DEPARTMENT OF FOOD AND RESOURCE ECONOMICS
UNIVERSITY OF COPENHAGEN

IFRO Working Paper

Labour markets for irrigated agriculture in central Ethiopia: Wage premiums and segmentation

Mengistu Assefa Wendimu
Peter Gibbon

2014 / 06

IFRO Working Paper 2014 / 06

Labour markets for irrigated agriculture in central Ethiopia:
Wage premiums and segmentation

Authors: Mengistu Assefa Wendimu, Peter Gibbon

JEL-classification: J41, J42, J43, J45, J46

September 2014

See the full series IFRO Working Paper here:
www.ifro.ku.dk/english/publications/foi_series/working_papers/

Department of Food and Resource Economics (IFRO)
University of Copenhagen
Rolighedsvej 25
DK 1958 Frederiksberg DENMARK
www.ifro.ku.dk/english/

Labour markets for irrigated agriculture in central Ethiopia: Wage premiums and segmentation

Mengistu Assefa Wendimu

Danish Institute for International Studies (DIIS)

Natural Resources and Development

Østbanegade 117, 2100 Copenhagen Ø, Denmark

Tel: +45 91325486

Fax: +45 32 69 87 00

Email: mas@diis.dk

and

Department of Food and Resource Economics

University of Copenhagen

Rolighedsvej 25, DK-1958 Frederiksberg C

and

Peter Gibbon

Danish Institute for International Studies

Østbanegade 117

2100 Copenhagen Ø, Denmark

E-mail: pgi@diis.dk

Abstract: *Labour market segmentation in developing countries has been considered in a growing literature, some of which suggests an informal sector wage premium. However, such studies have mainly focused on urban labour markets and have not discriminated between the informally self-employed and wage workers. This paper examines segmentation in rural markets for agricultural wage workers in Ethiopia, controlling for location, farming systems and observed worker characteristics. Applying an endogenous switching model with simultaneous estimation of wage equations it establishes an informal sector wage premium, self-selection into the informal sector and sectorally-distinct wage determination mechanisms.*

Keywords: *Labour market segmentation, Agricultural labour markets, Wage premiums, Large-scale agriculture, Ethiopia.*

Acknowledgment

This research is fully funded by the Danish Ministry of Foreign Affairs. The fieldwork expense of the second author was covered by the Danish Institute for International Studies. In both cases this support is greatly appreciated. The authors are grateful to Arne Henningsen for his help with R-programming and insightful comments on method. The authors also thank Ott Toomet and Henning Tarp Jensen for their comments and suggestions on an earlier draft. The authors take full responsibility for any remaining errors.

Introduction

Since the 1970s a long series of studies have claimed to show that, rather than exhibiting full integration, labour markets are characterized by wage premia not explicable in terms of workers' human capital attributes. Many of these studies have also claimed to show a dualistic segmentation of the labour market, between a so-called 'primary' segment or sector characterized by high pay and good working conditions and a 'secondary' one characterized by low pay and job insecurity, and with institutional barriers to entry to the primary segment. While these claims have been disputed, and the methodologies used in the first generation of such studies have been abandoned, discussion about labour market segmentation has not gone away. Indeed, this discussion has spread to developing countries where the so-called primary segment is arguably represented by formal and/or public employment rather than by employment in large-scale industrial enterprises as in 20th century developed countries.

With the spread of the labour market segmentation debate to developing countries, its terms have changed. Whereas in developed countries controversy came to revolve around whether the dualism hypothesis oversimplified segmentation and underestimated inter-segmental mobility, studies based on developing countries have challenged both the existence of segmentation *per se* and the assumption that, where it does exist, it is the primary sector that commands a wage premium.

Because of data availability issues, almost all of the developing country studies examining labour market segmentation have been on urban populations. Moreover, the samples of informal sector workers used include self-employed entrepreneurs as well as wage workers. Since the urban-rural wage gap is likely to be greater for informal rather than formal sector workers, and since at least some entrepreneurs are likely to have higher incomes than wage workers, this might be thought likely to skew results in favour of rejecting classic labour market dualism. There is therefore a good case for conducting more studies of rural labour markets in developing countries, with a specific focus on wage workers.

This paper tests the specific hypothesis that the market for wage labour in irrigated agriculture in central Ethiopia can be validly characterized as segmented. Labour market segmentation is understood here to comprise the combination of (i) a labour market divided into at least two segments, with significantly different selection principles; (ii) a wage premium significantly different from zero, enjoyed by workers in one of these segments; and (iii) restrictions on mobility between segments. Its data set is based on small but representative samples of agricultural labourers on large-scale formal and small-scale informal commercial farms and the analysis uses the methodology most commonly applied in labour market segmentation studies since Dickens and Lang's classic 1985 paper – an endogenous switching model in combination with simultaneously estimated wage equations.

The remainder of the paper is divided into six sections. The next section reviews the labour market segmentation literature. This is followed by a section on research design and the study area, including details on survey design and sampling as well as presenting descriptive statistics on the sample. The econometric model used is then set out, followed by a

presentation of the results generated by it. These are discussed before a final section concludes.

Labour market segmentation and dualism

Neo-classical labour market theory posits heterogeneity amongst workers but homogeneity in national labour market structure and wage determination. Occupational status and wages are determined by aggregate supply and demand for labour, as well as by more specific supply-side factors, mainly but not only [1] the differential human capital attributes of market participants. The latter are associated with individual productivity differences, which are then rewarded or penalized in terms of wage differentials (Becker 1964, Mincer 1974).

On the other hand, a number of classical and neo-classical economists pointed out exceptions to the homogeneity of labour markets. Cairns (1874) noted the existence of 'non-competing industrial groups' of workers, Marshall (1890) stated that the supply of skilled workers is inelastic and Pigou (1945) observed that, while competition in labour markets might lead to local wage convergence, individual firms with their own well-established rules could and did set wages without reference to external conditions. The American Institutionalist School of the mid-twentieth century, with its emphasis on the differential traits of industrial sectors (e.g., capital and labour concentrations and profit rates) and its explicit reference to limited mobility across sectors strengthened this emphasis (Reynolds 1951, Dunlop 1957). However a turning point in the economic treatment of labour markets occurred in the 1970s with the labour market dualism (LMD) thesis of Doeringer and Piore (1971) and Gordon, Edwards, and Reich (1973). This broke explicitly with neo-classical approaches – with or without acknowledged exceptions - by postulating two parallel ('primary' and 'secondary') labour markets or labour market segments with (i) bimodality in wages, wage determination and the quality of jobs encompassed, (ii) economically arbitrary allocation between segments and (iii) limited mobility between segments due to rationing.

LMD theory acknowledged that, consistent with a bimodal pattern of wage determination, human capital variables might underlay the distribution of wages within the primary sector alone. But wage determination in the secondary sector was either random or driven by unobserved factors and there was no overall association between human capital levels, wages and employment conditions, since institutional factors substituted entirely for market processes in allocating workers to segments and segmentation's structural character eliminated competitive pressures to equalize wages. Discrimination in terms of race, gender and social status was seen to be an important component of job allocation, resulting in few blacks, women, elderly people or people from poor backgrounds participating in the primary labour market.[2] The original empirical reference of the LMD thesis was the contemporary US labour market, although efforts were soon made to extend its application.

[1] Other factors include the work/leisure balance preferences and the dirty/clean occupational preferences of individual agents.

[2] Hudson (2007) has recently sought to update the LMD thesis in the US by taking into account the decline in union affiliation, influx of non-citizen immigrants, spread of 'contingent' work arrangements and outlawing of

In early versions of the LMD thesis the labour market's two segments were defined industrially. The demand side of the primary segment was made up of large-scale, mostly bureaucratized enterprises enjoying stable product market demand and characterized by strong unions and/or occupational associations (McNabb 1987, Osberg et al 1987, Baffoe-Bonnie 1989). By contrast, firms in the secondary market were held to be smaller, non-union, more hierarchically managed, and facing cyclical or 'peripheral' demand patterns. According to Leontaridi (1998), most empirical studies interpreting dualism in industrial terms provided some support for the segmentation thesis but fell short of demonstrating strict duality. The explanation offered was that segmentation applied within as well as between industrial branches. A second phase of LMD studies then focused upon occupational rather than industrial segmentation (Osterman 1975, McNabb and Psacharopoulos 1981 and Neumann and Ziderman 1986), although this was not operationalized consistently.

Meanwhile the standard procedure used to test for LMD was subjected to methodological criticism. This procedure involved dividing a sampled population into two exclusive groups according to industrial or occupational membership, estimating two corresponding wage equations using ordinary least squares (OLS) and then comparing the difference. According to Cain (1976) this entailed sample truncation, since creating a sample that was likely to mainly comprise low earners and running regressions on it will bias estimates of true functions by lessening the simple regression relation between earnings and any single independent exogenous variable. Moreover the standard procedure erroneously assumed that allocation of workers to segments is exogenous. Allocation of workers to sectors depends on selection decisions of workers as well as employers, meaning that using only sector-based OLS equations will introduce selection bias (Dickens and Lang 1985, van der Gaag and Vijverberg 1988 and Hartog and Oosterbeek 1993). Finally, with some exceptions, (e.g., Osterman 1975) studies using the standard procedure did not directly test for mobility/rationing.

Solutions devised to this problem included dividing samples using methods such as factor analysis or cluster analysis and/or by reference to variables not directly reducible to income (or education)[3] (e.g., Anderson, Butler and Sloan 1987, Drago 1992 and Flatau and Lewis 1993); or transforming the problem into one of unobserved variable bias treatable via running a sample selection probit and then fitting a selection bias-corrected earnings function on the low-wage sample in a two stage procedure (Heckman and Hotz 1986); or finally of transforming the problem into one of modelling constraints on switching between segments while simultaneously estimating separate wage equations for the two regimes (Dickens and Lang 1985, 1993).

---

race and gender discrimination. Using time series data he claims to find an overall increase in LMD in the US since the early 1970s, with citizenship status becoming of equal importance to race and gender in segmental allocation. However, transition from the secondary to the primary labour market segment is also more frequent than indicated by earlier work.

[3] Such as position on occupational rating scales, product end markets or training requirements. See for example Rosenberg 1980 and Van Ophem 1987.

Studies using the first of these solutions again lent support to segmentation but not to strict dualism, since they often generated more than two segments. Heckman and Hotz's own study paradoxically found evidence both of segmentation and of a positive effect on earnings of Mincerian human capital. However use of endogenous switching models, allowing specification of wage equations for two observable regimes as well as comparison of the log likelihood results for the two equation model with those for a single (human capital) one, proved the most popular method in the subsequent literature. It has also generally supported findings of LMD.[4]

Mainly because of the restrictiveness of some of the assumptions of switching models, the relatively consistent results they have generated have not closed the discussion on LMD in developed countries. In recent years this has been characterized by greater use of longitudinal data to directly assess mobility between/rationing by segment (e.g, Duryea et al 2006, Hudson 2007, Packard 2007, and Bosh and Maloney 2007) and by application of non-parametric methods such as propensity score matching to test for segmentation (Quintin and Pratap 2006).

