Check for updates

Journal of International Development
J. Int. Dev. **33**, 208–232 (2021)
Published online 22 October 2020 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/jid.3519

DURATION OF PRE-UNIVERSITY EDUCATION AND LABOUR MARKET OUTCOMES: EVIDENCE FROM A QUASI-EXPERIMENT IN GHANA

EMMANUEL ADU BOAHEN[1]*, KWADWO OPOKU[2] and SIMONE SCHOTTE[3]
[1]*University of Energy and Natural Resources, Sunyani, Ghana*
[2]*University of Ghana, Accra, Ghana*
[3]*UNU-WIDER, Helsinki, Finland*

Abstract: This paper provides new evidence on the effect of shortening the duration of pre-university education on long-term labour market outcomes in Ghana, expl`oiting the education reform of 1987 as a natural experiment. Our results indicate that the drastic cut in the duration of pre-tertiary education from 17 to 12 years improved the labour market success of treated cohorts. However, this is driven by a 'quantity' effect: the shorter course duration reduced the direct and indirect costs of acquiring post-primary education and allowed more students to enrol, which provided access to better job opportunities. On aggregate, this has dominated the negative effect on education 'quality'.
© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

Keywords: years of education; labour market outcomes; regression discontinuity; Ghana

1 INTRODUCTION

By recognizing the pivotal role of education in alleviating poverty and fostering economic development (inter alia, Becker, 1993; Duflo, Dupas and Kremer, 2017; Kuepié and Nordman, 2016), improving access and quality of education has become a key component of government strategies for inclusive growth. In most developing countries, however, education is still not accessible to all owing to the direct and indirect costs of attendance. In addition to the costs of tuition fees, transportation, books and supplies, among others, these include the opportunity costs of time spent in education instead of working.

*Correspondence to: Emmanuel Boahen, University of Energy and Natural Resources, Sunyani, Ghana.
E-mail: emmanuel.boahen@uenr.edu.gh
The copyright line for this article was changed on 9 March 2021 after original online publication.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.
This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and the content is offered under identical terms.

In deciding the optimal duration of schooling, researchers and policymakers are thus confronted with a trade-off. On the one hand, labour market productivity increases with high-quality education, which provides enough time for students to properly understand the theories, concepts and their applications to the world of work (Becker, 1993; Mincer, 1991). Students from disadvantaged backgrounds, in particular, may require extra time to catch up and may struggle if curricula are heavily compressed. On the other hand, early participation in the labour market is considered a more efficient means of using youth's human capital, and the resulting longer working life increases a country's labour force and therefore helps to facilitate economic growth (Meyer, Thomsen and Schneider, 2019). Also, having a shorter duration of education programmes may free resources, allowing larger numbers of students to be admitted and/or class sizes to be reduced. Furthermore, given the opportunity costs of education, reducing the number of years of schooling to complete a course may reduce dropouts and increase completion rates among economically disadvantaged students. The optimal duration will be determined by the interplay of these opposing effects.

Against these considerations, our paper provides new evidence on the effect of shortening the duration of pre-university education on long-term labour market outcomes in Ghana. To identify the causal relationship, we exploit the education reform of 1987 as a natural experiment in which the nationwide restructuring of basic and secondary schooling drastically decreased the duration of pre-tertiary education from 17 to 12 years. Our analysis adopts a fuzzy regression discontinuity design (FRDD), which takes advantage of the situation whereby the old and new education systems coexisted during the transition period after the reform. This means that older cohorts, who had enrolled in post-primary education before 1987 and continued their studies under the old system, were graduating at the same time as younger cohorts, who had entered post-primary education in 1987 or later and completed their studies in a shorter time under the new system. Using the 2010 Ghana Population and Housing Census, we exploit the reform-induced variation in the duration of pre-university education across different birth cohorts who entered the labour market around the same time—thus facing the same macroeconomic environment and labour market conditions—to estimate the long-term impact on labour force participation and quality of employment.

Most of the existing research in the area relies on case studies of recent reductions in the years of secondary education in Germany and Canada (inter alia, Büttner and Thomsen, 2015; Krashinsky, 2014; Meyer and Thomsen, 2016; Thomsen, 2015). However, their findings are unlikely to be readily applicable to developing country contexts, where evidence remains scarce. To our knowledge, this paper presents the first study that investigates the long-term effect of a reduction in the duration of pre-university education in the context of sub-Saharan Africa. While several previous studies investigate the effect of extending access to secondary schooling on labour market outcomes in sub-Saharan Africa (inter alia, Duflo et al., 2017; Knight and Sabot, 1990; Oyelere, 2010; Ozier, 2016), we are only aware of one study that assesses the link between secondary school duration and labour market outcomes (Abekah-Nkrumah, Asuming and Yusif, 2019). However, in their study on Ghana, Abekah-Nkrumah et al. (2019) focused on a later reform that extended senior high school by 1 year and estimated the effect on early labour market outcomes of recent graduates. The reform, introduced in 2007, was reversed just 3 years after implementation, reverting to the system that had been in place since the 1987 reform under study here.

Our results point to a quantity–quality trade-off in education in response to the drastic cut in the duration of pre-tertiary schooling in Ghana. On the one hand, our findings indicate that the reform increased access to secondary education by 15.5 percentage points

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

and access to tertiary education by 5.1 percentage points, reflecting a general increase in access to higher education. While we find no significant effect on rates of labour force participation, our main findings suggest that the reform increased the average chances of working in the formal sector and working as an employee by 8.2 and 7.8 percentage points, respectively. On the other hand, when comparing the labour market outcomes of graduates who completed the same level of education under the pre-reform versus post-reform system, we find that post-reform graduates fare worse in terms of education quality (they have a 3 to 5 percentage point lower likelihood of being able to read both English and any of the Ghanaian languages) and have lower chances of being employed in the formal sector or as paid employees at all the levels of education affected by the reform. This suggests that the positive impact on average labour market outcomes is mainly driven by a 'quantity' effect. Owing to the reform, completion rates for secondary and tertiary schooling increased, which allowed more students to gain access to better jobs. On aggregate, this has dominated the negative effect on education 'quality.'

The remainder of the paper is organized as follows. Section 2 explains the changes in the education system induced by the 1987 reform and discusses expected labour market effects from a theoretical perspective. Section 3 describes the sources of data, defines key variables and shows some relevant descriptive statistics. Section 4 presents the empirical framework, identification strategy and internal validity checks. Section 5 discusses the empirical findings, assesses potential transmission mechanisms and provides robustness checks. Section 6 concludes.

2 EDUCATIONAL REFORM AND TRANSMISSION MECHANISMS

2.1 Restructuring of the Education System under the 1987 Reform

Immediately after independence, Ghana initiated the Accelerated Development Plan for Education. Under the initiative, the existing 6 years of primary education was made free, there was a massive increase in the construction of primary and middle schools, and teacher training was expanded (Boahen and Yamauchi, 2018).

However, a succession of military and civilian governments after 1966 mismanaged the economy, which led to a smaller budget allocation to the education sector. Primary school enrolment started a downward trend, whereas dropout rates were rising. To address the situation, a committee was set up in 1973 to review the existing educational structure and to provide recommendations for reform. The existing structure of pre-tertiary education at the time comprised 10 years of basic education, divided into 6 years of primary school and 4 years of middle school. While some tertiary education institutions, such as teacher training colleges and polytechnics, were accessible after 5 years of secondary schooling (O level), entry into university demanded an additional 2 years of upper-secondary education (A level).[1] This means that pre-tertiary education at the time was 17 years for university entrants and 15 years for other forms of tertiary education.

[1]Prior to the reform, students were assessed at the end of the fifth year of secondary education through a nationwide examination referred to as the General Certificate Examination Ordinary Level (commonly known in the country as GCE O level). The most successful students in the GCE O-level exams proceeded to the final 2 years of secondary education. The certificate, acquired after passing the nationwide exam at the end of the last 2 years of secondary education, could be used to enter university. The less-successful students at the GCE O-level exams used their certificate to enter any of the training colleges or polytechnics, and those who were not able to pass the exams used it to search for jobs.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

In 1987, the New Educational Reform Programme (NERP) was introduced with the aims of averting the falling trend in enrolment, freeing resources to improve both access and quality of pre-tertiary education and allowing more children to complete at least basic education (Osei, 2004).

