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Learning by Doing: Skills and Jobs in Urban Ghana[1]

Monazza Aslam
Institute of Education, University of London
Kim Lehrer
University of Oxford

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This paper investigates the relationship between skills acquisition and job characteristics using a panel dataset of individuals in urban Ghana by analyzing on-the-job skills acquisition and exploring the link between mathematics skills and jobs which involve the handling of money. These mathematics skills are important, not only, in the workplace but also more generally. Survey respondents were administered a short mathematics test involving a number of theoretical and practical math questions. The relationship between skills and jobs is identified by examining individuals who changed jobs between survey rounds while controlling for individual time invariant characteristics. We argue that the process of job choice in Ghana allows us to identify causal impacts. The findings show that money handling is positively associated with higher math skills for women. These results are not driven by differences in mathematics scores between self-employed individuals and wage employed individuals and are robust to changes in the classification of money handling jobs. Moreover, the findings show that working in a job involving the handling of money is positively associated with higher math scores among women with high levels of education. This suggests that individuals at the low end of the distribution of years of education are not acquiring mathematics skills through money handling jobs. It is only the 36% of women who are already quite highly educated in the Ghanaian context who are acquiring these skills on the job.

[1]Corresponding Author: Kim Lehrer, Department of Economics, University of Oxford, Manor Road, Oxford, OX1 3UQ, United Kingdom, telephone: +44 1865 271073, email:kim.lehrer@economics.ox.ac.uk.
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1 Introduction

The benefits of a skilled and educated workforce are well established. Much of the analysis of skills development, however, has considered a one-dimensional view of skills in determining their role in individual socio-economic outcomes and in growth more generally. The skills generally considered are those acquired through formal schooling. More recently, there has been a drive to highlight the importance of non-cognitive skills, for example, interpersonal and social skills, that may have value in the labour market but that are often not considered in economic analysis (Heckman and Rubinstein 2001 and Heckman, Stixrud and Urzua 2006).

Existing research has primarily focused on establishing the relationship between cognitive skills on the one hand and economic and social outcomes on the other. There are numerous studies that substantiate the association between skills, including basic numeracy and literacy, and outcomes, such as, occupational choice, earnings, child health, and economic growth. There is convincing evidence, for instance, that cognitive skills have economically large effects on individual earnings and growth (see Hanushek (2005) and Hanushek and Woessmann (2007) for a summary of the literature). A large body of literature in the United States notes the growing importance of cognitive skills as determinants of wages (Murnane, Willet and Levy 1995), that better cognitive skills are associated with greater success in training and on-the-job performance (Bishop 1991), that among high school dropouts, cognitive skills are rewarded (Tyler 2002), and that numeracy skills are a major factor raising the likelihood of full-time employment (Rivera-Batiz, 1992). Currie and Thomas (2001) also note high returns to test scores in terms of wages and employment probabilities among lower socio-economic status children in the United Kingdom.

In developing countries the evidence is also substantial. For instance, Boissiere, Knight and Sabot (1985) find large earnings returns to literacy and numeracy skills amongst workers in Tanzania and Kenya while Alderman, Behrman, Ross and Sabot (1996) and Behrman, Ross and Sabot (2002) document statistically significant payoffs for cognitive skills in the rural wage labour market in Pakistan. More recently, Aslam, Bari and Kingdon (2010) and Aslam, Kingdon and Soderbom (2008) find better occupational choices and higher earnings amongst more skilled workers in urban and rural Pakistan using data from 2007. Jolliffe (1998) finds that cognitive skills have a positive effect on the total and off-

farm income of Ghanaian households. Teal (2007) finds steeply concave returns to education in Ghana and notes that skilled workers earn significantly more than unskilled workers and apprentices.

Another strand of literature regarding skills acquisition investigates how incentives for skills acquisition can be provided in the absence of enforceable contracts regarding skills. A study by Prasad and Tran (2010) investigates this issue by modelling skills acquisition within a principal-agent framework. The authors conclude that firm specific and general skills, which are acquired at a cost, perform distinct functions and that both skills are likely to be acquired together in equilibrium, though possibly inefficiently. Thus, workers often need to be provided with incentives to acquire skills. Job markets in developing countries differ in several ways from developed countries. The prevalence of self-employment activities is one. While wage workers working as employees may face this incentives dilemma, the incentive structure for a self-employed person may be entirely different. Moreover, the incentives to acquire skills for self-employed men and women may differ depending on the types of jobs they do and the extent to which they believe they can access capital. While this paper does not aim to model the incentives for skills acquisition, we investigate the empirical relationship between skills and jobs in the Ghanaian context.

A common feature of existing empirical research investigating the relationship between skills and socio-economic outcomes is the assumption that outcomes, including occupational attainment, are determined or somehow driven by cognitive skills. The main premise of this study, however, departs from this standard view and proposes the hypothesis that the job a person is engaged in influences skills. While many skills are learned through formal schooling, other types of skills, which may be highly valued in the labour market, may be learned on the job. We propose that practical and general math skills, such as those that people can learn through the repetition of tasks involving money, may be important, not only, in that they can be acquired at work but also because they may be important determinants of socio-economic outcomes. The importance of understanding whether practical and general mathematics skills are actually learned on the job is quite useful within the Ghanaian context, especially given relatively low levels of formal educational attainment and because the pattern of job creation during the past two decades has meant that individuals are increasingly turning towards self-employment which involves the handling of money, particularly in urban areas (Kingdon, Sandefur and Teal 2006, Fox and Gaal 2008, Nsowah-Nuamah, Teal and

Awoonor-Williams 2010). A large proportion of the Ghanaian workforce may be acquiring practical skills while at work which are simply not captured in typical skills measurement.

