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**REFERRAL AND JOB  
PERFORMANCE: EVIDENCE FROM  
THE GHANA COLONIAL ARMY**

Marcel Fafchamps and Alexander Moradi

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# REFERRAL AND JOB PERFORMANCE: EVIDENCE FROM THE GHANA COLONIAL ARMY

Marcel Fafchamps, University of Oxford and CEPR  
Alexander Moradi, University of Sussex

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Centre for Economic Policy Research  
53–56 Gt Sutton St, London EC1V 0DG, UK  
Tel: (44 20) 7183 8801, Fax: (44 20) 7183 8820  
Email: [cepr@cepr.org](mailto:cepr@cepr.org), Website: [www.cepr.org](http://www.cepr.org)

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## ABSTRACT

### Referral and Job Performance: Evidence from the Ghana Colonial Army

As formalized by Montgomery (1991), referral by employees improves efficiency if the unobserved quality of a new worker is higher than that of unrefereed workers. Using data compiled from army archives, we test whether the referral system in use in the British colonial army in Ghana served to improve the unobserved quality of new recruits. We find that it did not: referred recruits were more likely than unrefereed recruits to desert or be dismissed as 'inefficient' or 'unfit'. We find instead evidence of referee opportunism. The fact that referred recruits have better observed characteristics at the time of recruitment suggests that army recruiters may have been aware of this problem.

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Marcel Fafchamps  
Department of Economics  
University of Oxford  
Manor Road Building  
Manor Road  
Oxford  
OX1 3UQ

Alexander Moradi  
Department of Economics  
University of Sussex  
Arts E511  
Falmer  
Brighton  
BN1 9SN

Email:

[marcel.fafchamps@economics.ox.ac.uk](mailto:marcel.fafchamps@economics.ox.ac.uk)

Email: [A.Moradi@sussex.ac.uk](mailto:A.Moradi@sussex.ac.uk)

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## 1. Introduction

Since Granovetter's (1974) seminal work, it is widely recognized that job referral plays an important role in the way the labor market works. There are many different types of referrals – e.g., by relatives, teachers, or previous employers. One kind of referral that has attracted the attention of economists is referral by current employees. This form of referral is thought to play two possible roles: the transmission of information that is relevant to the hiring process; and the exchange of favors between employer, referee, and new recruit. In the latter case, referral is a source of inefficiency and inequity since it distorts the recruitment process to favour friends and relatives (Barr and Oduro 2002). In the former case, referral instead plays an efficiency-enhancing role: it raises the quality of the match, either by providing employers with better information about workers (Saloner 1985), or by providing workers with better information about job characteristics (Simon and Warner 1992, Mortensen and Vishwanath 1994) .

Montgomery (1991) provides an elegant formalization of employee referral. In his model, referral by employees is valuable because the unobserved quality of a new worker is positively correlated with the revealed quality of the current employee providing the reference. If the current employee has proved to be of high quality, anyone referred by this employee is also more likely to be of high quality. Underlying this assumption is the idea that social ties are characterized by homophily, and hence that characteristics of socially proximate individuals are correlated (Jackson 2008). As Montgomery shows, this assumption is sufficient to induce employers to rely on referral from high quality employees. It does, however, suppose that referees truthfully report the information at their disposal. Whether this is the case in practice is unclear.

We test this idea using data from recruitment into the British colonial army in Ghana. The conditions under which the Gold Coast Regiment (GCR) operated in the early 20th century provide an excellent vantage point from which to study employee referrals. The GCR was a big employer, with a peace-time strength of about 1,500 rank-and-file drawn exclusively from the indigenous population. Although there was a large army build-up during WWI, universal conscription was never introduced and the GCR had to compete for labor on the labor market.

Until the mid-1920s, referral by fellow soldiers was used explicitly by the army. Depending on the year, 20-80% of new enlistees were brought in by fellow soldiers, often from their home village or region. In the period 1908-1918 a financial reward was paid to the recruiter and the army kept a record, which means that there is clear and unambiguous information on employee referral. Another welcome feature is the homogeneous work conditions and skill requirements – compensation was uniform for new recruits and the tasks assigned to them were fairly basic and relatively similar. We thus have a large number of observations relative to a single employer seeking many workers with similar characteristics, and using employee referral in a systematic way.

Since the colonial army remunerated servicemen who brought suitable new recruits, we expect referral to be beneficial to the army as an employer. In particular, we expect referred recruits to have better hidden characteristics than unreferred ones. One key characteristic for army work is physical strength, a trait that is correlated with height. Other relevant characteristics include loyalty and discipline. Height is observable at recruitment; loyalty and discipline are only revealed later. If referees report information truthfully, we expect new recruits referred by servicemen to be revealed over time to have better unobserved characteristics. The Ghanaian colonial army offers a convenient vantage point into this issue. Unlike other employment

contracts, army recruits cannot leave of their own accord. If they do, it is recorded as desertion and can be prosecuted. Employee dismissal is also under the control of the employer, who customarily records the reason for termination. We therefore have a clear record of employees' revealed performance as seen by the employer.

Using army records covering enlistments over the 1908-1923 period, we compare the initial physical ability and subsequent performance of referred and unreferred recruits. We also test whether referred recruits brought in by higher rank servicemen are better than those brought by unpromoted soldiers: if the hidden characteristics of socially proximate individuals are correlated, then better workers should bring in better recruits. This assumes that referees report information truthfully. They may however behave opportunistically, either to obtain the reward or to ward off pressure from superiors to bring in new recruits. In this case, referred recruits are expected to be of lower unobserved quality. To deter opportunistic referral, the army may penalize soldiers who refer low quality recruits, for instance by reducing their chances of promotion. We do not observe this directly but, if it is the case, soldiers who have no more promotion prospects would be harder to discipline. Given the conditions prevailing in the Ghanaian colonial army, we therefore expect high rank soldiers to refer lower quality recruits.

Results strongly reject the idea that, in the case of the Ghanaian colonial army, employee referral improved the unobserved quality of recruits. While referred recruits were usually taller than unreferred ones, they were also more likely to desert or be dismissed as inefficient or unfit. Furthermore, recruits referred by higher ranked servicemen were of lower quality than those referred by low rank soldiers. These results survive a battery of robustness checks to which we subject them. Our findings are consistent with referee opportunism and they may explain why after WWI the colonial army stopped rewarding servicemen for bringing in new recruits.

These results contribute to the literature in several ways. First, much of the currently available evidence on employee referral comes from developed economies with large and active labor markets. Little evidence relates to other parts of the world, either now or in the past. We offer evidence from Africa during the colonial period. Our findings are different, suggesting that results obtained in one context may not be applicable elsewhere.

Secondly, referred workers have been shown to earn higher wages, have higher productivity, and enjoy lower turnover and higher tenure than other workers (Corcoran et al. 1980, Datcher 1983, Korenman and Turner 1994, Holzer 1997, Kugler 2002). Such findings have been interpreted as evidence of better match quality for referred workers. However, they could also be manifestations of nepotism, as for instance suggested by Barr and Oduro (2002). Our test is not subject to the same ambiguity because all new indigenous recruits in the colonial army were given identical pay and contract conditions. The measures of performance that we use cannot be suspected of reflecting favoritism: deserters were hunted down and jailed, and their deferred salary was not paid – hardly an expression of favoritism.

Finally, our findings bring to light an incentive problem germane to any referral process. That truth-telling need not be incentive compatible has long been recognized in the economic literature on contracts. But strangely the same scrutiny has seldom been applied to referrals. Given how prevalent referrals are in economic transactions, there is a need for more research on the incentive issues surrounding them.<sup>1</sup>

The paper is organized as follows. Background information on the Gold Coast Regiment

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<sup>1</sup>Fafchamps (2004) for instance presents evidence that there is little information sharing among African firms, making collective punishment for breach of contract difficult if not impossible. The explanation he offers is that entrepreneurs seldom regard information provided by referees as reliable, unless they know and trust the source of the information.

(GCR) is provided in Section 2 and the data is discussed in Section 3. Our testing strategy is outlined in Section 4 and empirical results are presented in Section 5.

