Signaling Workers' Quality in a Developing Country: Lessons from a Certification Program

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Introduction

$\Rightarrow$ This paper aims to identify the returns to signaling occupation-specific skills.

Motivation

- Firms confront a complex employment decision-making process, often characterized by limited information concerning the skills of potential workers (Oyer, Schaefer, et al. 2011).

- Traditionally, firms rely on general measures of human capital to infer workers' occupation-specific skills and productivity, which may be misleading.
    - For example, for certain low-skilled occupations, there may not be enough variation in schooling to accurately infer productivity.

- Therefore, there are potential gains from providing performance measures of the fundamental tasks that define particular occupations.
    - Policy benefits may be quite significant in developing countries, where information frictions are potentially bigger (Bloom et al. 2010; Hall and Jones 1999; McKenzie 2017).

This Paper

We use a **Regression Discontinuity design** to estimate the effect of signaling occupation-specific skills on income.

- The signaling device is a **certificate** issued by a government agency in Colombia (SENA).
- The agency is responsible for evaluating and certifying the skills possessed by workers performing various productive activities.
- Program participants expect **four mutually exclusive and exhaustive outcomes** depending on their performance in the certification exam: no certificate, **basic** [30,60), **intermediate** [60,90), or **advance** [90,100].
- We use administrative records from contributions to the social security system (PILA) to obtain income and employment status information for the two years following certification.

Contribution

Three elements distinguish this paper from previous work:

- This paper focuses on the returns of signaling occupation-specific skills while previous research mostly focuses on academic aptitude (Clark and Martorell 2014), general skills (Abel et al. 2020), noncognitive skills (Bassi and Nansamba 2022), or field-specific skills (Busso et al. 2023).

- Our design allows us to investigate the return to signaling among older workers, while most of the literature evaluates the effects of signals that occur earlier in life.

- This paper examines the impact of signaling skills with varying content, whereas previous research has primarily focused on dichotomous signals (Clark and Martorell 2014; Jepsen et al. 2016; Machin et al. 2020; Tyler et al. 2000).

Program Description

- Since 2004, a government agency in Colombia, SENA, has evaluated and certified workers' skills in different occupations.

- The certification process requires examining the candidate's knowledge and proficiency of particular **technical norms defining the quality standards for a specific occupation**.

- In total, SENA certifies occupation-specific skills in more than 900 technical norms.

- Participants must prove six months of experience in the tasks regulated by the technical norm on which they want to be certified.

- The process takes approximately four weeks and is entirely free.

Certification Process

1. **First Part:** Participants perform the task (or tasks) described in the technical norm in front of a group of SENA officials.
   - <u>Outcome</u>: Fail/Pass grade (almost everybody passes).

2. **Second Part:** Multiple choice exam evaluating the knowledge of the technical norm.
   - Computer-based exam.
   - Questions based on a bank of predefined questions. The length of the exam ranges from 18-40 questions.
   - The exam is graded from 0 to 100 points, which determines the level of certification.
   - Participants are only informed about the certification level obtained. They do not see the score. `Certificate`
   - <u>Outcome</u>: no certificate, **basic** [30,60), **intermediate** [60,90), or **advance** [90,100].

   $\implies$ In our analysis, we exploit the discontinuity around these certification thresholds.

Data

Certification Data

- Data on all individuals who started the certification process between January 2017 and December 2019 (668,927 participants).
- Information on:
  - Technical norm to which they apply to be certified,
  - Score on the first and second parts of the exam,
  - Socio-demographic information.

Labour Market Outcomes

- Employer-employee-linked administrative data from PILA.
- Information on:
  - Earnings,
  - Employment type (salaried work, self-employment, other),
  - Worker transitions between employers and in and out of PILA.

$\Rightarrow$ We focus on a sample of men (67% of participants).