Unique data from urban Ghana allow us to formalize this hypothesis. The data is from a longitudinal labour market survey conducted by the Centre for the Study of African Economies at the University of Oxford in collaboration with the Ghana Statistical Office. This data collection has been undertaken in urban Ghana since 2004 and a panel of data spanning 6 years is now available (2004, 2005, 2006, 2008, 2009, 2010). We use data collected in the last two waves of the survey (2009 and 2010). Detailed household and individual questionnaires were administered capturing information at the individual level for all individuals aged 15-65. In addition to collecting standard demographics, education, and employment information, the survey also includes measures of individual literacy and numeracy skills and of their innate ability. The latter is captured with the Raven's Progressive Matrices test, which measures dimensions of cognitive ability, as well as literacy and numeracy tests.

The Raven's Progressive Matrices test assesses reasoning in the visual modality and intellectual efficiency; the ability to become more efficient by learning from immediate experience with the problem (Mills et al., 1993). It is a test of inductive reasoning with the problems becoming progressively more difficult. The test appears as a series of pictures in which a pattern is displayed with a piece missing. Pieces are displayed at the bottom of the page with candidate patterns to replace the missing piece. The test taker is asked to select the piece that completes the pattern. The Raven's Progressive Matrices was constructed to measure “the ability to forge new insights, the ability to discern meaning in confusion, the ability to perceive, and the ability to identify relationships" (Raven et al. 2000a, p.1).

In addition to a test of inductive reasoning, individuals were also administered tests assessing their numeracy skills. The mathematics tests were composed of 3 sections in both 2009 and 2010; a basic mathematics section asking simple questions, such as addition and subtraction, a practical mathematics section which asked practical questions concerning addition and subtraction applied to practical settings, such as a shopkeeper calculating change, and an advanced theoretical mathematics section assessing more difficult questions, such as fractions. The tests are presented in the Appendix. The availability of this unique data measuring different kinds of skills and innate reasoning allows us to estimate individual

level skills production functions.

Much of this relationship is premised on the hypothesis that certain types of jobs involve the active handling of money and that this work characteristic is an important determinant of numeracy skills development. Among wage earners, for instance, cashiers, sales persons, bankers, and accountants are more likely to actively work with money than managers or teachers for example. Typically, most self-employed individuals handle money to some extent. However, the types of activities undertaken by the self-employed also allow us to rank the activities according to the degree with which they involve the handling of money. For instance, traders and street vendors handle money more frequently, compared to someone who is self-employed in services or in the manufacturing sector. We hypothesize that the nature of the job activity in which an individual is primarily engaged determines, in part, their math skills. In particular, such skills may be developed while at work due to the very nature of the job itself rather than learned in school.

The purpose of this study is to understand the link between mathematics skills and jobs which involve the handling of money. We explore differences in test scores and the characteristics of individuals' primary work activity. The relationship between skills and jobs is identified using the panel aspect of the data. Examining individuals who changed jobs between survey rounds enables us to control for individual time invariant characteristics. We argue that the process of job choice in Ghana allows us to identify causal impacts.

The paper proceeds as follows. Section 2 describes the data and the methodology while section 3 presents key descriptive statistics. Section 4 reports the main results and finds differential impacts by gender. These are discussed in Section 5 and Section 6 concludes.

2 Data and Methodology

The data used in this study is from a longitudinal labour market survey conducted by the Centre for the Study of African Economies at the University of Oxford in collaboration with the Ghana Statistical Office. We use data collected from 2009 and 2010. However,

some information from previous waves of the survey (such as, parental education) is used[2].

The sample is a stratified random sample of urban households in the four largest urban centres of Ghana; Greater Accra (including Tema), Kumasi, Takoradi, and Cape Coast. The sample was drawn from the Ghanaian Census of 2000. The data collection involved administering a household questionnaire to one household member, typically the household head or spouse. Additionally, a detailed individual questionnaire was conducted of all household members aged 15-65. Detailed information regarding education and labour market outcomes was collected. Individuals then completed cognitive ability (the Raven's Progressive Matrices test), literacy, and numeracy tests.

The numeracy instruments were designed to capture basic theoretical skills and more advanced skills. The first part of the test consists of mathematics questions measuring quite basic skills. The practical mathematics questions were designed with the view of reflecting individuals' practical knowledge and were based on real-life scenarios. Crucially, because the objective of the practical mathematics test was to measure numeracy skills rather than literacy, enumerators were trained to read out the numeracy test questions to the respondents in the local language. Finally, a more advanced theoretical section was also administered to respondents with the view of capturing knowledge of relatively more complex mathematics.

Detailed job activity information was asked of each respondent. This includes detailed information on activity status, type of work, and activities typically undertaken while working. This information allows us to distinguish between individuals who typically work with money and those who do not. Importantly, we believe that working in certain types of jobs involves the intense handling of money while others do not. Variables were created to capture the intensity of money use in specific jobs. The first is a dummy variable that takes on the value of one if an individual works in a wage job involving money handling, such as a cashier/teller, a shop assistant, in accounts/finance etc., as a trader (buying and selling goods in self-employment), self-employed in manufacturing or in services and zero otherwise. Jobs that do not involve the active handling of money include wage jobs such as working as a security guard or being employed as a factory worker. We also use a more refined measure of money intensity which allows for more variation in intensity using three levels of money

[2]Information that was unlikely to change over time was not repeatedly asked of all respondents.

handling intensity. They are:

1. Jobs involving a high intensity of money handling.
These include wage jobs of the following nature: Accountants, cashiers, sales assistants, and all trading jobs within the self-employment sector.
2. Jobs with a moderate intensity of money handling.
These include all self-employment jobs within the manufacturing and services sectors.
3. Jobs with minimal money handling.
These include all other wage jobs (excluding those already captured in the first category).

The analysis in this paper is restricted to the following sub-sample of all labour force participants: Persons working for wages, the self-employed (further classified as those working as manufacturers, providing services, or as traders), students who also report work, and unpaid family workers. Unemployed individuals are excluded from the analysis. Unemployment within urban Ghana is low. In the sample, only 7.6% (7%) of individuals aged 15-65 report being unemployed in 2009 (2010).