While findings from the latest generation of studies have been somewhat inconclusive, interest in labour segmentation/dualism analysis remains, reflecting ongoing disappointment with results from studies testing for human capital-based explanations of wage levels – which, even where a positive relation is detected, rarely find that this accounts for more than 30 percent of differences (Mortensen 2005). This holds for developing, just as it does for developed countries.[5]

Segmentation and dualism in developing countries

Where labour market segmentation has been explored in developing countries, studies often fail to confirm its existence. These studies date first from the 1980s and, while they include some from Africa, mainly relate to Latin America.[6] This is in the interpretive context of considering formal sector employment as the primary labour market segment and informal sector employment as the secondary one, and an empirical one of considerable overlap between public and formal employment. The reasons why segmentation should be less evident in developing than developed countries have not been much explored. They may

[4] Besides Dickens and Lang see Rebitzer and Robinson 1991 using US data, Basch and Paredes-Molinas 1996 using data from Chile, Roig 1999 using data from Spain and Adamchik and Bedi using data from Poland.There are nonetheless exceptions: Sloane et al's (1993) results using this model – as well as a variety of other methods - do not support LMD.

[5] For a discussion, in respect of Africa based mainly on results obtained by Bennell (1996), see Fields (2011). See also Teal (2011).

[6] See Corbo and Stelcner (1983) on Chile, Magnac (1991) on Columbia, Saavendra and Chong (1999) on Peru, Quintin and Pratap (2006) on Argentina, Falco et al (2010) on several African countries and Jones and Tarp (2014) on Mozambique. Pages and Stampini's (2009) study of six developing and transition economies find a formal sector wage premium in three of these but no premium in the three others. Note however that for South Africa Kingdon and Knight (2004) find a 50-64% formal/informal earnings differential after controlling for characteristics, depending on whether OLS or selectivity-corrected wage equations are used.

relate to the urban bias in the samples typically used, as well as the heterogeneity of the urban informal sector (see House 1984, Cunningham and Maloney 2001, Grimm et al 2012 and Günther and Launov 2012).

A second puzzle arising from the literature on developing country labour markets is that, despite the general rejection of formal/informal segmentation, a public sector wage premium is nonetheless commonly found.[7] Reasons for this most likely relate to the fact that public sector employers are generally larger in scale and more unionized than other types of formal enterprises.[8] They are also more likely to observe statutory minimum wages.

On the other hand, a number of developing or transition country studies go beyond rejecting the proposition of a formal sector wage premium to assert the existence of an informal sector premium. These include Yamada (1996), Marcouiller et al (1997) for one of their three national samples, Adamchik and Bedi (2000), Quintin and Pratap (2006) for some of their sub-samples, Arabsheibani and Stavena (2012), and Jones and Tarp (2014) for the urban part of their sample.

Whereas studies finding segmentation in developed countries have provoked discussion of the sources of the immobility of workers in the secondary labour market, these results have led to speculation on why formal sector workers may tolerate low pay rather than switch to open access informal employment. The main explanation suggested - arising from work on transition economies (Admachik and Bedi 2000) - is that they trade off lower wages for non-wage benefits such as greater job security and access to pensions. An alternative explanation, raising again the issue of informal sector heterogeneity, is that there are entry barriers to more remunerative roles within this sector including in some cases capital requirements which formal sector workers may be unable to meet (Falco et al 2010). Neither of these explanations has been subject to any kind of test – indeed Maloney (1999) claims that non-wage benefits cannot be measured.

Not only do the samples used in developing country studies rarely include rural workers but studies dealing mainly with rural and/or agricultural labour markets are very rare, particularly in Africa where a certain resistance to recognizing the existence of such markets is evident (see for example Binswanger, McIntire and Udry 1989 and Sahn and Sarris 1994). Nevertheless segmentation and wage premia in rural labour markets have been treated in a few works. Jones and Tarp (2014) identify a premium for non-agricultural (over agricultural) rural employment in Mozambique while, within agricultural wage employment, Tschirley

[7] Mazumdar (1981) for Malaysia, Gaag and van der Vijverberg (1989) and Lachaud (1995) for Cote d'Ivoire, Pradhan and Van Soest (1995) for Bolivia, Thomas and Vallee (1994), Miller and Vallee (1995) and Lachaud (1995) for Cameroon, Lachaud (1995) also for Burkina Faso and Mali, Gong and Van Soest (2002) for Mexico, Glinskaya and Lokshin (2005) for India and Bigsten, Mengistae and Shimeles (2013) for Ethiopia.

[8] The existence of scale premia is a general finding of the literature; for African studies see Strobl and Thornton (2002), Soderbom and Teal 2004, Soderbom et al 2005 and Falco et al 2010. Evidence on a unionization premium is more mixed. African studies tend to find such a premium in South Africa (Schultz and Mwabu 1998, Rama 2000, Butcher and Rouse 2001) but exhibit inconsistent or contrary findings elsewhere (Blunch and Verner 2004 and Kingdon, Sandefur and Teal, 2006).

and Benfica (2001) find a premium for employment on 'company farms' over that for employment on smallholder farms and on small-scale commercial ones, standardizing for employment duration.[9] Cramer, Oya and Sender (2008) replicate these results, also for Mozambique, while going on to propose the existence of rural labour market dualism in terms of income and working conditions, although they admit that an unstated share of their sample participate in both labour market segments.[10]

In addition to the general sparseness of economic studies of rural and/or agricultural labour markets in Africa, the paradox raised by this last group of (African) developing country studies suggests the usefulness of further, more detailed work. Given the lack of consistent support for a formal sector premium, why should there be a premium for more formalized agricultural employment? Will this result always arise when considering only wage employees, i.e. placing restrictions on informal sector heterogeneity, or is it (also) the result of a conflation of differences in formality/scale with other differences.[11]

Research design and study area

The main source of formal sector wage employment in rural Ethiopia is large-scale commercial agriculture while one of the main sources of informal sector wage employment is small-scale irrigated agriculture. Large-scale commercial agriculture in Ethiopia dates back to the 1950s, expanding during the 1960s to comprise 2% of the then cultivated area (Rahmato 1984). After the Derg came to power in 1975 all existing large-scale farms were nationalized and several new ones opened, mainly for cereals – thus maintaining large-scale farming's share of the cultivated area at 2% (Abera 2008). With the return of some state land to pastoralists following the overthrow of the Derg in 1991, large-scale farming initially contracted (Yasin 2010). But it grew again from around 2002 as a result of encouragement of private investment (domestic and foreign) and a string of ambitious public investments, particularly in the sugar sector.

Official Ethiopian data no longer report separately the area under large-scale farming but they do report that under 'large and medium-scale commercial' agriculture, defined mainly in terms of formality[12] rather than scale. In 2010 616,000 ha. of production was classified in this way – roughly equivalent to 5% of Ethiopia's cultivated area (CSA 2011).[13] Of this, around 86,000 ha. is currently irrigated (Hagos et al 2009), including 37,000 ha. under formal sector

[9] Small-scale commercial farms paid lower daily wages than smallholder agriculture but employment episodes on them were typically more than twice the length.

[10] This is a result of diversification of income sources, a recurrent theme in discussions of labour in Africa.

[11] In a later paper Oya (2013) states that the Mozambican survey on which Cramer, Sender and Oya (2008) is based, and a similar one in Mauritania, also provides evidence of crop-based , locational and farming system-related segmentation – although detailed results are not given.

[12] 'Farms which are profit-oriented using capital intensive mechanized…systems as well as modern farm management practices and inputs' (CSA 2011).

[13] Ethiopian ATA (2013) estimates the current cultivated area in Ethiopia at 12m ha.

sugar, just over 11,000 ha. under formal sector fruit and vegetable production serving the regional market (Somalia, Djibouti and Sudan) and around 1,500 ha. under covered cut flower production (Ethiopian Sugar Corporation 2012, EHDA 2012). Total wage employment for large- and medium-scale production of these three crops is around 220,000.[14]

Small-scale irrigated agriculture is defined here as production mainly or exclusively for the market and primarily or exclusively using wage labour, on irrigated farms of less than 10 ha. Around 56,000 ha. of small-scale production is currently under 'modern' (pump-fed) furrow irrigation (Hagos et al 2009). No data is available for its breakdown by crop.

In the absence of national or regional rural and/or agricultural labour market surveys in Ethiopia, or existing databases of agricultural wage labourers, a small survey was designed to test for agricultural labour market segmentation while holding constant farming systems and location. This was achieved by focusing only on irrigated as opposed to both irrigated and rainfed farming and on locations that were comparable. Because net returns to large- and small-scale irrigated agriculture are both in a range between two to three times greater than for their rainfed counterparts (Hagos et al 2009), wage levels in irrigated agriculture are likely to be higher than those in Ethiopian agriculture generally. As a result, the external validity of this study is confined to irrigated agriculture alone.

The survey was conducted in two areas in Ethiopia's Central Rift Valley (CRV) in Oromia region, south-west of Addis Ababa. Amongst the large-scale/formal farms in the CRV are two publicly-owned sugar plantations and several privately-owned cut flower farms with capital-intensive covered production. There is also around 7,300 ha. under pump-fed 'smallholder irrigation' in the area (Scholten 2007).

The two areas selected were Wonji/Awash town, the site of the country's oldest sugar plantation, a cut flower farm and around 1,300 ha. under irrigated small-scale production of sugar, cereals and vegetables; and that around Meki town where 1,315 ha. is under small-scale commercial vegetable production (Rodriguez de Francisco 2009). Besides both being centres of irrigated production these areas are geographically and ecologically similar: they are around 60 km apart by road but at similar distances from Addis, at similar altitudes and have similar climatic conditions and soil types.[15] The principal features of the two areas will be described briefly in turn before turning to survey design and sampling.

The sugar plantation comprising the main formal operation in Wonji/Awash is Ethiopia's oldest, dating back to 1954. Originally a joint venture with the Dutch multinational HVA, since 1976 it has been under exclusive public ownership. Sugar is grown using canal-fed furrow and overhead irrigation and modern heavy machinery. In 2013 there were 5,900 ha.

[14] The largest single component is made up of employment on formal fruit and vegetable farms, estimated by EHDA (2012) at 133,000 workers. EHDA estimates cut flower farm employment at 43,000 while the authors estimate formal sugar employment also at around 43,000.

[15] Wonji/Awash town is 110 km from Addis, at 1,588 metres, with annual rainfall of 700 mm. and sandy loam soils. Meki town is 130 km from Addis, at 1,638 metres, with annual rainfall of 831 mm and a mixture of clay and lighter soils.

under production, supplying two mills.[16] The plantation is divided for management purposes into 600 ha. blocks. At the time of the survey (May 2013) it employed 6,214 workers in all, of whom 2,112 were permanent (management, technical staff, factory workers, supervisors and foremen and 4,102 were agricultural labourers.