There were two major policies in the 1987 reform:

- First, the reform reduced pre-tertiary education from 17 to 12 years. Specifically, the old pre-tertiary education structure of 6–4–7 (6 years of primary school, 4 years of middle school and 7 years of secondary school, including 2 years pre-university)[2] was replaced by a 6–3–3 structure, consisting of 6 years of primary school, 3 years of junior secondary school (JSS), replacing the old middle schools, and 3 years of senior secondary school (SSS), while lengthening the school year.[3] Figure 1 provides an illustration of Ghana's educational system prior to and post the 1987 reform.
- Second, the 1987 reform introduced vocational and technical subjects into the basic education curriculum. Prior to the 1987 reform, only academic subjects were taught at both primary and middle schools within the country. The new curriculum placed greater emphasis on practical skills to prepare students for a wider range of future activities and to stimulate students' interest in technical and vocational education and training.[4] Similarly, the upper-secondary school curriculum was also revised, and students were allowed to choose their areas of specialization right from the first year.

Table 1 shows the implementation of the post-reform educational structure. The restructuring was phased in from 1987 to 1994. The last cohort of middle-school students was admitted in 1986/1987, prior to the reform. These students graduated 4 years later in 1989/1990, when the middle schools ceased to exist. Meanwhile, in 1987/1988, the first JSS cohort was admitted, which, after 3 years of studying, also graduated in 1989/1990. Thus, during this 3-year period, schools simultaneously contained both JSS and middle-school students who finished their basic education at the same time under two different systems. In early 1991, the first cohort of successful JSS students formed the first cohort to enter the new SSS system, graduating after 3 years in late 1993. During this time, older cohorts were still completing their secondary education under the pre-reform system, with the last cohort of O-level students graduating in 1994/1995 and A-level students graduating in 1996/1997.

[2]Prior to the reform, children from wealthier households tended to attend private primary schools for the first 6 years (there were only 145 of these so-called international schools vs. 9424 public primary schools by 1987). These were better endowed, and thus students were more likely to skip the middle-school years entirely and directly take the secondary school entrance exam. While legally possible, this option was only available to a minority of students who could afford private tuition or costly preparatory schools geared towards passing the entrance examinations. Most students within the public system completed 8–10 years (or more in case of repetition) of basic education before attempting the secondary school entrance exam. For example, in 1985, 30 per cent of all students entering secondary school came from private primary schools, while most of the remainder had completed the fourth year of middle school. The majority thus went through the 6–4–7 system, completing a total of 17 years of pre-university education (World Bank, 2004). The 1987 reform made it mandatory for every Ghanaian child to have 9 years of basic education.

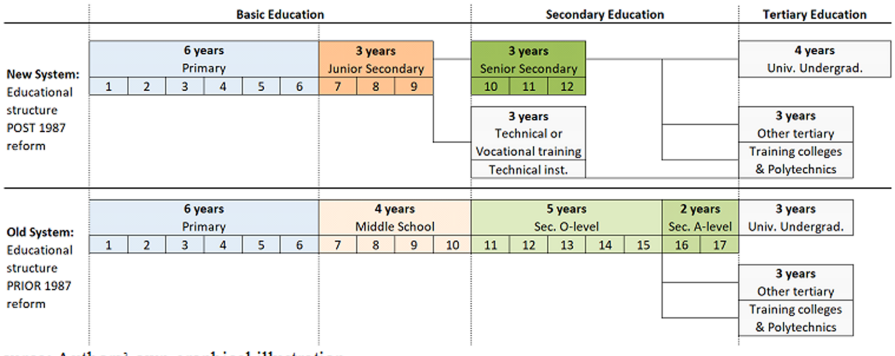
[3]For an extensive review of Ghanaian education reforms prior to 1987, see Akyeampong (2002), Akyeampong et al. (2007), Boahen and Yamauchi (2018) and Keichi and Nishimura (2015).

[4]The reform mandated every student in JSS to study technical skills and technical drawing (including metal work, block/brick work, woodwork and plastic designing) and also to select two or three pre-vocational subjects out of 12 options (including graphic design, picture making, textiles, basketry, bead making, sculpture, sewing, paper craft, catering, leatherwork, gourd and calabash work, and pottery and ceramics). There were 25 periods in a week, of which three were assigned to pre-technical and pre-vocational subjects (Akyeampong, 2002).

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License



Source: Authors' own graphical illustration.

Figure 1. Educational structure prior to and post 1987 reform. [Colour figure can be viewed at wileyonlinelibrary.com]

The 1987 reform came into being at a time of severe economic downturn and diminished government capacity. Therefore, the World Bank and other development partners supported the financing of the programmes under the reform. The resources provided by the World Bank were predominately used for school building and rehabilitation, textbook supply (to meet the new curriculum) and, to a lesser extent, for school furniture and equipment, other teaching materials and teacher training in the new curriculum. Statistical analysis has shown that the World Bank supported school building, and the rehabilitation programme nationally increased enrolments by around 4 per cent (World Bank, 2004). While relevant, this accounts for a relatively small proportion of the total rise in enrolment over the decade from 1987 to 1997 (Table 2). Importantly, the reform did not largely alter the expenditure components in terms of fees and other direct payments by students.

2.2 Expected Labour Market Effects of the 1987 Educational Reform

Labour market studies draw on three important theories to explain the relationship between education and outcomes in the labour market. First, human capital theory argues that education imparts skills to individuals that directly increase their productivity (Becker, 1993; Mincer, 1991). Second, according to screening theory, employers use education as a signalling device to determine the productivity, reliability and competency of job candidates, irrespective of whether they actually possess the expected attributes (Arrow, 1973; Spence, 1973; Stiglitz, 1975). Third, in the context of labour markets, social-closure theory points to institutional regulations that define requirements and thresholds for job entry. Limiting access to particular occupations creates distortions in the labour market, which increase the earnings of individuals employed in the restricted industry (Murphy, 1988; Parkin, 1979).

From a theoretical perspective, ex ante, the effect of NERP on labour market outcomes cannot be conclusively determined. On the one hand, the reduction in the number of years for completing pre-tertiary education likely allowed more students to attain basic, secondary and higher education. As students started graduating earlier, classrooms and teachers became available to accommodate more students per grade. This effect was likely reinforced by the provision of additional resources for school building and rehabilitation

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 1. Phase-in of the post-reform educational structure

		86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96
Basic education	Old system: Middle School	Last cohort started			Last cohort finished	Middle Schools ended					
	New system: JSS	JSS not yet started	First cohort started		First cohort finished						
Secondary Education	Old system: O and A levels				Last cohort started Form 1				Last cohort finished Form 5		Last cohort finished Form 7
	New system: SSS	SSS not yet started				First cohort started		First cohort finished			

Source: Authors' adaption from World Bank (2004).
JSS, junior secondary school; SSS, senior secondary school.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 2. Enrolment in basic and secondary education in Ghana

	1987/1988	1996/1997	Growth rate (%)
Primary school	1479449	2197172	48.5
Middle school/JSS	610094	738057	21.0
Secondary school/SSS	153284	199028	29.8

Source: Authors' adaption from Akyeampong (2002).
JSS, junior secondary school; SSS, senior secondary school.

under NERP. Moreover, NERP likely allowed more students to afford completing basic and secondary education, as the shorter duration of course programmes reduced the direct and indirect costs of acquiring a degree. These two effects would suggest that NERP increased the labour market success of treated cohorts according to all three theories outlined earlier. If NERP expanded access to post-primary education, this would have allowed more students to attain higher levels of education and thereby enhance their human capital. Moreover, assuming that with NERP the same skill set was acquired in a shorter time, graduates would start to build work experience earlier and benefit for longer from the labour market returns to their investments in human capital. In addition, if completion rates increased with NERP, more individuals would attain a degree, which would allow them to access better jobs owing to both signalling effects and degree requirements enforced on formal sector wage jobs, in particular.[5,6]

On the other hand, considering that NERP substantially reduced the duration of pre-tertiary education from 17 to 12 years, post-NERP students would have had to acquire the same skill set in a much shorter time, and there are reasons to believe that the quality of education would have been compromised (Agyeman et al., 2000). This not only would hamper human capital formation but might also have negative signalling effects on the labour market if employers were to evaluate prior-NERP and post-NERP secondary school graduates differently. Moreover, the extended period of pre-university education prior to NERP gave teachers more time to explain course materials to students with lower academic abilities who may have been left behind under NERP, causing higher dropouts and lower completion rates. If students were overburdened with workload owing to compressed curricula, this may have negatively affected their personality development (Thiel, Thomsen and Büttner, 2014; Thomsen, 2015), limited their cognitive development owing to the inability to conduct in-depth studies, therefore opting for less demanding subjects (Büttner & Thomsen, 2015; Meyer & Thomsen, 2016), and may have led to worse academic performance at the university level (Krashinsky, 2014). These effects would counteract the positive labour market effects discussed earlier.

