest of the country. Indeed, if we look at the dynamics, the average number of years of education almost doubles over time in both the centre and southern areas, while in the north it decreases. Even though in some areas education level seems to experience an upward trend, education inequality remains an issue in the north where it is strongly differentiated by gender. Female members' education with respect to the other household members is lower than in the other macro- regions. They benefit less from education with respect to men, particularly in the rural savannah areas, where the percentage of female headed households in 2005 was 13%, approximately one-fifth of the other two regions. Figures from the agricultural households' subsample confirm this trend.

The following rows provide information on the households' participation in labour activities. The first set of indicators represent the percentage rate of households' members of working age declaring to be employed, unemployed, inactive (see Table 3). Figures are in line with the findings at national level. There is a very low spatial diversity across regions with about three out of four adults employed in any working activity, with 1 to 3% of unemployed adults (with higher rates in the coastal area) and an average of 15% of adults declaring to be inactive. No definite pattern can be associated to these dynamics, neither in the full sample, nor for the agricultural households. Labour is the prevailing source of income in Ghana, and is mainly employed in agriculture and services segments because of the endemic characteristics of these sectors, which are both labour intensive. What is really striking is the evolution in the share of labourers, which takes different shapes across sectors and over the years. To get a better idea of the changing patterns in the reallocation of labour within the country we plot in Figure 6 a set of bar charts constructed for the full sample at regional level and reflecting the employment rate in each of the three different segments where households' heads are employed: agriculture, manufacturing and services (wholesale and retail trade, transport, storage and communication and community, social and personal services). It is evident that agriculture still plays a central role in the economy of the northern provinces - the poorest ones. Basically, in 1991 the agriculture sector absorbed the 80% of households' heads residing in the northern region, 60% in the centre and 41% in the south, evidencing a great spatial variability of the labour markets. The more we move towards the coastal regions the less important agriculture is for the local economy. Greater Accra region is a worthwhile example, showing the lowest share of households employed in this sector. Looking at the dynamics, although there are remarkable differences across the regions, we show a general declining pattern for the agriculture sector in all the areas studied, including the ones that rely more on agriculture. Conversely, the manufacturing sector (mainly constituted by electronics, automotive and light manufacturing, food processing, aluminium smelting and cement) is much more concentrated in the south. Looking at the map, the capital city's region shows the highest share of households (around 15%) employed in the sector, driving the difference between the centre and southern macro regions. We have to bear in mind that Greater Accra and the whole south benefited more by the SAP with respect to the northern and central regions, even though in the long run its effect fades out. In fact, by looking at the coastal area regions, the employment rate of household heads in the manufacturing sector is slightly shrinking (-2%), reducing its absorption of household heads from 15% to 12%. In the south the development process seems to run faster than in the north which is experiencing the industrial phase with a decade of delay (+3% of household heads employed). The same conclusions can be drawn for services, which is the second major segment contributing to the country's gross domestic product. Services include wholesale and retail trade, transport storage and communication, community, social and personal services. Figure 6 depicts disaggregated statistics across regions and over time for the services sector's sub-groups. If we look at the 2005/06 values, we see that in the northern area household heads employed in services are around 6%, 12% in the centre and 17% in the south. We do not find sharp improvements in any of the sectors between the first and the last round, meaning that at the time of the first wave the contribution of each services' segment on the overall regional economy was already stabilized. However, there are small movements that are important to consider to give insights to each region's structural transformation shape. The most interesting patterns are registered within the full sample, whilst for the sub-sample of agricultural households the share of household heads employed in each services' sub-sector does not fluctuate over time. The wholesale, retail and trade sector is the only sector among services representing a larger share of workers. It shows an

upward trend in all the three macro-regions, with a major incidence in the coastal one (+3.7% between the first and the last wave). This is the result of the running globalization process that is pushing to invest in services to manage the growth of tourism and a bulky demand of food and manufacturing imports. Demand for labourers in the sector of "Transport, storage and communications" is slightly increasing over time, even though this segment is the one among services that contributes less to the labour supply. In northern areas transport is almost absent, whilst it is particularly relevant in the Greater Accra region. This sector is likely to further grow further from 2005 onwards with the beginning of the digital era. Finally, the share of household heads working for "Community, social and personal services" has almost the same breadth of trade services but has a decreasing trend over time in all the three macro-regions. Once again, the capital region represents the hub also for this sector.

Given the distribution of labour reported above, as well as the nature and characteristics of the households located in the northern area, we expect that the highest share of income in the rural savannah would be dominated by agricultural output sales. Our findings confirm this expectation, but it is intriguing to note that income from self-employment related activities capture an important share of the overall income distribution within the households (see Table 4 in the Appendix). In the agricultural households' sub-sample, income from crops represents the major source of revenue for all households across all macro-regions, while income from self-employment is ranked right after. Self-employment is becoming increasingly important in the northern region (+2%) and this share seems to contribute to the gradual replacement of income from livestock sales (-10%). The analysis of the three surveys reveals a similar pattern for the full sample. In Figure 7 we report maps with pie charts quantifying the share of each source of income over the total per year. The relative importance of each sector varies across regions, confirming the importance of self-employment and non-agricultural wages in the southern macro-region (Central region, Greater Accra, Eastern region among all). Income of households living in the Greater Accra region comes mainly from non- agricultural wages and self-employment forms of labour. This greater concentration of non- agricultural jobs is larger where there has been an increase of services sectors. On the other side, the contraction of income from livestock sales is also confirmed at a more disaggregated level, while it is interesting to note that in regions such as Volta and Western region, there is an improvement in the profitability of crop sales. Agricultural markets are thus changing over time and differently across regions as a result of the slow process of structural transformation gradually occurring in the agricultural sector; this is characterized by a growing importance of agribusiness, with high-value agricultural products and cash crops[10] grown as a form of business. The evolution of cash crop cultures overtime is conspicuous, in particular between the second and third round of the survey (see Figure 8). In the northern macro-region, both food and cash crop values of production are increasing. Moving towards the central part of the country, Northern Region and Brong-Ahafo did not show any significant change in their production systems, which remain balanced between cash and food crops production. Although the cash crops expansion of the early 2000s occurred almost everywhere, there are important spatial differences to be noted in terms of value of production, particularly in the central and southern regions. The Ashanti region, which today is one of the largest world's cocoa suppliers, registers a great expansion in the cash crop value of production, in particular between the second and third wave. This is the most prominent case of specialization we find across the regions. A plausible explanation could be that this variation in the value of production is the consequence of an improvement in both human capital and in a change in the technological means of production, which are the expression of an increased productivity. It is not surprising that northern regions, which are the less educated ones, are lagging behind the rest of the country where a transition from an equilibrium of "subsistence" and "business" agriculture to a "business-based" one is in place

In Table 4 we report figures for the expenditure on agricultural inputs and their intensity of use. We disentangle the intensity of use from macro-regions to a regional scale and we plot in Figure 9 the regional averages of the most relevant figures. In the northern regions this shift towards a modern, and more commercial agriculture, is hindered by the chronic constraints affecting their livelihoods such as the absence of adequate infrastructures, the insufficient access to technology, agricultural inputs, and other facilities. The bar charts regarding the intensity of input use reported in Figure 9 clearly reflect this issue. However, if we look at the trend, there is a slow but increasing variation in all the regions for both pesticides and inorganic fertilizers. Inorganic fertilizers expenditure rose consistently between the second and third wave in almost all the regions apart from Volta, while northern macro- regions are still behind in terms of intensity of use of pesticides, seeds and hired labour.

It must be noted that since the figures reported above do not track the same people over time, it is hard to know whether and how this process of structural transformation can be strongly/weakly associated with households' demographic characteristics, residential choices, access to land, infrastructure and facilities or spatial transformation. In order to provide direct insights into the determinants of such a change, we move to a slightly more complex analysis by taking advantage of the pseudo-panel framework.

4. Empirical methodology

In this section we discuss the econometric models estimated and some econometric issues encountered in analysing patterns and determinants of structural transformation. According to the existing literature three different categories of indicators are usually employed to measure structural transformation. The first one is the change in production structure and it is generally defined by the share of income coming from each activity.

[10] Cocoa, among others.

The second one is a measure of productivity of labour, typically GDP per worker or GDP per hour (Herrendorf, 2013), while the last one is the employment share, which in literature is calculated using either the number of workers or the hours worked by sector (Duarte and Restuccia, 2010). Each dimension explores different aspects of structural transformation; we concentrate on the last one to investigate the determinants of change in time spent working in agriculture, services, industry and manufacturing sectors through time. In theory, when structural transformation occurs, people devote less time working in low productivity sectors (generally agriculture in poor countries), and increase time spent moving towards high productivity ones. Of particular interest here is the potential effect of some key correlates such as demographic shifts, land use, agricultural and non-agricultural wealth, technology adoption and mechanization, access to infrastructure and facilities, credit and migration.

In order to evaluate how structural transformation and agriculture transition may be affected by households' socio-economic characteristics, the best source would be a long-running panel dataset that allows tracking the same households over time. However, in both developed and developing countries, long-running panel datasets are rare, whereas cross sectional household surveys are often conducted on a regular basis, Ghana being no exception. Although such surveys do not allow following individuals over time, to overcome the unavailability of panel data, groups of people may be tracked from one wave to another on the basis of their common observable time-invariant characteristics, like for example date of birth, geographic location, poverty status, quality and size of operated land.

Consequent empirical economic analyses make use of cohort clusters rather than observations at the individual or household level. "Pseudo-panels" based on age cohort have been widely used in the literature, in particular after the seminal work of Deaton (1985), who suggested that cohorts constructed from repeated cross section data can be used to estimate a fixed effects model (e.g., Deaton and Paxson, 1994; Banks, Blundell and Brugiavini, 2001). The idea behind these synthetic panels is that on average the behavior of a group of households is well approximated by the behavior of other households belonging to the same cohort at another point in time. Technically, this approach is formally similar to instrumental variables technique, where the group indicators are used as instruments (Verbeek, 2008).

4.1 Model setup

Let's define i households, and s sectors, representing the four main segments of the Ghanaian economy (i.e. agriculture, services, industry, manufacturing). We define the share of worked hours $Sh_{is,t}$ for household i in sector s at time t as equal to $Sh_{is,t} = \frac{HW_{is,t}}{THW_{i,t}}$. with $HW_{is,t}$ and $THW_{i,t}$ being respectively the number of hours worked per week in sector s and the total number of hours worked in all sectors at time t by household i[11]. We assume that the share of hours worked in each sector can be expressed as a function of a set of controls:

$$Sh^{*}_{is,t} = f(D_{it}, L_{it}, W_{it}, I_{it}, F_{it}, G_{it}) \quad (1)$$

where $D_{is,t}$, are the demographic characteristics which include the household composition in terms of size and female members (by age), the dependency ratio and the average years of education of adults in working age; $L_{cs,t}$ and $W_{cs,t}$ represent farm-related variables (i.e. size of land (ha) operated, inequality in land distribution and annual expenditure in agricultural labour force) and wealth-related variables (i.e. total Tropical Livestock Units, dwelling ownership and poverty status), respectively. $I_{is,t}$ and $F_{is,t}$ are the access to infrastructure/facilities' variables (i.e. participation in Agricultural Cooperatives, access to electricity, distances from health facility, nearest road and banks[12]). Finally, $G_{is,t}$ is a vector of geographic variables (i.e. belonging to different agro-ecological zones and rural/urban).