A majority of agricultural labourers live with their families in 12 'camps' or villages on the plantation itself, roughly one for each block. The camps each have a resident supervisors and a labour allocation office to which workers report daily. A separate camp for permanent workers is located at the centre of the estate. Also serving the estate are a secondary school, five primary schools, a 176-bed hospital, two policlinics and a number of social facilities including a stadium. Recent estimates of the total population of the plantation range between 23,000 (Wendimu and Bekele 2011) and 50,000 (Dinka et al 2013) On the boundary of the estate in Awash town is a privately owned 7 ha. cut flower farm (3-4 ha. operational) with around 120 employees, growing in modern 'Israeli' greenhouses and exporting to the Netherlands.

Irrigated outgrower sugar production was introduced at Wonji in 1978 to complement estate production and today 4,570 ha. is cultivated by outgrowers on the plantation's periphery. Outgrower sugar uses a mixture of labour provided by the plantation (for harvesting), labour provided by outgrowers and labour hired by outgrowers. Outgrowers, who are forbidden from sub-letting sugar land, are paid a notional wage for all labour conducted by themselves or those they hire, as well as a tonnage payment for the sugar that they deliver. Three of the outgrower villages also have access to irrigated land set aside for non-sugar production, where cereal-vegetable rotations or vegetable rotations are practiced. Around Awash town there are three further areas where irrigated small-scale fruit or vegetable production is practiced, and at the other end of the estate is an area where independent small-scale commercial production of sugar takes place. Leaving aside outgrower sugar, around 900 ha. in Wonji/Awash is under small-scale irrigated production, with in all about 3,500 workers employed for 9-10 months of the year.

Both in Wonji/Awash and in Meki irrigated small-scale production of fruit, vegetables and cereals is on farms of 0.5–5.0 ha., mostly at the smaller end of this range. Irrigation is via informal extraction from rivers and (in Meki) from lakes and boreholes. Operators are mainly business people from the surrounding area, renting for a season or a year from local owners on a cash or output share basis and supplying all inputs including pumps.[17] Output is sold via brokers on a consignment basis on the Addis market. Operators employ a few labourers

[16] A new mill which would double existing crushing capacity was being commissioned during fieldwork.

[17] In 1975 ownership of privately-owned land in Ethiopia was transferred from landlords to the state, which gave transmittable use rights over it to former tenants and locally-resident landless labourers. There was a 10 ha. ceiling on plot size. Since 1991 use right-holders have been allowed to lease out up to half of their land, subject to certain conditions. In Oromia region it is estimated that 23% of all land is sub-let (Rahmato 1984, Gebreselassie 2006).

responsible for irrigation and chemical application on seasonal or multi-seasonal contracts,[18] as well as a much larger number on contracts lasting 1-3 days, for specific tasks. Hiring of these workers, which is mostly by farm foremen rather than farmers directly, occurs at daily physical labour markets taking place in sugar estate villages and in Meki and Awash towns. Wage negotiation also occurs in these physical markets. Based on farm operators' estimates of labour days/hectare and of labour days/year somewhere between 3,400 and 4,700 wage labourers are employed in the irrigated small-scale commercial agriculture area around Meki on a 'normal' day, for 9-10 months each year.

Survey Design and Sampling

A survey of 317 wage labourers was conducted by the authors in May 2013, covering amongst other matters demographic variables, education and land ownership status, and contractual status including wages. Because the survey design is cross-sectional the data derived from it cannot be used to directly address the issue of mobility between segments. However, this issue is addressed indirectly through questions concerning employment history.

The survey was designed to cover both formal and informal sector employees, with formality defined in terms of a combination of formality of the farm business where the worker was employed and formality in the worker's personal terms of employment. Formality of the farm business where employment takes place is operationalized here in terms of farms' capital-intensiveness (investment in permanent infrastructure and machinery) and farms having a share of permanent workers in the aggregate workforce of 20% or more. Formality of workers' personal terms of employment is operationalized in terms of whether they had income tax deducted at source.

Following pre-test of the instrument, 161 formal sector observations were obtained, of which 147 were sugar plantation workers and 16 were flower farm workers. 156 informal sector observations were obtained, of which 104 were from the Meki area and 52 from Wonji/Awash. In addition to the survey, informal interviews were held with sugar plantation management and foremen, small-scale farm operators and small-scale farm foremen.

Questionnaires were administered to formal sector workers in their homes in order to avoid possible bias arising from the proximity of supervisors and managers. Sugar plantation workers were sampled at a rate of 25 per camp,[19] from six of the 11 labour camps on the plantation selected at random, resulting in a broadly representative sample of the plantation's agricultural labourers.[20] Flower farm workers were sampled at random in a house-to-house

[18] Sometimes foremen have responsibility for irrigation and spraying as well as supervision. Most foremen are remunerated by a share of output, although some are paid a wage.

[19] Camp housing is laid out in parallel streets of 10-12 houses. Beginning with the streets at either end of the camp, workers in every other house were sampled until a target of 25 was reached.

[20] According to plantation's HR Department data, of its 4,102 agricultural labourers 23.7% were in the PPL grade, 49.0% were on seasonal contracts and 27.3% were on monthly or casual contracts. The proportions of

survey of the main working-class area of Awash town, from which observations of non-flower farm workers were eliminated. In both cases all questionnaires were administered in the evenings to ensure a high response rate.

A house-to-house survey of informal wage labour in Meki town was abandoned at an early stage as it emerged that many workers lived in communally-rented accommodation where it proved impossible to administer questionnaires individually. Thus, the instrument was administered to informal sector workers at their places of work, following negotiation with farm operators and/or foremen. In no case was access to a farm refused. The questionnaire was administered to workers as they worked, out of earshot of supervisors though sometimes not of other workers.

In Meki the main production zone around the town falls administratively into three villages. Ten farms were selected from each of these villages along a randomly-selected transept between the village's outer boundary and its centre, and 3-4 workers were then selected at random from the workers present on each farm. The same procedure was followed in the five separate small-scale production centres in the Wonji/Awash area. Here however, because irrigation originated almost entirely from the Awash river and non-sugar farms were therefore confined to a single transept following the river bank, a higher proportion of all farms was sampled than in Meki.

Because of the seasonal distribution of labour demand, virtually no hired labour was being used on outgrower sugar plots during the time of the survey. Therefore informal sector observations from Wonji/Awash, like those from Meki, are largely confined to vegetable production. No attempt was made to control for crop selection amongst vegetables in the small-scale sample, although it is believed that the overall crop specialization amongst the sample broadly reflects the cropping pattern of the area.

Sample characteristics

Descriptive statistics for the sample are presented in Table 1 below, sub-divided by sector of employment.

workers in these grades in the authors' sample were 25.9%, 53.0% and 21.1% respectively. The plantation HR Department recorded gender only for PPL grade and seasonal workers. Women made up 14.5% of those in these grades combined. The combined proportion for these grades in the authors' sample was 17.2%. No data on workforce breakdown could be obtained from management of the cut flower farm, meaning that the representativeness of this sub-sample could not be verified.

Table 1. Sample characteristics

Variable	Unit	Formal	Informal	t-values
		(N = 161)	(N = 156)	
Sex	% male	80.1	72.4	
Age	average in years	31.2	25.2	5.99***
Marital status	% currently married	70.2	49.4	
Household status	% with children	79.5	59.3	
Local residence	% 'born in this place'	45.3	23.1	
	% with locally resident spouse	60.9	37.2	
	% with locally resident parents	33.5	32.1	
Education	% no formal education	9.3	19.9	
	% highest stage primary	41.0	57.0	
	% highest stage post-primary	49.7	23.1	
Ethnicity	% with 'southern' ethnicities[21]	78.9	50.6	
Land	% owning land	12.4	37.8	
Agricultural work experience	mean N years as agricultural labourer	14.1	5.0	10.27***
Non-agricultural work experience	% who have worked outside agriculture at some time	17.4	26.3	
	average length of non-agricultural work experience in years (where applicable)	4.7	4.6	1.5
Contract type	% with daily contract	12.9	83.3	
Daily wage	mean pre-tax cash wage and monetary equivalent of non-cash wage in Birr[22]	40.69	48.53	-3.89***

These results, while not controlling for other factors, support some elements of the segmentation approach while undermining others. Workers in one sector command a statistically significant wage premium of around 16% as well as differing from workers in the other sector on a series of other variables. Thus, on visual inspection, segmentation appears to be confirmed. Moreover, some of the characteristics of workers in the formal sector resemble those predicted for primary sector workers in LMD models. For example, formal sector workers appear to be more likely to live in family households, to have more consistent employment histories as well as to have more pronounced degree of residential stability than informal sector workers. Yet the sign for the wage premium is the reverse of that predicted in LMD models, as it is in a number of the developing country studies reviewed above. So too is the sign for ethnicity suggested by these results. The overwhelming majority of formal sector workers are from (southern) ethnic groups historically associated with labour migration rather than with social advantage. On the other hand, the results also fail to support human capital-

21 Wolaita, Hadiya or Kambata.

22 For details on calculation see under 'Econometric model' and Appendix 1

based arguments. While human capital in the shape of education and work experience appears to be important in selection into the formal sector, better educated and more experienced workers do not appear to be rewarded by higher wages. These and other issues are explored below with the help of econometric methods.

Econometric model

When as here primary and secondary labour market segments are defined *ex ante* (in terms of formality and informality), and workers are allocated to the respective sectors based on their observable and an observable characteristics, the simplest procedure to test for segmentation is to estimate two separate OLS wage equations as follows (Sloane et al. 1993):

$$lnW_{Fi} = x_i'\beta_F + \epsilon_{Fi} \quad (1)$$
$$lnW_{Ii} = x_i'\beta_I + \epsilon_{Ii} \quad (2)$$

Here lnW_{Fi} is the log of the *i*th individual´s wage in sector *j* (j= Formal, Informal), x_i is a vector of explanatory variables in the wage determination process, β_F and β_I are vector of parameters to be estimated, and, ϵ_{Fi} and ϵ_{Ii} are error terms which are assumed to be $N(0, \sigma_F^2)$ and $N(0, \sigma_I^2)$, respectively. However, as noted in the literature review, the main challenge and/or limitation of this procedure arises from the fact that (i) there might be no *a priori* information as to how individuals are assigned into segments (Dickens and Lang, 1985), i.e. it may not be known which workers are employed in the formal sector and which in the informal sector (although this is not in our case); and (ii) that even if this information is available, equations (1) and (2) cannot be consistently estimated using OLS since, where labour markets exist, allocation of workers to sectors cannot be considered exogenous. Prior to being employed as a result of an employer decision, workers have to first determine in which labour market (sector) he or she want to find a job (self-selection). Comparing differences in daily wages or returns to education and experience between the workers of formal and informal sectors using OLS estimates, will thus introduce selection bias to any differences that may be found (see literature review above). To correct for selection bias in testing for segmentation, the most commonly used method is endogenizing the sector selection process by adding a third equation for sector selection as follows (Adamchik and Bedi 2000):

$$y_i^* = lnW_{Fi} - lnW_{Ii} + k_i'\alpha + \eta_i \quad (3)$$

Substituting wage equations (1) and (2) into equation (3), we can write a reduced form probit model for formal sector selection as:

$$y_i^* = z_i'\gamma + \epsilon_{wi} \quad (4)$$

where $z_i'\gamma = x_i'(B_F - B_I) + z_i'\alpha$ therefore z_i includes all components of x_i and k_i; and $\epsilon_{wi} = \epsilon_{Fi} - \epsilon_{Ii} + \eta_i$. Given this relationship between ϵ_{wi}, ϵ_{Fi}, and ϵ_{Ii}, the correlation Corr$(\epsilon_{Fi}, \epsilon_{wi})$ is likely positive, while the correlation Corr$(\epsilon_{Ii}, \epsilon_{wi})$ is likely negative.

y_i^* may be interpreted as the difference in utilities between the formal and informal sectors, where utilities in the formal and informal sectors depends on the respective sectors incomes, other observable factors influencing the utility difference $(z_i\gamma)$, and unobserved error

term ϵ_{wi}. If y_i^* is positive, person i derives a higher utility level from working in the formal sector than from working in the informal sector, while if y_i^* is negative, person i derives a higher utility level from working in the informal sector than from working in the formal sector. Worker i belongs to the formal sector if and only if the latent variable $y_i^* > 0\ i.e. \epsilon_{wi} > -z_i'\gamma$.