Descriptive Statistics

	Full Sample	Estimation Sample
	A. Demographic Characteristics	
Demographic Characteristics		
Male	0.70	
Age	38.24	41.99
Less Than High School	0.19	0.20
High School	0.41	0.46
Some College	0.37	0.30
More Than College	0.04	0.04
	B. Certification Program	
Certification Level (Mean)		
No Certification	0.01	0.01
Basic	0.13	0.13
Intermediate	0.40	0.39
Advanced	0.47	0.47
Certification Two-Part Exam (Mean)		
First	99.15	99.02
Second	81.97	82.02
	C. Labour Market Outcomes	
Employment Rate		0.88
Self-Employment		0.09
Income (1000s)		1,153
Ln of Income		13.96
Individuals	627,340	181,691
Observations		1,434,061

Empirical Strategy

- Sharp regression discontinuity design (Cattaneo et al. 2020; Lee and Lemieux 2010).
- $T_{it}^c = 1(score > c)$ is an indicator taking the value of one if individual i, taking the exam in year t, obtains a certification score, $score_{it}$, above the threshold c.
- Thresholds of interest: 30 (basic), 60 (intermediate), 90 (advanced).
- Main specification:

$$Y_{is} = \alpha + \beta score_{it} + \delta_{RD}^c T_{it}^c + \tau score_{it} \times T_{it}^c + \gamma Z_i' + \varepsilon_{is} \quad (1)$$

- Y_{is}: Ln(earnings) $s > 0$ quarters after certification.
- Z_i are predetermined covariates: age, education dummies, industry FE.
- Equation (1) estimated using individuals with scores within a chosen optimal bandwidth h (Cattaneo et al., 2020).

Validity of the design

Main Results

Table: Sharp RD Estimates of the Effects of Obtaining a Basic, Intermediate, and Advanced Certificate on Log of Income - Two Years After Certification

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Basic Certificate	0.019	0.028	0.002	-0.009	0.027	0.049	0.039	0.062
	(0.030)	(0.037)	(0.037)	(0.040)	(0.034)	(0.043)	(0.031)	(0.033)
# of Observations	164,242	162,247	160,912	159,819	158,344	156,895	155,954	140,679
Optimal Bandwidth	10.140	7.738	9.994	10.470	7.661	9.038	7.203	8.306
Intermediate Certificate	-0.010	-0.002	-0.001	-0.013	-0.006	0.009	0.017	0.008
	(0.013)	(0.013)	(0.013)	(0.013)	(0.016)	(0.016)	(0.018)	(0.018)
# of Observations	164,242	162,247	160,912	159,819	158,344	156,895	155,954	140,679
Optimal Bandwidth	8.798	9.714	9.357	8.753	10.300	10.790	11.000	10.410
Advanced Certificate	0.087**	0.087**	0.082*	0.127***	0.104***	0.094***	0.099**	0.099**
	(0.028)	(0.031)	(0.034)	(0.029)	(0.029)	(0.027)	(0.032)	(0.032)
# of Observations	164,242	162,247	160,912	159,819	158,344	156,895	155,954	140,679
Optimal Bandwidth	3.955	3.548	2.981	3.684	3.625	4.113	3.082	3.013

Note: Standard errors are clustered at the technical norm level.; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Robustness Checks

Main conclusion: No effect on income for the basic or intermediate certificate. Obtaining an advanced certificate has a substantial effect on income.

- The certificate seems to provide new and reliable information to incumbent and/or potential employers.
- The effects are comparable to spending an additional year at school in Colombia (Garcia-Suaza et al. 2014; Herrera-Id'arraga et al. 2015; Morales et al. 2021).

Results are robust to:

- Including year and location fixed effects and excluding controls, using alternative bandwidths, and using non-bias-corrected RD estimates (Calonico et al. 2014).
- Using a sample of men and women, and a sample of salaried workers (at time of certification).

Additional falsification tests:

- Placebo thresholds, away from the real thresholds determining the treatment assignment.

Heterogeneity - Advanced Certificate

- **Education:** We estimate a gradient of positive and significant returns for the advanced certificate, suggesting that:
  - Information about schooling reinforces the revelation of ability provided by the certificate.
- **Employment status:** Positive returns for all workers, except for those initially unemployed.
  - The returns take time to materialize for self-employed workers.
- **Tenure and firm size (salaried workers only)**: Returns primarily observed among workers with a minimum of three years of tenure and working in large firms.
  - Potential explanation: while employers revise their priors about workers' productivity, promotion or wage adjustments are usually available for tenured workers.
  - Also, larger firms offer better career progression opportunities than smaller firms (Oi and Idson 1999).