We start by examining the linear functional relationship resulting from (1), which is represented as follows:

[11] Information on labour time allocation is reported within the questionnaire for primary, secondary and – eventually - tertiary activities at the individual level. The time span considered is represented by the hours spent working in the last seven days. Data on hours worked were purged from outliers to make sure they would not exceed the cap of 40 weekly hours (per worker) across activities. Values exceeding the maximum were then replaced by a proportional amount of hours in a way that their sum across occupations was equal to 40..

[12] All variables apart from electricity are computed at community level.

$$Sh_{it} = \delta_{it} + \beta_0 + D'_{it}\beta_1 + L'_{it}\beta_2 + W'_{it}\beta_3 + I'_{it}\beta_4 + F'_{it}\beta_5 + G'_{it}\beta_6 + \eta_t + u_{it}, \quad (2)$$

where i indexes households ($i = 1, \dots, N$) and t indexes the time span ($t = 1, \dots, T$). Then δ_{it} captures the households' unmeasurable and unobserved skills and abilities, η_t the time trend and finally u_{it} the disturbance. Even though this model assumes that the error term u_{it} is not correlated with the predictors and δ_{it}, it must be recognized that δ_{it} might be correlated with any of the demographic controls D'_{it}. Similarly to Ackah and Aryeetey (2012) a pooled analysis of the data based on an equation like Eqn. (2) generates a number of issues regarding individual heterogeneity, "in part because such analysis cannot control for unobservables, and in part because it assumes that repeated observations on each household are independent" (Ackah and Aryeetey, 2012, p. 85).

4.2 Construction of the Pseudo-Panel

Following Deaton (1985) we solve this issue constructing a pseudo-panel by the use of a set of C cohorts ($c = 1, \dots, C$), that by definition represent groups of households that share a vector of common characteristics that are constant over time. These are constructed according to a joint set of multiple characteristics, namely the (i) household head's age category, (ii) the head's sex and (ii) his/her residing region for a total of 114 groups followed over time[13]. By tracking the cohorts, we are able to average Eqn. (2) over the cohort members to obtain a new equation (3) expressed in terms of cohort means, that represent the observation units in the new pseudo-panel framework. This procedure, which allows the clearing out of the heterogeneity across households yields the following structural form

$$\overline{Sh}_{cs,t} = \overline{\mathbf{X}'_{ct}}\beta + \overline{\delta_{ct}} + \overline{u_{ct}} + \eta_t, \quad c = 1, \dots, C; t = 1, \dots, T \quad (3)$$

In Eqn. (3), $\overline{Sh}_{cs,t}$ and $\overline{\mathbf{X}'_{ct}}$ represent respectively the average values of the share of hours worked in each sector and the vector including all the explanatory variables for all observed households at time t in cohort c. $\overline{\delta_{ct}}$ is defined as the average of the fixed effects for all the households belonging to cohort c in year t, and can be treated as the unobserved cohort fixed effect if the sample size in each cohort is sufficiently large (Warunsiri and McNown, 2010). All error components in (2) that are correlated with the control variables have been purged from the error term, in this way the estimation of equation (3) with cohort fixed effects yields unbiased and consistent results. However, since the number of observations per cell varies substantially, the error term $\overline{u_{ct}}$ is heteroskedastic, leading to biased standard errors. We follow Dargay (2007) and Warunsiri and McNown (2010) and correct this heteroskedasticity using Weighted Least Squares (WLS) estimation by weighting each cohort with the square root of the number of observations contained in each cell.

However, while from one side WLS estimator helps in addressing the heteroskedasticity issue, on the other it may produce inflated R^2. This issue is quite common in the literature, in fact, as reported by Willet and Singer, the goodness-of-fit obtained under WLS regression "is frequently much larger than the value obtained under the corresponding OLS fit. […] This increment reflects, in part, the success of the weighting in solving the problem of heteroscedasticity" (Willet and Singer, 1998, p. 237).

To check for possible biases in the measurement of the coefficients arising from the adoption of the WLS estimator, we supplement the estimates from the WLS with results obtained from the Fixed Effects specification[14].

5. Results and discussion

Before discussing the econometric results, we looked at the mean values of the hours worked in each sector per year and by the seven age-cohort groups. Summaries are reported in table 5 and Figure 10. Overall, comparing the allocation of time in each sector, we see that the average amount of time devoted to agriculture decreases over time (~-6%), with services (~+3%), industry (~+1%) and manufacturing

[13] See Annex A for details about cohorts' construction

[14] A number of supplementary robustness checks will be included at a later stage. These will include (i) results from samples disaggregated by demographic characteristics like gender, rural/urban residence or agricultural households/non-agricultural households; (ii) control of the measurement error problem by improving the size of cells from 6-years age bands to 10-years generation bands.

(~+2%) that conversely experience an upward trend. A more detailed picture is provided in Figure 10 where we plot the share of time disentangling the sample by ages' cohorts. Looking at the differential across years for each age cohort we note that the largest variation of time allocation occurs in particular among cohorts with younger head of households, namely the 15-21 and 22-28 age cohorts. In relation to the first case, the large decrease in time allocated to agricultural jobs (~-14%) is compensated by an improvement in the time devoted to both industry (~+10%) and services (~+5%). Looking at the other cohort, we register a similar pattern; this time all sectors contribute to compensate the shrinkage in time allocation to agriculture: time spent in industry increases by ~+2%, in manufacturing by ~+5% and in services by ~+4%. Smaller movements are registered for the other cohorts.

5.1 WLS estimates

From now on we will discuss the econometric results, focusing on the estimates for equation (3). The estimates from the regressions with FE and WLS are reported in Table 6 and Table 7 in odd and even columns. Both tables present the share of hours worked per week in all the sectors aforementioned. In Table 6, columns (i) and (ii) show the results for hours worked in agriculture, whilst columns (iii) and (iv) concern the services sector. Results for industry (columns (i) and (ii)) and manufacturing (columns (iii) and (iv)) are reported in Table 7. All regressions are conducted on households' demographic, wealth, productivity and facilities' characteristics. Cohorts fixed effects (not shown) are included in order to expunge the dependence between the regressors and the error term evidenced in equation (3). Results are consistent across the two specifications for most of the variables. In order to provide a complete picture of the results we will comment on the two tables jointly. We start by looking at the effect of households' gender composition on the hours worked in each sector. Household composition in terms of share of females in different ages does not really affect the time allocation across occupations. Looking at Table 6 and Table 7 we only find consistent results for time spent in industry, which decreases consistently for young females (15-19) with respect to males. Even though only significant in the FE specification, we find that households with a large share of females aged 20-34 experience a decrease in the share of hours devoted to agriculture. Time spent working in agriculture also decreases as the dependency ratio (or consumer-producer ratio) increases. It is interesting to see that the higher the consumer-producer ratio the greater the work effort (time) allocated to services. Households with a higher than average education for people in working age tend to leave agriculture and enter into services. The average number of years of education significantly and negatively influence the number of hours worked per week in agriculture, and significantly and positively affect the time spent on services. Turning to the vector $L_{cs,t}$, farm related variables are not significant (when correcting for heteroskedasticity) apart from the variable on annual expenditure on agricultural labour, which results in a negative response for services. Operated land has a positive but non-statistically significant coefficient for agriculture, however, both the t-statistics at the border (-1.49) and the significance in the FE specification can provide weak evidence that the higher the land, the more the time spent in agricultural jobs might be economically viable. Interesting, but sometimes counterintuitive results arise when moving to wealth-related variables. For instance, the number of total tropical livestock units is negatively related with time spent in agriculture, and positively related with time spent in services sectors. A counterintuitive result arises when controlling for the percentage of households owning a dwelling, which results in a positive correlation with the time spent in agriculture. When looking for the poverty status, we find negative and statistically significant coefficients for time spent in agriculture and positive and statistically significant coefficients for that which relates to manufacturing. On average, richer households reduce the time spent working in agriculture and increase the time devoted to manufacturing. Regarding infrastructural attributes, of note is the overall effect of the electricity ownership, which we employ as a proxy to control for access to infrastructures: the coefficients for time spent in agriculture have the expected sign (negative), even though weakly significant, while we register an increase in time spent in services and industry sectors. Among the other variables included within the vector of access to infrastructure, only the distance from the nearest motorable road appears to be significant. This variable, which is often used in empirical research as a proxy for household market access is significant for agriculture, whilst in relation to services we can draw some conclusions based only for the FE specification. A longer distance from motorable roads may present a problem for farmers to reach urbanized centres to sell the agricultural products; this may form an incentive to reduce the time spent in agriculture in favour of other sectors. We use the distance to the nearest bank as a proxy for the distance to the nearest city, assuming that banks are located mainly in urbanized centres. Distance to the nearest bank is positively and significantly related to hours spent in agriculture, suggesting that the farther away the town, the more hours people will work in agricultural jobs, since they would face problems moving back and forth from the town easily. This result confirms the finding of Magai et al (2015). However, distance from the nearest bank can also be interpreted as an indicator of financial inclusion, in particular as a measure of access to credit and use of bank services. When access to financial services is not hampered by constraints such as the distance to financial institutions, the time spent for agricultural activities increases. The amount of credit borrowed by households, which is further introduced, confirms the signs of the distance to banks, although not significant. As shown until now, the reasons why people move in/out from agriculture and the other sectors are several and complex. The variability in the households' occupational portfolio, and thus in the sectoral composition of GDP, are often related to spatial changes. Thus, it is crucial to also control

for the relevance of migration and how it acts in Ghanaian context. We use in-migration as a proxy for spatial transformation, defining it as the percentage of households within the cohort moving to the village in the previous five years. The resulting coefficient is negatively related to time spent working in agriculture, and positively related to time spent working in manufacturing. The striking finding is that on average in Ghana, people deciding to move away from the original position look to jobs in fields different than agriculture.

6. Final remarks

In Sub-Saharan Africa, the structural transformation process has not been as growth-enhancing as in Asia, but it is characterized by a vivid expansion of the low productive sectors, in particular services. In order to trace an exhaustive picture of the evolution of economy, society and productivity in Ghana we first provide a descriptive analysis of the factors involved in agricultural and economic transition, both at national and regional scale, and afterwards we try to assess which are the determinants influencing workers' time allocation in each sector.