As there is no clear theoretical prediction of which of these opposing effects dominates, the effect of NERP on labour market outcomes is essentially an empirical question.

[5]Prior to NERP, a minimum of 15 years was required to attain secondary school certification, while individuals who had attended school for 12–14 years could only signal pre-secondary education to employers based on their degree. Post-NERP students only needed 12 years of education to attain an SSS certificate.

[6]In the early 1990s, when the first batch of students affected by NERP were completing secondary school, it was difficult to get formal sector jobs with basic levels of education. For example, SSS completion was the minimum requirement to teach as an untrained teacher in public primary schools in the early 1990s (Tanaka, 2012). More so, middle-skill jobs, like messenger or secretary positions, at the time requested a minimum of secondary school certification but made no mention of years of education.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

3 DATA AND DESCRIPTIVE STATISTICS

The main source of data for this study is the 10 per cent sample of the 2010 Ghana Population and Housing Census, which is representative of the full population (see descriptive statistics presented in Table S1). To ensure that individuals were out of school and in the labour market at the time of the survey,[7] the sample is restricted to include people aged 26 to 60 years.[8] The resulting sample size counts 830 640 observations.

We use years of education as our main measure of education outcomes affected by the 1987 reform. The data on years of education are constructed based on the highest level of education completed by the individual.[9] In addition, we use reported ability to read both English and any other Ghanaian language to construct a binary literacy measure.

The main labour market outcomes of interest are created from the occupational information provided in the dataset. We use three binary variables as our main measures of long-term labour market success, capturing (i) labour force participation, (ii) formal employment and (iii) being a paid employee. In addition, to assess the effect of changes in the school curriculum towards vocational and technical subjects for career choices, we use the information on the sector of employment provided in the data to create binary variables indicating work in construction, manufacturing and crafts.

Ethnicity, religion[10] and gender are the only variables identified in the dataset that are generally constant over time and are not affected by the acquired level of education, and hence they provide good pre-treatment covariates.

The data allow us to identify the actual exposure to the 1987 reform with some limitations. As NERP did not alter the duration of primary school education, individuals with, at most, primary education completed are considered untreated. For individuals with, at most, secondary education completed, exposure to NERP is clearly identifiable because grades are coded differently if acquired under the pre-reform or post-reform education system. However, the treatment status of persons with tertiary education cannot be determined from the data. We therefore assume that any individual with tertiary education (accounting for 8.7 per cent of the sample) who was born on or after the cut-off point (Section 4.2) is treated (a robustness check including and excluding those with tertiary education is provided in Section 5.1).

Table 3 provides descriptive statistics for the whole sample. It gives means and standard deviations for years of education and binary variables: secondary, tertiary, formal, employee, labour force participation, literacy, religious affiliation, ethnicity and gender. The table suggests that the treated cohorts show more favourable education outcomes. For example, whereas 26 per cent of the treated cohorts enrolled in secondary or higher education, the same applies to 17 per cent in the control cohorts. Similarly, at 44 versus 40 per cent, the literacy rate is higher among the treated compared with the control cohorts. The table indicates little difference between cohorts with respect to the pre-treatment covariates of gender, religion and ethnicity.

[7]Drawing on data from the Ghana Living Standard Survey 2005–06 (GLSS 5), Figure S1 suggests that 98 per cent of all Ghanaians are likely to be out of school at age 26 years and beyond.
[8]In Ghana, 60 years is the mandatory retirement age for individuals working in the formal sector.
[9]As there is no information on repetition in the dataset, we infer the years of education based on the general number of years needed for the highest grade completed.
[10]Religion is categorized into Christian, Islamic and others. Christianity and Islam are the two largest religions in Ghana, accounting for about 80 per cent of the population.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 3. Descriptive statistics

	Control cohort			Treated cohort			Full sample		
	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*
Years of education	6.56	5.86	417234	7.03	5.13	413406	6.79	5.53	830640
Level of education									
1 if no education	0.36	0.48	417234	0.27	0.445	413406	0.32	0.465	830640
1 if primary	0.10	0.50	417234	0.11	0.489	413406	0.10	0.495	830640
1 if JSS/middle	0.37	0.463	417234	0.35	0.456	413406	0.36	0.560	830640
1 if secondary	0.10	0.295	417234	0.16	0.368	413406	0.13	0.335	830640
1 if tertiary	0.07	0.261	417234	0.10	0.302	413406	0.09	0.282	830640
Literacy									
1 if literate	0.40	0.491	417234	0.44	0.496	413406	0.42	0.494	830640
Labour market									
1 if in labour force	0.90	0.290	417234	0.88	0.324	413406	0.89	0.312	830640
1 if formal	0.13	0.348	417234	0.13	0.343	413406	0.13	0.345	830640
1 if employee	0.16	0.370	417234	0.18	0.384	413406	0.17	0.377	830640
Gender									
1 if male	0.47	0.500	417234	0.47	0.500	413406	0.47	0.499	830640
Ethnicity									
1 if Akan	0.48	0.500	417234	0.47	0.499	413406	0.47	0.499	830640
1 if Ewe	0.14	0.350	417234	0.14	0.348	413406	0.14	0.349	830640
1 if Mole Dagbani	0.14	0.342	417234	0.14	0.356	413406	0.14	0.350	830640
1 if other ethnicity	0.24	0.424	417234	0.24	0.430	413406	0.24	0.427	830640
Religion									
1 if Christian	0.71	0.455	417234	0.72	0.451	413406	0.71	0.453	830640
1 if Islamic	0.15	0.359	417234	0.18	0.380	413406	0.16	0.370	830640
1 if other religion	0.14	0.348	417234	0.11	0.312	413406	0.13	0.331	830640

Note: SD represents standard deviation, and *N* represents sample size.
Source: Authors' calculation based on 2010 Ghana Population and Housing Census (GPHC).

4 EMPIRICAL FRAMEWORK

4.1 Regression Approach

We use two estimation strategies to evaluate the causal effect of the reform-induced drastic reduction in the duration of pre-tertiary education on labour market outcomes in Ghana. First, we use a FRDD to analyse the overall impact of the reduction in the years of schooling on education and labour market outcomes. Second, we compare the education and labour market outcomes of treated and untreated individuals at specific ages and at the specific levels of education.

As described in Section 2.1, NERP created a discontinuity in the duration of education across treated and untreated birth cohorts who respectively entered post-primary education after or before 1987. Our main analytical approach in the FRDD is to combine the year of birth and the policy implementation year to construct an indicator variable, which is used as an instrument for the probability of being treated. Let Y_i represent a set of bivariate labour market outcomes of individual i, Z_i is an indicator function that takes the value one for individuals assigned to treatment and zero otherwise, X_i is the assignment variable (birthyear) and $h(X_i)$ is a flexible function in X.

Following Lee and Lemieux (2010), the data-generating process can then be expressed as follows:

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

$$\text{Indicator function}: Z_i = 1(X_i \geq c) \tag{1}$$

$$\text{First stage}: D_i = \mu + \beta Z_i + h(X_i) + \pi U_i + u_i \tag{2}$$

$$\text{Second stage}: Y_i = \alpha + \delta \widehat{D}_i + h(X_i) + \tau V_i + v_i \tag{3}$$

where D_i is a bivariate variable capturing the actual treatment status of individual i (equal to one if exposed to NERP and zero otherwise), U_i are predetermined covariates of D_i and V_i are predetermined covariates of Y_i.[11]

Combining Equations 1, 2 and 3 under the identifying assumption discussed in Section 4.2, the parameter of interest, δ, identifies the local average treatment effect (LATE). We estimate Equations 2 and 3 using the two-stage least squares, where Z_i is used as an instrument for D_i. Regional fixed effects are included in the estimation, and standard errors are clustered at the district level.

In the case of the second design, we separately estimate the average treatment effect by level of completed education, as follows:

$$Y_i = \alpha_j + \delta_j D_i + \tau_j V_i + \epsilon_i \forall i \in j, \text{ where } j = 1, 2, 3 \tag{4}$$

where $j = 1$ refers to individuals with middle school/JSS as the highest level of education, $j = 2$ refers to individuals with O level/SSS as the highest level of education and $j = 3$ refers to individuals with A level/SSS as the highest level of education.