Table

Mechanisms - Advanced Certificate

- **The certificate transfers valuable information about productivity to potential employers, facilitating transitions.**
  - Self employed workers move to salaried work upon obtaining the advanced certificate.
  - Such transition occurs three quarters after obtaining the certificate, consistent with a frictional labor market.

Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate - Initially Self-Employed

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Ln (income)	0.005	0.102*	0.088	0.155*	0.093*	0.211**	0.118*	0.200**
	(0.037)	(0.048)	(0.064)	(0.069)	(0.043)	(0.069)	(0.057)	(0.068)
# of Observations	14,972	14,495	14,305	14,182	13,983	13,800	13,729	12,267
Bandwidth	5.965	3.904	3.133	2.287	4.034	2.266	3.703	3.085
Salaried Work	-0.009	0.018	0.062	0.189**	0.135*	0.166***	0.201***	0.127*
	(0.030)	(0.040)	(0.051)	(0.058)	(0.059)	(0.050)	(0.058)	(0.057)
# of Observations	16,502	16,502	16,502	16,502	16,502	16,502	16,502	14,692
Bandwidth	3.162	3.251	2.057	1.816	1.936	2.583	2.059	3.001

Note: Standard errors are clustered at the technical norm level.; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

- No evidence of transitions to salaried work for those initially unemployed: employers seem to complement the signal from the certificate with information from current employment status.

Table

Mechanisms - Advanced Certificate

- The certificate transfers valuable information about productivity to **incumbent** employers.

- Firms are willing to keep their "talented" workers (Moen and Rosen, 2004).
  - Salaried workers do not reallocate to other employment sectors.
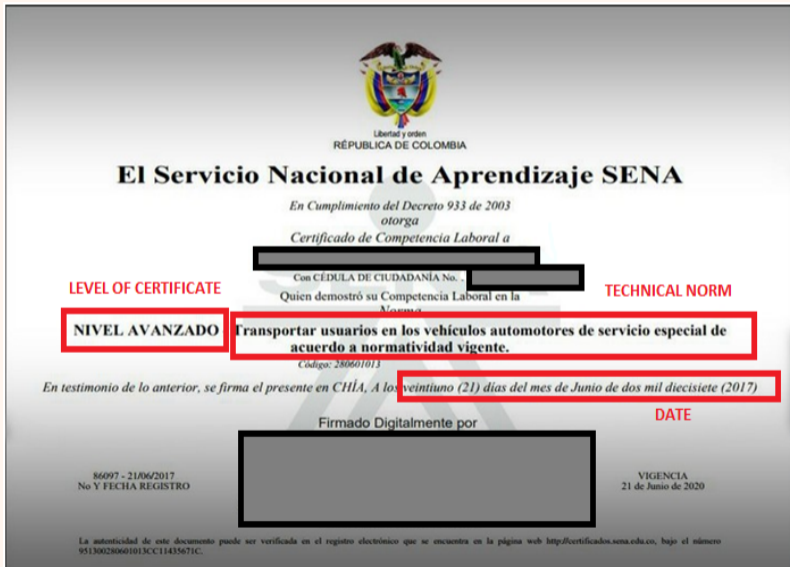 - The change in income is driven by movements within the same firm.

Table: Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate: Income and Job-to-Job Transitions

	Q4 - J2J Transition	Q8 - J2J Transition	Q4 - No J2J Transition	Q8 - No J2J Transition
Ln (Income)	0.084	0.086	0.136***	0.107**
	(0.094)	(0.061)	(0.033)	(0.036)
# of Observations	23,599	32,661	116,295	90,188
Bandwidth	2.448	3.026	3.599	3.393

Note: Standard errors are clustered at the technical norm level.; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Conclusion

- We use an RD design to find causal evidence of the effect of signaling occupation-specific skills on income.

- **Finding 1**: No effect on income for the basic or intermediate certificate.

- **Finding 2**: Obtaining an advanced certificate has a substantial effect on income.
  - Returns are significant and depend on initial employment status.
  - The certificate transfers valuable information about productivity to potential (signaling channel) and incumbent employers (promotion channel).