Our findings show that in Ghana structural transformation is occurring slowly, not in every region, and not at the same speed. Overall, the different magnitude of changes is not enough to rapidly transform local economies in the same way. A remarkable dualism emerges between south and north, but more specifically between the coastal area and the rest of the country. This is particularly evident when looking at the reallocation of labour across sectors, at the agricultural production and technology adoption. Northern areas still rely a great deal on low productive agriculture and the economy's transition to high-productive agriculture or other sectors appears to be slow at the moment. The agricultural sector's draining is not compensated by a quick reallocation of labour to services or industry. On the other hand, in southern regions while agricultural employment did decrease, the labour that was released was absorbed mostly by low-productivity sectors, with a presumable low impact on economy wide-productivity. This might be due to the weak and inadequate transformation of the agricultural sector itself, which did not experience an increase in the agricultural productivity that could lead in turn to the development of other spin off industries.

Plausible explanations for that are related to factors such as the level of education, adoption of technologies and as reported in the literature, also by migration flows. In order to investigate the incidence of such correlates on time allocation, we have proposed a pseudo-panel estimation technique based on cohorts clustered at age, sex and region of residence of the household head's level. Controlling for a large set of variables that affect time spent in each sector, our models deal particularly well with agriculture and services related time shares.

One of the most striking findings regards the education of individuals, which is one of the main determinants of households' occupational choices across sectors. Results are robust in particular regarding agriculture and services. Mobility of labour is likely to occur in particular for households with higher educated individuals, who reduce time spent working in agriculture and increase time devoted to services related jobs. Moreover, we show that addressing structural constraints remains crucial for agriculture capacity to generate employment opportunities. Poor connectivity, which accounts for the lack of Green Revolution, leads to limited competition, market fragmentation and undermines households' possibility to shift their production systems towards more sustainable ones. Infrastructure constraints should be lifted in order to promote, first of all, development of agricultural sector, since isolation of Ghanaian households from main infrastructures contributes to trap them in agricultural jobs. Structural transformation in Ghana is associated also with North-South migration and as in most developing countries with a rural-urban mobility (Osei and Jedwab, 2013): this is reflected in an exit from agriculture and in a growth in time spent into manufacturing sector.

REFERENCES

ACET. (2014) African transformation report: Growth with depth. Accra, Ghana: African Center for Economic Transformation.

Ackah C., and Medvedev M. (2010) Internal Migration in Ghana: Determinants and Welfare Impacts. Paper presented at the Centre for the Studies of African Economies Annual Conference on Economic Development in Africa. March, Oxford, UK.

Ackah, C., and Aryeetey, E. (2012) Globalization, trade and poverty in Ghana. Chapter 4, pp. 75-101 IDRC.

AfDB (2013) African Economic Outlook, Tunis, Tunisia.

Allen R. (2009) The British Industrial Revolution in Global Perspective. Cambridge: Cambridge University Press.

Akudugu M.A. (2012) Estimation of the Determinants of Credit Demand by Farmers and Supply by Rural Banks in Ghana's Upper East Region. Asian Journal of. Agriculture and Rural Development, 2(2), 189 – 200.

Antoci, A., Russu, P., and Ticci, E. (2009) Distributive impact of structural change: Does environmental degradation matter?. Structural Change and Economic Dynamics, 20(4), 266-278.

Antoci, A., Russu, P., and Ticci, E. (2012) Environmental externalities and immiserizing??? structural changes in an economy with heterogeneous agents. Ecological Economics, 81, 80-91.

Banks J., Blundell R., Brugiavini A. (2001) Risk Pooling, Precautionary Saving and Consumption

Growth, Review of Economic Studies, 68, 757–779.

Beegle, Kathleen, Joachim De Weerdt, and Stefan Dercon. (2011). Migration and Economic Mobility in Tanzania: Evidence from a Tracking Survey. Review of Economics and Statistics 93 (August): 1010–1033.

Breisinger C., Diao X., Thurlow J. (2009) Modeling growth options and structural change to reach middle income country status: The case of Ghana. Economic Modelling, 26(2), 514-525.

Christiaensen, L., and Kaminski, J. (2015). Structural change, economic growth and poverty reduction–Micro-evidence from Uganda. African Development Bank Group (Working Paper 229- No. 2322).

Christiaensen, L., Weerdt, J., and Todo, Y. (2013). Urbanization and poverty reduction: the role of rural diversification and secondary towns1. Agricultural Economics, 44(4-5), 435-447.

Christiansen, L., and Todo, Y. (2014). Poverty reduction during the rural–urban transformation – The role of the missing middle. World Development, 63, 43–58.

De Brauw, A., Mueller, V., and Lee, H. L. (2014). The role of rural–urban migration in the structural transformation of Sub-Saharan Africa. World Development, 63, 33-42.

De Vries, G., Timmer, M., and de Vries, K. (2015). Structural transformation in Africa: Static gains, dynamic losses. The Journal of Development Studies, 51(6), 674-688.

Deaton A. (1985) Panel data from time series of cross-sections. Journal of econometrics, 30.1 (1985): 109-126.

Deaton, A. Paxson C. (1994) Intertemporal Choice and Inequality, Journal of Political Economy, 102(3), 437-467.

Deininger, K., Jin, S., Xia, F., and Huang, J. (2014). Moving off the farm: Land institutions to facilitate structural transformation and agricultural productivity growth in China. World Development, 59, 505-520.

Duarte, M., and Restuccia, D. (2010). The Role of the Structural Transformation in Aggregate

Productivity, Quarterly Journal of Economics, 125(1), 129–173

Dzadze P, Osei M., Aidoo R, Nurah G. (2012) Factors determining access to formal credit in Ghana: A case study of smallholder farmers in the Abura-Asebu Kwamankese District of Central Region of Ghana. Journal of Development and Agricultural Economics, 4(14), 416 – 423.

Fisher, A.G.B., 1939. Primary, Secondary and Tertiary Production, Economic Record 15, 24–38. Foster, A., and M. Rosenzweig. 2007. Economic development and the decline of agricultural employment. In T. P. Schultz and J. Strauss, eds. Handbook of Development Economics. Amsterdam:

North-Holland, vol. 4, chap. 47.

Fox, L., and T.P. Sohnesen, 2012. Household Enterprises in Sub-Saharan Africa: Why They

Matter for Growth, Jobs, and Livelihoods. World Bank Policy Research Working Paper 6184

Gollin, D., Jedwab, R., and Vollrath, D. (2013). Urbanization with and without Structural

Transformation. In 2013 Meeting Papers (No. 344). Society for Economic Dynamics.

Hananu B., Abdul-Hanan A., Zakaria H. (2015) Factors Influencing Agricultural Credit Demand in Northern Ghana, African Journal of Agricultural Research, 10(7), 645 – 652.

Herrendorf, B., Rogerson, R., and Valentinyi, A. (2011). Two perspectives on preferences and structural transformation. IEHAS discussion papers 1134. Institute of Economics, Hungarian Academy of Sciences.

Jayne, T. S., Chamberlin, J., and Headey, D. D. (2014). Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. Food Policy, 48, 1-17.

Jedwab, R., and Osei, R. D. (2012). Structural Change in Ghana 1960-2010. Institute for International Economic Policy Working Paper. Washington, DC: Institute for International Economic Policy, George

Washington University.

Kim, S. (2007) Immigration, Industrial Revolution and Urban Growth in the United States, 1820-

1920: Factor Endowments, Technology and Geography," NBER Working Papers 12900, National

Bureau of Economic Research, Inc.

Kimuyu P., Omiti J. (2000) Institutional Impediments to Access to Credit by Micro and Small

Scale Enterprises in Kenya. IPAR Discussion Paper No.026/2000. IPAR. Nairobi.

Kolavalli S., Robinson E. J., Diao X., Alpuert V., Folledo R., Slavova B., and Ngeleza G. K. (2015) Economic transformation in Africa: Where will the path Lead?. Journal of African Development, 14(2), 41-78.

KonaduÂAgyemang K. (2000) The best of times and the worst of times: structural adjustment programs and uneven development in Africa: the case of Ghana. The Professional Geographer, 52(3), 469-483.

Kuznets, S. (1966) Modern economic growth: Rate, structure and spread. London: Yale University Press.

Lewis, W. A. (1954) Economic development with unlimited supplies of Labour. Manchester

School of Economic and Social studies, 22, 139–191. doi:10.1111/j.1467-9957.1954.tb00021.x

Lin J. Y. (2012) From Flying Geese To Leading Dragons: New Opportunities and Strategies for

Structural Transformation in Developing Countries. Global Policy, 3(4), 397-409.

Maddison, A. (1980) Economic Growth and Structural Change in the Advanced Countries, in Western Economies in Transition, Irving Leveson and Jimmy Wheeler, eds. (London: Croom Helm, 1980).

McCullough, E. B. (2015). Labor productivity and employment gaps in Sub-Saharan Africa. World Bank Policy Research Working Paper, (7234).

McMillan, M., Rodrik, D., Verduzco-Gallo, Í. (2014) Globalization, structural change, and productivity growth, with an update on Africa. World Development, 63(1), 11-32.

McMillan, M., and Headey, D. (2014). Introduction–understanding structural transformation in Africa. World Development, 63, 1-10.

Michaels, G., Rauch, F., and Redding, S. J. (2012). Urbanization and Structural Transformation. The Quarterly journal of economics, 127(2), 535-586.

Osei, R. D., and Jedwab R. (2013). Is Structural Change in SubÂSaharan Africa Different? New

Historical Evidence from Ghana in 1960Â2010, June 2013.

Propper C., Rees H. and Green K. (2001) The Demand for Private Medical Insurance in the UK:

A Cohort Analysis, The Economic Journal, 111, C180–C200

Ravallion M., and van de Walle D. (2008) Does Rising Landlessness Signal Success of Failure for

Vietnam's Agrarian Transition? Journal of Development Economics 87, 191 – 209.

Rendhall, M. (2013). Structural change in developing countries: has it decreased gender inequality?. World Development, 45, 1-16.

Rodrik D. (2014) An African growth miracle? National Bureau of Economic Research (NBER) No. 20188.

Szereszewski R. (1965) Structural changes in the economy of Ghana, 1891-1911 (pp. 53-1). London: Weidenfeld and Nicolson.

Verbeek, M. (2008) Pseudo-panels and repeated cross-sections. In The Econometrics of Panel

Data, 369-383. Springer Berlin Heidelberg.