3 Descriptive Statistics

Table 1 reports key descriptive statistics of the sample for both 2009 and 2010. The average age of individuals in the sample is approximately 35 years old and the mean years of schooling is about 9 years. Men, on average, have completed somewhat more education than women. Table 2 summarizes the test score results. Each test score is presented as the percentage of correct answers ranging from zero to one hundred percent correct. The difficulty level of the numeracy tests was increased from 2009 to 2010 because of the high scores on the basic theoretical mathematics test in 2009. One of the criticisms of using test scores in their current form (as percentage of correct answers) and exploiting the change over the two years of the survey is that the content of the tests and hence the level of difficulty across the two years changed. This design change could be problematic because it may be that the changes to the tests were not evenly distributed across the distribution of test score results. Therefore, the percentage of correct responses is converted into z-scores for each year and these are the main variable of interest. By thus standardizing the scores in the two years, we are able to compare the changes in z-scores across the two years in spite of any

differences in the distributions of test score results. When the analysis is conducted separately by gender, z-scores are computed separately for men and women.

The Raven's Progressive Matrices test was only conducted in 2009 as it is generally considered to be no longer valid after the test taker has previously seen the test. As can be seen from table 2, individuals scored quite high on the basic theoretical mathematics test. However, the performance on both the practical mathematics test as well as the advanced theoretical mathematics test was poorer, though there is a lot of variation in the scores. This variation is explored further in the following section.

Table 3 describes the job activities of working age individuals in urban Ghana. Further distinguishing by gender highlights the striking gender divide in job activities. For instance, men are more likely to be in wage employment compared to women (42% in 2009 for men compared to 16% for women and 47% for men in 2010 compared to 17% for women). Within self-employment activities, women are more likely to engage in a money intensive activity. Men, on the other hand, are more likely to be involved in moderate money handling activities. Table 4 presents the number of individuals engaged in money intensive activities by gender. Women are more likely to be involved in money handling activities. However, the nature of these activities varies by gender as shown in Table 3.

The summary statistics reveal gender differences in test scores and job activities in urban Ghana, highlighting the importance of considering this distinction in the analysis. Figures 1 graphically depicts this gender difference in the mathematics test z-score and demonstrates that, on average, men outperform women on the test. Figures 2 and 3 illustrate the difference in mathematics knowledge between individuals working in jobs involving money handling and those without. Figure 2 presents these results for women and shows that women working with money perform poorer on the tests than those not working with money. This does not appear to be the case for men (Figure 3). These relationships are further investigated below.

Table 5 presents t-tests of differences in test scores for both men and women who work with and without money. Men who work with money score significantly higher on the Raven’s Progressive Matrices test while the opposite pattern holds for women. The calculated z-score for the total mathematics test, and all of its component sections, is

significantly higher for women who work without money. The relationship is weaker amongst men and, if anything, is in the opposite direction. These findings, though interesting, cannot be interpreted as causal evidence of a relationship between job characteristics and skills. Women with higher math skills may self select into jobs that do not require handling money. Therefore, we investigate changes in test scores using a panel of individuals from 2009 and 2010.

The panel estimates presented in section 4 are derived from individuals who switched money categories from 2009 to 2010. When we use the intensity of money handling as our measure, we find that 23% of individuals in the sample have changed money categories between 2009 and 2010 (111 of 488 people). When we use the binary measure of money handling described in section 2, we find that 21% if the sample have switched between 2009 and 2010 with 13% switching from not working with money to working with money and 8% switching out of working with money.

Examining individuals who changed jobs between survey rounds enables us to control for individual time invariant characteristics. There remains the concern that individuals who changed jobs between 2009 and 2010, particularly those whose job activity changed in terms of money handling intensity, did so because of unobservable time variant characteristics that are correlated both with job choice and mathematical skills. However, we argue that the process of job choice in Ghana allows us to identify causal impacts. Many of the jobs we hypothesize to be among the most cash-intense (traders), are jobs of 'last resort' (Haywood and Falco, 2011).

Haywood and Falco (2011) argue that the nature of self-employment in urban developing countries is different from that of developed countries. As most self-employed individuals operate with little or no capital in developing countries, the absence of jobs and unemployment benefits often results in an involuntary ‘falling into’ self-employment rather than a voluntary transition into these jobs. Within the Ghanaian context, therefore, trading jobs are likely to be ‘last resort’ jobs. If anything, people would select out of these last resort activities rather than voluntarily selecting into them.

4 Results

This section presents empirical results of the determinants of mathematics skills. By examining individuals who changed jobs between survey rounds, we are able to estimate a fixed effects regression which controls for individual time invariant characteristics. Table 6 reports the panel estimates separately for all individuals and for men and women, respectively. The dependent variable is the z-score of the total percent of responses answered correctly on the mathematics test. Columns (1) – (3) use the main money dummy variable described in section 2 as the measure for money handling while estimates in columns (4) – (6) are based on the money intensity categorical variable with the least money intensive category as the omitted category.

The results in columns (1) – (3) show that being involved in jobs involving money handling increases individuals' math skills significantly. This is especially true for women. Working with money raises women's mathematics test scores by 0.713 of a standard deviation. This is equivalent to an increase of 15.37 percent on a mean of 54.33 in 2010. Using the more nuanced definition of money handling captured through the categorical variable shows that this result is largely driven by women working in moderate money intense jobs.

Given that we have categorised all self-employment jobs as working with money, to some degree, one may worry that the results are being driven entirely by self-employment. Table 7 demonstrates that this is not in fact the case. Self-employment alone does not have a significant impact on mathematics test scores for men. In fact, self-employment negatively impacts women's math test scores by almost 1 standard deviation. Including self-employment as an additional control in the regressions in Table 7 does not significantly change the results from Table 6. In fact, the coefficient on the binary money variable in column (3) becomes larger and both intense and moderate money handling jobs are found to positively and significantly impact math skills for women (column 6).