4.2 Identification and Internal Validity Checks

We aim to estimate the causal impact of a reduction in the duration of pre-tertiary schooling on labour market outcomes in Ghana, taking advantage of the 1987 educational reform that reduced pre-university education from 17 to 12 years. The identification and estimation of the LATE using the year of birth to instrument the probability of treatment demand five assumptions.

First, there is a discontinuity in the probability of exposure at the cut-off. In determining the cut-off value, information from other data sources and literature on education in Ghana was used. Although children in Ghana are expected to begin primary one by age 6, unlike in most developed countries, there are no laws that strictly determine the year or month of entry into primary school. In fact, households in rural communities, in particular, tend to enrol their children later than the official age. In line with findings in the existing literature (Akyeampong et al., 2007; Boahen & Yamauchi, 2018), Figure S2 shows that the average age of entry into primary school was about 7.5 years for cohorts born during the 1970s. If we set the age of entry into primary school at 8 years, then with no grade repetition, children would start middle school or JSS at age 14 on average. This implies that individuals born in 1973 or later are much more likely to be affected by the 1987 reform than individuals born before the cut-off. This, however, is not a perfect rule. Owing to late or early primary school entry as well as grade repetition, some individuals born before 1973 could have been treated, and vice versa. This fits the FRDD approach: the jump in the probability of treatment for cohorts born after 1973 is greater than zero but less than one.

[11]Note that with a parametric specification, the researcher should specify $h(Z_i)$ the same way in both regressions (Imbens and Lemieux, 2008).

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Second, the forcing variable was not manipulated. We can reasonably assume that parents did not make fertility choices in anticipation of the (future) policy, and therefore, the year of birth is exogenous to the change in the years of education (Elsayed and Marie, 2015).

Third, treatment and control groups are exchangeable/comparable around the cut-off. As can be seen from Figure S3, the treatment and control groups share similar predetermined characteristics, and there are no jumps around the cut-off.

Fourth, to the best of our knowledge, there were no other educational or labour market policies that may have benefitted the treated cohort without benefitting the control cohort. Importantly, our approach takes advantage of the situation that the old and new education systems coexisted during the transition period after the reform. As described in Section 2.1, the reform was implemented in such a way that older cohorts, who had enrolled in post-primary education before 1987 and continued their studies under the old system, were graduating at the same time as younger cohorts, who had entered post-primary education in 1987 or after and completed their studies in a shorter time under the new system. This implied that during the transition period, treated and untreated birth cohorts simultaneously graduated from secondary education and either entered the labour market around the same time (thus facing the same macroeconomic environment and labour market conditions[12]) or continued to tertiary education (thus benefitting in the same way from the expansion in tertiary education facilities that occurred around the time of the reform).[13]

Fifth, NERP affected the years of education monotonically across the population. That is, the duration of pre-tertiary education either remained unchanged (for individuals who exited the education system after primary school or who would have skipped middle school) or reduced for cohorts affected by the reform, but there is no reason to believe that it increased the years of schooling for any subgroups.

5 RESULTS

5.1 Relevance of the Birthyear Instrument

Figure 2 presents the first-stage results graphically. There is a clear and statistically significant jump in the probability of treatment (exposure to NERP) and in the years of education at the threshold.[14,15] The figure further indicates that a quadratic specification

[12]We found no report of a major economic reform that could have had a differential effect on the labour market conditions faced by cohorts born before or after 1973. The last batch of pre-NERP students completed secondary school in 1996, while the first batch of post-NERP students graduated in 1993. Owing to this overlap, any labour market policy implemented during this time would have benefitted both the treatment and comparison groups.

[13]Two new universities were established, and six technical institutions were upgraded to polytechnics in 1992—just 1 year before the first batch of students affected by NERP completed secondary school. However, this expansion in tertiary education is unlikely to have benefitted only the treated cohort. Given an average age of 8 years to start primary school and a minimum of 17 years to complete secondary school under the old pre-NERP system, the control cohorts that were born between 1966 and 1972 would have also benefitted from the expansion in tertiary education that occurred in 1992. Thus, any discontinuity in access to tertiary education around the 1973 birth cohort threshold is likely to be attributable to NERP.

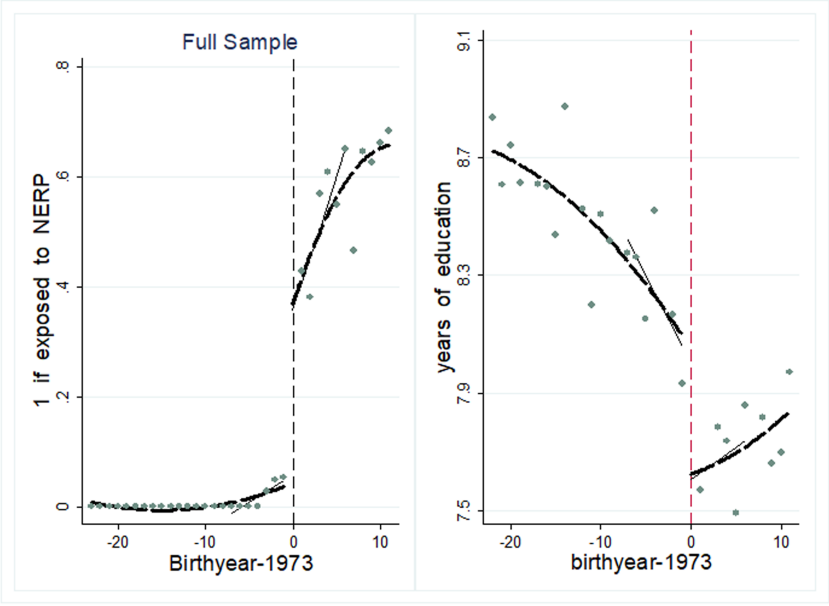
[14]Figure S4 plots the discontinuity for the whole sample and excluding those with tertiary education, for whom the treatment status cannot be determined from the data (Section 3). The figure suggests no significant difference in the discontinuity between the two.

[15]If the reform is the only policy creating the discontinuities in Figure 2, then there should not be a jump at the threshold for individuals with primary as their highest level of education, because the reform did not affect the duration of primary education. Figure S5 confirms this.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License



Source: Authors' computation based on 2010 GPHC.

Figure 2. Impact of being born after 1973 on years of education and exposure to New Educational Reform Programme (NERP). [Colour figure can be viewed at wileyonlinelibrary.com]

seems to fit the data. However, recent empirical studies in the area advocate the use of local linear regression to uncover policy parameters. Therefore, we report two sets of results in the rest of the estimations, first using a quadratic specification for the full sample and second using a local linear regression with an ad hoc bandwidth of 7. This specification compares cohorts born between 1966 and 1972 (likely to be enrolled in the old educational system) with cohorts born between 1973 and 1979 (likely to enrolled in the new educational system).

Table 4 presents the first-stage results using quadratic specifications for the full sample and a local linear regression that uses an ad hoc bandwidth of 7.[16] Columns (1) and (3) present results without covariates, and columns (2) and (4) present results with covariates. The results are similar across specifications (confidence intervals show substantial overlap), suggesting that just above 30 per cent of the individuals were born after the cut-off received treatment. In addition, Table 5 indicates that NERP reduced total years of schooling by 0.37–0.54 years.

5.2 Impact on Labour Market Outcomes

We start the analysis by graphically illustrating the discontinuities in labour market outcomes potentially induced by the reform. The graphs presented in Figure 3 show no

[16]As a robustness check to the baseline estimates, we present regression results for optimal bandwidth using the rd code in STATA written by Austin Nicholas.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 4. Impact of birthyear instrument on exposure to NERP

	(1)	(2)	(3)	(4)
Exposure to NERP	Full sample	Full sample	Bandwidth of 7	Bandwidth of 7
1 [birthyear ≥ 1973]	0.312*** (0.003)	0.309*** (0.003)	0.326*** (0.013)	0.319*** (0.013)
Observations	830640	830640	429118	429118
Covariates	No	Yes	No	Yes
Spline	Quadratic	Quadratic	Linear	Linear

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Year of birth, re-centred at the discontinuity threshold (1973), is used as an instrument for exposure of the reform.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

Table 5. Impact of birthyear instruments on years of education

	(1)	(2)	(3)	(4)
Years of education	Full sample	Full sample	Bandwidth of 7	Bandwidth of 7
1 [birthyear ≥ 1973]	−0.543***	−0.541***	−0.368***	−0.373***
	(0.0286)	(0.0282)	(0.029)	(0.040)
Observations	830640	830640	429118	429118
Covariates	No	Yes	No	Yes
Spline	Quadratic	Quadratic	Linear	Linear

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Year of birth, re-centred at the discontinuity threshold (1973), is used as an instrument for exposure of the reform.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

discontinuity around the cut-off in terms of labour force participation rates, while positive jumps are visible for the probabilities of being in formal employment and working as a paid employee.