APPENDIX 1

Table 1. Descriptive statistics – Full Sample

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
Households living in rural area	65.40	60.33	51.79
Farmer households	65.13	63.34	56.58
Demographics			
Household size	4.48	4.31	4.01
# children in hh	2.08	1.35	1.61
# adults in hh	2.36	2.04	2.43
Dependency ratio	0.47	0.39	0.40
# sons in hh	1.20	0.75	0.99
# daughters in hh	1.06	0.74	0.90
Average yrs of education in hh	2.65	4.00	5.34
Highest yrs of education in hh	4.70	6.19	8.25
Education of female relative all hh members	35.02	27.80	37.43
Head characteristics			
Female headed hh	32.17	31.93	29.72
Head of hh age	44.29	44.94	44.96
Head of hh single	31.24	46.24	45.36
Female head of hh widow	7.37	8.77	8.65
Head of hh yrs of education	3.40	5.11	6.59
N	4520	5998	8688
Participation in labour activities			
# adult hh members employed	1.65	1.29	1.70
# adult hh members unemployed	0.06	0.06	0.06
# adult hh members inactive	0.42	0.47	0.54
Employed adult members of on all adult hh members	72.52	68.61	74.64
Unemployed adult members of on all adult hh members	2.01	2.60	1.73
Inactive adult members of on all adult hh members	13.00	16.66	14.96
Weekly hours worked	36.85	34.52	39.99
Hourly wage - 2005 GH¢	0.15	1.85	0.60
Head employed in agriculture	55.90	49.52	48.98
Head employed in manufacturing	7.98	9.50	9.64
Head employed in wholesale and retail trade	11.85	14.00	13.81
Head employed in transport, storage and communication	3.34	3.88	4.22
Head employed in community, social and personal services	13.16	12.47	11.53
# adults employed in agriculture	1.56	0.81	1.10
# adults employed in manufacturing	0.16	0.17	0.21
# adults employed in wholesale and retail trade	0.30	0.29	0.29
# adults employed in transport, storage and communication	0.04	0.04	0.05
# adult hh members employed in community, social and services	0.17	0.17	0.17
N	4347	5327	7722
Total # people employed in agriculture	9,938,713	10,600,000	13,000,000
Total # people employed in industry	2,511,103	3,323,276	4,786,961
Total # people employed in services	5,833,305	7,131,740	8,933,604
Consumption, annual per adult equivalent spending, 2005 GH¢			
Food expenditure	198.96	359.21	334.92
Non-food expenditure	153.52	259.06	286.12
Expenditure on housing	11.51	16.62	23.19
N	4523	5998	8688
Income			

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
Gross total household income - 2005 GH¢	765.33	1164.62	1960.05
On-farm crop production - 2005 GH¢	98.73	170.87	390.51
On-farm production of livestock - 2005 GH¢	20.71	52.52	32.41
Wage Employment - Agriculture & Fishing - 2005 GH¢	15.50	11.74	22.07
Wage Employment - Nonfarm Activities - 2005 GH¢	140.64	175.99	287.79
Non-agr business - 2005 GH¢	456.73	702.71	1167.32
Transfers and other sources - 2005 GH¢	33.03	50.79	59.95
On-farm crop production	30.73	32.91	31.87
On-farm production of livestock	5.36	5.71	1.96
Wage Employment - Agriculture & Fishing	2.19	1.53	1.90
Wage Employment - Non-farm Activities	15.53	14.26	17.51
Non-agr business	34.66	30.30	32.14
Transfers and other sources	10.24	12.72	11.45
N	4523	5998	8688
Durables			
Value of durables - 2005 GH¢	643.72	2210.21	1225.30
HH owning refrigerator	9.69	18.81	22.76
HH owning fan	16.81	26.73	31.51
HH owning stove	16.11	14.49	18.94
HH owning furniture	69.54	71.99	57.83
HH owning house	32.25	33.63	33.58
HH owning bike	18.17	21.72	24.21
HH owning car	2.21	2.98	3.31
N	109	1303	1629
value of agricultural assets - 2005 GH¢	332.7	154.1	138.2
N	3848	5261	8638
Access to credit			
Credit beneficiary households	20.01	35.11	28.05
N	4523	5998	8688
Formal loan source	10.72	12.44	23.19
Informal loan source	91.16	84.30	73.27
Informal loan source - Relative and Friends	73.15	57.55	53.74
Outstanding loan amount - 2005 GH¢	79.61	104.97	181.74
Loan purpose - Agriculture activity	17.24	11.36	16.43
Loan purpose - Business	21.33	26.16	27.47
Loan purpose - Housing	3.31	4.81	5.34
N	905	2063	2337
Total households	3,320,000	4,245,694	5,538,133
# farmers	2,958	3,695	4,755
Total farmers	2,171,172	2,561,278	2,883,937

Note: Figures for loan sources and loan purposes are calculated on the subsample of credit beneficiary households, respectively for 910, 1968, 2281 observations (GLSS3, GLSS4, GLSS5). Durable goods are computed

Table 2. Descriptive statistics -Agricultural Households

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
Households living in rural area	84.31	83.44	83.13
Demographics			
Household size	4.90	4.78	4.68
# children in hh	2.35	1.43	2.04
# adult in hh	2.52	2.07	2.71
Dependency ratio	0.50	0.39	0.46
# sons in hh	1.36	0.80	1.26
# daughters in hh	1.16	0.75	1.09
Average yrs of education in hh	2.23	3.13	3.85
Highest yrs of education in hh	4.39	5.26	7.03
Education of female relative all hh members	31.12	22.18	33.39
Head characteristics			
Female headed hh	25.56	26.66	23.19
Head of hh age	45.36	46.29	47.11
Head of hh single	26.62	41.31	35.96
Female head of hh widow	6.39	8.67	7.88
Head of hh yrs of education	2.89	4.11	4.98
N	2958	3695	4755
Participation in labour activities			
# adult hh members employed	1.82	1.36	1.91
# adult hh members unemployed	0.03	0.03	0.03
# adult hh members inactive	0.34	0.41	0.50
Employed adult members on all adult hh members	74.52	70.44	74.68
Unemployed adult members on all adult hh members	0.84	1.07	0.97
Inactive adult members on all adult hh members	10.33	14.91	13.37
Weekly hours worked	33.04	33.34	34.14
Hourly wage - 2005 GH¢	0.12	0.64	0.52
Head employed in agriculture	78.14	73.87	77.54
Head employed in manufacturing	3.80	5.34	4.73
Head employed in wholesale and retail trade	5.05	6.28	4.56
Head employed in transport, storage and communication	1.15	1.22	1.46
Head employed in community, social and personal services	7.69	8.27	4.65
# adults employed in agriculture	2.23	1.22	1.78
# adults employed in manufacturing	0.10	0.12	0.16
# adults employed in wholesale and retail trade	0.19	0.17	0.16
# adults employed in transport, storage and communication	0.02	0.01	0.02
# adults employed in community, social and personal services	0.10	0.11	0.08
N	2951	3391	4468
Consumption, annual per adult equivalent spending, 2005 GH¢			
Food expenditure	148.79	278.88	222.14
Non-food expenditure	112.01	197.32	168.99
Housing expenditure	6.26	11.32	9.97
N	2958	3695	4755
Income			
Gross total household income - 2005 GH¢	629.51	911.83	1735.56
On-farm crop production - 2005 GH¢	149.46	253.94	671.76
On-farm production of livestock - 2005 GH¢	30.80	69.76	33.13
Wage Employment - Agriculture & Fishing - 2005 GH¢	13.58	11.02	23.81

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
Wage Employment - Nonfarm Activities - 2005 GH¢	75.78	75.96	112.74
Non-agr business - 2005 GH¢	338.10	466.83	855.46
Transfers and other sources - 2005 GH¢	21.80	34.32	38.65
On-farm crop production	46.42	52.28	57.78
On-farm production of livestock	7.89	7.38	2.13
Wage Employment - Agriculture & Fishing	1.87	1.43	2.03
Wage Employment - Non-farm Activities	8.63	6.97	6.12
Non-agr business	27.75	22.90	25.24
Transfers and other sources	7.43	9.04	6.70
N	2958	3695	4755
Farm activity			
Operated land - hectares	2.26	2.47	3.28
Owned land - hectares	3.12	3.77	3.86
HH owning land with deed	5.92	11.05	16.58
Tropical Livestock Unit - cattle	3.1	3.3	3.7
Tropical Livestock Unit - total	0.9	1.4	1.1
Tropical Livestock Unit per hectare	0.8	1.0	0.7
Cash crop production - 2005 GH¢	91.79	92.02	334.09
Food crop production - 2005 GH¢	133.20	110.36	336.14
Cash crop production as a share of total value of production	48.39	41.63	55.36
Food crop production as a share of total value of production	3.19	3.93	5.15
Share of crop production sold	48.4	41.9	55.4
N	2958	3695	4755
Agricultural inputs			
Inorganic fertilizer expenditure - 2005 GH¢	2.26	2.68	11.34
Pesticides expenditure - 2005 GH¢	2.03	3.38	8.20
Seeds and seedlings expenditure - 2005 GH¢	1.60	2.68	2.64
Fertilizer, pesticides and seeds expenditure - 2005 GH¢	6.05	10.03	25.55
Inorganic fertilizer expenditure - 2005 GH¢ per hectare	14.81	16.83	23.91
Pesticides expenditure - 2005 GH¢ per hectare	62.71	70.37	55.99
Seeds and seedlings expenditure - 2005 GH¢ per hectare	1.68	3.01	5.26
Fertilizer, pesticides and seeds expenditure - 2005 GH¢ per hectare	1.20	2.15	5.31
HH hiring labourers for crop production	1.53	3.12	2.25
Hired labour expenditure - 2005 GH¢	4.73	8.97	14.19
Hired labour expenditure - 2005 GH¢ per hectare	16.61	16.46	17.36
N	2958	3695	4755
Agricultural assets			
Value of agricultural assets - 2005 GH¢	335.69	146.70	148.75
N	108	1194	1362
HH owning tractor	0.30	NA[a]	0.32
HH owning plough	0.37	0.13	1.06
HH owning cart	0.24	0.40	0.95
HH owning sprayer	2.16	3.38	6.39
N	2958	3695	4755
Durables			
Value of durables - 2005 GH¢	625.06	2122.26	1195.40
HH owning refrigerator	2.81	7.05	9.02
HH owning fan	5.54	11.79	14.13
HH owning stove	9.03	7.29	7.79
HH owning furniture	62.12	64.92	50.77
HH owning house	41.77	44.16	46.99
HH owning bike	24.40	29.76	34.77

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
HH owning car	1.08	1.21	1.57
N	2958	3695	4755
Access to credit			
Credit beneficiary households	29.41	35.34	31.57
N	2958	3695	4755
Formal loan source	10.23	11.49	21.54
Informal loan source	91.38	83.62	74.54
Informal loan source - Relative and Friends	73.68	57.01	54.34
Outstanding loan amount - 2005 GH¢	75.30	80.94	144.62
Loan purpose - Agriculture activity	17.59	17.70	24.58
Loan purpose - Business	20.92	20.18	21.57
Loan purpose - Housing	3.22	4.59	5.27
N	870	1321	1425
Total farmers	2,171,249	2,561,339	2,883,958

[a] Data on number of tractors is not available for GLSS4

Table 3. Descriptive statistics – Full Sample and Agricultural Households, by Macro regions