The magnitude of the impact of working with money on test scores is quite large. Furthermore, it is useful to compare its size to the magnitude of additional formal schooling. We are unable to identify the causal impact of formal schooling on test scores, not only

because it is endogenous but also because it does not vary between the two survey years in our dataset. We are, however, able to compare, for illustrative purposes, the difference in the average test scores between different levels of education and working with and without money.

Formal education in Ghana is organised into basic, secondary, and post-secondary education. Basic education comprises primary school of six years followed by junior high school of three years. Individuals who succeed at junior high school can choose to attend senior high school for another three years. Senior high school may be followed by post secondary education consisting of university, polytechnic, teacher training college, or nursing training college. We divide our sample into three education categories; the first with individuals having completed primary school or less (6 years or less), the second having completed primary school and less than or equal to junior high school (between 7 and 9 years of schooling), and the final category as individuals with senior high school or above (10 years or more). In our sample, 21.5 percent of individuals are in the lowest education category (29.8 percent of women and only 8.2 percent of men) while 35.1 percent of the sample falls into the middle education category (37.1 percent of women and 31.9 percent of men). 43.5 percent of the sample is in the highest education category (33.2 percent of women and 60.0 percent of men).

In order to compare the magnitude of the effect of working with money with the size of the association between formal education and test scores, we investigate the differences in z-scores of individuals in the sample in the three education categories. A change from the lowest education category to the middle category is associated with an increase in the z-score of 0.432 of a standard deviation (0.358 for men and 0.417 for women). Transitioning from the middle to the highest education category yields an improvement in z-score of 0.591 of a standard deviation (0.563 for men and 0.579 for women). Given the magnitude of the impact of working with money of 0.384 of a standard deviation (table 6, column 1), the size of this effect is comparable to additional years of schooling. This is especially true for women; working with money improves their test scores by 0.713 of a standard deviation (table 6, column 3) which compares to a 0.417 standard deviation improvement in test scores of a middle level of schooling (compared to the lowest educational category) and 0.579 of a standard deviation for the highest schooling category (compared to the middle educational category). Therefore, working with money has a comparatively large impact.

We also consider the interaction of money handling and formal schooling. There is little variation in years of schooling for an individual between the two survey rounds. Therefore, we do not include years of schooling in the regression analysis as an independent variable. However, we can analyze differential impacts of money handling for sub-categories of individuals depending on their years of completed schooling. Estimating the skills production functions for these sub-samples of workers with different levels of schooling allows us to identify whether money handling and the intensity of money handling impacts people with different schooling levels differently. These results are presented in tables 8 and 9. We use the three education categories described above.

Table 8 investigates the pooled sample of men and women. The dependent variable is the z-score of the total mathematics test score. The first three columns use the money dummy variable as the measure of money handling and columns (4) – (6) use the money intensity categorical variable as the measure of the intensity of money handling. Each of these columns looks further at the sub-sample of workers with low (column 1), middle (column 2), and high (column 3) levels of schooling. Similarly, this is repeated in columns (4) through (6). There appears to be no association of money handling with test scores for individuals with low and middle levels of schooling. However, there is a statistically significant relationship between moderate money handling and test scores amongst the most highly educated sub-sample.

Table 9 differentiate the results by gender. Columns (1) – (6) present the results for men while columns (7) – (12) repeat the analysis for women. We find no significant results for men regardless of their formal educational attainment. This consistent with the findings of tables 6 and 7. The results for women show that only women who have completed higher levels of schooling benefit from working with money. In order to further understand these differential findings amongst women with different educational attainment, we analyze whether job characteristics other than money handling. A table of descriptive statistics is present in table A1 in the appendix and shows that women are evenly distributed across self-employment, wage employment, and between sectors by educational category. These results suggest that there is indeed a role of money handling in skill development and that the results are not driven by occupational selection based on levels of education that is correlated with money handling.

In order to investigate any potential link between employment type and education category, table 10 replicates table 9 while controlling for self-employment. Table 10 demonstrates that the inclusion of self-employment changes the results for highly educated men and for women with low levels of education. Among highly educated men, moderate money handling has a significantly (at the 5% level) positive impact on test scores. This result is countered by a statistically significant (at the 10% level) negative coefficient on the self-employment dummy variable. The sum of the impacts of self-employment and moderate money handling are statistically insignificant implying that only highly educated men who work in wage jobs involving moderate money handling have higher test scores.

Among women, we find that the results do not change significantly for those with high levels of schooling. However, for women with low levels of schooling, we now find that working with money has a significant positive impact on test scores. The magnitudes of the coefficients on money in table 10, columns (7) and (10) are comparable to those of the self-employment dummy variables which are of the opposite sign. Therefore, women with low levels of schooling who are wage employed and work with money benefit through improved test scores. However, self-employed women do not as, by definition, there are no self-employed individuals who do not work with money.

The finding that only highly educated women benefit from working with money in terms of improved test scores is consistent with research on returns to education in Ghana. Teal (2007) shows that the largest increases in wages accrue to those with higher levels of education. In a sample of firm workers from Ghana, the average years of education were found to be 9.5 years. At this level of education, the rate of return of an additional year of schooling is under 5% and the monthly wage for a worker with average characteristics is approximately US$40. This is less than US$10 more than workers with less than primary education. However, in contrast, those with very high years of schooling have wages more than twice as much as the average. Kingdon and Söderbom (2008) graph earnings-education profiles for wage and self-employed men and women in Ghana. Their findings show steep returns to education for both men and women in wage work who have completed more than 10 years of schooling. While the pattern of returns for the self-employed is not as apparent as that for wage workers, their results do show that women with approximately 12 years of education or more have extremely high returns to additional years of schooling.

Though the reasons underlying the shape of the education-earnings profile in Ghana are not well understood, one possible explanation is that the quality of education at low levels of schooling is poor and inhibits the development of pupils' marketable skills. This may also explain why we only find significant impacts of working with money for highly educated individuals. Perhaps those with very low levels of schooling do not have the basic knowledge necessary to enable them to improve their mathematical skills while working on the job.