## 2. Background

The GCR was a big, supra-regional employer, with a peacetime strength of about 1,500 men.<sup>2</sup> It was used to maintain internal security but also served during World War I (WWI) in the campaigns against German colonies in neighboring Togo, Cameroon, and subsequently Tanganyika (now Tanzania). Although all commissioned officers in the GCR were British, the rank-and-file was drawn from the indigenous population with a significant share (20%-40%) of indigenous personnel originating from neighboring countries, notably Burkina Faso, Liberia, Nigeria, Niger, Sierra Leone, and Togo. The army maintained several bases of varying size across Ghana.

Universal conscription was never introduced and the GCR had to compete for labor on the labor market. Military service at that time involved unskilled labor with little degree of differentiation. The ideal recruit was a man who was loyal and amenable to discipline. Various recruitment methods were in use. Firstly, recruiting parties would tour an area encouraging men to enlist. Secondly, the task was delegated to chiefs who, under the system of ‘indirect rule’, acted as agents of the colonial administration and provided men using financial inducements and coercion. Thirdly, until 1923 soldiers of the GCR were explicitly encouraged to bring new recruits. Referrals represented a significant hiring channel; 35% of new enlistees were brought in by fellow soldiers, often from their home village or region. From 1908 until the end of WWI, a practice of ‘bringing-in money’ was systematically applied: upon acceptance of the new recruit,

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<sup>2</sup>This section draws heavily on the work of Killingray (1982).

the bringer received a payment equivalent to about a week's pay.<sup>3</sup>

Recruits had to pass certain minimum requirements laid down in official army handbooks, though officers had some discretion in enforcing these rules. Among the easily observable requirements were height and chest circumference, which were used to screen the health and physical fitness of potential recruits. Once the recruit was accepted and had sworn his oath, he was subject to military law. This meant that punishments for breaches of discipline could be imposed, including fines, drill and general fatigue work, detention and imprisonment (RWAFF Ordinance, 1923). Moreover, the army withheld about one-third of the soldier's basic pay as compulsory saving until the period of service was completed. This policy acted as deterrent against desertion. All new recruits received the same pay.

Promotion is clearly and unambiguously recorded. Local recruits all had to earn promotion through the ranks, based on merit and ability. However, Africans were not allowed to hold positions of responsibility that would place them over white men. The highest rank that Africans could reach after long and distinguished service was Regimental Sergeant Major. Promotion, however, paid off. The basic daily rate of pay for a Private was one shilling. This increased to 1.25, 1.5 and 3 shillings for a Corporal, Sergeant, and Company Sergeant Major (CSM), respectively. In addition, the military offered living allowances and occasional gratuities and rewards; non-monetary benefits included uniforms, housing, and medical care.

WWI brought a massively changed situation. The demand for recruits increased dramatically as troops were to be used in Togoland (1914), the Cameroons (1914-16), and the East African campaign (1917-18). About 7000 men enlisted in the GCR during the war, compared to a yearly intake of about 200 recruits in peacetime. The years 1917 and 1918 stand out, with

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<sup>3</sup>Killingray (1982) mentions an amount "varying from five shillings to ten shillings" (referring to 1896).

3800 and 1600 new recruits respectively. These numbers were obtained along the recruiting channels mentioned above: recruiting parties were intensified and chiefs had to fulfil quotas. Recruitment was extended to ethnic groups and areas previously not – or less – targeted such as Ashanti and the coastal peoples of Ghana and Togo. Physical requirements were also reduced. Going over the sea to fight in East Africa was extremely unpopular. Consequently, new recruits were guarded and quickly shipped to East Africa before completing their training. Corporal punishment (flogging), abolished in 1908, was reintroduced in 1917 to prevent absenteeism and desertion.

### **3. Data**

The data used in this study were collected from military personnel records held by the General Headquarters of the Ghana Armed Forces in Accra, Ghana. We drew an almost complete sample of recruits enlisted between 1912 and 1923. We had more difficulties to locate recruits 1908-1911, who are somewhat underrepresented. Overall, the raw data set consists of 7,507 fighting troops and 844 motor drivers.

The army collected a wealth of information on the recruit's background including age, place of birth, ethnicity, religion, and previous occupation. Additionally, height and chest circumference were measured as part of routine medical examinations. Summary statistics are given in Table 1. The circumstances by which the recruit entered the army were recorded on attestation papers. Entries in the field 'Bringer' fall into three categories: a) referrals by a fellow soldier stating his name, rank, and regimental number; b) recruits sent by chiefs; and c) volunteers. Around 35% of soldiers were recruited through a bringer, another 23% were sent by chiefs, and 8% are

recorded as having volunteered. The rest were recruited directly by the army. We identified 1,127 bringers, who account for 2,837 referrals. The majority took on the role of bringer on only one occasion; 96% of bringers referring less than 10 recruits account for 70% of all referrals. A small number of (long serving) soldiers were active recruiters: 46 bringers in varying positions ranging from Malam,<sup>4</sup> Pay Clerk, and Private to Regimental Sergeant Major account for referrals of the remaining 928 recruits. We know from secondary sources that the bringer was compensated; the actual compensation amount was unfortunately not recorded on attestation papers which are our primary source of information.

Personnel files contain information on the soldier's conduct and career within the army. The cause of discharge is an excellent indicator of the soldier's quality. 'Deserted', 'inefficient', and 'medically unfit' are categories that indicate poor performance as seen by the employer, whereas the remaining categories such as 'demobilization' or 'completion of service' indicate a good performance.<sup>5</sup> The cross tabulation of frequencies are presented in Table 2. It is clearly evident that the GCR as an employer had massive problems recruiting reliable, physically fit, capable men: one fourth of enlisted recruits did not meet these requirements ex post, i.e., they deserted or were discharged as 'medically unfit' or 'inefficient'.

A substantial proportion (37%) of the attestation papers are silent on termination. After the war, the army modified its system for recording the details of demobilization. It appears that recruits who completed their service normally are not recorded on attestation papers – only those who deserted or were dismissed early. Numbers of deserters and dismissals based on this

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<sup>4</sup>A Malam is a Muslim 'military chaplain' appointed to the establishment of the GCR.

<sup>5</sup>A small number of soldiers were discharged for reasons of 'misconduct' (109 recorded cases, accounting for only 1.30% of the sample). While these cases fit under the rubric 'low quality', the category is very heterogeneous and include a wide range of offenses going from insubordination to theft and rape. These cases are excluded from our analysis since they probably follow a different data generating process.

interpretation agree with various other official documents.<sup>6</sup> In our analysis we therefore assume that if the date of discharge is missing on attestation papers, the soldier served at least until the end of WWI and demobilized at some unknown later date. This brings the number of soldiers serving at the end of WWI to 5159 (4475 fighting troops and 684 motor drivers) which is in line with estimates by Killingray (1982).<sup>7</sup>

#### 4. Testing strategy

We want to contrast two possible models of referral: the Montgomery model in which referral helps employer select new recruits with better unobserved characteristics; and an alternative model that allows for referee opportunism. Let  $q$  stand for the quality of a new recruit and let  $R = 1$  if the recruit is referred by another soldier, and 0 otherwise. Montgomery's model predicts that referred recruits should be of higher quality:<sup>8</sup>

$$E[q|R = 1] > E[q|R = 0] \tag{4.1}$$

This is a correlation, not a causal relationship. Hence we avoid many of the complications induced by the difficulty of correctly identifying causal effects. But we need to control for factors that have affected the quality of recruits over time, such as WWI, and may be correlated

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<sup>6</sup>Summary statistics of desertions in our data correspond to figures reported by the Governor to Secretary of State (Thomas, 1975). Similarly, individual entries of desertions and dismissals match WWI Service Medal Rolls of the GCR. The 1914-15 Star, in particular, was awarded to all members of the GCR who were deployed in Togo and Cameroon between 5th August 1914 and 31st December 1915. The Service Medal Rolls list name and regimental numbers of deserters and others who were not eligible to the award. WO 329/2956, The National Archives.

<sup>7</sup>If we omit all recruits with missing termination information, we are left with only 2634 men (2505 fighting troops and 129 motor drivers) at the end of WWI.

<sup>8</sup>In a perfect competition equilibrium we would expect the financial incentive paid to the bringer to match  $E[q|R = 1] - E[q|R = 0]$ . But in this case the employer has monopsonic power, so the reward to the bringer could be smaller.

with the use of referral. More about this in the next section.