	Full Sample									Agricultural Households								
	91/92 North	98/99 North	05/06 North	91/92 Center	98/99 Center	05/06 Center	91/92 South	98/99 South	05/06 South	91/92 North	98/99 North	05/06 North	91/92 Center	98/99 Center	05/06 Center	91/92 South	98/99 South	05/06 South
Households Demographic Characteristics																		
Farmers	88.7	88.3	78.6	72.8	66.5	57.5	46.1	39.7	33.9	100	100	100	100	100	100	100	100	100
RURURB==Rural	81.3	81	81.3	72.2	68.9	60.2	49.1	48	42.2	86.2	85	89	84	80.8	79.2	83.6	88.3	86.5
Household size	5.78	5.27	5.62	4.46	4.26	3.87	4.00	3.98	3.56	5.97	5.43	6	4.77	4.67	4.38	4.4	4.46	4.17
Dependency ratio (hh members aged <15 & >64/hh size)	0.49	0.18	0.45	0.49	0.42	0.42	0.45	0.42	0.36	0.5	0.18	0.46	0.5	0.44	0.46	0.49	0.48	0.46
avg years of education in hh	0.85	2.48	2.02	2.85	4.2	5.42	3.09	4.35	6.53	0.66	2.06	1.39	2.67	3.66	4.57	2.45	2.85	4.52
highest years of education in hh	2.36	2.57	4.71	5.05	6.77	8.43	5.14	6.88	9.39	2.15	2.11	3.93	4.99	6.39	7.93	4.77	5.51	7.87
education of female members relative to education of all hh members	14.9	3.42	23.7	37.6	32.6	40.4	39.3	31.2	39	14	1.44	21	36.1	28.8	37.9	33	25.7	35.2
female headed hh	9.26	14.3	13.4	34.3	36.8	33.3	38.1	32.3	31.4	6.9	11.6	8.01	29.3	30.9	27.3	31.5	30.6	28.6
Age - Head	45.8	45.3	46.1	44.9	45	45.2	42.8	44.8	44.2	45.7	45.7	46.2	45.6	46.5	47.6	44.5	46.3	46.9
single head of hh	18.1	19.5	18.9	33.8	53.2	48.7	32.9	47.4	51.4	14.7	16	13.5	29.5	49.2	41.2	29.3	46.1	45.1
female head of hh widow	5.49	7.1	7.63	7.98	8.51	9.48	7.25	9.85	7.95	4.25	6.43	5.34	6.95	7.93	8.57	6.8	12.5	8.58
avg years of education head of hh	1	2.55	2.21	3.62	5.43	6.79	4.03	5.74	8.04	0.85	2.1	1.48	3.42	4.89	5.94	3.25	4.14	6.02
Observations	637	740	1882	2255	3060	3936	1628	2198	2746	565	665	1530	1641	2168	2242	750	862	894
Participation in labour activities																		
hh share of employed adult members on all adult hh members	69.9	76.3	76.3	72	66.6	74.5	74.3	68.5	74.2	70.6	75.5	77.8	73.8	68.1	73.6	79	71.7	74.6
hh share of unemployed adult members on all adult hh members	1.15	1.23	1.04	2.04	2.21	1.47	2.33	3.67	2.36	0.98	0.83	1.01	1.04	0.85	0.94	0.31	1.77	0.99
hh share of inactive adult members on all adult hh members	15.7	13.2	14.5	12.3	17.2	13.7	12.9	17.2	17	15.6	14.2	13	10.1	15.9	13	6.93	13.2	14.4
(mean) hours/week	40.4	35.5	36.8	35.1	34.8	37.5	37.9	33.8	44.7	39.5	34.8	35.5	31.6	33.4	33.3	31.3	32	34.9
(mean) wage/hrly	0.06	0.83	0.47	0.15	1.53	0.53	0.19	2.69	0.73	0.06	0.73	0.42	0.12	0.69	0.49	0.17	0.44	0.65
HH head employed in Agriculture	80.3	70.9	69.6	59.7	51.5	53.2	40.6	38.6	34.9	88	77.8	79.9	75.6	70.1	76.5	76.2	79.2	77.9
HH head employed in Manufacturing	1.9	4.34	4.24	6.58	8.81	9.6	12.5	12.5	11.9	0.88	3.97	2.19	4.46	6.08	5.96	4.55	4.75	4.16
HH head employed in Wholesale and Retail Trade	5.21	9.63	6.65	12.2	13.9	13	14.1	15.9	17.7	2.65	5.68	3.33	5.92	7.11	4.86	4.95	4.89	4.94
HH head employed in Transport	1.42	1.11	1.09	2.94	3.04	3.62	4.68	6.12	6.3	0.71	0.52	0.15	1.28	1.73	1.41	1.2	0.62	2.66
HH head employed in Community	6.32	10.5	6.53	11.9	11.9	10.3	17.7	14.1	15.3	4.42	8.7	3.65	8	9.03	5.26	9.49	6.18	4.15
Observations	633	628	1651	2174	2725	3675	1540	1974	2396	565	565	1373	1638	1996	2215	748	830	880

	Full Sample									Agricultural Households								
	91/92 North	98/99 North	05/06 North	91/92 Center	98/99 Center	05/06 Center	91/92 South	98/99 South	05/06 South	91/92 North	98/99 North	05/06 North	91/92 Center	98/99 Center	05/06 Center	91/92 South	98/99 South	05/06 South
Access to Credit																		
Dummy for credit beneficiary households	16.9	14.6	24.6	23.9	36.1	30.9	15.8	42.3	25.7	18.9	13.7	25.3	31.7	36.1	33.3	32.4	53.7	33.4
Observations	638	740	1904	2255	3060	4003	1630	2198	2780	566	665	1551	1641	2168	2289	751	862	915
Formal Loan source	7.41	17.8	19.5	12.2	13.3	25.2	8.91	10.6	21.3	7.48	13.4	15.9	11.5	11.6	22.6	8.64	10.9	23.1
Informal Loan source	93.5	76.1	78.1	89.6	80.4	71.3	93.4	90.2	74.5	93.5	79.3	82	90.2	79.2	73.7	93	91.8	71.4
Loan source - Relatives and friends	86.1	58.1	65.2	70.5	49.8	51	73.3	67	53.8	86	64	69.5	71	49.3	52.2	74.1	67.7	48.7
Credit amount	32.2	45.7	84.7	88.8	102	180	80.2	117	220	32.3	41.3	78.7	83.2	84.6	157	77.4	84.5	163
Loan purpose - Agriculture	26.9	19.3	27	18.4	12.1	17.9	10.9	9.38	10.1	26.2	23.2	29.8	18.7	17.3	25.8	11.5	17	18.4
Loan purpose - Business	16.7	28.9	21.6	20	23.3	25.8	26	29.2	32.4	16.8	28.4	17.4	19.6	18.4	20.9	25.5	21	26
Loan purpose - Housing	1.85	4.58	5.26	3.53	4.69	5.14	3.49	4.99	5.69	1.87	3.13	5.69	3.27	4.94	4.95	3.7	4.37	5.7
Observations	108	112	413	539	1081	1220	258	870	704	107	96	337	520	786	769	243	439	319
Income																		
Gross total household income	488	707	2190	747	1060	1774	899	1506	2114	463	671	2116	674	906	1564	658	1150	1772
Gross Annual Crop Income- Own Cons Imputed	185	272	903	97.4	154	310	66.7	153	295	206	305	912	132	224	495	144	279	845
Gross income own-farm production of livestock	48.7	42.4	25.5	20.6	32.1	30.9	9.96	85.9	37.2	54.1	47	27.5	27.6	37.5	39.1	20.3	168	25.1
Wage Employment- Agriculture & Fishing	5.4	4.07	8.66	14.5	10.5	22.1	20.9	16.8	27.3	3.99	3.05	8.16	14.4	10.5	22.9	19	19.7	39.9
Wage Employment- Nonfarm Activities	54.9	67.2	119	120	147	208	203	263	459	41.2	44.1	64.9	86.1	88.8	126	79.4	75	127
Gross income from non-agr business	188	305	1119	462	657	1142	555	935	1219	153	256	1089	387	502	833	371	580	694
Transfers and other sources of income	5.76	16.6	15.9	33.5	59.2	60.7	43	53.1	76.3	5.46	15.7	13.8	26.1	44	47.6	24.8	28.6	41.4
Share of income from crops	53	61.4	59.7	31.8	32.9	32.3	20.5	21	20.4	59.3	68.7	70.3	43	48.2	53.2	44.2	46.9	56.6
Share of income from livestock	12.1	9.49	2.62	5.66	5.54	2.25	2.29	4.37	1.33	13.3	9.97	2.59	7.5	6.73	2.33	4.62	6.49	1.26
Share of income ag wage	0.99	0.59	0.58	1.97	1.25	2.11	2.96	2.31	2.15	0.64	0.35	0.51	1.91	1.31	2.05	2.72	2.73	3.36
Share of income from non-ag wage	7.75	6.54	6.17	13.2	12.9	13.8	21.8	19.4	26.9	4.97	4.41	2.59	9.41	8.1	6.98	9.71	6.62	7.39
Share of income from selfemp	23.4	14.9	25.2	34.4	30.4	33.9	39.5	36.7	32.6	19.9	12.1	21.8	29.2	24.4	26.8	30.6	29.5	24.9
Share of transfers and other sources of income	2.41	6.18	4.73	11.9	15.1	12.5	11	12.1	12.7	1.86	4.5	2.18	9.05	11.3	8.65	8.09	7.82	6.5
Observations	638	740	1904	2255	3060	4003	1630	2198	2780	566	665	1551	1641	2168	2289	751	862	915
Durables																		
total value of durables - imputed	348	666	656	725	2116	1163	636	2957	1532	307	668	600	737	2270	1209	600	3076	1704

HH owns a refrigerator	0.6	2.78	5.05	8.07	17.5	20.6	15.1	27.1	32.6		0.45	1.58	2.28	4	9.07	11.1	1.84	7.06	10.5
HH owns a fan	2.82	5.82	11.9	13.5	23.7	27.9	26.3	39.4	44.1		0.68	2.69	6.25	7.01	14.5	16.1	5.67	13.4	16.9
HH owns a stove	9.66	6.23	4.91	13.9	12.1	16.2	21.5	21.1	28.1		8.16	5.48	3.39	9.22	8.32	8.65	9.2	6.43	9.87
HH owns a furniture	31.6	45.5	31.8	70.7	73.9	58.9	81.2	79.8	66.8		28.6	42.3	30	66	69.4	54.3	76.5	74.5	61.7
HH owns a house	39	46.6	51.1	34.2	32.3	31.9	27.2	30.3	28.9		39.5	49.1	55.8	40.5	39.9	41.6	46.2	50	50.9
HH owns a bike	67.6	72.8	73.2	14.5	16.2	20.7	5.79	9.15	9.49		71	76.7	79.8	17.3	19.7	25.2	8.13	11.9	15.3
HH owns a car	1.41	0	1.12	1.91	2.44	2.52	2.89	4.93	5.23		1.13	0	0.71	1.22	1.94	1.81	0.77	0.55	1.82
Observations	497	617	1900	1934	2672	3983	1417	1972	2755		441	548	1551	1399	1905	2289	652	759	915
total value of agricultural assets - imputed	479	135	287	126	181	182	718	284	128		479	109	316	128	169	131	718	102	84.1
Observations	42	103	404	54	800	814	13	400	411		42	97	368	53	762	666	13	335	328

Table 4. Descriptive statistics (land, inputs, livestock, agricultural assets), by Macro-regions