Equations (1), (2) and (4) together constitute a switching regression model. Equation 4 is commonly known as a sector selection equation (the switching equation) that sorts individuals into different sectors given their background characteristics. Following Dickens and Lang (1985) and Roig (1999) the likelihood function for the problem, given wages and background characteristics information on *n* individuals, can be specified as

$$L = \prod_i^n [Pr(\epsilon_{wi} > -z_i'\gamma | z_i', \epsilon_{Fi})\, f(\epsilon_{Fi}) + \Pr(\epsilon_{wi} \leq -z_i'\gamma | z_i', \epsilon_{Ii})\ f(\epsilon_{Ii})] \quad (5)$$

Where $f(\epsilon_{Fi})$ and $f(\epsilon_{Ii})$ are the density of the errors ϵ_{Fi} and ϵ_{Ii}, respectively. Assuming that ϵ_{Fi}, ϵ_{Ii} and ϵ_{wi} are jointly normally distributed $N(0, \sum)$ where

$$\sum = \begin{bmatrix} \sigma_F^2 & \sigma_{FI} & \sigma_{Fw} \\ \sigma_{FI} & \sigma_I^2 & \sigma_{Iw} \\ \sigma_{Fw} & \sigma_{Iw} & 1 \end{bmatrix} \quad (6)$$

then the log of the likelihood function is given by:

$$\ln L = \left\{ \left[1 - \Phi \left(\frac{-Z_i'\gamma - \frac{\sigma_{Fw}}{\sigma_F}(\ln W_{Fi} - x_i'\beta_F)}{(1-\sigma_{Fw}^2)^{\frac{1}{2}}} \right) \right] \left(\frac{\phi\left(\frac{\ln W_{Fi} - x_i'\beta_F}{\sigma_F} \right)}{\sigma_F} \right) \right. \quad (7)$$

$$\left. + \Phi \left(\frac{-Z_i'\gamma - \frac{\sigma_{Iw}}{\sigma_I}(\ln W_{Ii} - x_i'\beta_I)}{(1-\sigma_{Iw}^2)^{\frac{1}{2}}} \right) \left(\frac{\phi\left(\frac{\ln W_{Ii} - x_i'\beta_I}{\sigma_I} \right)}{\sigma_I} \right) \right\}$$

where $\phi(.)$ and $\Phi(.)$ are the density and the distribution function of the standard normal, $\sigma_{F\eta}$ and $\sigma_{I\eta}$ are the covariances between (ε_F, w) and (ε_I, w), respectively, and σ_w^2 is normalized to equal one. Finally, the Newton-Raphson search algorithm is used to obtain the Maximum Likelihood (ML) estimator for $\gamma, \beta_F, \beta_I, \sigma_{Fw}, \sigma_{Iw}, \sigma_F\ and\ \sigma_I$. All estimations and calculations were conducted within the statistical software environment "R" (R Core Team 2014 version 3.1) using the add-on package "sampleSelection" (Toomet and Henningsen 2008 version1.0) for estimating the switching regression model and calculating the conditional and unconditional expectations, where the maximisation of the likelihood function is conducted by the add-on package "maxLik" (Henningsen & Toomet 2011; version 1.2).

Although switching regressions should help to overcome the problem of selection bias, they are sensitive to the error term distribution assumption and the specification of both the switching equation and the wage equations (Adamchik and Bedi 2000, Pratap and Quintin 2006). One proposed way to deal with the sensitivity of these models is to include in the sector choice/switching model at least one instrumental variable influencing sector choice

(and thus probably correlated with unobserved individual preferences and abilities) but not influencing earnings.

In what follows two instrumental variables not included in the wage equations - land ownership and length of local residence - will be included in the switching model in order to achieve identification of the selection equation. The justification for considering the first of these variables as instrumental is that while land ownership may be related to sector selection - either because those owning land may look for more flexible types of employment or because those in full-time continuous employment may decide they cannot fully benefit from owning land - whether or not land is owned should not have any effect on a worker's daily wage rate.[23] The justification for considering the second as instrumental is that because the sugar plantation has an employment policy favouring those who are born on the plantation (see below), these have a higher chance of finding employment in the formal sector. However being born 'locally' should not influence the level of their daily wage.[24] These two variables are both highly significant in the sector choice model but they are insignificant in the wage equation models, confirming their quality as instrumental variables. Their use is also supported by a sensitivity analysis that was conducted (see below).

With the exception of variables referring to agricultural work task specialization (digging field channels, land preparation, crop preparation and maintenance, planting, irrigation, weeding, harvesting and 'miscellaneous tasks'[25] the model's initial group of independent variables are those given in Table 1 above. The model's dependant variable is the logarithm for workers' daily wage.

Formal sector agricultural workers in Wonji are paid at 15 day intervals and observations for these workers' cash wages are based on workers' last pay checks and the actual number of days they reported working in the last 15-day period. Informal sector workers at paid when their contracts expire and observations for these workers are based on computing their daily pay from their current contract length. Data on informal workers' previous contracts was also collected and will be used in robustness checks below. Because informal sector workers pay no income tax, formal sectors workers' daily wages are expressed in pre-tax terms. Two of the three categories of formal sector agricultural labourers on Wonji sugar plantation, seasonal workers and 'Permanent Pieceworkers' (PPLs), received certain social entitlements in addition to their cash wages according to their grade. These have been given monetary equivalents and added to these workers' pre-tax cash wages. Appendix I explains how these equivalents have been calculated. To the authors' knowledge this is the first developing

[23] Aslam and Kingdon (2009) use land ownership as an instrumental variable in testing for labour market segmentation in Pakistan, arguing that while not affecting wages it may provide a safety net encouraging a worker to relinquish the security of public employment. The dissociation of land ownership from wage levels in Ethiopia is underlined by a legal prohibition on transfer of use rights (*de facto* ownership) by sale (see footnote 17 above).

[24] When included in a wage equation for Ethiopian cut flower workers, local origin also proved to have no long-term influence on wages (Mano et al 2010).

[25] See notes to Table 3 below.

country study of labour market segmentation where formal sector workers' social wage has been included in the analysis.

Results

Switching (selection) model

Table 2 below presents the results of the switching model. The full list of initial independent variables (see above) was narrowed using log likelihood ratio tests to arrive at the list in the Table.

Table 2. Switching model estimates (formal sector selection)

Variables	Estimate (st. error)	*P*-value
Intercept	-2.50 (0.46)	0.000001***
Age	0.03 (0.02)	0.0819·
Female	-0.21 (0.24)	0.3827
Ethnicity		
Wolaita	1.15 (0.31)	0.0002***
Kambata	2.55 (0.36)	00000***
Hadiya	1.13 (0.32)	0.0005***
Amhara	0.76 (0.31)	0.0177*
Others	0.77 (0.56)	0.1663
Experience	0.08 (0.02)	0.00004***
Own land	-0.99 (0.24)	0.00004***
'Born in this place'	0.91 (0.24)	0.0002***
Log likelihood	-190.74	

Notes: The dependent variable has the value of 1 if the worker is in the formal sector. The omitted ethnicity dummy is Oromo. Significance codes: *0.001 '***', 0.01 '**', 0.05 '*', 0.1 '.'*

Controlling for other factors, allocation of workers to the formal sector is strongly or very strongly influenced by ethnicity (particularly membership of the three 'southern' ethnicities, see footnote 21 above), by land ownership status and by whether the worker was born in the immediate vicinity of where he or she was now working. Agricultural work experience influences selection somewhat more mildly, although it is highly significant. Age also influences selection mildly, but only at a 10% significance level. Despite the notable disparities in educational attainment between formal and informal sector workers evident from Table 1 (Descriptives), education proved insignificant in all versions of the switching model that were run and is therefore dropped in this version. Gender also does not significantly influence selection into the formal sector. Thus, according to the switching model estimates, human capital attributes explain very little of worker allocation between segments, while ethnicity and the instrumental variables chosen explain a great deal more. This finding parallels some aspects of the LMD hypothesis as it was originally elaborated, although in this case the ethnic groups more likely to participate in the 'primary' segment are not historically socially advantaged ones.

The preponderance of 'southern' Ethiopian ethnicities in the formal sector workforce of the study area, as compared to its 'native' population which is drawn from the Oromo ethnic group, is explicable in terms of the historical labour recruitment policy of the sugar plantation

whose workers make up a majority of this survey's formal sector worker sample. Originally, the need for distant hiring was justified by claims that there was an insufficient local labour force, and/or that locals were less interested in wage employment and less productive as compared to migrant labourers (personal communication with plantation management). Recruitment of migrant labour and justification of it in these terms is a near-universal historical feature of large-scale agriculture in developing countries, although its rationale is often subjective, reflecting cultural stereotypes (Daviron 2010).

Given the 60-year existence of the plantation together with its institutionalized residential system (see above), this 'southern' workforce has now been stabilized. Hence the historical ethnic skewing of recruitment can be continued by giving preference in hiring to those born on the plantation. This preference was confirmed to the researchers by plantation management and accounts for the magnitude and significance of the estimate for '(not) born in this place' in the switching model. The plantation's special institutional features will be discussed in more detail below in relation to the formal sector wage equation results.

Formal and informal sector wage equations

Table 3 below presents ML estimates for the formal and informal sector wage equations as well as (for reference) OLS estimates. Seven dummies for work task specialization were included in the wage equations. The types of work performed in the task categories correspond broadly across sectors, but not exactly due to differences in crop specialization. The inclusion of these dummies may partly correct for bias due to unobserved differences in workers' ability.