Recruit quality  $q$  can be divided into components  $h$  that are observable at the time of hiring – such as height – and unobservable components  $d$  – such as loyalty and discipline. Let  $q = f(h, d)$ . To the extent that referral is informative about unobservable characteristics, we expect  $E[d|R = 1] > E[d|R = 0]$ : referred recruits should prove to be more loyal and disciplined. Montgomery’s model makes less clear predictions about observable characteristics. The correlation between the referee’s characteristics and those of the new recruit may hold for both observable and unobservable characteristics, in which case we would also expect referred recruits to be taller, i.e.,  $E[h|R = 1] > E[h|R = 0]$ . But if the army believes referred recruits to be better in terms of unobservables, it may recruit referred soldiers that are shorter because their sub-average height is compensated by better discipline. In this case, we would observe  $E[h|R = 1] < E[h|R = 0]$  and  $E[d|R = 1] > E[d|R = 0]$ . The important point is that a pure screening model of referral would never predict a situation in which referred recruits are better in terms of observable  $h$  but worse in terms of unobservable  $d$ . Indeed in this case referral would not provide any valuable information since  $h$  is observable at the time of hiring.

In Montgomery’s model, referees truthfully pass onto their employer the information at their disposal. In practice, referees may misrepresent the information they have – or claim to have. For instance, a soldier may recommend favorably someone they do not know in order to get the reward. Alternatively, he may recommend a friend or relative even though he know him to be less qualified for army work. To the extent that the bringer is doing the new recruit a favor by recommending him, we would expect the magnitude of misrepresentation to increase with social proximity between bringer and new recruit, something we test. Another possibility is that the army puts pressure on its soldiers to bring new recruits, as seems to have happened

according to Killingray (1982). If this is true, we expect bringers to minimize effort by bringing low quality recruits. They may also misrepresent army life to new recruits in order to lure them into applying.

In all these cases, we expect referred recruits to be worse than unreferred ones. It is fair to assume that army recruiters understand this. If we are willing to assume that  $h$  and  $d$  are at least partly substitutable, recruiters may compensate for a lower expected  $d$  on referred recruits by insisting on a higher  $h$ . We would then observe referred recruits to be taller at the time of hiring, but over time to reveal themselves to be less disciplined.

These observations form the basis of our testing strategy. Height and chest circumference recorded at the time of recruitment are taken as measure for  $h$ . For  $d$  we use information on contractual performance as indicated by the cause for termination. For those recruits who are discharged by the army, we use the motive for termination recorded in army files, e.g., whether ‘inefficiency’ or ‘medically unfit’ is listed as cause for dismissal. Desertion is a very strong indication of recruit quality, but because it is triggered by the recruit it follows a slightly different process which needs to be properly understood in order to interpret the data correctly.

There are many reasons why a recruit may choose to desert.<sup>9</sup> Some have to do with work conditions in the army itself. Others have to do with conditions at home that require the recruit to return to his village. In any case, desertion was punishable and the punishments should act as a deterrent to desertion. However, not every deserter was apprehended and punished.<sup>10</sup> A longer distance between place of origin and place of posting makes it easier to avoid being traced.

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<sup>9</sup>Technically, a soldier was considered a deserter after 30 days of unauthorised absence.

<sup>10</sup>A reward was paid for information that led to the apprehension of deserters. The rate of apprehension and conviction varied. In 1906, for example, 24 of 40 deserters were apprehended, whereas 7 of 50 deserters were apprehended in 1907. Report of the Inspector General, CO 445/24, The National Archives.

Hence the probability of a recruit deserting is expected to increase in the distance between place of origin and place of posting. The army may enlist the help of the bringer in order to trace the runaway recruit. This would raise the probability of being found and punished, and hence should deter desertion. This generates a confounding effect – a reason other than a higher  $d$  to expect referred recruits to be less likely to desert. If, however, we find that referred recruits are *more* likely to desert, this constitutes even stronger evidence towards referee opportunism.

## 5. Empirical results

We begin by applying the testing strategy outlined in the previous section. We then scrutinize the data more in detail for evidence of opportunism, first in general, and then more specifically for desertion and dismissal. At the end of the section we subject our results to various robustness checks.

### 5.1. Testing the referral model

Our first set of results is presented in Table 3. The dependent variables are height and chest circumference measured at the time of recruitment. Adult height is a measure of nutritional and health status (WHO, 1995). The medical literature nowadays refutes that chest circumference is an indicator of lung capacity, but in early 20th century it was considered to be so (Pignet, 1901). Chest circumference was recorded in Ghanaian army records and it is a good predictor of promotion in the Kenya colonial army (Moradi and Mylavarapu, 2008). It is therefore reasonable to assume that, at the time of recruitment, medical officers considered height and chest circumference to be indicators of physical fitness.

In columns 1 and 3 we only include dummies for the method of recruitment, i.e., referred by

a fellow soldier, sent by a traditional chief, or volunteered. The omitted category is ‘no entry’ – which typically refers to direct recruitment. Results show a strong positive association between referral, height, and chest circumference. In contrast, recruits sent by chiefs tend to be shorter with a smaller chest circumference.

Recruitment methods tended to vary over time, with more pressure put on traditional chiefs to send recruits during WWI. To correct for this, we reestimate the regressions with a dummy for WWI and a separate dummy for the 1917/18 period which witnessed the largest buildup of the colonial army to assist its East African operations in Tanganyika. Some 81% of all soldiers in our dataset were recruited during WWI, and 64% in the 1917/18 period alone. Results are shown in columns 2 and 4 of Table 3. Not surprisingly the WWI and 1917/18 dummies are associated with lower quality recruits: the army had to lower its standards in order to admit more recruits at a time when enrolling was less attractive. The referral dummy remains positive and statistically significant for height, but is no longer significant for chest circumference.

A potential source of bias is the former occupation of the new recruit. Some 61% of new recruits list farming as their former occupation. Given the economic context of the time, we expect farmers to come from a poorer background and hence to be shorter than average. If bringers tend to recommend fellow villagers, this could cause a bias. We reestimate both regressions including the previous occupation information available from army records. This includes dummies for whether the recruit’s previous occupation was in farming or in the Armed Forces (2%). We also include a literate dummy and a skill index. To construct the skill index, we use information on the recruit’s previous occupation and simply rank occupations from 1 to 5 from the least to the most complex. This constitutes our skill index.<sup>11</sup>

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<sup>11</sup>For example, carriers and day labourers were coded 1, farmers and stewards coded 2, carpenters and tailors

Results, not reported here to save space, show little change with respect to our main variable of interest. Farmers do not appear significantly different from other recruits. Literate recruits tend to be taller, but the coefficient is only significant at the 10% level. Skilled and literate recruits tend to have a smaller chest circumference, a possible consequence of engaging in less strenuous work. In the eyes of army recruiters their skills may have compensated for perceived strength deficiency.

Next we do the same for desertion and for early dismissal as ‘inefficient’ or ‘medically unfit’. In this case, the event of interest unfolds over time. The longer a recruit stays in the army, the longer the exposure to the ‘risk’ of deserting or being dismissed. To control for the length of exposure, we estimate duration models. Results are presented in Table 4. Coefficients are reported in the form of hazard ratios: estimates larger than 1 imply a higher risk of desertion or dismissal, and vice versa for estimates smaller than 1. The same regressors are used as in Table 3. Results indicate that referred recruits and recruits sent by chiefs are at a much higher risk of deserting or being dismissed as inefficient or unfit. Volunteers are also more likely to desert, but not to be dismissed. There was a significant drop in desertions during WWI and 1917/18 – probably because sanctions were much harsher. This does not, however, affect our results: as seen in columns 2 and 4 of Table 4, our main results do not change when we include dummies for WWI and 1917/18.

As we did for Table 3, we reestimate the regressions with occupation and skill variables. We expect farmers to be more at risk from desertion, and this for several reasons. First, farming is a seasonal activity: soldiers may want to return home to assist with the harvest, which conflicts with terms of employment in the army. Secondly, the soldier may return to the village to take

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were coded 3, clerks were coded 4, engineers and school directors were coded 5 (Armstrong, 1972).

over the family farm from an ailing or deceased parent. This makes us suspect that soldiers with a farming background are more likely to desert. They may also slack in their duties in the hope of being dismissed as inefficient or unfit. Note that skill and occupation are at least partly observable by army recruiters – and what we know is what they put down in their records. If these characteristics predict desertion, this was in principle observable to the employer and should therefore have been taken into account at hiring.