5 Explaining the Gender Differences

The results in this study consistently demonstrate a positive impact of working in jobs that involve the handling of money for women only. Furthermore, these results seem to be driven largely by highly educated women. These gender differences are interesting. Understanding the underlying mechanisms generating these results is important for formulating appropriate policies within Ghana to encourage skills formation. This paper does not provide a theoretical model of on-the-job skills development. However, in this section, we explore several possible explanations for the observed gender differences.

One possible explanation is based on differences in incentives between men and women, particularly in self-employment. It is generally the case in Ghana that women have access to less capital than men. In our sample, in 2009 only 64% of self-employed women had purchased any capital in the previous 12 months (including the purchase of buildings, land, machinery, equipment, tools, cooking utensils, etc.) compared to 82% of self-employed men. This difference is statistically significant at the 1% level. This pattern is very similar in 2010 with 71% of self-employed women and 85% of self-employed men having purchased any capital in the previous 12 months. Again, this difference is statistically significant at the 1% level.

In this setting, physical capital and human capital may either be substitutes or complements in self-employed business operations. If, in fact, they are substitutes and women are more likely to be capital constrained than men, women may be more likely to improve their skills on the job. This may explain the results of this paper. For example, in Ghana, the cost of a calculator, a computer, or a cash register are relatively high as compared to average profit. In this scenario, if women are more likely to be capital constrained than

men and, therefore, less likely to own one of these devices, they may be more inclined to improve their math skills.

Another possible explanation may be that men and women work different hours with women working longer hours than men and therefore acquiring more skills during work hours. However, we find that men and women in the sample work, on average, the same number of hours. The inclusion of hours worked or hours worked interacted with the money dummy variables in the regression estimates does not change the results significantly.[3]

Finally, another explanation for the findings is that women are generally better at multi-tasking (Fisher 1999) and are therefore able to passively learn mathematics skills while handling money.

6 Conclusions

This paper investigates the relationship between skills and job characteristics using a panel dataset of individuals in urban Ghana. The paper analyzes on the job skills acquisition and explores the link between general mathematics skills and jobs which involve the handling of money. These mathematics skills are important, not only, in the workplace but also more generally. In addition to completing a standard labour force survey, respondents also completed a mathematics test. Differences in their abilities to answer these types of questions and the characteristics of their primary work activity are explored. The relationship between skills and jobs is identified using a panel data set of urban workers in Ghana.

The findings of the paper suggest that money handling is positively associated with higher math skills only among women. It is not the case that self-employed workers have more or less skills than those in wage employment and the effect of money handling is not driven by employment type (wage or self-employment). Moreover, the findings show that working in a job involving the handling of money is positively associated with higher math scores among women with high levels of education. This suggests that individuals at the low end of the distribution of years of education are not acquiring mathematics skills through money handling jobs. It is only the 36% of women who are already quite highly educated in

[3] Results available upon request.

the Ghanaian context who are acquiring these skills on the job. This may be due to the necessity of a minimum level of schooling for individuals to benefit from the gains of this type of on the job skills development. This is quite realistic as those with no schooling would not necessarily have the basic mathematics skills necessary to develop more advanced skills, irrespective of the type of work in which they are engaged.

The results in this study consistently demonstrate a positive impact of working in jobs that involve the handling of money for women only. Three possible explanations for this finding are suggested in this paper. Firstly, differential access to capital by gender in conjunction with the substitutability between human and physical capital may explain why women invest in mathematics skills at work. Secondly, differential hours worked are explored as a potential explanation. However, this is not the case and the key findings of the paper remain robust to the inclusion of hours worked by men and women in the labour market. Finally, women's greater capability at multi-tasking and at passive learning is considered as another possible explanation for the findings.

The findings of this paper can also provide some guidance to policy makers. If it is the case that money handling activities develop individual math skills, there may be a role for policy interventions in providing adult learning in a more practical setting. However, there appears to be a minimum skill level necessary in order for money handling to improve math skills. As evidenced from the average math test score in our sample, the quality of math education in primary and junior high school in Ghana needs to be improved. This is necessary, not only, for individuals to transition to higher levels of formal education, hence benefitting from higher returns, but also in order for them to take advantage of on the job skills acquisition opportunities.