Table 3. Estimates for two sector wage equations

	Formal Sector (N = 161)		Informal Sector (N = 156)	
Variables	ML	OLS	ML	OLS
Intercept	3.36 (3.38)***	3.34 (0.38)***	3.63 (0.34)***	3.58 (0.35)***
Age	-0.006 (0.02)	-0.006 (0.02)	-0.00006 (0.02)	-0.002 (0.02)
Age squared	0.0001 (0.0003)	0.0001 (0.0003)	0.0004 (0.0002)	0.0002 (0.0003)
Female	-0.18 (0.08)*	-0.18 (0.08)*	-0.12 (0.07)	-0.10 (0.08)
Ethnicity				
Wolaita	0.17 (0.10)•	0.17 (0.10)•	-0.01 (0.08)	0.003 (0.08)
Kambata	0.07 (0.11)	0.08 (0.08)	-0.08 (0.19)	0.13 (0.18)
Hadiya	0.09 (0.10)	0.09 (0.10)	-0.12 (0.09)	-0.09 (0.09)
Amhara	0.14 (0.11)	0.15 (0.12)	0.15 (0.09)	0.19 (0.10)*
Others	-0.12 (0.19)	-0.11 (0.20)	-0.15 (0.19)	-0.12 (0.20)
Primary education	0.21 (0.10)*	0.21 (0.10)*	0.03 (0.09)	0.05 (0.09)
Secondary education	0.25 (0.10)*	0.25 (0.10)*	-0.04 (0.10)	0.01 (0.10)
Experience	0.03 (0.01)*	0.03 (0.01)*	0.006 (0.01)	0.002 (0.02)
Experience squared	-0.001 (0.0003)	-0.001 (0.0004)	-0.0007 (0.0006)	-0.0008 (0.0006)
Married	-0.05 (0.06)	-0.05 (0.07)	-0.09 (0.07)	0.07 (0.08)
Field preparation	-0.07 (0.11)	-0.08 (0.12)	0.24 (0.17)	0.22 (0.18)
Crop preparation and maintenance	-0.15 (0.09)	-0.15 (0.10)	0.41 (0.17)*	0.40 (0.18)*

Irrigation, spraying	0.06 (0.10)	0.06 (0.0.10)	0.21 (0.19)	-0.21 (0.20)
Weeding	-0.11 (0.10)	-0.11 (0.10)	-0.15 (0.19)	0.15 (0.21)
Harvesting	-0.20 (0.09)*	-0.20 (0.09)*	0.05 (0.17)	0.04 (0.18)
Miscellaneous tasks	-0.31 (0.08)***	-0.31 (0.08)***	0.25 (0.17)	0.22 (0.18)
σ	0.28 (0.02)***		0.36 (0.03)***	
ρ	-0.03 (0.26)		-0.58 (0.23)*	
R-Squared		41		27
Adjusted R-squared		33		17

Notes: The omitted education dummy is no formal education. The omitted work task specialization dummy is planting. In the case of both formal and informal sectors, most workers categorized as performing 'miscellaneous tasks' are field guards. For the formal sector this category also includes cleaners and some agricultural labour temporarily deployed to factory work. For the informal sector it also includes fence makers and well-diggers. Significance codes: *0.001* '***', *0.01* '**', *0.05* '*', *0.1* '.'

The ML estimates show a negative and statistically significant correlation, at the 0.05% level, between the error term of the informal sector wage equation and that of the switching equation, thus suggesting self-selection into the informal sector. This correlation supports the simultaneous estimation of the switching equation and the two wage equations.

In line with the segmentation approach the estimates from the wage equation show that the wage setting mechanisms in the two sectors differ in important respects. As predicted in this approach, wage distribution in the formal sector is mainly determined by the variables given in the model. These include certain social advantage variables such as gender but also human capital variables – so that there is an upward sloping wage curve for schooling and experience (see Dickens and Lang 1985 and Appendix II). Moreover, as also predicted in the segmentation approach human capital variables fail to explain the distribution of wages for workers in the informal sector and there is a flat wage curve with respect to them. While the distribution of wages for formal sector workers may be affected by worker characteristics that are not observed, that for informal sector workers is mainly influenced by unobserved variables.

Because it is mentioned in some contributions to the literature as a possible unobserved influence on informal sector wages, the survey included a question to informal sector workers on whether they knew their employer or were related in some way to them. When the wage equations were run with this variable included (together with an equivalent for formal sector workers[26]) it proved insignificant. A Pearson correlation was also run for this relation for informal sector workers but the result was again insignificant[27]. The OLS estimation results are in general very similar to the ML ones.

[26] Whether they were recruited through a friend, relative or a foreman known to them personally.

[27] Results available on request from the authors. Mano et al (2010) likewise reject a relation between 'personalistic' recruitment and long-term wages for Ethiopian cut flower workers.

Wage premia

At the core of the segmentation approach is a prediction that primary sector workers enjoy a statistically significant wage premium. According to Oaxaca (1973), in a segmented labour market the higher wages observed for similar workers in one segment rather than the other can be decomposed into a portion related to differences in workers' observable (human capital) characteristics and an unexplained portion. For Oaxaca, the unexplained portion could be attributed to discrimination. However, given the suggestion of a wage premium in favour of the definitionally-open access informal sector in the case examined here, some other wage determination principle must be operating.

The more recent literature (e.g., Hartog and Oosterbeek 1993 and Adamchik and Bedi 2000) uses the categories of unconditional and conditional wage rates to capture the point of Oaxaca's distinction in a more exact way. These categories refer to the difference between the expected wage for a randomly assigned worker in a given segment prior to their assignment to a given segment (unconditional wage) and that obtained by given workers after they been actually assigned (conditional wage). Unconditional wages reflect observed characteristics while conditional ones reflect observed and unobserved ones. Using the sample mean values for the continuous variables and the sample modes for the categorical variables listed in Table 1 and the model parameter estimates presented in Tables 2 and 3, the predicted unconditional and conditional daily wage rates for workers in the two sectors are computed here using the sample selection package in R (Toomet and Henningsen, 2008). [28]

Table 4 shows that the unconditional daily wage offered to an average worker will be substantially higher in the informal rather than in the formal sector. More interestingly the results for conditional wage rates show that informal sector workers (unlike formal sector ones) earn a very high premium by self-selection into the 'correct' sector.

Table 4. Predicted mean daily wage rates for formal and informal sector workers (in Birr)

	Predicted mean daily wage rate
Unconditional wage rates (All workers)	
Wage in the formal sector	36.01
Wage in the informal sector	48.63
Conditional wage rates, formal sector workers	
Wage in the formal sector	39.20
Wage in the informal sector	31.91
Conditional wage rates, informal sector workers	
Wage in the formal sector	31.80
Wage in the informal sector	45.91

To further examine how wage premia vary with levels of education and work experience (in years), unconditional and conditional daily wage rates for specific sub-samples of both formal and informal sector workers are predicted in Table 5. These predictions use the

[28] The models used for predicting unconditional and conditional wage rates are presented in Appendix II.

sample medians for the continuous explanatory variables and the sample modes for the categorical variables listed in Table 1.[29]

Table 5. Expected mean daily wage rates for formal and informal sector worker sub-samples (in Birr)

		Formal sector workers (161)			Informal sector workers (156)		
Education	Experience	Unconditional wage (1)	conditional wage in the formal sector (2)	Conditional wage in the informal sector (3)	Unconditional wage (4)	Conditional wage the in formal sector (5)	conditional wage in the informal sector (6)
No education	2	27.66	27.66	42.95	46.6	28.22	61.56
	5	29.96	29.96	43.82	46.06	30.57	64.71
	10	33.45	33.45	43.38	44.70	34.12	66.69
	15	36.23	36.23	41.26	42.10	37.00	67.35
	20	39.25	39.25	32.46	32.79	40.45	60.34
Primary Education	2	34.12	34.12	44.26	47.47	34.47	64.07
	5	36.97	36.97	45.15	47.94	37.34	66.67
	10	41.26	41.26	45.15	46.53	42.10	69.47
	15	44.70	44.70	42.95	43.38	45.60	69.41
	20	48.42	48.42	33.78	33.78	49.90	62.80
Secondary Education	2	35.52	35.52	41.26	44.26	35.87	59.74
	5	38.47	38.47	42.10	44.26	38.86	62.18
	10	42.95	42.95	42.10	43.38	43.82	64.72
	15	46.53	46.53	39.65	40.45	47.47	64.72
	20	50.40	50.40	31.50	31.50	51.99	57.97

Columns 1 and 4 in Table 5 showing unconditional mean daily wage rates in the formal and informal sectors indicate that while these rise with increasing levels of education and experience for formal sector workers, there is no such relation for informal sector workers. This result is in line with the prediction of the LMD model, i.e. there is an upward return to education and experience in the formal sector alone.

Columns 2 and 6 in the table shows daily wage rates for workers who have selected into the formal and informal sectors, respectively. Conditional and unconditional daily wage rates for formal sector workers are exactly the same across all sub-samples (Columns 1 and 2). This result corroborates that of the switching regression by showing that unobserved variables do not play a significant role in determining formal sector wages. For the informal sector workers, conditional daily wage rates are consistently higher than the unconditional wage rates (Columns 4 and 6) demonstrating the importance of unobserved variables. The conditional formal sector daily wage for a worker with a secondary education and 15 years of experience is 46.53 Birr while the informal sector conditional wage for a worker with the

[29] That is, the reference individual is aged 25, male, from the Kambata ethnic group, owns no land, was not 'born in this place' and performs the field preparation work task.

same education and experience but presumably different unobserved characteristics is 64.72 Birr. This amounts to a 28.1 % wage premium for this informal sector worker sub-sample.

The predicted conditional daily wages presented in Columns 3 and 5 help us to examine in more detail the effects of sectoral self-selection on daily wage rates. The conditional wages in Column 3 are the daily wage rates that formal sector workers would receive if they were working in the informal sector and the conditional wages in Column 5 are those that informal sector workers would receive if they were working in the formal sector. While there is a positive selection effect for all sub-samples of informal sector workers (Column 6 versus 5), a positive selection effect for formal sector workers is more sporadic. It applies only to five out of 15 formal sector worker sub-samples and kicks in only for workers with at least primary education and 15 or more years' work experience:[30] other sub-samples of formal sector workers would have higher daily wage rates if they were working in the informal sector (Columns 3 versus 2). More precisely, for the 'average' formal sector worker, with a mean work experience of 14.1 years and modal educational level of secondary education, daily wage rates are higher in the formal than in the informal sector. In other words, for formal sector workers to benefit from formal sector wage work they need at least 14.1 years' work experience and secondary education.

Finally it is important to note that, because of the significant effect of unobserved variables on daily wage rates in the informal sector, the potential losses or gains from switching for formal sector workers are generally very moderate compared to the losses that all sub-samples of informal sector workers would experience.

Robustness checks

Two data robustness tests were performed, although these apply only to the data for informal sector workers. The first compares the results for data from a geographic sub-sample of informal sector workers with those from the full sample of these workers and the other compares the results for current employment contract data for informal sector workers with those for these workers' earlier employment contracts.