When we reestimate the regressions in Table 4 with these extra variables,<sup>12</sup> we find that, as anticipated, a farming background is strongly associated with a higher risk of desertion and dismissal. In the case of desertion, the referral dummy remains significant, albeit with a smaller coefficient. In the dismissal regression, the referral dummy is no longer significant. This suggests that the association between referral and dismissal is due to the fact that referred recruits are more likely to come from farming. Although past occupation is observable to the employer, this does not negate the fact that referred recruits had a higher risk of early dismissal.

Taken together these results contradict the pure screening model of referral: referred recruits are better in terms of observed characteristics such as height and chest circumference, but worse in terms of unobservables, judging by their subsequent work performance. This is consistent with opportunistic behavior on the part of refereeing soldiers. The evidence is also consistent with the idea that the army knew (or suspected) that referred recruits were on average less disciplined or loyal, and compensated by insisting on higher standards of physical strength.

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<sup>12</sup>The results are not shown to save space.

## 5.2. Evidence of opportunistic behavior

The evidence so far points in the direction of opportunistic referee behavior. We now investigate this idea more fully. We begin by looking for circumstantial evidence of collusion between bringer and recruit. Suppose the bringer and recruit agree to collect the reward and then desert. Given that a portion of a soldier's salary is only returned at completion of service, the financial penalty for deserting increases over time. We would therefore expect collusion to show up in the form of a higher incidence of desertion among refereed recruits immediately after hiring.

To investigate this possibility, we plot in Figure 1 the Kaplan-Meier survival table, that is, the proportion of new recruits who do not desert against the time since the beginning of their contract. We observe a relatively rapid fall in survival rate at the beginning of the contract, consistent with the idea that those who decide they do not like the army leave early. But the Figure also shows no difference between referred and unreferred recruits up to 6 months after hiring. It is only after 6 months that we observe a higher desertion rate among referred recruits. We therefore find no prima facie evidence that referee and recruit collude to defraud the army of the bringer's reward. This is, of course, only one extreme form of untruthful refereeing.

A further test of the truthful refereeing hypothesis is to control for the rank of the bringer. In the truthful refereeing model, the revealed quality of the refereeing soldier is a predictor of the hidden quality of the new recruit. If this is true in our data, a higher quality bringer should be associated with better quality recruits. We have information on the rank of the bringer, an index of quality. In the context of the British colonial army over the study period, indigenous recruits – and hence bringers – occupied only five ranks. Army records show the rank of the bringer to be Private (31% of referred recruits), Lance Corporal (11%), Corporal (9%), Sergeant

(21%), or CSM (16%).<sup>13</sup> If the truthful refereeing hypothesis is correct, higher ranked bringers should bring better recruits.

In contrast, if referees behave opportunistically, higher ranked soldiers may have found it easier to force the hand of the employer. In our context, this means getting the bringer's reward even when the proposed recruit is of worse quality. Of course, the army may retaliate against a bringer who has recommended recruits who turned out to be unsuitable. The strongest penalty that can credibly be imposed is delayed promotion. This penalty, however, would have no effect on Sergeants and CSMs given that, in the colonial army, these were the highest ranks indigenously recruited soldiers could hope to reach. In the presence of opportunistic refereeing we therefore expect Sergeants to bring recruits of lower unobserved quality – in reaction to which the army may insist on better observable characteristics.

The army records report whether the new recruit was a relative of the bringer. This concerns 3% of all recruits, but 8% of all those referred. In the truthful referral model, we would expect referees to have better information about relatives – and hence to be able to recommend better quality recruits. Bringers may, however, be pressurized by relatives to provide a recommendation – or, if they are facing a lot of pressure from their officers to bring recruits, they may pressurize relatives to join. In these cases, we would expect the quality of new recruits to be worse when they are recommended by a relative. By the same reasoning, recruit quality should be lower for those with relatives in the army who may indirectly have favored their candidacy or encouraged them to join. Some 15% of recruits are recorded as having a relative in the army. This is a high

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<sup>13</sup>The data also lists the rank of Regimental Sergeant Major (3% of referred recruits). Given the small number of occurrences, this rank was merged with that of Company Sergeant Major for the purpose of the analysis presented here. In a number of instances, the rank is missing or not clear from the record (Malam, Pay Clerk, Orderly Room Clerk, Headman, etc.).

figure, so we expect the term ‘relative’ to have been interpreted rather loosely.

We test these predictions by adding dummies for the rank of the bringer, for whether the bringer is kin, and for whether the recruit has relatives in the army. Results for height and chest circumference are presented in Table 5. We see that new recruits brought by a relative are shorter and have a smaller chest circumference. We also find that recruits referred by a sergeant are taller. Whether this is indicative of truthful screening depends on whether these recruits are also less likely to desert and be dismissed early.

To investigate this, we reestimate the duration models presented in Table 4. Results are presented in Table 6. In columns 1 and 4 we include regressors already appearing in Table 4 plus the rank of the bringer, the former occupation of the new recruit, and a number of additional controls. Coefficients are reported as odds ratios: a coefficient larger than 1 indicates a higher likelihood of desertion or dismissal, and vice versa for coefficients smaller than 1. In columns 2 and 5 we add the height and chest circumference of the new recruit at the time of recruitment. The purpose of this is to check whether these observable characteristics predict subsequent performance. In columns 3 and 6 we further include ethnicity dummies.

We find that recruits brought by a Sergeant or CSM are much more likely to desert. We find smaller or non-significant coefficients for lower ranks. This is consistent with Sergeants bringing recruits of lower unobserved quality, something for which they cannot be punished by being denied promotion. We also find that a small chest circumference predicts a higher likelihood of subsequent dismissal as medically unfit or inefficient. Since new recruits brought in by a relative also had a smaller chest circumference, in their case a lower  $d$  is not compensated by a higher  $h$ . This suggests some form of favoritism: recruits with family ties in the army were allowed into the army although they were of inferior quality in terms of both observables and unobservables.

### 5.3. Desertion

To summarize, we have found evidence that is consistent with referee opportunism, but none that is consistent with worker referral as improving screening of unobservable characteristics. We now present additional robustness checks regarding desertion. We argued earlier that deterrence is strongest for soldiers posted near their place of origin because it is easier for the army to find and bring back those who run away. Hence we expect the risk of desertion to increase with distance from place of origin.

To investigate this possibility, we computed the arc distance between the posting of recruits and their place of origin. Regression results, not shown here to save space, indicate that, for Ghanaian recruits, the likelihood of desertion increases with the distance between military posting and place of origin. This finding does not carry over to the full sample. This is not surprising given that men returning to their village outside Ghana (e.g., in French West Africa or Liberia) were beyond British jurisdiction.

Deterrence varied over time. During the war – especially in 1917/18 – the penalties for desertion were significantly increased. These increased penalties nevertheless have less deterrent effect on those runaway soldiers who can avoid being found. This suggests a strategy for testing the deterrent effect of distance. Let  $a$  denote punishment inflicted on a deserter, conditional on being found. Let  $f$  denote the probability of being found, which we assume to fall with distance  $k$  between the recruit's place of birth and his military base. Expected punishment is  $af(k)$ . The probability of desertion  $p$  is a decreasing function of  $af(k)$ . Now consider an increase in the

penalty  $\Delta a$ . How does this increase affect deterrence as a function of distance? We have:

$$\frac{\partial(\Delta a f(k))}{\partial k} = \Delta a f'(k) < 0$$

which means that an increase in the penalty has a stronger deterrent effect on recruits posted near their place of origin. If we let  $f(k) = b - fk$ , the above boils down to an interaction term between distance  $k$  and the change in penalty  $\Delta a$ . We expect the coefficient of  $k\Delta a$  to be larger than 1, implying that the relationship between distance and desertion increased with stricter penalties.

Finally, consider referred soldiers who think of deserting. The bringer can help locate them. The likelihood of punishment is thus higher. Consequently other things being equal we expect a lower risk of desertion from referred recruits. Of course, if referred recruits are less disciplined, they may be more likely to desert in spite of the penalty, which is what we have found. But this does not mean that the deterrence effect is absent. To investigate this possibility, we interact  $k\Delta a$  with the referred dummy: a bringer can help locate a deserter irrespective of distance, so this should increase the deterrence effect of the change in penalty even for distant recruits. The same argument does not in principle apply to dismissal.