Table 6 presents the regression estimates of the discontinuity in the labour market outcomes. The results indicate that NERP increases the likelihood of being in the labour force by 1.8 percentage points under the quadratic specification using the full sample, while the effect is insignificant for the local linear regression. Given the results from the preferable local linear regression specification and the graphical evidence from Figure 3, we conclude that the reform did not affect labour force participation. The local linear regression further suggests that NERP increased the probability of working in the formal sector by 8.2 percentage points and of working as an employee by 7.8 percentage points. The latter is equivalent to an increase in the probability of working as an employee by 51.7 per cent (0.078/0.151) for the treatment group relative to the mean of the comparison group.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

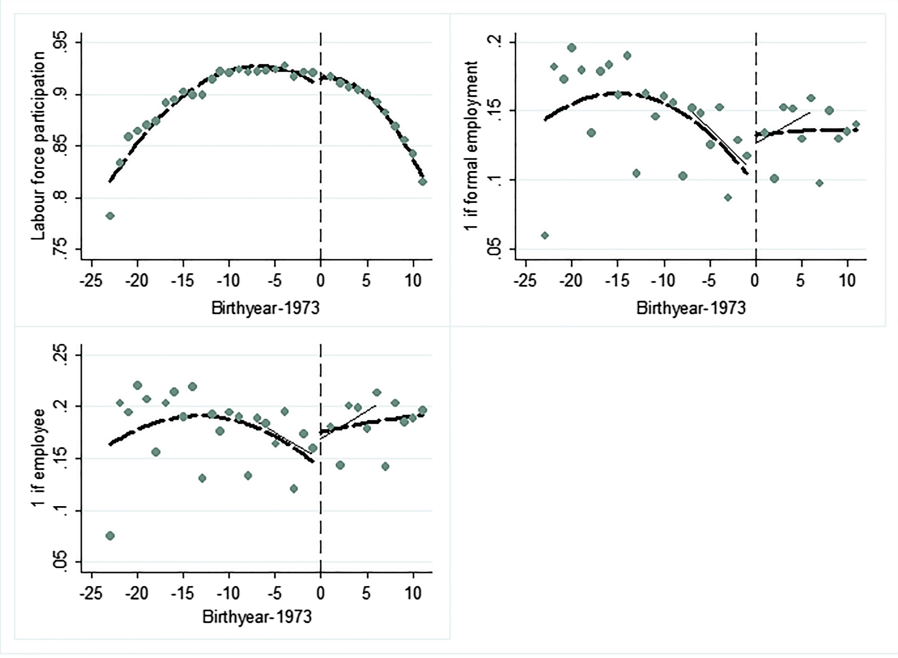


Figure 3. Impact of the shortening of the years of education on labour market outcomes. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 6. Impact of shortening the number of years of education on labour market outcomes

Outcomes	(1) Full sample	(2) Bandwidth of 7
1 [if participates in labour force]	0.0184*** (0.0056)	0.0077 (0.0055)
1 [if works in formal sector]	0.102*** (0.00792)	0.0824*** (0.0079)
1 [if works as employee]	0.0981*** (0.0102)	0.0780*** (0.0109)
Observations	830640	429118
Spline	Quadratic	Linear
Covariates	Yes	Yes
Fixed effects	Yes	Yes

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Year of birth, re-centred at the discontinuity threshold (1973), is used as an instrument for exposure of the reform.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

Given that self-employment and work in the informal sector are generally characterized by lower earnings and less-secure working conditions, we conclude that the reform-induced reduction in years of pre-tertiary education led to improved labour market outcomes in Ghana. Our estimated effects show the same sign, although of a smaller magnitude compared with the findings of Ozier (2016), who concluded that increased access to

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

secondary education in Kenya reduced the number of informal sector employees by 30 percentage points and the probability of becoming self-employed by 40 to 50 per cent.

5.3 Mechanisms

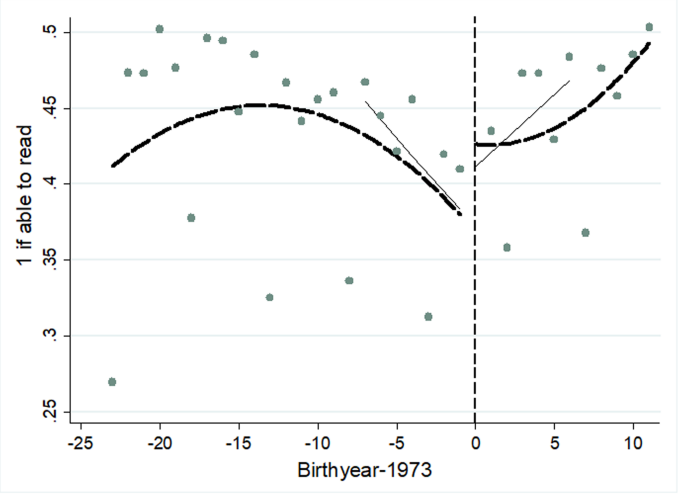
We investigate three possible transmission mechanisms through which NERP may have affected labour market outcomes. First, we assess the impact of NERP on educational attainment in terms of literacy rates and secondary and tertiary school completion. Second, we compare the education and labour market outcomes of treated and untreated individuals at specific ages and at specific levels of education. Third, we rule out changes in curriculum as potential confounding factors.

5.3.1 Impact on educational attainment

Figure 4 shows the relationship between the running variable and the share of individuals who can read both English and any other Ghanaian language. We observe a clear positive jump in literacy rates around the threshold.

Table 7 provides the regression results for the literacy variable. We detect a positive treatment effect on literacy rates by 13 to 14 percentage points depending on the chosen specification. On average, 37.7 per cent of the comparison group were literate, and therefore, the local linear regression estimate is equivalent to an increase in literacy by 34.6 per cent.

Figure 5 shows the relationship between the running variable and two dummy variables capturing secondary (1 if the highest level of education is secondary or higher) and tertiary (1 if the highest level of education is tertiary) educational attainment. In line with the results on literacy rates, both graphs show clear, statistically significant jumps at the threshold.



Source: Authors' computation based on 2010 GPHC.

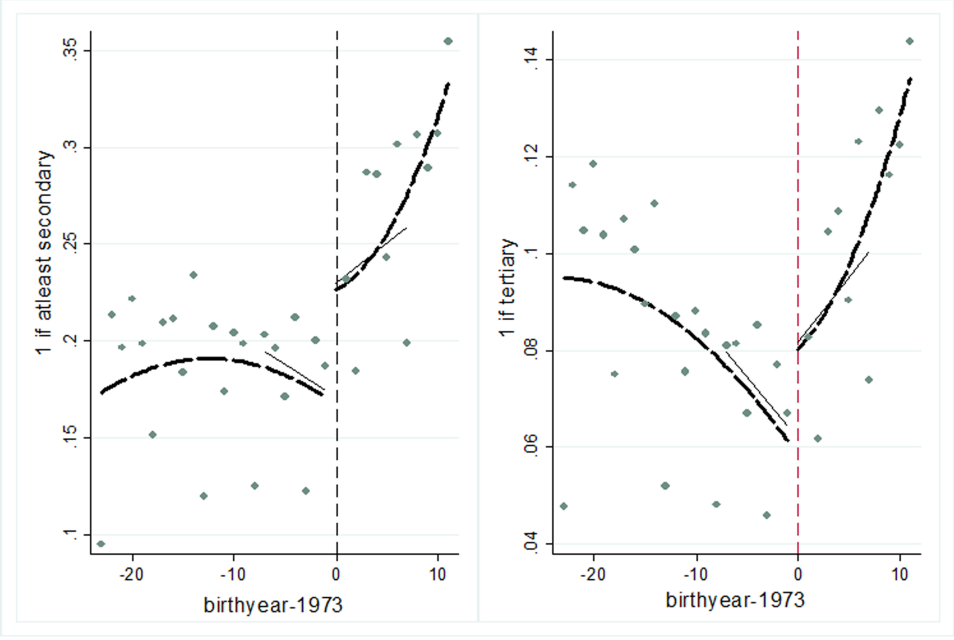
Figure 4. Impact of the shortening of the years of education on literacy. [Colour figure can be viewed at wileyonlinelibrary.com]

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 7. The impact of shortening pre-tertiary education on literacy

Outcomes	(1) Full sample	(2) Bandwidth of 7
1 [if able to read both English and any Ghanaian language]	0.1402*** (0.0175)	0.1306*** (0.0198)
Observations	830640	429118
Spline	Quadratic	Linear
Covariates	Yes	Yes
Fixed effects	Yes	Yes

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Year of birth, re-centred at the discontinuity threshold (1973), is used as an instrument for exposure of the reform.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level
**Significance at the 5% level.
***Significance at the 1% level.