	Agricultural Households								
	91/92	98/99	05/06	91/92	98/99	05/06	91/92	98/99	05/06
Land	North	North	North	Center	Center	Center	South	South	South
Operated land - hectares	2.63	2.28	4.86	2.03	2.26	2.47	2.46	3.12	3.63
Owned land - hectares	2.73	2.47	4.99	2.78	3.94	3.12	4.28	4.02	3.97
(mean) land own_t??	0	0.41	3.55	6.89	10.3	15.9	8.26	22.7	29.9
Cash crop production - 2005 GH¢	47	59.6	177	98.9	68.7	226	110	178	715
Food crop production - 2005 GH¢	152	175	734	162	109	268	56.1	52.8	128
Share of crop production sold	19.8	24.6	39.2	56.1	40.7	57.5	53.1	59.9	65.3
Production value of cash crops relative to food crops ratio	0.57	0.51	0.7	2.34	3.07	4.46	6.9	8.98	10.2
Observations	566	665	1551	1641	2168	2289	751	862	915
Agricultural Input									
Annual agricultural crop costs and expenses.	29.9	42.4	70	36.6	58.1	77.3	37.1	44.9	82.9
Inorganic fertilizer expenditure - 2005 GH¢	5.21	5.19	14.2	1.98	2.47	9.12	0.66	0.84	13.7
Pesticides expenditure - 2005 GH¢	0.21	0.74	1.43	2.26	3.13	9.52	2.9	6.46	11.4
Seeds and seedlings expenditure - 2005 GH¢	3.26	1.69	2.15	1.03	3.47	2.97	1.61	1.73	2.38
Fertilizer, pesticides and seeds expenditure - 2005 GH¢	8.78	12.2	21.8	5.56	9.57	23.6	5.04	9.09	33.3
Hired labour expenditure - 2005 GH¢	7.36	9.79	19	16.7	19.6	26.4	16.4	16.7	22.8
HH hiring labourers for crop production	32.7	57.4	41.7	71.5	75.1	60.4	66.2	71.3	59.2
Inorganic fertilizer expenditure - 2005 GH¢ per ha	2.43	3.74	5.74	1.8	3.73	5.45	0.83	0.59	4.41
Pesticides expenditure - 2005 GH¢ per ha	0.14	0.26	0.55	1.51	2.71	7.86	1.32	2.55	4.01
Seeds and seedlings expenditure - 2005 GH¢ per ha	1.96	1.26	1.2	1.26	4.6	2.7	1.8	1.29	2.22
Fertilizer, pesticides and seeds exp. - 2005 GH¢ per ha	4.8	6.78	9.18	4.98	11.7	16.8	4.13	4.42	13
Hired labour expenditure - 2005 GH¢ per hectare	4.28	7.62	8.08	22.2	22.6	22.7	13.7	10.1	13.9
Observations	566	665	1551	1641	2168	2289	751	862	915
Livestock									
Tropical Livestock Units: cattle	0.98	1.41	1	0.11	0.15	0.17	0.04	0.01	0.02
Tropical Livestock Units: total	2.02	2.76	1.99	0.59	0.78	0.74	0.48	1.02	0.49
Livestock TLU/ha	0.88	1.42	0.78	0.84	1.04	0.72	0.37	0.53	0.35
Observations	496	516	1357	1035	1115	1277	435	448	410
Agricultural Assets									
HH owns tractor(s)	0.71	0	1.03	0.18	0.04	0.17	0.27	0	0
HH owns plough(s)	1.41	0.3	4.69	0.12	0.1	0.05	0.13	0.06	0
HH owns cart(s)	0.53	1.65	4.21	0.24	0.08	0.05	0	0	0
HH owns sprayer(s)	0.18	0.29	1.11	3.11	3.56	8.03	1.6	5.81	7.53
Observations	566	665	1551	1641	2168	2289	751	862	915
Total value of agricultural assets	479	109	316	128	169	131	718	102	84.1
Observations	42	97	368	53	762	666	13	335	328

Table 5. Share (%) Hours/week working in agriculture, services, industry, manufacturing

	GLSS3	GLSS4	GLSS5
	1991-92	1998-99	2005-06
Agriculture	61.54	54.45	55.2
Services	27.02	31.04	29.93
Industry	1.63	2.12	2.94
Manufacturing	9.7	12.35	11.64
Observations	4,278	5,593	8,098

Table 6. Determinants of share of hours worked in agriculture and services. Fixed Effects and Weighted Least Squares models.

	FE Agriculture (i)		WLS Agriculture (ii)		FE Services (iii)		WLS Services (iv)	
	b	t	b	t	b	t	b	t
Demographic								
% (#/hhsize) of females 15-19	-0.321	[-0.01]	-2.715	[-0.14]	-14.927	[-0.61]	-9.492	[-0.49]
% (#/hhsize) of females 20-34	-16.739*	[-1.97]	-11.564	[-1.49]	2.690	[0.21]	2.680	[0.33]
% (#/hhsize) of females 35-59	-4.553	[-0.55]	-0.977	[-0.16]	5.945	[0.68]	0.861	[0.14]
Household Size (AE)	-0.055	[-0.06]	-0.323	[-0.44]	-0.869	[-0.94]	-0.031	[-0.04]
Dependency ratio (hh members aged <15 & >64/hh members aged 15-64)	-5.982**	[-2.04]	-3.393*	[-1.91]	5.281**	[2.18]	3.269*	[1.71]
Avg years of education (adults 15-60)	-3.230****	[-3.06]	-3.134****	[-4.64]	3.534****	[3.53]	3.249****	[4.41]
Land and Lab. Exp.								
Size of land operated (ha)	0.189**	[2.59]	0.168	[1.49]	-0.053	[-0.85]	-0.014	[-0.12]
Inequality in land distribution within each EA (Gini coefficient)	-2.824	[-0.24]	4.146	[0.54]	14.069	[0.76]	-5.284	[-0.63]
Annual expenditure on hired labour (cedis/ha)	0.050**	[2.01]	0.036	[1.25]	-0.114****	[-3.22]	-0.099****	[-2.97]
Wealth								
Tropical Livestock Units: total	-3.479****	[-2.97]	-2.417****	[-3.40]	2.196	[1.62]	1.750**	[2.13]
Owns a house	11.382**	[2.07]	9.343**	[2.02]	-1.059	[-0.21]	-6.394	[-1.32]
Poverty Status	-8.273*	[-1.88]	-6.731****	[-2.80]	-0.031	[-0.01]	1.822	[0.72]
Access to infrastructure								
Farmers participate in Agr Coop	7.099	[1.57]	3.586	[0.92]	-6.045	[-1.14]	-5.299	[-1.23]
Household has Electricity	-1.983	[-0.22]	-10.507*	[-1.66]	11.383	[0.97]	17.491**	[2.57]
KM from nearest road	-1.407**	[-2.53]	-1.086**	[-2.10]	1.058*	[1.87]	0.703	[1.26]
Facilities								
Permanent market within the community	-6.220	[-1.01]	-4.719	[-1.17]	12.378**	[2.33]	7.716*	[1.82]
KM from rural community to health facility	-0.006	[-0.08]	-0.026	[-0.66]	0.020	[0.28]	0.015	[0.35]
KM from rural community to nearest bank	0.189**	[2.54]	0.104**	[2.43]	-0.238****	[-2.95]	-0.159****	[-3.39]
Credit								
Credit amount (cedis)	0.005	[0.69]	0.008	[1.32]	-0.005	[-0.73]	-0.008	[-1.20]
Migration (HH moved to village in prev. 5y)	-17.387*	[-1.82]	-14.503**	[-2.19]	-6.230	[-0.50]	3.066	[0.44]
Geo								
RURURB==Rural	23.165**	[2.33]	23.05****	[3.88]	-19.269*	[-1.89]	-14.595**	[-2.37]
Agroecological zone 1	1.170	[0.40]	0.116	[0.05]	-2.074	[-0.66]	-2.171	[-0.85]
Agroecological zone 2	2.284	[0.84]	-0.403	[-0.21]	-0.520	[-0.19]	0.160	[0.07]
year==1998/99	3.080	[1.43]	4.307**	[2.34]	-5.009*	[-1.87]	-5.313****	[-2.70]
year==2005/06	10.59****	[3.90]	10.14****	[4.33]	-10.15****	[-2.95]	-9.800****	[-3.99]
Constant	65.57****	[5.91]	48.00****	[4.61]	25.687**	[2.33]	46.75****	[3.69]
Observations	342		342		342		342	
r2	0.419		0.993		0.364		0.986	
F	12.391		205.137		3.714		106.987	

Note: (i) Heteroskedastic-consistent standard errors are estimated in WLS; robust standard errors clustered at cohort level are estimated for FE models;

(ii) t-statistics in brackets;

(iii) Significance levels: *p<0.1, **p<0.05, ****p<0.001.

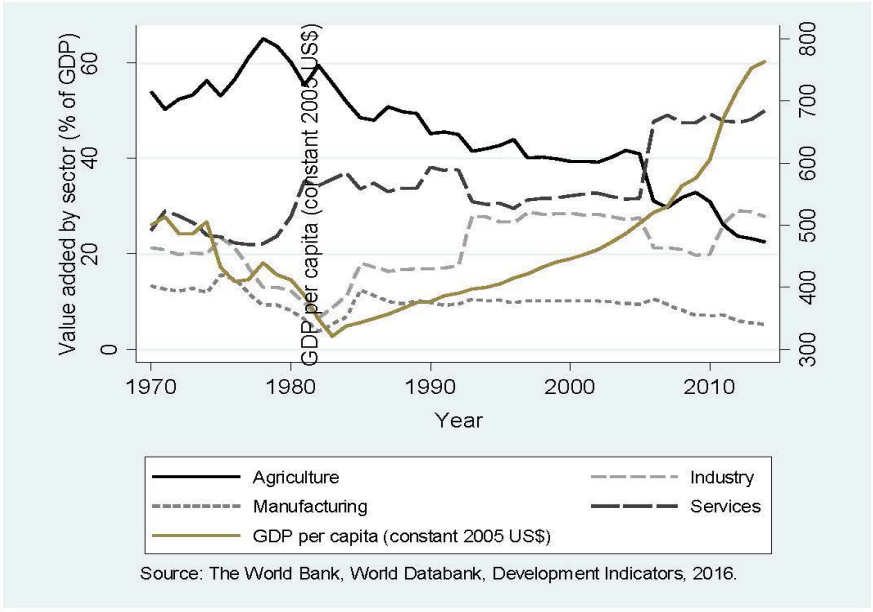
Table 7. Determinants of share of hours worked in industry and manufacturing estimates. Fixed Effects and Weighted Least Squares models.