Findings are reported in Table 7 using only recruits of Ghanaian origin. Columns 1 and 4 report coefficient estimates without distance. These are given for comparison purposes only. In columns 2 and 5 we introduce distance  $k$  and an interaction term between  $k$  and referral. We find that distance is associated with a higher likelihood of desertion and dismissal, but this association is more than neutralized for referred recruits. This is consistent with the idea that distant recruits that are referred can be located more easily and hence, other things being equal,

are less likely to desert than unreferred distant recruits.

Next we introduce an interaction term  $k\Delta a$  where  $\Delta a$  is proxied by the period 1917-18 when the war intensified and desertion was punished more severely. We also interact  $k\Delta a$  with referral. Results are presented in columns 3 and 6. For desertion we find, as expected, that the disincentive effect of proximity is stronger when desertion is punished more severely. This is apparent from the coefficient of  $k\Delta a$  being larger than 1 and strongly significant. The direct effect of  $\Delta a$  itself, however, is a strong reduction in the likelihood of desertion, as evidenced by a coefficient of the ‘serving in 1917-18’ dummy much below 1. The interaction term between referral and  $k\Delta a$  shows, as anticipated, an odds ratio well below 1 for desertion.

Turning to dismissal, we find that the likelihood of dismissal increases with the distance between military base and place of origin. This suggests that the army may have dismissed recruits that perhaps could not be prevented from deserting. Again we find that this relationship does not apply to referred soldiers. In contrast to desertion, we find no evidence of a 1917-18 effect: the coefficients of both  $k\Delta a$  and its interaction with referral are not statistically significant. This is not surprising: dismissal is initiated by the army, and during the war all available soldiers were needed, even those who were less efficient or less fit.

Next we investigate whether the quality of referred recruits varied with the incidence of desertion and dismissal prior to the date of enlistment of the new recruit. The idea is that, if desertion is common, the potential for opportunistic referral is higher since, presumably, penalties for bringing an unsuitable recruit will be lower when the quality of new recruits is in general poor.

It is reasonable to assume that bringers had some idea of desertion rates prevailing at the time of referral. They may therefore respond to the deterioration of the selection process by

bringing in less suitable recruits. We test this idea by including as additional regressor the desertion rate in the 12 months preceding the recruit's enlistment, and we interact this regressor with the referral dummy. The total number of new recruits is also included as additional control, to avoid spurious inference due to changes in recruitment levels.

Results, shown in Table 8, indicate that referred recruits are significantly more likely to subsequently desert when the incidence of desertion was high in the period immediately preceding their recruitment. This is again consistent with referee opportunism. There is no such pattern for dismissals.

#### **5.4. Further robustness analysis**

As final robustness checks, we investigate whether the patterns documented here are driven by specific observations.

First we examine whether our results are driven by a few very active referees. To this effect, we exclude recruits who were brought by recruiters who in total referred more than 9 new recruits and reestimate the regressions presented in Tables 5 and 6. The total number of referred recruits drops by 30%. Regression results on height and chest circumference, not reported here to save space, are very similar to those reported in earlier Tables. Regression results on desertion and dismissal again indicate a higher likelihood of desertion and dismissal among referred recruits. We also find that recruits brought by Sergeants and Company Sergeant Majors are more likely to desert. The effect, however, is less strong than before, possibly because those who bring many recruits hold higher ranks.

Secondly, we revisit the fact that attestation papers are silent on termination. So far we have assumed silence to imply that the recruit completed his term with the army some time after

November 9, 1918 but the exact date of termination was not recorded on the attestation papers. As we have argued earlier, this is a reasonable assumption since it agrees with various estimates reported by Killingray (1982). We nevertheless worry that this assumption may be incorrect. To investigate whether this affects our results, we reestimate the desertion and dismissal models without those recruits for whom the circumstances of contract termination are not recorded.

This, however, raises another potential problem, namely, selection bias induced by missing data. A cursory inspection of the data indicates a strong time trend in the proportion of missing observations, with less information available for individuals recruited towards the end of the period we study. This suggests using a time trend as instrument to correct for possible selection bias. To this effect, we reestimate the duration models with a selection correction using the method proposed by Boehmke, Morey and Shannon (2006). This model assumes a Weibull distribution for the hazard. Our data easily accommodates a Weibull distribution, so this is unproblematic. Results are reported in Table 9. As we can see, results with the selection correction confirm our previous findings, with recruits referred by fellow soldiers more likely to desert and be dismissed as inefficient or medically unfit. Other results are confirmed as well.

## **6. Conclusions**

Using information compiled from army personnel records, we test whether the referral system in place in the British colonial army in Ghana served to better screen recruits for characteristics unobserved at hiring. This is what is predicted by Montgomery's seminal model of worker referral.

We find that the referral system in place did not lead to a selection of recruits with unob-

servable high-quality: referred recruits were taller and had a larger chest circumference – two observable qualities recorded by army recruiters at the time of hiring – but were significantly more likely to desert and to be discharged as ‘medically unfit’ or ‘inefficient’. This is also true for referrals from relatives serving in the army. These findings are difficult to reconcile with Montgomery’s model of referral. But they are consistent with a model of opportunistic referral in which army recruiters are aware of the incentive problem and seek to compensate the lower unobservables of referred recruits with higher observables.

We find some evidence to support the hypothesis of referee opportunism. In particular, we find the unobserved quality of new recruits to be worse when the bringer had reached the rank of Sergeant or CSM and had no further promotion prospects. It is unclear from our results whether referees misreported the recruit’s unobserved quality to the army, or the job’s characteristics to the new recruit.

The unobservable quality of referred recruits falls more at times when the proportion of bad recruits is high. We do not, however, find evidence of collusion between bringer and recruit to defraud the army. Furthermore, referral lowered the likelihood of desertion for those recruits posted far from their place of origin, suggesting that referral played some useful role for the army in locating and bringing back deserters. We only find limited evidence of nepotism insofar as new recruits with a kin in the army were accepted even though their lower than average physique was ex-ante observable and they had a higher risk of dismissal.

Although these findings are specific to an employer and moment in time, they nevertheless cast doubt on the idea that employee referral always serve a useful screening role. In the case of the colonial army, referral was probably a convenient method for attracting recruits, albeit one fraught with adverse incentive problems that army recruiters seem to have been aware of.

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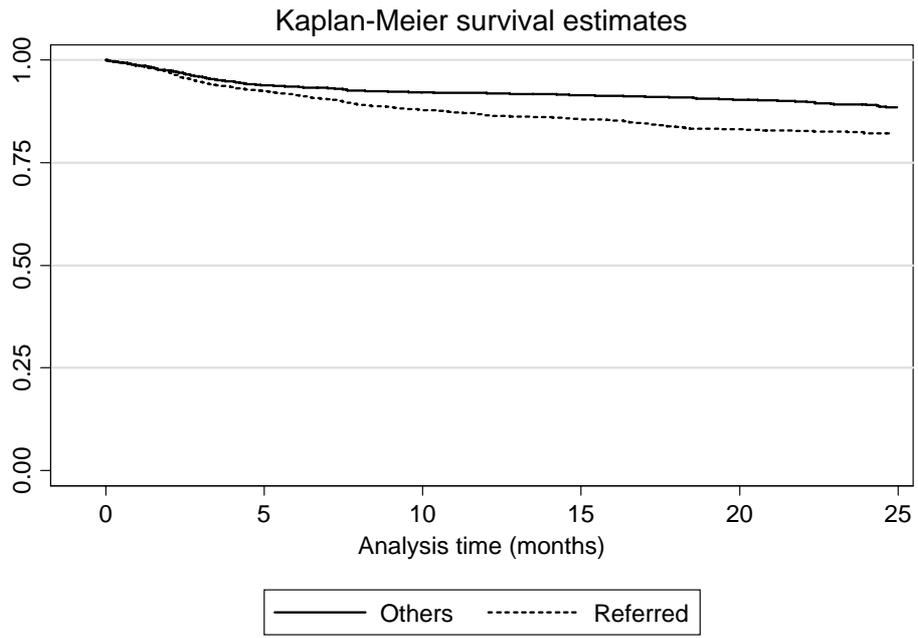