Source: Authors' computation based on 2010 GPHC.

Figure 5. Impact of shortening the number of year of pre-tertiary education on higher education. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 8 quantifies the effect of exposure to the new secondary education system on access to secondary education and tertiary education. Both the quadratic specification and local linear regression indicate a statistically significant rise in secondary education by 17.9 and 15.5 percentage points, and in tertiary education by 6.2 and 5.1 percentage points, respectively. The estimates are precise (small confidence intervals) and show a

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 8. Impact of exposure to new secondary education system on higher education

Outcomes	(1) Full sample	(2) Bandwidth of 7
1 [if attained secondary education]	0.179*** (0.0108)	0.155*** (0.0101)
1 [if attained tertiary education]	0.0621*** (0.00703)	0.051*** (0.007)
Observations	830640	429118
Spline	Quadratic	Linear
Control	Yes	Yes
Fixed effects	Yes	Yes

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Year of birth, re-centred at the discontinuity threshold (1973), is used as an instrument for exposure of the reform.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

substantial overlap for the two specifications. The preferred local linear regression indicates that the reform led to an increase in secondary education of 91.4 per cent (0.155/0.1695) and in tertiary education of 69.8 per cent (0.051/0.073) relative to the mean among the comparison group.

The substantial increase in literacy rates and in secondary and tertiary educational attainment as a result of the reform may be attributable to two factors. First, the reduction in years of secondary education from 7 to 3 freed classrooms and other resources that allowed more students to be admitted. This was supplemented by additional funding provided for school building and rehabilitation. Second, the much shorter course duration led to an important reduction in the direct and indirect costs of completing secondary education. We infer that the low enrolment in higher education prior to NERP resulted from limited access and the high costs of secondary schooling, and the reform helped to reduce these two constraints.

5.3.2 Impact on outcomes at specific levels of education

In this section, we use the second estimation strategy described in Section 4.1 to evaluate the education and labour market outcomes of individuals in the comparison and treatment groups who attained the same level of educational qualification under the pre-reform versus post-reform system.

Regression results on literacy rates and labour market outcomes are presented in Tables 9 and 10, respectively. The tables shows the impact on individuals who graduated from the old 4-year middle school versus new 3-year JSS in columns (1) and (2), the old 5-year secondary school (O level) versus new 3-year SSS in columns (3) and (4), and the old 7-year secondary school (A level) versus new 3-year SSS in columns (5) and (6). Columns (1), (3) and (5) use the full sample at the various levels of education, whereas columns (2), (4) and (6) restrict the sample to individuals aged 34 to 37 years[17] at the time of the survey.

[17]The restriction for the 4-year age cohort is done for two reasons. First, between the 1992/1993 and 1995/1996 academic years, both the old and new educational systems produced secondary school graduates. Thus, in 2010, individuals in the age range of 34–37 years may have been exposed to pre-reform and post-reform education. Second, restricting the sample size to a 4-year age interval would likely reduce the confounding effect and minimize the bias that may occur for using a long age interval.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 9. The impact of shortening pre-tertiary education on literacy, by level of pre-university education

	JSS vs. middle		SSS vs. O level		SSS vs. A level	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcomes	Full sample	4-year cohort	Full sample	4-year cohort	Full sample	4-year cohort
1 [if able to read both English and any Ghanaian language]	0.004	–	−0.018**	–	−0.028**	−0.047**
	(0.0038)	0.0.039***	(0.0075)	0.028***	(0.01375)	(0.0218)
		(0.0063)		(0.0084)		
Observations	251811	44548	57728	12513	46881	10905
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Exposure of the reform is captured by the actual reported level of education.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

Table 10. Impact of shortening the years of education on labour market outcomes, by level of pre-university education

	JSS vs. middle		SSS vs. O level		SSS vs. A level	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcomes	Full sample	4-year cohort	Full sample	4-year cohort	Full sample	4-year cohort
1 [if participates in labour force]	−0.0287***	0.00005	0.0183*	−0.0149**	−0.0104	−0.00034
	(0.00265)	(0.00287)	(0.00971)	(0.00621)	(0.0056)	(0.0163)
1 [if works in formal sector]	−0.0177***	−0.0246***	−0.0658***	−0.0670***	−0.101***	−0.128***
	(0.00236)	(0.00327)	(0.00845)	(0.0119)	(0.0158)	(0.0299)
1 [if works as employee]	−0.0065*	−0.0147***	−0.0518***	−0.0529***	−0.0791***	−0.127***
	(0.00332)	(0.00314)	(0.00615)	(0.0111)	(0.0132)	(0.0278)
Observations	251811	44548	57728	12513	46881	10905
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors clustered at the district level (270 clusters) are reported in parentheses. Predetermined covariates include gender, ethnicity and religion. All the estimations include regional fixed effects (10 regions). Exposure of the reform is captured by the actual reported level of education.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

The impact of shortening pre-tertiary education on literacy by level of education is reported in Table 9. The results from our preferred 4-year interval specification show that across education levels, graduates' reported ability to read both English and any Ghanaian language declined by about 3–5 percentage points.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

The results reported in Table 10 assess the impact of shortening pre-tertiary education on labour market outcomes by attained level of education. While the findings regarding the impact on labour force participation are somewhat mixed and largely insignificant, we observe a sizeable and significant negative effect on the quality of employment. The results from our preferred 4-year interval specification indicate that the reduction in the duration of pre-secondary education reduced the likelihood of formal employment by 2.5 percentage points and the likelihood of working as an employee by 1.5 percentage points. The effect is yet more pronounced at higher levels of education. Comparing SSS with O-level graduates, who have a 3-year difference in the total duration of education, we find a significant decline in the chances of formal employment and working as an employee by 6.7 and 5.3 percentage points, respectively. Comparing SSS with A-level graduates, who have a 5-year difference in the total duration of education, we find a strong negative impact on the likelihood of formal employment and working as an employee of 12.8 and 12.7 percentage points, respectively.

Both sets of results presented in this section suggest that the sharp reduction in the duration of education induced by NERP reduced the quality of education. This corroborates earlier findings in the literature pointing to major weaknesses in the implementation of the reform, which failed to achieve quality targets (Agyeman et al., 2000).

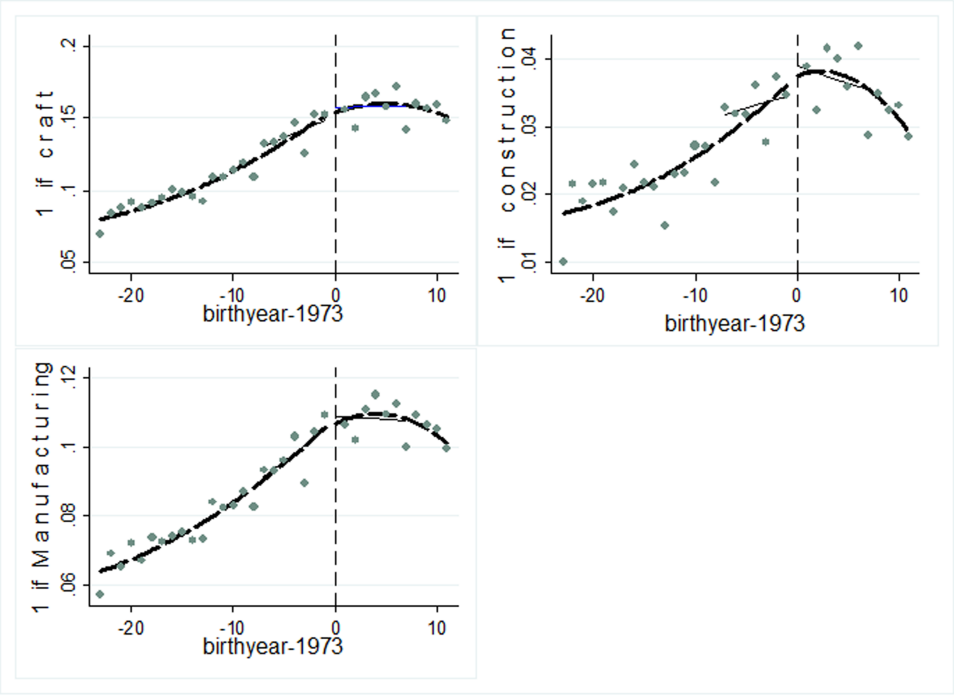
5.3.3 Impact of shortening pre-tertiary education versus curriculum changes

In addition to the effects on completion rates and schooling quality discussed in the two preceding subsections, the labour market effects of NERP detected in Section 5.2 could also be partly driven by changes in the secondary school curriculum induced by the reform. As discussed in Section 2.1, NERP introduced vocational and technical subjects into the JSS curriculum. This was intended to aid those not advancing to higher education to find jobs or create their own businesses using the skills they acquired in school. If the curriculum change had any effect on labour market outcomes, we would expect to see a higher likelihood among the treated cohort to engage in vocational-related careers—including crafts, construction and manufacturing—compared with the control cohort. Figure 6 plots the relationship between the running variable and the probability of engaging in each of these three sectors. We see that the distributions of all the three outcomes are continuous at the threshold for the quadratic fitted lines, although the local linear line for the likelihood of employment in construction suggests a possible discontinuity at the threshold.