	FE Industry (v)		WLS Industry (vi)		FE Manufacturing (vii)		WLS Manufacturing (viii)	
	b	t	b	t	b	t	b	t
Demographic								
% (#/hhsize) of females 15-19	-10.78**	[-2.26]	-10.69****	[-3.07]	26.325	[0.95]	16.534	[0.94]
% (#/hhsize) of females 20-34	-2.167	[-1.02]	-2.105	[-1.22]	15.062	[1.22]	9.189	[1.31]
% (#/hhsize) of females 35-59	-0.732	[-0.52]	-0.709	[-0.62]	-1.516	[-0.19]	1.683	[0.31]
Household Size (AE)	0.206	[0.89]	0.211	[1.21]	0.775	[1.00]	0.056	[0.08]
Dependency ratio (hh members aged <15 & >64/hh members aged 15-64)	-0.529	[-0.98]	-0.517	[-1.28]	1.069	[0.35]	1.126	[0.72]
Avg years of education (adults 15-60)	-0.138	[-0.79]	-0.136	[-0.79]	-0.195	[-0.19]	0.065	[0.11]
Land and Lab. Exp.								
Size of land operated (ha)	-0.024	[-0.84]	-0.024	[-0.77]	-0.112	[-1.44]	-0.157	[-1.57]
Inequality in land distribution within each EA (Gini coefficient)	1.229	[0.67]	1.181	[0.63]	-13.006	[-0.81]	3.952	[0.59]
Annual expenditure on hired labour (cedis/ha)	-0.002	[-0.25]	-0.003	[-0.30]	0.067**	[2.22]	0.016	[0.66]
Wealth								
Tropical Livestock Units: total	-0.456*	[-1.70]	-0.466**	[-1.98]	1.755	[1.48]	0.752	[1.23]
Owns a house	-0.512	[-0.68]	-0.521	[-0.56]	-9.826*	[-1.88]	0.556	[0.13]
Poverty Status	0.707*	[1.72]	0.704	[1.31]	7.575	[1.55]	4.728**	[2.19]
Access to infrastructure								
Farmers participate in Agr Coop	0.505	[0.47]	0.495	[0.47]	-1.473	[-0.27]	1.102	[0.32]
Household has Electricity	5.807****	[2.89]	5.847****	[3.98]	-15.147*	[-1.76]	-12.07**	[-2.15]
KM from nearest road	0.014	[0.12]	0.014	[0.10]	0.400	[0.76]	0.541	[1.18]
Facilities								
Permanent market within the community	0.984	[1.51]	0.977	[1.15]	-7.204	[-1.30]	-3.067	[-0.84]
KM from rural community to health facility	0.019	[1.45]	0.019	[1.31]	-0.035	[-0.42]	0.000	[0.01]
KM from rural community to nearest bank	0.000	[0.01]	-0.000	[-0.04]	0.051	[0.56]	0.024	[0.63]
Credit								
Credit amount (cedis)	-0.001	[-0.77]	-0.001	[-0.76]	0.002	[0.19]	0.002	[0.46]
Migration (HH moved to village in prev. 5 yrs)	0.785	[0.59]	0.776	[0.51]	22.237*	[1.80]	10.194*	[1.71]
Geo								
RURURB==Rural	-3.148**	[-2.55]	-3.166**	[-2.59]	-1.057	[-0.16]	-7.333	[-1.36]
Agroecological zone 1	0.457	[0.99]	0.447	[0.66]	0.483	[0.24]	1.258	[0.63]
Agroecological zone 2	0.478	[1.36]	0.463	[0.81]	-2.376	[-1.42]	-0.898	[-0.53]
year==1998/99	-0.821	[-1.64]	-0.805	[-1.57]	2.941	[1.12]	1.490	[0.91]
year==2005/06	-0.709	[-1.11]	-0.710	[-1.27]	0.195	[0.06]	-0.772	[-0.37]
Constant	2.044	[1.33]	1.474	[0.56]	7.303	[0.75]	15.016	[1.41]
Observations	342		342		342		342	
r2	0.277		0.678		0.217		0.895	
F	1.815		3.094		2.351		12.578	

Note: (i) Heteroskedastic-consistent standard errors are estimated in WLS; robust standard errors clustered at cohort level are estimated for FE models;
(ii) t-statistics in brackets;
(iii) Significance levels: *p<0.1, **p<0.05, ****p<0.001.

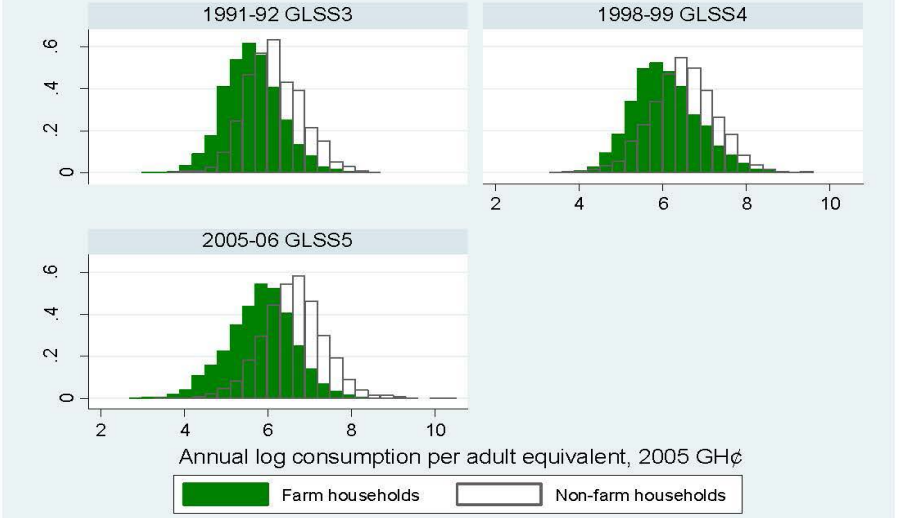
APPENDIX 2 – List of Figures

Figure 1. Value Added by sector (% of GDP), 1965- 2014



Source: The World Bank, World Databank, Development Indicators, 2016.

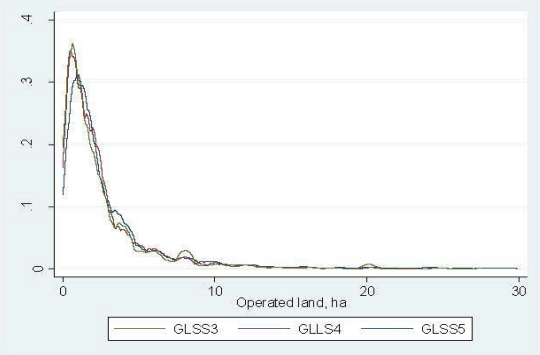
Figure 2. Frequency distribution of consumption for GLSS3, GLSS4, and GLSS5



Source: Authors' computation based on 1991-92, 1998-9, 2005-06 Ghana Living Standards Survey (GLSS).

Note: We perform a t-test for the comparison of means between the agricultural/non-agricultural households for each year ($H_0: \mu_0 = \mu_1$). The two-tailed p-value confirms that in all cases the difference in means is statistically significantly different from 0.

Figure 3. Distribution of operated land sizes: kernel density functions by GLSS waves, ha



Note: Kernel density functions for each wave use the Epanechnikov kernel and optimal bandwidth.

Figure 4. Landholding sizes: pie chart by year

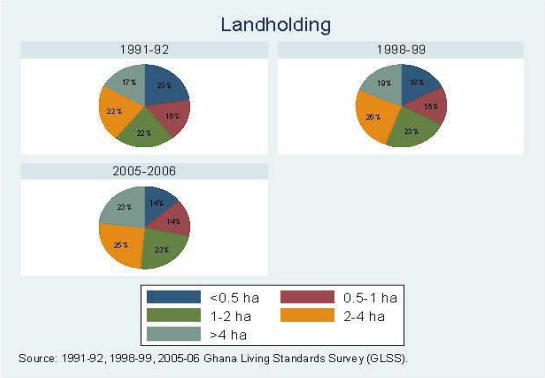


Figure 5. Use of agricultural inputs by land endowment

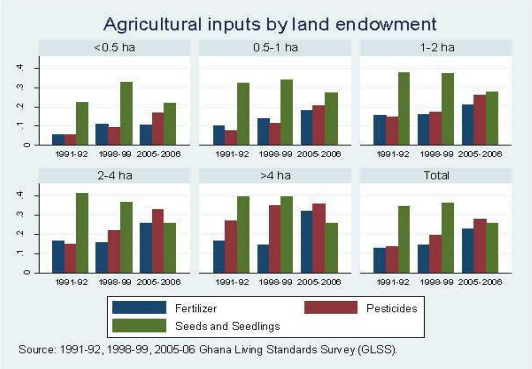


Figure 6. Share of household heads employed in agriculture, manufacturing and services, trend across regions.

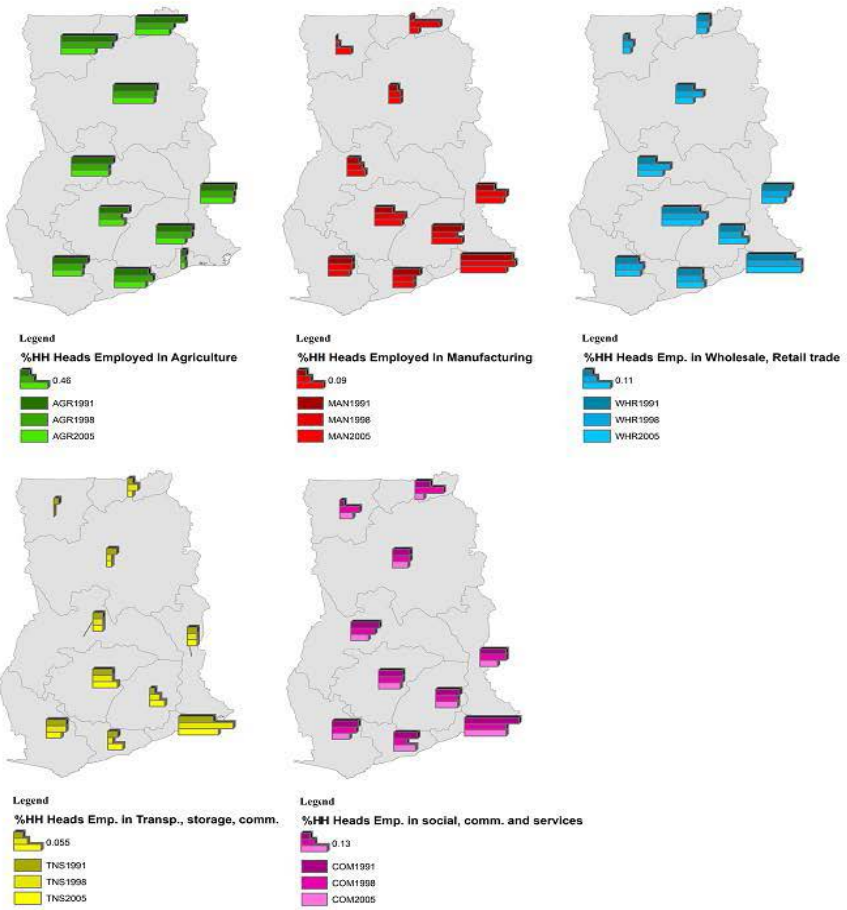


Figure 7. Share of income by sources, across regions in 1991, 1998, 2005.