Figure 1. Survival estimates for desertion

**Table 1: Summary statistics**

	Obs	Mean	Std. Dev.	Min	Max
Characteristics at time of recruitment					
Height (cm)	8191	168.13	7.26	125.7	203.2
Chest circumference (cm)	8033	85.42	5.25	63.5	139.7
Age (years)	8169	24.17	4.92	14	55
Mode of recruitment					
Referral	8351	34.0%			
Sent by chief	8128	23.5%			
Volunteered	8128	8.2%			
Direct recruitment by army	8128	34.3%			
Deserted	8351	11.2%			
Dismissed as medically unfit/inefficient	8351	15.2%			
Rank of bringer: (*)					
Private	8343	9.1%			
Lance Corporal	8343	3.1%			
Corporal	8343	3.2%			
Sergeant	8343	6.4%			
CSM and RSM	8343	6.7%			
Unknown and Other (Malam, Pay Clerk, etc.)	8343	5.4%			
Bringer is kin	8348	2.8%			
Recruit has a relative in the army	8348	15.2%			
Previous occupation					
Farmer	8351	60.9%			
Soldier/Police	8351	1.9%			
Literate (yes=1)	8351	6.7%			
Skills in previous occupation (1 unskilled to 5 skilled)	7829	2.08	0.70	1	5
Conditions of employment					
Distance Place of birth – enlistment (in 100 km) (**)	3821	1.82	1.70	0	6.6
Motor Transport Unit	8351	10.1%			
Enlisted in WW1	8351	80.9%			
Enlisted in 1917/18	8351	64.3%			
Military conditions at time of recruitment					
Desertion rate in the 12 months prior to enlistment	8351	5.5%	2.4	0.0	20.2
Dismissal rate in the 12 months prior to enlistment	8351	6.1%	6.2	0.0	44.3
Number of recruitments 12 months prior to enlistment	8351	1840	1336	8	3990

The standard deviation is not reported for binary variables; their minimum=0 and maximum=1

(\*) Calculated over all recruits; proportions sum to 34%.

(\*\*) Ghanaian recruits for whom information is available

**Table 2: Recruitment channels and cause of discharge (Enlistments 1908-1923)**

Cause of discharge	Recruitment Channels								Total	
	Referral		Chief		Volunteer		Not specified			
		%		%		%		%		%
Deserted	419	15%	234	12%	55	8%	229	8%	937	11%
Dismissed as inefficient	231	8%	55	3%	16	2%	79	3%	381	5%
Dismissed as medically unfit	318	11%	254	13%	41	6%	277	9%	890	11%
Other	1,870	66%	1,370	72%	553	83%	2,350	80%	6,143	74%
Total	2,838		1,913		665		2,935		8,351	

Note: "Other" summarises causes of discharge that indicate a soldier of good quality such as 'Cessation of hostilities', 'Completion of service', 'Died' and 'Killed in action'. "Not specified" indicates that the field for the bringer was left blank in the original source, which corresponds to direct recruitment.

**Table 3: Referral and observable quality**

	Height (in cm)		Chest circumference (in cm)	
Referred by fellow soldier	1.182*** (6.104)	0.439** (2.214)	0.501*** (3.496)	-0.121 (-0.845)
Sent by traditional chief	-0.958*** (-4.518)	-0.220 (-0.993)	-0.646*** (-4.313)	0.111 (0.700)
Volunteer	0.388 (1.238)	1.198*** (3.742)	-0.110 (-0.447)	0.711*** (2.825)
Enlisted in WW1 (yes=1)		-2.071*** (-8.277)		-1.008*** (-5.568)
Enlisted in 1917/18 (yes=1)		-1.381*** (-6.070)		-1.854*** (-12.05)
Constant	167.915*** (1232)	170.508*** (779.3)	85.407*** (852.0)	87.402*** (525.9)
Number of observations	8191	8191	8033	8033
R-squared	0.012	0.039	0.007	0.045

Estimator is OLS. Robust t-values in parentheses. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1

**Table 4: Referral and unobservable quality**

	<b>Desertion</b>		<b>Dismissal</b>	
Referred by fellow soldier	2.077*** (8.596)	1.803*** (6.963)	1.530*** (5.953)	1.398*** (4.717)
Sent by traditional chief	1.921*** (6.853)	2.063*** (6.826)	1.946*** (8.331)	2.131*** (8.346)
Volunteer	1.311* (1.761)	1.397** (2.089)	1.039 (0.256)	1.137 (0.826)
Enlisted in WWI		0.897 (-0.881)		1.072 (0.792)
Enlisted in 1917/18		1.505*** (3.187)		1.014 (0.150)
Serving in WWI (1=yes)		0.516*** (-5.253)		0.547*** (-6.132)
Serving in 1917/18 (1=yes)		0.572*** (-4.230)		0.704*** (-3.435)
Number of observations	14626	14626	14626	14626
Number of failures (desertions/ dismissals)	908	908	1214	1214
Number of subjects	7685	7685	7685	7685

Estimator is duration model. Reported coefficients are hazard ratios; z-values in parentheses.

**Table 5: Referral and observable quality -- with additional controls**

<b>Referred by fellow soldier</b>	<b>Height</b>		<b>Chest circumference</b>	
<b>Rank of bringer:</b>				
Private (1=yes)	0.578*	0.184	0.290	-0.167
	(1.897)	(0.593)	(1.302)	(-0.740)
Lance Corporal	0.141	-0.437	-0.607*	-1.126***
	(0.312)	(-0.954)	(-1.739)	(-3.279)
Corporal	1.305***	0.657*	0.174	-0.274
	(3.180)	(1.656)	(0.480)	(-0.767)
Sergeant	1.109***	0.637*	0.703**	0.183
	(3.076)	(1.745)	(2.524)	(0.646)
Company Sergeant Major	1.270***	0.724**	-0.124	-0.509**
	(3.710)	(2.146)	(-0.499)	(-2.049)
Unknown and others (Malam, Pay Clerk, etc.)	1.086***	0.473	0.522**	0.059
	(2.745)	(1.235)	(2.060)	(0.233)
Bringer is kin (1=yes)	-0.925*	-0.421	-0.829**	-0.327
	(-1.936)	(-0.883)	(-2.121)	(-0.866)
<b>Relative in the army</b>				
Recruit has relative in the army (1=yes)	0.111	-0.840***	1.136***	0.269
	(0.457)	(-3.322)	(6.052)	(1.352)
<b>Other recruiting channels</b>				
Sent by traditional chief	0.503**	0.195	0.547***	0.378**
	(2.033)	(0.747)	(3.187)	(2.085)
Volunteer	1.205***	1.008***	0.850***	0.677***
	(3.705)	(3.097)	(3.297)	(2.616)
<b>Previous occupation:</b>				
Farmer	0.013	-0.610***	-0.051	-0.434***
	(0.065)	(-2.796)	(-0.360)	(-2.742)
Armed forces (police, army)	0.979*	0.509	1.287***	0.963**
	(1.762)	(0.965)	(3.207)	(2.515)
Skills in previous occupation (from 1 unskilled to 5 skilled)	-0.038	0.093	-0.302***	-0.152*
	(-0.320)	(0.756)	(-3.603)	(-1.720)
Literate (yes=1)	0.438	0.397	-0.752***	-0.815***
	(1.415)	(1.261)	(-3.263)	(-3.459)
<b>Other controls</b>				
Enlisted in WW1 (1=yes)	-2.535***	-1.857***	-1.234***	-0.578***
	(-9.602)	(-6.647)	(-6.307)	(-2.748)
Enlisted in 1917/18 (1=yes)	-1.470***	-1.131***	-1.622***	-1.534***
	(-6.152)	(-4.511)	(-10.08)	(-8.905)
Motor Transport Unit (1=yes)	0.961***	1.552***	-0.009	0.055
	(3.242)	(5.037)	(-0.039)	(0.243)
Age fixed effects (14-23 yrs)	YES	YES	YES	YES
Ethnic group fixed effects		YES		YES
Constant	171.530***	169.547***	88.728***	90.350***
	(446.2)	(138.4)	(319.1)	(84.30)
Number of observations	7724	7695	7582	7445
R-squared	0.090	0.157	0.118	0.170

Estimator is OLS. Robust t-values in parentheses. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1