As noted above, the sample of informal sector workers was drawn from two distinct geographical areas. While these areas were similar in many respects, unobserved differences between them may have compromised their treatment as a single sample. To test for this, the base model was re-estimated using an additional dummy variable for location (Meki = 1), keeping all other variables in the base model unchanged. Here the assumption is that explanatory variables have the same effect on daily wage rate in both locations but that they may have different intercepts. The result shows that location has no any significant impact on

[30] For formal sector workers with secondary education the premium kicks in for those with at least 10 years' work experience. Uneducated formal sector workers with at least 20 years' work experience also enjoy a premium.

daily wage rate and the labour markets in the two locations can be treated as a single labour market (Appendix III, Table 7).[31]

Data from informal sector workers was collected not only for their current employment contracts but also for previous contracts. In order to test the robustness of the estimations obtained from the model using current employment contract data[32], the model was re-estimated using data for the last employment contract held by informal sector workers prior to their current contract. Again, all other data including for that for wage equation variables for formal sector workers was held constant. The results (Appendix III, Table 8) again differ very little from those in Table 3 above.

Discussion

In concluding his methodological demolition of the earliest versions of the LMD literature Cain (1976) observed that, despite its problems, the LMD thesis was nonetheless useful. This was because, contrary to human capital perspectives, it underlined that workers' labour market decisions may be endogenous, and that certain labour markets may have 'strong historical and institutional dimensions' – thus 'enriching our understanding of the economics of bureaucratic organizations'. The results obtained by this study of labour markets for irrigated agriculture in Ethiopia support a finding of segmentation in the senses of parallel labour markets with distinct wage determination mechanisms and of a segmental wage premium. But contrary to the LMD thesis, although not to some studies from developing countries, the primary-secondary (formal-informal) sector wage premium is an inverse one. The external validity of these results is limited to irrigated agriculture in Ethiopia, but they are nevertheless challenging. This section briefly discusses why segmentation is likely to be found in agricultural labour markets generally in developing countries before turning to reasons for the inverse wage premium. Data indirectly relevant to the issue of mobility between segments will be presented later in the section.

Segmentation is likely to be a common feature of agricultural labour markets in developing countries because of the special institutional features of scale-based and capital intensive investments. Historically these were normally undertaken only when product demand and prices were underwritten in some way, for example by private monopoly and/or public marketing systems. In most circumstances, including for sugar in Ethiopia, these conditions remain. Stable product demand and prices provide strong incentives for labour force stabilization since labour productivity is likely to depend upon accumulation and retention of tacit skills. Provision of guarantees of employment continuity and non-wage benefits, alongside organization of internal labour markets with clear career advancement criteria and mechanisms, are recurrent solutions to this problem. Wherever stable demand coincides with large-scale investment a part of the market for agricultural labour will normally be institutionally differentiated in this way (Riisgaard and Gibbon 2014).

[31] Note also that mean daily wage rates in Birr for informal workers in Wonji/Awash (47; st. dev. 17) and Meki (49; st. dev. 22) are very similar.

[32] The mean durations of informal sector workers' current and immediately previous contracts were 7.02 days, and 7.33 days respectively. For both contracts durations ranged between one day and 30 days.

The two most obvious explanations for the inverse wage premium found here are firstly that lower formal sector cash wages are compensated for by the social wage and secondly that they are compensated for by greater job security. In the first case, as shown above, even when the social wage is fully monetized there remains a significant inverse premium. In the second case insufficient data is available on medium-long term employment continuity, either for formal or informal workers, to confirm or disconfirm the explanation. However close to half of the formal sector workers sampled were on either non-rolling seasonal contracts or casual ones - meaning that while they enjoyed employment that was more regular than informal sector workers, these workers' status fell short of employment security.

If formal workers' (relative) employment security, like their social wage, fails to fully compensate for the inverse cash wage premium, then two further explanations for it may be considered. The first of these lays in cultural and institutional impediments to mobility from the formal to the informal labour market. Table 6 shows plantation workers amongst the formal sector sample remaining embedded in the plantation for extended durations. Not only are almost half of all workers born on the plantation, but many also have resident parents and the great majority have no work experience off-plantation.[33] Typically, when they leave the plantation it is not for other work, but only to retire. In other words, most plantation workers are not familiar with work or wage rates off-plantation and may possibly even fear experiencing them.

At the same time, the plantation operates a classical internal labour market with a highly differentiated system of remuneration and a lengthy three-step career ladder (Table 6). This represents the main supplementary explanation offered here. Rewards for workers on the plantation career ladder's highest step are great relative to other plantation workers and even substantial relative to workers in informal irrigated agriculture. Almost all workers on this step started on the lowest one, although advancement takes half or more of their working life. In other words, by offering a clear and relatively steep career advancement path, the plantation raises workers' switching costs. Even where these costs - narrowly defined as losing the monetary value of current social benefits - are low, switching therefore will be unprofitable.

Table 6. Plantation labour: Demographic and employment history data

Variable	*Frequency or mean (st. dev.)*	*Total N observations*
Plantation was first employer	84.4%	147
No other agricultural employment since first employed at plantation	86.4%	
No non-agricultural employment since first employed at plantation	87.1%	147
Born on plantation	45.3%	147
Born on plantation and with parents still living on plantation	24.5%	147
Mean N years since first employed on plantation by contract type		147

[33] Workers on the sugar plantation are even prohibited from initiating certain income-generating activities in the camps, such as small shops, which may compete with plantation work (interviews with plantation foremen and HR department).

PPL	25.5 (7.4)	38
Seasonal	11.9 (6.3)	78
Monthly/Casual	4.9 (4.2)	31
All	14.1 (9.6)	
Mean gross daily pay by contract type (in Birr)		147
PPL	54.7 (15.0)	38
Seasonal	39.9 (11.6)	78
Monthly/casual	31.9 (10.7)	31
All	42.0 (14.8)	
Proportion of workers in Seasonal grades promoted from Monthly/casual grades	83.3%	78
Proportion of workers in PPL grade promoted from another grade	91.9%	38
Average interval in years between first employment on plantation and promotion to permanent grade	17.0 (7.0)	38

Note: For method of calculation of gross daily wages see above and Appendix I.

Both these explanations underline the endogenous nature of the segmentation found here, as well as its institutional foundations.

Finally, while LMD approaches do predict that human capital-based wage models should work (only) for primary labour markets, the specific reasons why they may work well in this case for formal sector workers are worth dwelling on for a moment. In developed countries the demand side of the primary labour market is composed of a mixture of traditional large scale industries operating internal labour markets and large modern bureaucratic organizations. The former select using assumptions about 'fitting in', i.e. the congruence of candidates' imputed value sets with those of existing workers and they promote according to seniority. The latter select using education as an imputed signal of higher ability, and promote according to both seniority and education. Thus the apparent paradox occurs of the model's fit for (the primary) part of the labour market but not the labour market as a whole.

In the case of the formal agricultural labour market in Ethiopia the demand side is dominated by a single large public employer selecting and promoting exclusively on an internal labour market basis. The reason why education can still correlate with wage levels within this sector relates to the fact that, as Spence (1973) observed in his seminal contribution, the signalling value of education derives not from any intrinsic relation between 'learning' and ability but simply because it can communicate information and because it is costly. Although not visible from survey data, it emerged during the course of fieldwork that a large part of plantation workers' education – particularly their secondary and post-secondary education – was acquired subsequent to their employment, by way of voluntary after-work study at plantation schools. Educational attainment thus correlated with seniority. Yet the plantation did not 'need' 40 year-old field workers, as opposed to its technical and managerial staff, to have

completed secondary education. More importantly amongst more field workers, education signalled non-frivolous use of leisure time and willingness to comply with the value system of plantation management – in which education was highly esteemed.

Conclusion

The authors' results show that the conditional wage for workers in irrigated informal commercial agriculture in Ethiopia command a statistically significant wage premium over those in irrigated formal large-scale commercial agriculture (between 13% and 41%, depending on the workers' level of education and work experience), controlling for location and workers' observed characteristics. They also show that quite different wage determination mechanisms apply in the two sectors, with human capital characteristics partly explaining differences in wages within the formal sector but playing no discernible role in informal sector wage determination. These results have been arrived at applying an endogenous switching model with simultaneous estimation of segmental/sectoral wage equations to a small but representative cross-sectional sample of farm workers.

While a finding of differentiated sector-specific wage determination mechanisms is consistent with well-established structuralist and institutionalist approaches to labour market analysis, the latter approaches definitively attributed a positive wage premium to the 'primary' sector. The findings here of an 'inverse' wage premium, and correspondingly of informal sector self-selection, duplicate those of some earlier developing country studies but are the first of their kind in an empirical context where restrictions have been placed on informal sector heterogeneity by considering only wage workers.

Where an inverse premium has been found in the past, worker retention in the formal sector has been explained in terms of the compensatory effects either of social wages and/or of greater job security. While confirming the existence both of a social wage and superior job security in the formal sector the present study argues that the former does not fully compensate the wage gap while coverage of the latter applies meaningfully to only part of the formal sector workforce. In addition, the existence of internal labour markets in the formal sector, in the form of seniority systems incorporating differentiated wage scales and levels of job security, raises workers' switching costs above their short-term monetary value. Furthermore labour management in certain large-scale agricultural enterprises emphasizes residential workforce stabilization and recruitment from specific ethnic groups and from the offspring of existing workers, meaning that workers' experience of or even information about opportunities elsewhere will be limited.

While this may explain worker retention in the formal sector despite the inverse premium, there are several questions raised by the findings that stay unanswered. These include the external validity of the findings as regards rainfed farming systems in Ethiopia and as regards other countries in the same region, as well as the related questions of what conditions sustain (relatively) high wages in irrigated informal commercial agriculture and the medium-long term prospects of stability of these conditions. While these questions remain open, the results

presented here at least challenge facile assumptions that large-, or for that matter small-, scale agriculture invariably generates superior employment (including wage income) outcomes.

References

Abera, H. (2008). Adoption of improved tef and wheat production technologies in crop-livestock mixed systems in northern and western Shewa zones of Ethiopia. PhD thesis, Faculty of Natural and Agricultural Sciences, University of Pretoria.

Adamchik, V. and Bedi, A. (2000). 'Wage differentials between the public and private sectors: Evidence from an economy in transition'. *Labour Economics* 7, 203-224.

Anderson, K., Butler, J. and Sloan, F. (1987). 'Labour market segmentation: A cluster analysis of job groups and barriers to entry.' *Southern Economic Review* 53, 571-590.

Arabsheibana, G. and Staneva, A. (2012). Is there an informal employment wage premium? Evidence from Tajikstan. IZA Discussion Paper 6727, Bonn.

Aslam, M. and Kingdon, G. (2009). 'Public-private sector segmentation in the Pakistan labour market'. *Journal of Asian Economics*, 20 (1), 34-49

Baffoe-Bonnie, J. (1989). 'Family labour supply and labour market segmentation'. *Applied Economics* 21 (1), 69-83.

Basch, M and Paredes-Molina, R. (1996). 'Are there dual labour markets in Chile?' *Journal of Development Economics* 50, 297-312.

Becker, G. (1964). *Human capital: A theoretical and empirical analysis with special reference to education*. Chicago: Chicago University Press.

Bennell, P. (1996). 'Rates of return to education: Does the conventional approach apply to Sub-Saharan Africa?' *World Development* 24 (1), 183-199.

Bigsten, A., Mengistae, T. and Shimeles, A. (2013). 'Labour market integration in urban Ethiopia, 1994-2004.' *Economic Development and Cultural Change* 61 (4), 889-931.