The results presented in Table 11 show that, according to the preferred local linear regression specification, the impact of NERP on career choice in vocational or technical fields is not statistically different from zero. This finding resonates with the criticism by Agyeman et al. (2000) of the implementation of the reform, indicating that it did not improve the quality of education outcomes and suggesting that the post-reform curriculum was rather inferior to the pre-reform one. Based on our findings and arguments provided in the literature, we conclude that the change in curriculum is unlikely to be driving the detected positive aggregate impact on labour market outcomes. Moreover, if there was any effect, we expect that the vocationalization of the curriculum would have tended to increase the likelihood of self-employment, thus working against the labour market effects detected in Section 5.2.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License



Source: Authors' computation based on 2010 GPHC.

Figure 6. Impact of exposure to the new education system on vocational careers. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 11. Impact of exposure to the new education system on vocational careers

Outcomes	(1) Full sample	(2) Bandwidth of 7
1 [if works in crafts]	−0.0165* (0.00935)	0.000989 (0.00765)
1 [if works in construction]	−0.00386 (0.00320)	0.00401 (0.00314)
1 [if works in manufacturing]	−0.00837 (0.00631)	−0.00269 (0.00671)
Observations	830640	429118
Spline	Quadratic	Linear
Covariates	Yes	Yes
Fixed effects	Yes	Yes
	(1)	(2)

Notes: Robust standard errors are clustered at the district level (170 clusters) are in parenthesis. All the estimations include regional fixed effects. Predetermined covariates included are gender, ethnicity and religion. NERP is used as an instrument to for exposure of the reform. Years of birth have been re-centred at the discontinuity threshold (1973). Outcome variable 'employee' is a dummy defined as 1 (if a person is employed by somebody); the rest of the variables are also dummies and similarly defined as employee. Total observations are from 2010 population and housing census in Ghana.
Source: Authors' estimation based on 2010 Ghana Population and Housing Census (GPHC).
*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

5.4 Robustness Checks

We investigate the robustness of the findings presented in Sections 5.1 and 5.2 with respect to four considerations, including (i) the choice of the bandwidth, (ii) the choice of the primary school starting age, (iii) the exclusion of outliers, (iv) heterogeneity in effects across population groups and (iv) the clustering of standard errors at different levels.

First, the longer the bandwidth, the larger the likelihood of the estimator being affected by cohort effects. Therefore, we re-estimate the effect on labour market outcomes using two alternative specifications with smaller bandwidths of 4 and 2, as well as using an approach that allows for optimal bandwidth selection, following Imbens and Kalyanaraman (2012). Tables S2 and S3 present the results. We find very similar effects across specifications. The robustness of the results even using a short bandwidth of 2 provides a strong indication that the estimated effects are not driven by cohort effects or confounding factors in the macroeconomic or labour market environment. This is because the last batch of pre-NERP students completed secondary school (A level) in 1996, while the first batch of post-NERP students graduated from SSS in 1993. As treated and untreated students graduated simultaneously during this transition period, any labour market policy implemented during this time would have benefitted both the treatment and comparison groups.

Second, our baseline specification assumes a uniform school starting age across regions. In practice, school starting ages tend to differ geographically. We address this concern by re-estimating the effect on labour market outcomes using the variation in school starting age across districts. This is done by combining the mean age of beginning primary school across districts and birthyears of individuals to determine the year one first enters JSS/middle school—which then serve as the running variable and the cut-off occurring at 1987, the implementation year of NERP. Table S4 presents the results. The results from the table are consistent with the baseline regression, although the size of the effect is slightly smaller in this specification.

Third, we assess the sensitivity of results with respect to the inclusion or exclusion of outliers. The data suggest that some respondents did not know their exact ages and therefore used the nearest fifth or tenth birthyear as an approximation (for example, the frequency of people born in 1960 is 33330, whereas the frequencies between 1961 and 1964 are all hovering around 15000). To ensure that this clustering is not driving the discontinuity assessed in this study, we re-estimate the effect on labour market outcomes excluding those birthyears in which bunching is likely to occur. Table S5 presents the results. The overall pattern is consistent with our baseline specification, although effect sizes tend to be somewhat smaller in this specification. While this may suggest that the reform had a more pronounced effect on the labour market outcomes of individuals from low socio-economic backgrounds (who are less likely to know their exact date of birth), this finding must be interpreted with caution as the data do not allow us to explicitly test for heterogeneous effects by wealth level.

Fourth, Table S6 tests heterogeneity in effects across population groups by re-estimating the effect on labour market outcomes separately for men and women.[18] We find the

[18]We are only able to disaggregate effects by pre-determined characteristics (such as gender, religion or ethnicity). While it would have been interesting to test for heterogeneity in effects across geographic regions, this is complicated by the chosen focus on long-term labour market outcomes observed 20 years after the first batch of JSS students graduated. Given that rural–urban mobility is likely endogenous to educational attainment, selective migration would lead to biased estimates.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

reduction in the duration of pre-tertiary education has a stronger positive impact on the labour market success of women. This may be explained by the strong impact of the reform on post-primary education of women compared with men.[19]

Fifth, we check the robustness of findings with respect to the clustering of standard errors at different levels. In our baseline specification, standard errors are clustered at the district level. We experimented with two alternative specifications: (i) clustering standard errors by year of birth and (ii) clustering both by year of birth and at the district level using the multi-stage clustering method of Cameron, Gelbach and Miller (2011). As can be seen from Table S7, the estimated effects on formal sector employment and working as an employee remain significant across specifications.

6 CONCLUSION

In this study, we investigated the causal effect of shortening the duration of pre-university education on long-term labour market outcomes in Ghana. We used the education reform of 1987 as a natural experiment, whereby the nationwide restructuring of basic and secondary schooling drastically reduced the duration of pre-tertiary education from 17 to 12 years. Our identification strategy exploited the reform-induced discontinuity in the duration of schooling across pre-reform and post-reform birth cohorts who entered the labour market around the same time and thus faced the same macroeconomic environment and labour market conditions.

Our findings indicate that the reform, on average, improved the labour market success of treated cohorts. While we find no statistically significant effect on rates of labour force participation, results from our preferred specification indicate that NERP increased the probability of working in the formal sector by 8.2 percentage points and of working as an employee by 7.8 percentage points. We rule out changes in curriculum as potential drivers and attribute the identified effects to an expansion in access to education because of NERP. We detect a positive treatment effect on average literacy rates across education levels of 13 to 14 percentage points. Moreover, according to our preferred specification, the treatment group is on average 15.5 percentage points more likely than the comparison group to have completed secondary school and has a 5.1 percentage point higher likelihood of having acquired tertiary education. We argue that this was likely driven by a combination of three factors: first, the reduction in years of schooling freed resources to admit more students; second, the shorter course duration reduced the direct and indirect (opportunity) costs of obtaining a secondary school degree; and, third, additional financial support went into school building and rehabilitation.

However, this increase in the number of students acquiring higher levels of education came at the expense of lower quality. That is, compared with pre-NERP graduates, those who attained the same level of schooling in a shorter time under the post-NERP education system show worse literacy outcomes and are less likely to work in formal employment or as an employee, with the latter effects being more pronounced at higher levels of education. This result corroborates earlier claims in the literature pointing to major weaknesses of the reform in meeting its quality targets (Agyeman et al., 2000) and is consistent with the findings obtained by existing studies evaluating educational reforms in Germany and Canada, which generally suggest that a reduction in the years of secondary

[19]Secondary education among women increased by 16.6 compared with 14.5 percentage points among men.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

DOI: 10.1002/jid

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

education negatively affects human capital development and hence outcomes in the labour market (for example, Büttner & Thomsen, 2015; Krashinsky, 2014; Meyer & Thomsen, 2016; Thomsen, 2015).