**Table 6: Referral and unobservable quality -- with controls**

Referred by fellow soldier	Desertion			Dismissal		
Rank of bringer:						
Private	1.368** (2.331)	1.372** (2.268)	1.211 (1.309)	1.247** (1.962)	1.212* (1.654)	1.121 (0.931)
Lance Corporal	1.296 (1.255)	1.330 (1.354)	1.157 (0.683)	1.154 (0.847)	1.211 (1.130)	1.125 (0.677)
Corporal	1.322 (1.489)	1.330 (1.468)	1.169 (0.776)	1.250 (1.382)	1.291 (1.539)	1.093 (0.514)
Sergeant	2.234*** (6.252)	2.329*** (6.446)	1.928*** (4.984)	1.444*** (2.952)	1.455*** (2.925)	1.324** (2.137)
Company Sergeant Major	1.526*** (2.875)	1.587*** (3.094)	1.357** (2.002)	1.131 (0.930)	1.138 (0.954)	1.082 (0.552)
Unknown and others (Malam, Pay Clerk, etc.)	1.509*** (2.783)	1.591*** (3.070)	1.444** (2.303)	1.113 (0.792)	1.109 (0.723)	0.998 (-0.0115)
Bringer is kin (1=yes)	0.981 (-0.099)	1.036 (0.181)	0.921 (-0.415)	0.971 (-0.211)	0.998 (-0.0126)	1.169 (1.035)
<b>Relative in the army</b>						
Recruit has relative in the army (1=yes)	0.862 (-1.428)	0.850 (-1.538)	1.040 (0.345)	1.332*** (3.567)	1.374*** (3.861)	1.175* (1.875)
<b>Other recruiting channels</b>						
Sent by traditional chief	1.679*** (4.497)	1.739*** (4.694)	1.658*** (4.013)	1.808*** (6.007)	1.824*** (5.966)	1.568*** (4.028)
Volunteer	1.357* (1.827)	1.345* (1.727)	1.101 (0.549)	1.146 (0.838)	1.079 (0.458)	1.082 (0.456)
<b>Previous occupation:</b>						
Farmer	1.516*** (4.374)	1.512*** (4.247)	1.478*** (3.715)	1.617*** (5.928)	1.619*** (5.790)	1.378*** (3.185)
Armed forces (police, army)	0.849 (-0.544)	0.948 (-0.180)	1.013 (0.0412)	1.333 (1.373)	1.423 (1.604)	1.250 (0.970)
Skills in previous occupation (from 1 unskilled to 5 skilled)	1.040 (0.650)	1.051 (0.822)	1.005 (0.0750)	0.951 (-0.942)	0.950 (-0.940)	0.974 (-0.448)
Literate	0.884 (-0.758)	0.881 (-0.764)	0.880 (-0.739)	1.018 (0.131)	0.982 (-0.132)	0.988 (-0.0851)
<b>Other controls</b>						
Enlisted in WWI	0.954 (-0.347)	0.954 (-0.342)	0.903 (-0.701)	1.230** (2.132)	1.194* (1.775)	1.285** (2.278)
Enlisted in 1917/18	1.388** (2.413)	1.384** (2.358)	1.280* (1.701)	0.970 (-0.303)	1.005 (0.0452)	0.960 (-0.376)
Serving in WWI	0.490*** (-5.285)	0.500*** (-5.033)	0.497*** (-4.852)	0.440*** (-7.807)	0.439*** (-7.610)	0.465*** (-6.970)
Serving in 1917/18	0.587*** (-3.861)	0.607*** (-3.579)	0.588*** (-3.581)	0.810** (-1.982)	0.825* (-1.765)	0.819* (-1.825)
Motor Transport Unit	0.656** (-2.028)	0.668* (-1.929)	0.582** (-2.483)	1.030 (0.167)	1.015 (0.0839)	1.153 (0.695)
Age (years)	1.018** (2.526)	1.016** (2.190)	1.006 (0.796)	0.992 (-1.076)	0.996 (-0.559)	1.012 (1.574)
Height (cm)		1.004 (0.798)	1.007 (1.229)		1.008 (1.593)	1.004 (0.693)
Chest circumference (cm)		1.005 (0.695)	1.005 (0.673)		0.983** (-2.320)	0.980*** (-2.743)
Ethnic group fixed effects			YES			YES
Number of observations	13548	13144	13094	13548	13144	13094
Number of failures (desertions/dismissals)	859	831	825	1119	1077	1074
Number of subjects	7147	6927	6898	7147	6927	6898

Estimator is duration model. z-values in parentheses. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1

**Table 7: Referral and unobservable quality -- with distance (Ghanaian recruits only)**

	Desertion			Dismissal		
<b>Referred by fellow soldier</b>	1.456**	2.403***	2.118***	1.342*	2.564***	2.571***
	(2.435)	(4.410)	(3.345)	(1.863)	(4.863)	(4.520)
<b>Distance (in 100km) between place of birth and military base (place of certificate)</b>		1.090**	0.907		1.153***	1.152**
		(2.172)	(-1.117)		(4.267)	(2.419)
military base*Referred		0.795***	0.953		0.777***	0.779***
		(-3.844)	(-0.512)		(-5.057)	(-3.771)
military base*Servicing in 1917/18			1.248**			1.001
			(2.413)			(0.017)
military base*Servicing in 1917/18*Referred			0.772**			0.992
			(-2.157)			(-0.109)
<b>Relative in the army</b>						
Recruit has relative in the army	0.754*	0.736*	0.706**	1.509***	1.330**	1.329**
	(-1.800)	(-1.854)	(-2.091)	(3.673)	(2.405)	(2.390)
<b>Other recruiting channels</b>						
Sent by traditional chief	1.494***	1.547***	1.472**	2.060***	2.187***	2.185***
	(2.618)	(2.827)	(2.550)	(5.158)	(5.626)	(5.537)
Volunteer	0.991	1.042	0.988	1.110	1.218	1.216
	(-0.033)	(0.155)	(-0.046)	(0.407)	(0.766)	(0.758)
<b>Previous occupation:</b>						
Farmer	1.509***	1.476**	1.461**	1.558***	1.488***	1.488***
	(2.623)	(2.482)	(2.409)	(3.190)	(2.837)	(2.837)
Armed forces (police, army)	0.327	0.302	0.312	0.852	0.701	0.702
	(-1.082)	(-1.163)	(-1.131)	(-0.265)	(-0.553)	(-0.552)
Skills in previous occupation	0.837	0.854	0.845	0.789**	0.832*	0.832*
	(-1.450)	(-1.278)	(-1.354)	(-2.301)	(-1.789)	(-1.791)
Literate	0.617	0.634	0.648	0.937	0.934	0.935
	(-1.587)	(-1.506)	(-1.427)	(-0.291)	(-0.306)	(-0.303)
<b>Other controls</b>						
Enlisted in WWI	1.320	1.432	1.523*	1.259	1.305	1.309
	(1.207)	(1.505)	(1.730)	(1.407)	(1.570)	(1.577)
Enlisted in 1917/18	1.482	1.376	1.409	0.872	0.817	0.815
	(1.615)	(1.305)	(1.370)	(-0.766)	(-1.143)	(-1.148)
Servicing in WWI	0.814	0.756	0.716	0.557***	0.535***	0.533***
	(-0.907)	(-1.220)	(-1.432)	(-3.611)	(-3.763)	(-3.731)
Servicing in 1917/18	0.337***	0.360***	0.289***	0.706**	0.741*	0.746
	(-4.665)	(-4.398)	(-4.230)	(-1.998)	(-1.722)	(-1.324)
Motor Transport Unit	0.688	0.691	0.695	1.092	1.132	1.132
	(-1.403)	(-1.382)	(-1.359)	(0.369)	(0.513)	(0.514)
Age (years)	1.025***	1.025***	1.026***	0.990	0.991	0.991
	(2.608)	(2.661)	(2.770)	(-1.008)	(-0.946)	(-0.945)
Height (cm)			1.005			1.008
			(0.859)			(1.234)
Chest circumference (cm)			1.003			0.982**
			(0.365)			(-2.072)
Number of observations	6308	6308	6308	6308	6308	6308
Number of failures (desertions/dismissals)	389	389	389	498	498	498
Number of subjects	3446	3446	3446	3446	3446	3446

Estimator is duration model. z-values in parentheses. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1