Binswanger, H., McIntire, J. and Udry, C. (1989). 'Production relations in semi-arid African agriculture'. 122-144 in Bardhan, P. (ed.). *The economic theory of agrarian institutions*. Oxford: Clarendon Press.

Blunch, N. and Verner, D. (2004). 'Assymetries of the union premium in Ghana'. *World Bank Economic Review* 18 (2), 237-252.

Bosh, M. and Maloney, W. (2007). Gross worker flows in the presence of informal labour markets: Evidence from Mexico 1987-2002. IZA Discussion Paper 2864. Bonn.

Butcher, K. and Rouse, C. (2001). 'Wage effects of unions and industrial councils in South Africa'. *Industrial and Labor Relations Review* 54, 349-374.

Cain, G. (1976). 'The challenge of segmented labour market theories to orthodox theory: A survey.' *Journal of Economic Literature* 14, 1215-1257.

Cairns, W. (1874). *Some leading principles of political economy, newly expounded*. London: Macmillan.

Central Statistical Agency (CSA) (2011). Large and medium scale commercial farm sample survey. *Statistical Bulletin 50*5. Addis Ababa.

Corbo, V. and Stelcner, M. (1983). 'Earnings determination and labour markets: Gran Santiago, Chile 1978.' *Journal of Developmnent Economics* 12 (1-2), 251-266.

Cramer, C., Sender, J. and Oya, C. (2008). 'Lifting the blinkers: A new view of power, diversity and poverty in Mozambican rural labour markets.' *Journal of Modern African Studies* 46 (3), 361-392.

Cunningham, W. and Maloney, W. (2001). 'Heterogeneity among Mexico's micro-enterprizes: An application of factor and cluster analysis.' *Economic Development and Cultural Change* 50 (1), 131-156.

Daviron, B. (2010). 'Mobilising labour in African agriculture: The role of the International Colonial Institute in the elaboration of a standard of colonial administration, 1895-1930.' *Journal of Global History* 5, 479-501.

Dickens, W. and Lang, K. (1985). 'A test of dual labour market theory'. *American Economic Review* 75 (4), 792-805.

Dickens, W. and Lang, K. (1993). 'Labour market segmentation theory: Reconsidering the evidence.' *Labour Economics* 29, 141-180.

Dinka, O.M., Loiskandl, W. and Ndambiki, J.M. (2013). 'Understanding Behaviour and Spatial Flactuations of Ground water levels in long-term irrigated agriculture: the case of a Sugar Estate'. *Polish Journal of.Environmental Studies* 22 (5) 1325-1334.

Doeringer, P. and Piore, M. (1971). *Internal labour markets and manpower analysis*. Lexington: DC Heath.

Drago, R. (1992). Divide and conquer in Australia: A study of labour segmentation. National Institute of Labour Studies, Flinders University. Working Paper 121.

Dunlop, J. (1957). 'The task of contemporary wage theory', in Taylor, G. and Pierson, F. (eds.) *New concepts in wage determination*, 117-139. New York: McGraw Hill.

Duryea, S., Marquez, G., Pages, C. and Scarpetta, S. (2006). For better or worse? Job and earnings mobility in nine middle- and low-income countries. Brookings Trade Forum. Washington.

Ethiopia Agricultural Transformation Agency (ATA) (2013). Status of soil resources in Ethiopia and priorities for sustainable management. Addis Ababa.

Ethiopian Horticultural Development Authority (EHDA) (2012). Ethiopian Horticultural Sector Statistical Bulletin 01. Addis Ababa.

Ethiopian Sugar Corporation (2012). Tafach Newsletter 1 (1). Addis Ababa.

Falco, P., Kerr, A., Rankin, N., Sandefur, J. and Teal, F. (2010). The returns to formality and informality in urban Africa. Centre for the Study of African Economies, Oxford University. Working Paper 2010-03.

Fields, G. (2011). 'Labour market analysis for developing countries'. *Labour Economics* 18, S16-S22.

Flatau, P. and Lewis, P. (1993). 'Segmented labour markets in Australia'. *Applied Economics* 25, 285-294.

Gaag, J. and van der Vijverberg, W. (1989). Wage determination in Cote d'Ivoire: Experience, credentials and human capital. *Economic Development and Cultural Change*, 37 (2), 371-81.

Gebreselassie, S. (2006). Land, land policy and smallholder policy in Ethiopia: Options and scenarios. Future Agricultures Discussion Paper 80. Accessed 2 May 2014 at www.future-agricultures.org

Glinskaya, E. and Lokshin, M. (20050. Wage differentials between the public and private sectors in India. World Bank Policy Research Working Paper 3574. Washington.

Grimm, M., Knorringa, P. and Lay, J. (2012). 'Constrained gazelles: High potentials in West Africa's informal economy.' *World Development* 40 (7), 1352-1368.

Günther, I. and Launov, A. (2012). 'Informal employment in developing countries: Opportunity or last resort?' *Journal of Development Economics* 97 (1), 88-98.

Gordon, D., Edwards, R. and Reich, M. (1982). *Segmented work, divided workers.* Cambridge: Cambridge University Press.

Hagos, F., Makombe, G., Namara, R., and Awulachew, S. (2009). Importance of irrigated agriculture in the Ethiopian economy: Capturing the direct net benefits of irrigation. International Water Management Institute, Research Report 128. Colombo.

Hartog, J. and Oosterbeek, H. (1993). 'Public and private sector wages in the Netherlands'. *European Economic Review* 37 (1), 97-114.

Heckman, J. and Hotz, V. (1986). 'An investigation of the labour market earnings of Panamanian males: Evaluating the sources of inequality.' *Journal of Human Resources* 2, 507-542.

Henningsen, Arne & Ott Toomet (2011). maxLik: A package for maximum likelihood estimation in R. Computational Statistics 26(3) p. 443-458.

House, W. (1984). 'Nairobi's informal sector: Dynamic entrepreneurs or surplus labour?' *Economic Development and Cultural Change* 32 (2), 277-302.

Hudson, R. (2007). 'The new labour market segmentation: Labour market dualism in the new economy'. *Social Science Research* 36, 286-312.

Jones, S. and Tarp, F. (2014). 'Priorities for boosting employment in Sub-Saharan Africa: Evidence from Mozambique'. Draft, Department of Economics, Copenhagen University, March.

Kingdon, G. and Knight, J. (2004). 'How flexible are wages in response to local unemployment in South Africa?' *Industrial and Labour Relations Review* 59 (3).

Kingdon, G., Sandefur, J. and Teal, F. (2006). 'Labour market flexibility, wages and incomes in Sub-Saharan Africa in the 1990s.' *African Development Review* 18 (3), 392-427.

Lachaud, J-P. (1995). 'Public-private wage differentials in French-speaking Africa: A comparative analysis.; *Labor*, 9 (2), 295-341.

Leontaridi, M. (1998). 'Segmented labour markets: Theory and evidence.' *Journal of Economic Surveys* 12 (1), 63-101.

Maloney, W. (1999). 'Does informality imply segmentation in urban labour markets? Evidence from sectoral transitions in Mexico?' *World Bank Economic Review*, 13 (2), 275-302.

Mano, Y., Yamano, T., Suzuki, A. and Matsumoto, T. (2010). Local and personal networks and the development of labour markets: Evidence from the cut flower industry in Ethiopia. GRIPS Discussion Paper 10-29, National Graduate Institute for Policy Studies, Tokyo.

Marcouiller, D., Ruiz de Castilla, V. and Woodruff, C. (1997). 'Formal measures of the informal sector wage gap in Mexico, El Salvador and Peru'. *Economic Development and Cultural Change* 45 (2), 367-392.

Marshall, A. (1890). *Principles of economics: An introductory volume*. London: Macmillan.

Mazumdar, D. (1981). *The urban labour market and income distribution: A study of Malaysia*. New York: Oxford University Press.

McNabb, R. (1987). 'Testing for labour market segmentation in Britain.' *The Manchester School* 55 (3), 257-273.

McNabb, R. and Psacharopoulos, G. (1981). 'Further evidence on the relevance of the dual labour market theory for the UK.' *Journal of Human Resources* 16 (3), 442-448.

Miller, V. and Vallee, L. (1995). 'Labour regulation and segmentation in Cameroon'. In Gauthier, B. (ed.). Economic reform and the development of the manufacturing sectorin Cameroon. World Bank RPED Country Study Series. Washington.

Mincer, J. (1974). *Schooling, education and earnings*. New York: Columbia University Press.

Mortensen, D. (2005). *Wage dispersion: Why are similar workers paid differently?* Cambridge, Mass.: MIT Press.

Neumann, S. and Ziderman, A. (1986). 'Testing the dual labour market hypothesis: Evidence from the Israel labour mobility survey.' *Journal of Human Resources* 21 (2), 230-237.

Oaxaca, R. (1973). 'Male-female wage differentials in urban labour markets'. *International Economic Review* 14 (3), 693-709.

Osberg, L., Mazany, R., Apostle, R. and Clairmont, D. (1987). 'Segmented labour markets and the estimation of wage functions'. *Applied Economics* 19, 1603-1624.

Osterman, P. (1975). 'An empirical study of labour market segmentation'. *Industrial and Labour Relations Review* 28 (4), 508-523.

Oya, C.(2013). 'Rural wage employment in Africa: Methodological issues and emerging evidence.' *Review of African Political Economy* 40: 136, 251-273.

Packard, T. (2007). 'Do workers in Chile choose informal employment? A dynamic analysis of sector choice.' World Bank Policy Research Working Paper 4232. Washington.

Pages, C. and Stampini, M. (2009). 'No education, no good jobs? Evidence on the relationship between education and labour market segmentation.' *Journal of Comparative Economics* 37, 387-401.

Pigou, A. (1945). *Lapses from full employment*. London: Macmillan.

Pradhan, M. and Van Soest, A. (1995). 'Formal and informal sector employment in urban areas in Bolivia.' *Labour Economics* 2 (3), 275-297.

Quintin, E and Pratap, S. (2006). 'Are labour markets segmented in developing countries?' *European Economic Review* 50, 1817-1841.

R Core Team (2014). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org:

Rahmato, D. (1984). Agrarian reform in Ethiopia. Uppsala: Scandinavian Institute of African Studies.

Rama, M. (2000). 'Wage misalignment in CFA countries: Are labour market policies to blame?' Journal of African Economies 9 (4), 475-511.

Rebitzer, J. and Robinson, M. (1991). 'Employer size and dual labour markets'. *Review of Economics and Statistics* 73 (4), 627-635.

Reich, M., Gordon, D., and Edwards, R. (1973). 'Dual Labor Markets: A Theory of Labor Market Segmentation' (1973). *American Economic Review* 63(2), 359-365.

Reynolds, L. (1951). *The structure of labour markets: Wages and labour mobility in theory and practice*. Westport: Greenwood Press.

Riisgaard, L. and Gibbon, P. (2014). 'Labour management on contemporary Kenyan cut flower farms: Foundations of an Industrial-Civic compromise.' *Journal of Agrarian Change* 14 (2), 260-285.