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Figures

Figure 1: Female Mathematics Test Z-Scores by Job Activity Money Status

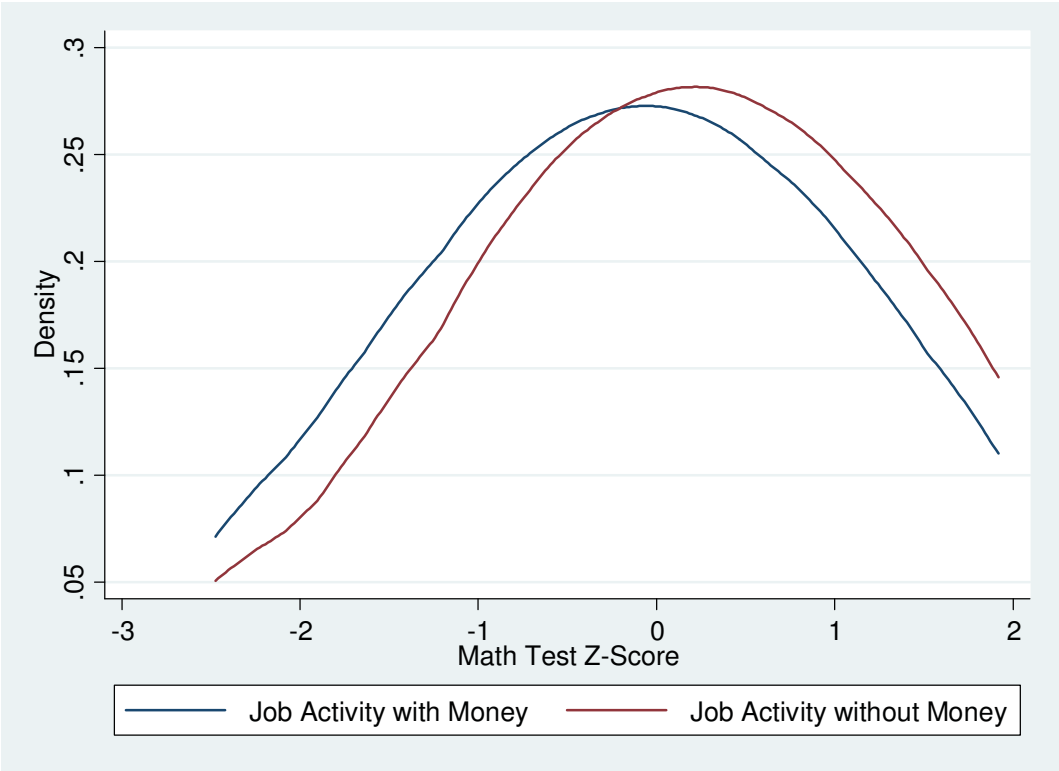
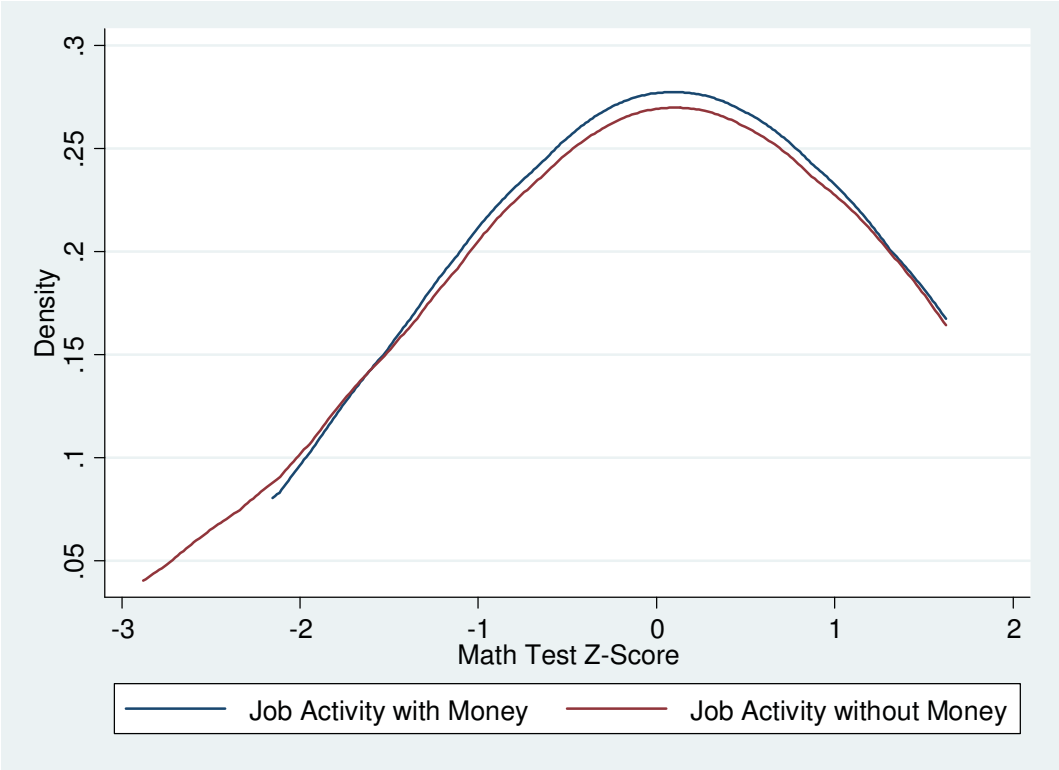


Figure 2: Male Mathematics Test Z-Scores by Job Activity Money Status



Tables

Table 1: Descriptive Statistics

Variable Mean (Standard Deviation)	2009		2010	
	Male	Female	Male	Female
Age (years)	34.96	35.56	35.94	37.35
	(10.69)	(10.30)	(10.75)	(11.20)
Total Years of Schooling (years)	10.88	9.59	10.67	8.11
	(2.72)	(2.94)	(2.78)	(3.83)
Number of Observations	153	164	209	284

Table 2: Skills Measures: Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Male		Female	
	2009	2010	2009	2010	2009	2010
Raven's Progressive Matrices Test	59.34		61.50		57.29	
	(20.52)		(21.30)		(19.62)	
Total Mathematics Test	74.23	57.71	76.53	62.39	72.05	54.33
	(15.68)	(22.81)	(14.06)	(23.72)	(16.84)	(21.56)
Basic Theoretical Mathematics Test	98.10	81.15	99.20	86.30	96.97	77.43
	(7.83)	(27.89)	(5.12)	(24.50)	(9.62)	(29.60)
Practical Mathematics Test	78.02	56.86	79.20	58.16	76.89	55.93
	(33.27)	(26.81)	(32.49)	(28.87)	(34.10)	(25.25)
Advanced Theoretical Mathematics Test	54.47	24.68	58.20	37.12	50.95	15.71
	(24.40)	(36.00)	(22.62)	(40.29)	(25.54)	(29.57)
Number of Observations	257	389	125	163	132	226

Notes: All scores are reported as the percent of correct answers (0-100).