**Table 8: Referral and unobservable quality -- with incidence of desertion/dismissal prior to recruitment**

	Desertion			Dismissal		
<b>Referral by fellow soldier</b>	1.128 (0.598)			1.235* (1.940)		
Rank of bringer:						
Private	0.778 (-0.917)	0.746 (-1.042)		1.152 (0.990)	1.065 (0.420)	
Lance Corporal	0.735 (-0.991)	0.708 (-1.104)		1.021 (0.109)	1.043 (0.215)	
Corporal	0.738 (-1.015)	0.715 (-1.087)		1.136 (0.691)	1.044 (0.221)	
Sergeant	1.254 (0.831)	1.167 (0.564)		1.298* (1.691)	1.246 (1.371)	
Company Sergeant Major	0.844 (-0.596)	0.808 (-0.743)		0.945 (-0.335)	0.962 (-0.220)	
Unknown and others	0.869 (-0.522)	0.897 (-0.397)		0.998 (-0.015)	0.938 (-0.369)	
Bringer is kin (1=yes)	1.011 (0.058)	0.939 (-0.319)		0.992 (-0.057)	1.172 (1.051)	
<b>Incidence of desertion &amp; dismissal</b>						
Desertion rate in the 12 months prior to enlistment	0.993 (-0.255)	0.951 (-1.296)	0.958 (-1.131)			
Desertion rate in the last 12 months*Referred	1.082** (2.492)	1.102** (2.439)	1.084** (2.088)			
Dismissal rate in the 12 months prior to enlistment				1.001 (0.061)	1.009 (0.834)	1.010 (0.869)
Dismissal rate in the last 12 months*Referred				1.011 (0.923)	1.007 (0.537)	1.005 (0.416)
Number of recruitments 12 months prior to enlistment	1.000 (-1.016)	1.000 (0.246)	1.000 (0.740)	1.000*** (5.648)	1.000*** (5.187)	1.000* (1.954)
<b>Relative in the army</b>						
Recruit has relative in the army		0.868 (-1.345)	1.049 (0.414)		1.386*** (4.004)	1.218** (2.262)
<b>Other recruiting channels</b>						
Sent by traditional chief	2.005*** (6.468)	1.606*** (3.974)	1.578*** (3.576)	1.977*** (7.317)	1.596*** (4.391)	1.486*** (3.443)
Volunteer	1.346* (1.856)	1.313 (1.635)	1.074 (0.405)	1.103 (0.632)	1.134 (0.772)	1.073 (0.413)
<b>Previous occupation:</b>						
Farmer		1.512*** (4.345)	1.471*** (3.674)		1.597*** (5.569)	1.375*** (3.124)
Armed forces (police, army)		0.856 (-0.519)	1.015 (0.0479)		1.282 (1.173)	1.246 (0.953)
Skills in previous occupation		1.038 (0.614)	1.006 (0.0870)		0.962 (-0.732)	0.980 (-0.342)
Literate		0.878 (-0.798)	0.886 (-0.708)		1.022 (0.162)	0.988 (-0.083)
<b>Other controls</b>						
Enlisted in WWI	1.017 (0.127)	1.025 (0.172)	0.924 (-0.512)	0.970 (-0.328)	1.108 (1.017)	1.264** (2.048)
Enlisted in 1917/18	1.760*** (3.253)	1.320 (1.361)	1.137 (0.556)	0.651*** (-3.015)	0.649*** (-2.804)	0.841 (-1.022)
Serving in WWI	0.517*** (-5.188)	0.488*** (-5.252)	0.502*** (-4.788)	0.596*** (-5.207)	0.500*** (-6.437)	0.509*** (-5.912)
Serving in 1917/18	0.567*** (-4.258)	0.575*** (-3.963)	0.575*** (-3.702)	0.665*** (-4.021)	0.757*** (-2.638)	0.778** (-2.287)
Motor Transport Unit		0.670* (-1.809)	0.569** (-2.418)		0.752 (-1.469)	0.993 (-0.030)
Age (years)		1.017** (2.364)	1.007 (0.875)		0.997 (-0.456)	1.013 (1.610)
Height (cm)			1.007 (1.229)			1.003 (0.659)
Chest circumference (cm)			1.005 (0.699)			0.982** (-2.463)
Ethnic group fixed effects			YES			YES
Number of observations	14626	13548	13094	14626	13548	13094
Number of failures (desertions/dismissals)	908	859	825	1214	1119	1074
Number of subjects	7685	7147	6898	7685	7147	6898

Estimator is duration model. z-values in parentheses. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1

**Table 9: Referral and unobservable quality -- with selection correction**

<i>Duration equation</i>	Desertion				Dismissal			
	Coef.	Robust z	Coef.	Robust z	Coef.	Robust z	Coef.	Robust z
<b>Referred by fellow soldier</b>	0.55	<b>5.95</b>			0.30	<b>4.09</b>		
Rank of bringer:								
Private			0.35	1.76			0.18	1.03
Lance Corporal			0.21	0.73			0.18	0.80
Corporal			0.26	1.04			0.22	0.98
Sergeant			0.73	<b>3.99</b>			0.15	0.81
Company Sergeant Major			0.65	<b>3.11</b>			0.29	1.50
Unknown and others			0.55	<b>2.55</b>			0.30	1.50
Bringer is kin (1=yes)			-0.12	-0.42			0.16	0.88
<b>Distance with place of birth:</b>								
Distance (km)			-0.08	<b>-3.33</b>			-0.04	<b>-2.38</b>
Distance* Enlistment in 1917/18			0.05	1.87			0.07	<b>2.85</b>
Distance* Enlistment in 1917/18*Referred			-0.05	-1.42			-0.01	-0.43
<b>Relative in the army</b>								
Recruit has relative in the army			-0.27	<b>-1.98</b>			0.14	1.37
<b>Other recruiting channels</b>								
Sent by traditional chief	0.58	<b>4.85</b>	0.28	1.94	0.60	<b>6.45</b>	0.68	<b>5.29</b>
Volunteer	0.50	<b>2.13</b>	0.32	1.65	0.14	0.87	0.15	0.74
<b>Previous occupation:</b>								
Farmer			0.25	<b>2.09</b>			0.53	<b>4.92</b>
Armed forces (police, army)			-0.56	-1.19			0.08	0.26
Skills in previous occupation			-0.10	-1.17			-0.06	-0.82
Literate			-0.37	-1.58			0.07	0.40
<b>Other controls</b>								
Enlisted in WW1	-0.82	<b>-3.43</b>	-0.02	-0.12	-0.08	-0.87	0.13	1.03
Enlisted in 1917/18	0.42	<b>3.88</b>	-0.03	-0.15	0.08	0.87	-0.38	<b>-2.01</b>
Motor Transport Unit			0.15	0.64			0.72	<b>3.22</b>
Age of recruit at enlistment (in years)			0.02	<b>2.50</b>			0.00	0.02
Intercept	-6.11	<b>-46.03</b>	-6.58	-19.08	-7.33	-45.78	-7.77	-22.02
<b>Selection equation</b>								
Referred by fellow soldier	0.16	<b>3.58</b>	0.21	<b>4.55</b>	0.16	<b>3.55</b>	0.21	<b>4.53</b>
Sent by traditional chief	0.57	<b>9.94</b>	0.66	<b>11.63</b>	0.57	<b>9.90</b>	0.66	<b>11.64</b>
Volunteer	0.09	1.45	0.13	1.93	0.10	1.47	0.13	1.93
Enlisted in WW1	0.91	<b>4.02</b>	0.47	<b>6.23</b>	0.29	<b>3.99</b>	0.46	<b>6.08</b>
Enlisted in 1917/18	-0.12	<b>-4.99</b>	-0.25	<b>-3.95</b>	-0.31	<b>-4.91</b>	-0.25	<b>-3.89</b>
Year of enlistment	-0.10	<b>-11.25</b>	-0.07	<b>-7.14</b>	-0.10	<b>-11.42</b>	-0.07	<b>-7.38</b>
Motor Transport Unit	-0.75	<b>-13.47</b>	-0.60	<b>-10.84</b>	-0.74	<b>-13.74</b>	-0.60	<b>-10.82</b>
Intercept	185.58	<b>11.28</b>	128.00	<b>7.13</b>	187.54	11.44	132.77	<b>7.37</b>
Number of observations	8351		6543		8351		6543	

Estimator is weibull duration model with selection correction. Robust z-values reported.