Rodriguez de Francisco, J. (2009). Preconditions for payment for environmental services establishment in Central Rift Valley, Ethiopia. MSc thesis, Department of Environmental Sciences, Wageningen University.

Roig, A. (1999). 'Testing Spanish labour market segmentation: An unknown regime approach.' *Applied Economics* 31, 293-305.

Rosenberg, S. (1980). 'Male occupational standing and the dual labour market.' *Industrial Relations* 19, 34-49.

Sahn, D. and Sarris, A. (1994). 'The evolution of states, markets and civil institutions in rural Africa'. *Journal of Modern African Studies*, 32 (2), 279-303.

Saavendra, J. and Chong, A. (1999). 'Structual reform, insitutions and earnings: Evidence from the formal and informal sector in urban Peru.' *Journal of Development Studies* 35 (4), 95-116.

Scholten, W. (2007). Agricultural development and water use in the Central Rift valley of Ethiopia: A rapid appraisal. University of Twente, Enshede.

Schultz, T. and Mwabu, G. (1998). 'Labour unions and the distribution of wages and employment in South Africa.' *Industrial and Labor Relations* 51.

Sloane, P., Murphy, P., Theodossiou, I and White, M. (1993). 'Labour market segmentation: A local labour market analysis using alternative approaches.' *Applied Economics* 25, 569-581.

Soderbom, M and Teal, F. (2004). 'Size and efficiency in African manufacturing firms: Evidence from firm-level panel data'. *Journal of Development Economics* 73, 369-394.

Soderbom, M., Teal F. and Wambugu, A. (2005). 'Unobserved heterogeneity and the relation between earnings and firm size: Evidence from two developing countries.' *Economic Letters* 87, 153-159.

Spence, A. M. (1973). 'Job market signaling'. *Quarterly Journal of Economics*, 87 (3), 355-374.

Strobl, E. and Thornton, R. (2002). Do large employers pay more in developing countries? The case of five African countries. IZA Discussion Paper 660. Bonn.

Teal, F. (2011). 'The price of labour and understanding the causes of poverty.' *Labour Economics* 18, S7-S15.

Thomas, M. and Vallee, L. (1996). 'Labour market segmentation in Cameroonian manufacturing'. *Journal of Development Studies* 32 (6), 876-898.

Toomet, O. & Henningsen, A. (2008). 'Sample Selection Models in R: Package sampleSelection'. *Journal of Statistical Software* 27(7).

Tschirley, D. and Benfica, R. (2001). 'Smallholder agriculture, wage labour and rural poverty in land abundant areas in rural Africa: Evidence from Mozambique'. *Journal of Modern African Studies* 39 (2), 333-358.

Van der Gaag, J. and Vijverberg, W. (1988). 'A switching regression model for wage determinants in the public and private sectors of a developing country.' *The Review of Economics and Statistics* 70 (2), 244-252.

Van Ophem, H. (1987). 'An empirical test of the segmented labour market theory for the Netherlands.' *Applied Economics* 19, 1497-1514.

Wendimu, S. and Bekele, W. (2011). 'Determinants of individual willingness to pay for quality water supply. The case of Wonji Shoa Sugar Estate, Ethiopia', *Journal of Ecology and the Natural Environment* 3 (15), 474-480.

Yamada, G. (1996). 'Urban informal employment and self-employment in developing countires: Theory and evidence.' *Economic Development and Cultural Change* 44 (2), 289-314.

Yasin, M. (2010). Pastoral land tenure issues and development in the middle Awash valley. MA thesis, Department of Regional and Local Development Studies, University of Addis Ababa.

Appendix I: Method for calculating the monetary value of formal sector workers' social wages

The assumptions used in these calculations are based on the information gathered from the sugar plantation's HR Department, interviews with local informants and the Ethiopian constitution (on statutory pension benefits). The benefits making up the social wage were received only by sugar plantation workers. Casual and rolling monthly contract workers receive no benefits, although most have access to housing provided to them by other workers. Seasonal workers receive benefits (i) – (v). PPL grade workers receive all the benefits listed. Whereas the daily cash wage rate for formal sector workers has been computed by dividing workers' wages by the actual number of days they worked during the reference pay period, computation of the daily value of the social wage is based on dividing the money equivalent of a given benefits by the full calendar period that the benefit applies to (e.g., one or more 30-day months, or a 365 day year).

The monetary value of the benefits is computed as follows:

(i) Housing provision (HP) - we assume the rent in a nearby village for a similar type of housing to that provided free on the plantation to be about 60 birr per month. Housing provision is therefore worth

$$HP = \frac{60 birr}{30 days} = 2 birr / \text{day}$$

(ii) Subsidized sugar - The value of the subsidy (based on prices in a nearby village) incorporated in the price of the monthly sugar ration received by entitled workers is estimated to be about 40 birr per month (1.33 birr per day).

(iii) Sick pay (SP) - In principle those workers entitled to sick pay could receive full pay during sick leave for one month per year and half pay during sick leave for an additional two months per year. Thus they could qualify for an annual total of 60 days' sick leave with full pay. However in line with information received we assume that those qualified actually take only 25% of their aggregate annual sick leave entitlement. The mean daily wage for those who can qualify for sick leave is 35.36 birr. SP is therefore worth

$$SP = \frac{15 days \times 35.36 birr / day}{365 days} = 1.45 birr / \text{day}$$

(iv) Access to medical care (MC) - We assume that those workers qualifying for free medical care visit a nurse or a doctor five times per year. We also assume that the expense per visit in a nearby village is about 60 birr. The value of MC is therefore

$$MC = \frac{5 visit \times 60 birr / visit}{365 days} = 0.82 birr / \text{day}$$

(v) Maternity leave (ML) - Women with this entitlement qualify for leave on full pay for one month before each birth and two months after. We assume that entitled women employees give birth every two years, thus receiving on average 45 days paid maternity leave per year. The mean daily wage for women is 21.35 birr. The value of ML is therefore

$$ML = \frac{45days \times 21.35birr/\text{day}}{365days} = 2.63birr/\text{day}$$

(vi) Pension (P) - We assume that those workers entitled to a pension receive when pensionable the minimum old age pension payment in Ethiopia, which was in 2013 294 birr per month. 50% of a qualified pensioner's pension is transferable on death to their spouse, for an additional 10 years. We assume that qualified pensioners receive a pension for five years on average on retirement and that the transferable share of their pension is received by a spouse for the entire period of eligibility. We further assume that those qualifying for a pension earn this qualification over a period of 20 years before going on pension. Thus the value of a pension, discounted over the qualification period, is

$$P = \frac{5years \times 12months \times 294birr/month}{20year} + \frac{10years \times 12months \times 147birr/month}{20year} = 1764birr/year = 4.83birr/day$$

Appendix II: Equations for predicting unconditional and conditional daily wage rates

Unconditional expectations:

$$E(lnW_{Fi}|x_i') = x_i'\beta_F \quad (8)$$

$$E(lnW_{Ii}|x_i') = x_i'\beta_I \quad (9)$$

Conditional expectations

$$E(lnW_{Fi}|y_i^* > 0, z_i') = x_i'\beta_F + \sigma_F\rho_F f(z_i'\gamma)/F(z_i'\gamma) \quad (10)$$

$$E(lnW_{Ii}|y_i^* > 0, z_i') = x_i'\beta_I + \sigma_I\rho_I f(z_i'\gamma)/F(z_i'\gamma) \quad (11)$$

$$E(lnW_{Ii}|y_i^* \leq 0, z_i') = x_i'\beta_I - \sigma_I\rho_I f(z_i'\gamma)/(1 - F(z_i'\gamma)) \quad (12)$$

$$E(lnW_{Fi}|y_i^* \leq 0, z_i') = x_i'\beta_F - \sigma_F\rho_F f(z_i'\gamma)/(1 - F(z_i'\gamma)) \quad (13)$$

Appendix III: Robustness checks

Table 7. Estimates for two sector wage equations including location dummy for Meki

	Formal Sector (N = 161)	Informal Sector (N = 156)
Variables	ML	ML
Intercept	3.31 (0.31)***	3.36 (0.34)***
Age	-0.003 (0.02)	-0.004 (0.02)
Age squared	0.00001 (0.0003)	0.00001 (0.0003)
Female	-0.23 (0.07)**	-0.10 (0.07)
Experience	0.02 (0.01)*	0.005 (0.01)
Experience squared	-0.0004 (0.0003)	-0.001 (0.001)
Primary education	0.22 (0.10)*	-0.02 (0.10)
Secondary education	0.25 (0.10)*	-0.08 (0.13)
Married	-0.04 (0.06)	-0.12 (0.08)

Field preparation	-0.04 (0.11)	0.16 (0.20)
Crop preparation and maintenance	-0.13 (0.09)	0.29 (0.17)
Irrigation, spraying	0.06 (0.10)	-0.31 (0.19)
Weeding	-0.08 (0.10)	-0.07 (0.19)**
Harvesting	-0.16 (0.09)	-0.006 (0.17)
Miscellaneous tasks	-0.30 (0.08)***	-0.04 (0.18)
σ	0.29 (0.02)***	0.37 (0.03)***
ρ	-0.07 (0.19)	-0.64 (0.18)***

Table 8. Estimates for two sector wage equations using data for informal sector workers' immediately previous employment contract

Variables	Sector selection equation	Formal Sector (N = 161) ML	Informal Sector (N = 156) ML
Intercept	-2.45 (0.46)***	3.57 (3.38)***	4.02 (0.39)***
Age	0.03 (0.02)	-0.02 (0.02)	-0.01 (0.02)
Age squared		0.0003 (0.0003)	0.0001 (0.0003)
Female	-0.22 (0.25)	-0.16 (0.08)*	-0.05 (0.09)
Ethnicity			
Wolaita	1.12 (0.31)***	0.20 (0.10)*	0.01 (0.09)
Kambata	2.51 (0.37)***	0.10 (0.10)	0.37 (0.36)
Hadiya	1.06 (0.32)***	0.11 (0.10)	0.06(0.12)
Amhara	0.73 (0.32)*	0.15 (0.11)	0.12 (0.12)
Others	0.63 (0.62)	-0.37 (0.19)	-0.37 (0.23)
Own land	-1.02 (0.25)***		
Born in this place	0.92 (0.25)***		
Experience	0.08 (0.02)***	0.03 (0.01)*	0.01 (0.02)
Experience squared		-0.001 (0.0004)	-0.001 (0.001)
Primary education		0.24 (0.10)*	-0.02 (0.10)
Secondary education		0.27 (0.10)**	-0.12 (0.13)
Married		-0.06 (0.06)	-0.08 (0.08)
Field preparation		-0.03 (0.12)	0.02 (0.20)
Crop preparation and maintenance		-0.11 (0.10)	0.02 (0.20)
Irrigation, spraying		0.13 (0.10)	-0.21 (0.19)
Weeding		-0.09 (0.10)	-0.72 (0.22)**
Harvesting		-0.18 (0.09)*	-0.13 (0.20)
Miscellaneous tasks		-0.23 (0.08)**	-0.23 (0.20)
σ		0.29 (0.02)***	0.40 (0.05)***
ρ		0.02 (0.24)	0.42 (0.65)