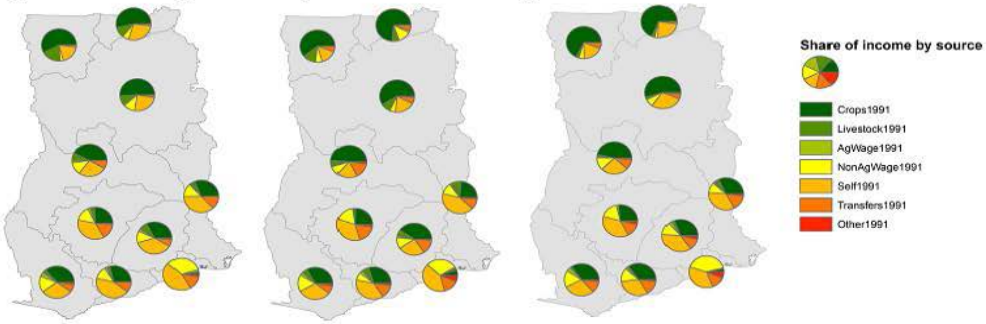


Figure 8. Total value of production of cash crops and food crops, trend across regions

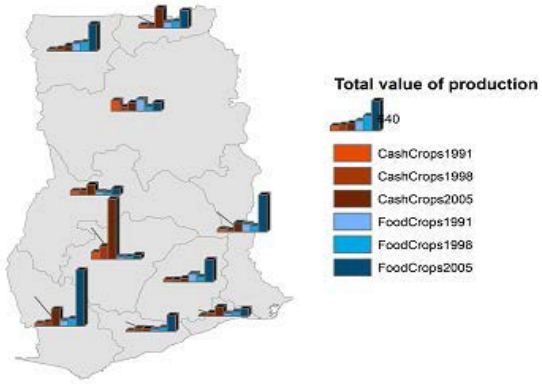


Figure 9. Input expenditure per Ha, trend across regions

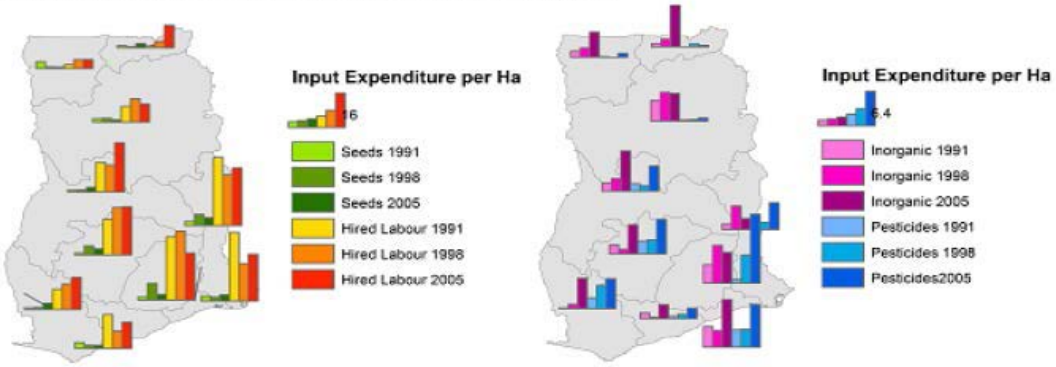
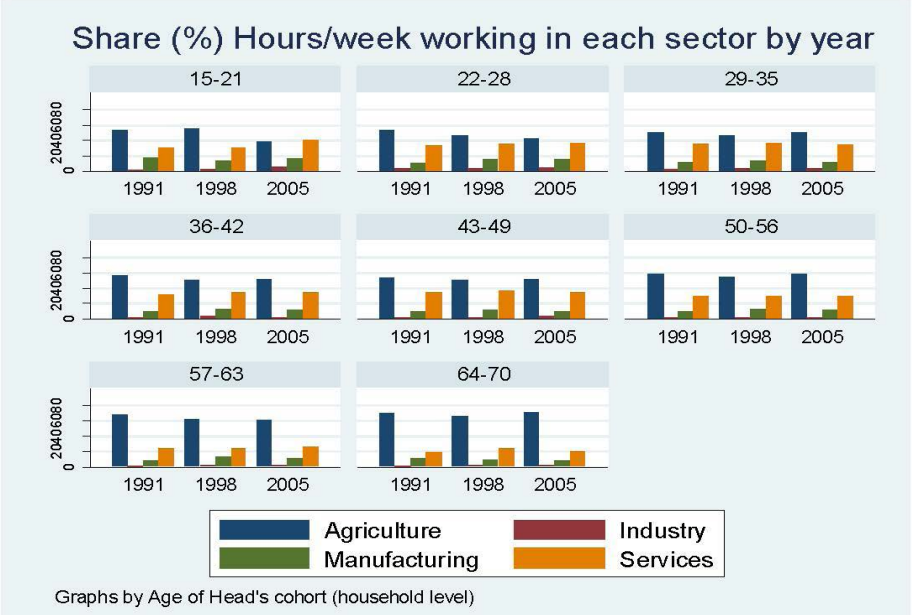


Figure 10. Share of hours/week worked in agriculture, industry and services, by age of head's cohorts, over time.



ANNEX A – Cohorts construction

A.1 Cohorts construction

Cohorts can be defined in terms of single or multiple characteristics. Using a multidimensional grouping system would help increase ing the number of cohort-groups. Hence, we construct our pseudo-panel by grouping households into cohorts according to a joint set of multiple characteristics, namely the household head's age category, his/her sex and residing region.

Since we also want to also analyze the sector of economic activity of the head, we restrict the sample to households with heads aged 15 to 64. More specifically, since the three cross sections fall seven years apart from each other, we reduce the first sample (1991/92) to households whose heads are 15 to 50 years old, the second (1998/99) to households with heads between 22 and 57 y. o. and the third round (2005/06) to household heads with ages ranging between 29 and 64. Similarly to Ackah et al. (2012) we allow households to "age" over time by tracking the same groups across the years.

For each variable included into the analysis, averages within each cohort are treated as individual observations within the pseudo-panel. Following Verbeek and Nijman (1993) we construct the cohorts ensuring that the number of observations per group would be as large as possible to reduce biases in the estimates. On the other hand, since we have only three cross- sections, if the cohorts include a large number of households, the number of cohort-groups generated will be too small, affecting the overall cross-sectional dimension of the panel. We use seven-years bands to define the generational cohorts, which result in eight age classes (15-21, 22-28, 29-35, 36-42, 43-49, 50-56, 57-63 and 64 to 70) generated for each region in each survey year. Our pseudo- panel finally results from the interaction of 7-years generation bands with the ten regions of domicile and a gender variable (male/female) for the household's head, for a total of 114 (out of 160) cohorts tracked over time15[15].

Households whose heads are of these ages and are found in the relevant cross-sections are pooled to form the pseudo cohorts. Even though the households interviewed will change in each round, they will still be fully representative of the cohort designed according to the characteristics of the population.

[15] Most authors include the birth region or more often year of birth intervals (Propper, Rees and Green, 2001), which are both time invariant variables. In a cohorts' framework, each household belongs to the same group for the whole period.

ANNEX B – Unemployment

To check the robustness of our estimates, we also include among the time allocation the time spent not working, accounting for the time declared by people in working age as not working/inactive. We consider as non-working time: (i) when job is not declared and registered time is missing, (ii) the difference between the total amount of workable hours per week – which we set as 40 (8 hours/day per 5 working days) – and the real time worked. Similarly to the procedure applied for $Sh_{is,t}$ variable, we winsorize all values exceeding 40. Differently from $Sh_{is,t}$ the share of hours worked is computed over 40 as follows: $Sh^{40}_{is,t} = \frac{HW_{is,t}}{40}$.

$$Sh^{40}_{unemp,it} = 1 - \sum_{s=1}^{4} \frac{HW_{is,t}}{40}$$

which will be 0 in case of full employment (all individuals within the same household i work 40 hours per week), and 1 in case of full unemployment.

Hereafter we report the descriptive statistics of the share of hours/week worked in the different fields, overall and divided by cohorts. We have to bear in mind that data refers to the last week before the interview. Share of time spent not working is quite high. First of all, this may be due to sensitivity of responses to the agricultural business cycle; in addition the date of the interview reflects possible seasonal movements across months. Secondly, respondents can be reticent or underreport the time spent working. Third, data does not consider time spent in domestic chores, which will presumably capture a great share of time in particular for women.

Table B.1. Share (%) Hours/week working in agriculture, services, industry, manufacturing, not working, by year

	GLSS3 1991-92	GLSS4 1998-99	GLSS5 2005-06
Agriculture	42.44	31.86	30.67
Industry	1.16	1.54	1.46
Manufacturing	6.82	7.91	6.17
Services	18.91	20.36	16.63
Not Working	30.61	38.31	44.86
Observations	4,278	5,593	8,098

Table B.2. Share (%) Hours/week working in agriculture, services, industry, manufacturing, not working by age cohort and year

	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06
Age cohort	*15-21*	*15-21*	*15-21*	*22-28*	*22-28*	*22-28*	*29-35*	*29-35*	*29-35*	*36-42*	*36-42*	*36-42*
Agriculture	39.69	37.11	20.08	41.24	33.38	27.77	38.11	33.5	34.14	39.96	32.86	31.55
Industry	0.59	1.64	3.12	2.64	2.7	3.18	2.22	2.56	2.39	1.49	1.81	1.62
Manufacturing	13.05	9.3	8.17	7.99	11.05	9.65	8.49	9.88	7.67	6.92	7.81	7.19
Services	22.4	20	21.1	25.75	26.3	23.8	26.69	26.61	23.54	23.26	22.67	20.57
Not Working	24.26	31.95	47.54	22.15	26.46	35.33	24.27	27.43	31.81	28.36	34.78	38.92
Observations	96	84	156	629	686	1108	851	1036	1476	748	1075	1504

	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06	GLSS3 91-92	GLSS4 98-99	GLSS5 05-06
Age cohort	*43-49*	*43-49*	*43-49*	*50-56*	*50-56*	*50-56*	*57-63*	*57-63*	*57-63*	*64-70*	*64-70*	*64-70*
Agriculture	33.95	28.59	27.79	35.6	31.07	30.9	43.41	33.39	31.72	46.25	36.71	34.29
Industry	1.05	1.18	1.5	1.14	1.21	0.96	0.81	0.84	1	0.47	1.07	0.92
Manufacturing	6.46	6.38	5.67	6.46	6.93	5.8	4.99	7.37	5.7	6.98	4.64	3.61
Services	22.13	20.74	18.41	18.17	16.98	15.63	15.11	12.77	13.69	12.44	12.84	9.63
Not Working	36.41	43.1	46.26	38.46	43.77	46.56	35.67	45.64	47.72	33.87	44.72	51.23
Observations	597	817	1250	613	843	1187	405	541	726	339	511	691

Note: Household level statistics based on household head's age-cohort membership