Table 3: Activity Choice

	(1)	(2)	(3)	(4)	(5)	(6)
	All		**Male**		**Female**	
	2009	**2010**	**2009**	**2010**	**2009**	**2010**
Workers						
Wage Work						
Accounts/Finance	6	4	4	3	2	1
Cashier/Teller	1	3	0	0	1	3
Manual work	88	79	60	54	28	25
Manufacturing	3	5	3	2	0	3
Office/Secretarial/Clerical	20	22	10	11	10	11
Official/Technical/Managers/Supervisors	12	24	11	18	1	5
Other jobs involving money	4	7	2	5	2	2
Other jobs not involving money	61	53	31	33	30	20
Sales/Shop assistants	25	33	11	15	14	18
Number of Observations	**220**	**230**	**132**	**141**	**88**	**88**
(% of labour force participants)	25.9	28.0	42.0	47.3	16.4	16.9
Self-employed						
Manufacturing						
Agriculture, Fishing, Livestock	2	2	0	2	2	0
Arts & crafts	1	2	1	1	0	1
Carpentry	8	4	8	4	0	0
Processed Food	40	55	0	1	40	54
Metal/Welding	5	6	5	6	0	0
Sewing/Tailoring	33	37	7	8	26	29
Other	8	8	5	4	3	4
Number of Observations	**97**	**114**	**26**	**26**	**71**	**87**
(% of labour force participants)	11.4	13.9	8.3	8.7	13.2	16.7
Services						
Building, Construction, Plumbing, Carpentry	3	11	3	11	0	0
Driving taxis, buses, etc.	3	5	3	5	0	0
Electrician	7	7	7	7	0	0
Hairdressing	20	14	2	1	18	13
Mechanic	6	7	6	7	0	0
Other	16	8	7	7	9	1
Number of Observations	**55**	**52**	**28**	**37**	**27**	**14**
(% of labour force participants)	6.5	6.3	8.9	12.4	5.0	2.7
Trade						
Clothes	32	29	6	3	26	26
Electronics	1	19	1	6	0	13
Processed Food	47	11	1	0	46	11
Unprocessed Food	66	31	7	1	59	30
Household items	31	77	5	7	26	70
Tools/Building materials	3	1	2	1	1	0
Water	9	11	1	1	8	10
Fuel	4	4	0	0	4	4
Jewellery	5	5	3	3	2	2
Phone products	11	2	5	2	1	4
Other	6	6	5	1	6	1
Number of Observations	**215**	**196**	**36**	**25**	**179**	**171**
(% of labour force participants)	25.3	23.8	11.5	8.4	33.3	32.8
Total Number of Observations	**587**	**593**	**222**	**230**	**365**	**361**

Table 4: Activities Involving Money Handling

	(1) **2009**	(2) **2010**
Men		
Intense Money Handling		
Wage Work	17	23
Traders	36	25
Moderate Intensity Money Handling		
Self-Employed Manufacturing	26	26
Self-Employed Services	28	38
Low Intensity Money Handling		
Wage	115	118
Number of Observations	**211**	**230**
Women		
Intense Money Handling		
Wage Work	19	24
Traders	179	171
Moderate Intensity Money Handling		
Self-Employed Manufacturing	71	88
Self-Employed Services	27	14
Low Intensity Money Handling		
Wage	69	64
Number of Observations	**365**	**362**
Total (Men & Women)	**576**	**591**

Table 5: Test Scores among Men and Women Working With and Without Money

	All				Male				Female			
	With Money	Without Money	t-test	N	With Money	Without Money	t-test	N	With Money	Without Money	t-test	N
Raven's Progressive Matrices	52.6	56.1	**	925	61.8	57.6	*	356	49.2	53.4	*	569
Total Math Z-Score	-0.072	0.101	**	810	0.074	0.004		362	-0.099	0.123	**	448
Basic Theoretical Math Z-Score	-.0114	0.117	***	1114	-0.060	0.031		442	-0.089	0.105	*	672
Advanced Theoretical Math Z-Score	-0.162	0.115	***	842	-0.044	0.018		370	-.0163	0.052	**	472
Practical Math Z-Score	-0.002	0.135	**	1058	0.194	0.009	**	423	-0.054	0.266	***	635

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 6: Panel Estimates
Dependent Variable: Z-Score Total Mathematics Test

	(1) **All**	(2) **Male**	(3) **Female**	(4) **All**	(5) **Male**	(6) **Female**
Money	0.384**	0.294	0.713**			
	(2.02)	(1.28)	(2.04)			
Intense Money Handling				0.293	0.193	0.599
				(1.30)	(0.64)	(1.60)
Moderate Money Handling				0.490**	0.395	0.913**
				(2.07)	(1.31)	(2.19)
Constant	-0.253**	-0.101	-0.599**	-0.247**	-0.106	-0.595**
	(-2.03)	(-0.86)	(-2.20)	(-1.98)	(-0.90)	(-2.18)
N	810	362	448	810	362	448
R^2	0.0172	0.0133	0.0364	0.0196	0.0155	0.0432

Notes: *t* statistics in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7: Panel Estimates, Controls for Self-Employment
Dependent Variable: Z-Score Total Mathematics Test

	(1) **All**	(2) **Male**	(3) **Female**	(4) **All**	(5) **Male**	(6) **Female**
Money	0.619**	0.429	1.158**			
	(2.32)	(1.32)	(2.36)			
Self-Employed	-0.382	-0.222	-0.699	-0.742**	-0.770	-0.994*
	(-1.26)	(-0.59)	(-1.29)	(-2.03)	(-1.42)	(-1.72)
Intense Money Handling				0.585**	0.372	1.147**
				(2.20)	(1.14)	(2.35)
Moderate Money Handling				1.138***	1.152*	1.693***
				(2.87)	(1.88)	(2.76)
Constant	-0.189	-0.0801	-0.451	-0.113	-0.0468	-0.382
	(-1.41)	(-0.65)	(-1.53)	(-0.80)	(-0.37)	(-1.28)
N	810	362	448	810	362	448
R^2	0.0239	0.0162	0.0509	0.0369	0.0319	0.0688

Notes: *t* statistics in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 8: Panel Estimates by Schooling Categories
Dependent Variable: Z-Score Total Mathematics Test

	(1) All, Low Schooling	(2) All, Middle Schooling	(3) All, High Schooling	(4) All, Low Schooling	(5) All, Middle Schooling	(6) All, High Schooling
Money	0.201	0.575	0.306			
	(0.23)	(1.57)	(1.34)			
Intense Money Handling				0.201	0.667	-0.101
				(0.22)	(1.65)	(-0.33)
Moderate Money Handling				0.125	0.447	0.682**
				(0.10)	(1.02)	(2.31)
Constant	-0.856	-0.637**	0.179	-0.829	-0.627**	0.249*
	(-1.11)	(-2.51)	(1.38)	(-0.97)	(-2.45)	(1.86)
N	115	285	410	115	285	410
R^2	0.00277	0.0331	0.0127	0.00316	0.0371	0.0401