Summarizing, the detected positive impact of the drastic reduction in the duration in pre-tertiary education induced by the 1987 reform on average long-term labour market outcomes in Ghana must be interpreted against the country context at the time. Three key factors deserve attention in this regard. First, the 17 years of pre-tertiary education in Ghana far exceeded the average of 12–14 years required in most of the world. The reduction by 5 years freed substantial resources, which allowed more students to enrol. Second, the restructuring of the education system was supplemented by additional resources provided for school building and rehabilitation, leading to further improvements in education access. Third, the reform was implemented at a time when enrolment rates were on the decline and the vast majority of students dropped out of education before completing secondary school, often owing to being unable to afford the direct and indirect costs of attendance. In such a setting, allowing more students to access and complete both basic and secondary education was of prime importance, and those who benefitted were able to seize better job opportunities. However, while, in this specific setting, the improvement in labour market outcomes due to better education access dominated the negative effects associated with the reduction in education quality, we expect that outcomes would have been yet more favourable if the quality had not been compromised. Moreover, as the evidence from other countries has shown, the quality effect may easily dominate in other settings, and governments should pay utmost attention not to compromise the quality of education when restructuring the duration of course programmes.

REFERENCES

Abekah-Nkrumah G, Asuming PO, Yusif H. 2019. Duration of high school education and youth labour market outcomes: evidence from a policy experiment in Ghana. *Journal of International Development* **31**(7): 617–631. https://doi.org/10.1002/jid.3429

Agyeman DK, Baku JJ, Gbadamosi R, Addabor E, Adoo-Adeku K, Cudjoe M. 2000. Review of education sector analysis in Ghana 1987–1998. In *Working group on education sector analysis*. UNESCO: Paris, France.

Akyeampong AK. 2002. Vocationalisation of Secondary School Education in Ghana: A Case Study. In *Regional Vocational Skills Development Review*. World Bank: Washington DC.

Akyeampong K, Djangmah J, Seidu A, Oduro A, Hunt F. 2007. Access to Basic Education in Ghana: The Evidence and the Issues. In *CREATE Country Analytic Review*. The University of Education at Winneba/University of Sussex.

Arrow KJ. 1973. Higher education as a filter. *Journal of Public Economics* **2**(3): 193–216. https://doi.org/10.1016/0047-2727(73)90013-3

Becker G. 1993. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, 3rd edition. The University of Chicago Press: Chicago, IL.

Boahen AE, Yamauchi C. 2018. The effect of female education on adolescent fertility and early marriage: evidence from free compulsory universal basic education in Ghana. *Journal of African Economies* **27**(2): 227–248. https://doi.org/10.1093/jae/ejx025

Büttner B, Thomsen SL. 2015. Are we spending too many years in school? Causal evidence of the impact of shortening secondary school duration. *German Economic Review* **16**(1): 65–86. https://doi.org/10.1111/geer.12038

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Cameron AC, Gelbach JB, Miller DL. 2011. Robust inference with multi-way clustering. *Journal of Business & Economic Statistics* **29**(2): 238–249.

Duflo E, Dupas P, Kremer M. 2017. *The Impact of Free Secondary Education: Experimental Evidence from Ghana*. Mimeo, MIT: n/a.

Elsayed A, Marie O. 2015. How does reducing years of compulsory schooling affect education and labor market outcomes in a developing country? Working paper, 944; Economic Research Forum (ERF).

Ghana Statistical Service. 2011. Ghana Population and Housing Census 2010 (10% at EA level), v1.0. Available at: http://www.statsghana.gov.gh/nada/index.php/catalog/51 (last access August 2020).

Ghana Statistical Service. 2014. Ghana Living Standards Survey VI 2012–2013 (GLSS 6), v1.0. Available at: https://www2.statsghana.gov.gh/nada/index.php/catalog/51 (last access August 2020).

Ghana Statistical Service. 2016. Ghana Living Standard Survey V 2005–2006 (GLSS 5), v2.0. Available at: https://www2.statsghana.gov.gh/nada/index.php/catalog/51 (last access August 2020).

Imbens GW, Kalyanaraman K. 2012. Optimal bandwidth choice for the regression discontinuity estimator. *The Review of Economic Studies* **79**(3): 933–959. https://doi.org/10.1093/restud/rdr043

Imbens GW, Lemieux T. 2008. Regression discontinuity designs: a guide to practice. *Journal of Econometrics* **142**(2): 615–635. https://doi.org/10.1016/j.jeconom.2007.05.001

Keichi O, Nishimura M. 2015. *Comparative Analysis on Universal Primary Education Policy and Practice in Sub-Saharan Africa: The Cases of Ghana, Kenya, Malawi and Uganda*, 1st edition. Sense Publishers: Rotterdam.

Knight J, Sabot R. 1990. *Education, Productivity and Inequality: The East African Natural Experiment*. Oxford University Press: Oxford.

Krashinsky H. 2014. How would one extra year of high school affect academic performance in university? Evidence from an educational policy change. *Canadian Journal of Economics/Revue canadienne d'économique* **47**(1): 70–97. https://doi.org/10.1111/caje.12066

Kuepié M, Nordman CJ. 2016. Where does education pay off in sub-Saharan Africa? Evidence from two cities of the Republic of Congo. *Oxford Development Studies* **44**(1): 1–27. https://doi.org/10.1080/13600818.2015.1110568

Lee DS, Lemieux T. 2010. Regression discontinuity designs in economics. *Journal of Economic Literature* **48**(2): 281–355. https://doi.org/10.1257/jel.48.2.281

Meyer T, Thomsen SL. 2016. How important is secondary school duration for postsecondary education decisions? Evidence from a natural experiment. *Journal of Human Capital* **10**(1): 67–108. https://doi.org/10.1086/684017

Meyer T, Thomsen SL, Schneider H. 2019. New evidence on the effects of the shortened school duration in the German states: an evaluation of post-secondary education decisions. *German Economic Review* **20**(4): e201–e253. https://doi.org/10.1111/geer.12162

Mincer J. 1991. Education and unemployment. NBER working paper, 3838. DOI: https://doi.org/10.3386/w3838

Murphy R. 1988. *Social Closure: The Theory of Monopolization and Exclusion*. Clarendon Press: Oxford.

Osei GM. 2004. The 1987 junior secondary-school reform in Ghana: vocational or pre-vocational in nature? *International Review of Education* **50**: 425–446. https://doi.org/10.1007/s11159-004-4616-9

Oyelere RU. 2010. Africa's education enigma? The Nigerian story. *Journal of Development Economics* **91**(1): 128–139. https://doi.org/10.1016/j.jdeveco.2009.04.001

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Ozier O. 2016. The impact of secondary schooling in Kenya: a regression discontinuity analysis. *Journal of Human Resources* **53**(1): 157–188. https://doi.org/10.3368/jhr.53.1.0915-7407R

Parkin F. 1979. *Marxism and Class Theory: A Bourgeois Critique*. Tavistock Press: London.

Spence M. 1973. Job market signaling. *Quarterly Journal of Economics* **87**(3): 355–374. https://doi.org/10.2307/1882010

Stiglitz EJ. 1975. The theory of screening, education and distribution of income. *The American Economic Review* **65**(3): 283–300.

Tanaka C. 2012. Profile and status of untrained teachers: experiences in basic schools in rural Ghana. *Compare: A Journal of Comparative and International Education* **42**(3): 415–438. https://doi.org/10.1080/03057925.2011.634540

Thiel H, Thomsen SL, Büttner B. 2014. Variation of learning intensity in late adolescence and the effect on personality traits. *Journal of the Royal Statistical Society, Series A* **177**(4): 861–892.

Thomsen SL. 2015. The impacts of shortening secondary school duration. *IZA World of Labor* **166**: https://doi.org/10.15185/izawol.166

World Bank. 2004. *Books, Buildings, and Learning Outcomes: An Impact Evaluation of World Bank Support to Education in Ghana*. World Bank, Operations Evaluation Department (OED): Washington DC.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

© 2020 UNU-WIDER. Journal of International Development published by John Wiley & Sons Ltd.

10991328, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/jid.3519 by University of Ghana - Accra, Wiley Online Library on [26/04/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License