Notes: *t* statistics in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 9: Panel Estimates by Schooling Categories and Gender
Dependent Variable: Z-Score Total Mathematics Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Male						**Female**			
	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling
Money		0.507	0.236				0.0522	0.712	1.155*			
		(0.98)	(0.91)				(0.06)	(1.35)	(1.95)			
Intense Money Handling					0.464	0.0147				0.0522	0.813	0.219
					(0.74)	(0.04)				(0.05)	(1.46)	(0.31)
Moderate Money Handling					0.550	0.457				0.662	0.510	1.623***
					(0.87)	(1.24)				(0.40)	(0.81)	(2.69)
Constant		-0.522**	0.153		-0.528**	0.156	-0.655	-0.788*	-0.364	-0.845	-0.764*	0.0263
		(-2.17)	(1.16)		(-2.12)	(1.18)	(-0.79)	(-1.77)	(-0.94)	(-0.88)	(-1.69)	(0.06)
N		113	230		113	230	96	172	180	96	172	180
R^2		0.0281	0.00992		0.0286	0.0186	0.000223	0.0459	0.0638	0.0154	0.0547	0.148

Notes: *t* statistics in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. There are no observations for men with low schooling who switch money categories. Columns (1) and (4) are therefore left blank.

Table 10: Panel Estimates by Schooling Categories and Gender, Controls for Self-Employment
Dependent Variable: Z-Score Total Mathematics Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
				Male						**Female**		
	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling	Low Schooling	Middle Schooling	High Schooling
Money		0.464	0.460				3.179**	1.082	0.556			
		(0.74)	(1.17)				(2.44)	(1.44)	(0.70)			
Self-Employed		0.0855	-0.352		-	-1.020*	-3.127**	-0.738	0.898	-3.127**	-0.600	-1.350
		(0.12)	(-0.77)			(-1.73)	(-2.94)	(-0.70)	(1.14)	(-2.86)	(-0.53)	(-1.08)
Intense Money Handling					0.464	0.293				3.179**	1.082	0.556
					(0.74)	(0.74)				(2.38)	(1.42)	(0.73)
Moderate Money Handling					0.550	1.478**				3.789**	0.873	2.805**
					(0.87)	(2.13)				(2.19)	(0.93)	(2.25)
Constant		-0.534**	0.176		-0.528**	0.228	-0.785	-0.531	-0.484	-0.976	-0.562	0.441
		(-2.04)	(1.30)		(-2.12)	(1.66)	(-1.17)	(-0.91)	(-1.21)	(-1.27)	(-0.94)	(0.79)
N		113	230		113	230	96	172	180	96	172	180
R^2		0.0286	0.0170		0.0286	0.0539	0.400	0.0582	0.0852	0.415	0.0619	0.166

Notes: *t* statistics in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. There are no observations for men with low schooling who switch money categories. Columns (1) and (4) are therefore left blank.

Appendix

2010

Short Math Test

1. 7 + 4 = ____
2. 15 ÷ 3 = ____
3. 4 x 6 = ____

Long Math Test

Practical

(The enumerator should read the questions to the respondent in the local language)

1. Grace bought some cloth costing 14.50 Cedis and paid using a 20 Cedis note. How much change will she get back?
2. Kwame set up a stand selling food in a market. Kwame must pay 2000 Cedis to set up the stand. He must also pay 100 Cedis per month in rent. In the first year, how much does Kwame have to pay in total?
3. 4 children take 2 sweets each from a bag of sweets. After that, 1 sweet remains in the bag. How many sweets were there in TOTAL in the bag to begin with?
4. A customer orders 3 tables from Paul, a carpenter. To make each table, Paul needs 6 pieces of wood. Paul is able to buy wood in packages of 5 pieces (per package). Each package costs 60 Cedis. How much will it cost Paul for the wood for the 3 tables?
5. Amina is having guests for dinner. She is going to prepare banku and goat stew. She must buy 2 kgs of goat meat, ½ kg of tomatoes and 1 packet of spices to prepare the meal. 1 kg of goat meat costs 8 Cedis, 1 kg of tomatoes costs 4 Cedis and 1 package of spices costs 3 Cedis. What is the total cost to Amina for purchasing these items?

General

1. 7000 – 325 =

2. [0.25] = ?

(a) 2 ½
(b) ½
(c) 2/5
(d) ¼

2009

Short Math Test (3 questions)

4. Tell me the missing numbers: 5, ___ , ___ , 8 , 9, 10

5. 2 + 5 = ____

6. 10 ÷ 2 = ____

Long Math Test

(6 questions – 2 'practical maths' and 4 'general maths' – the practical maths questions will be asked by the enumerator in Ga/Twi)

Practical Math

(The enumerator should read out the questions to the respondents in Ga/Twi)

6. Mercy bought some clothes costing 16.50 Cedis and paid using a 20 Cedis note. How much change will she get back?

7. Kofi set up a fruit stand in a market in town. The manager of the market says that Kofi must pay him 1000 Cedis to set up the stand. Kofi must also pay the manager 100 Cedis per month. In the first year, how much does Kofi have to pay in total to the manager?

General Math

2. 485 – 123 =

3. 246 ÷ 2 =

4. Which is between ¾ and 4/3?

(a) 1
(b) 3
(c) ½
(d) 3/2

4. Which is largest?

(a) 0.1
(b) 0.01
(c) 0.111
(d) 0.1101

Table A1: Female Employment by Education Category

	Type			Sector			
	Wage	Self-Employed	Total	Manufacturing	Services	Trade	Total
Low Schooling	28	188	216	56	7	125	188
Middle Schooling	54	215	269	73	21	121	215
High Schooling	94	147	241	30	13	104	147
Total	176	550	726	159	41	350	550