- Our findings are (partly) compatible with traditional learning models where wages adjust upon the arrival of new information about productivity;
  - In the context of a frictional labor market: limited opportunities for promotions and wage adjustments.

Certificate

RÉPUBLICA DE COLOMBIA
Libertad y orden

El Servicio Nacional de Aprendizaje SENA

En Cumplimiento del Decreto 933 de 2003
otorga
Certificado de Competencia Laboral a

Con CÉDULA DE CIUDADANÍA No.

Quien demostró su Competencia Laboral en la Norma

LEVEL OF CERTIFICATE

TECHNICAL NORM

NIVEL AVANZADO

Transportar usuarios en los vehículos automotores de servicio especial de acuerdo a normatividad vigente.

Código: 280601013

En testimonio de lo anterior, se firma el presente en CHÍA, A los veintiuno (21) días del mes de Junio de dos mil diecisiete (2017)

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Validity

Two falsification tests that support the validity of the RD design.

1. Examine the density of the running variable, $score_{it}$, around each threshold.
2. Investigate whether treated individuals are similar in terms of predetermined characteristics around each threshold.

Validity Test 1 - Manipulation of Score

1. Manipulation of the score seems unlikely in our context for several reasons:
   - The test format is multiple choice,
   - The grading is performed (by a computer) in a location different than the testing location, and
   - The underlying score is not revealed to participants.

2. We formally test for the presence of manipulation of the score using the test proposed by Frandsen (2017).
   - The results of the manipulation test around all three thresholds lead us to fail to reject the null of the absence of manipulation.

Validity Test 1 - Manipulation of Score
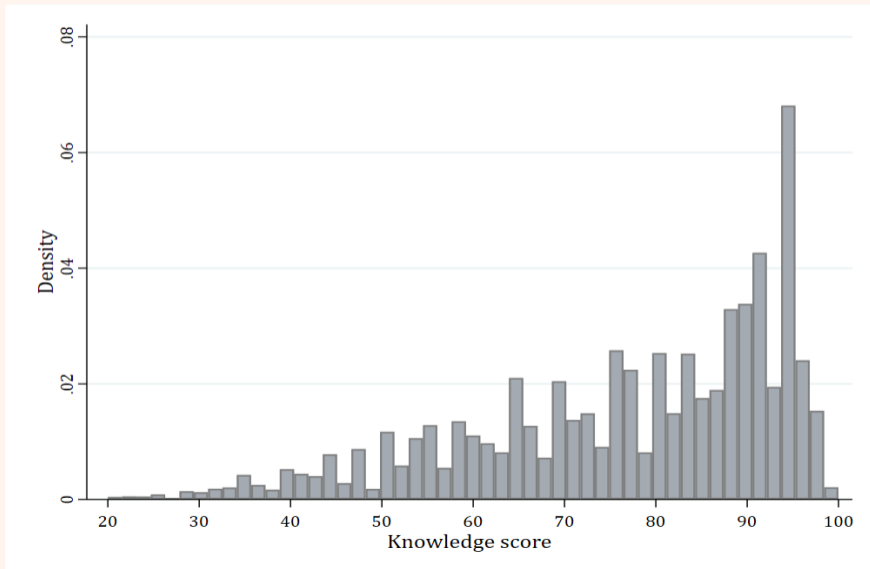
Validity Test 2 - Covariate Balance Check

	(1) Threshold 30	(2) Threshold 60	(3) Threshold 90
Age	1.204	-0.142	-0.105
	(0.959)	(0.342)	(0.734)
High School	0.052	-0.049*	-0.050
	(0.054)	(0.019)	(0.032)
Some College	-0.014	-0.001	-0.031
	(0.061)	(0.023)	(0.056)
More Than College	0.017*	0.006	0.001
	(0.007)	(0.004)	(0.014)
Income at Certification (1000s)	36.989	-31.001	91.652
	(50.301)	(29.250)	(79.819)
Number of Observations	181,395	181,395	181,395
Bandwidth	8.600	9.900	3.300

⇒ Individuals just below each corresponding threshold are not statistically different from individuals just above the threshold. Go back

Heterogeneity - Further Results

Table: Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1. By education level								
1a. Less than high school	0.078	0.065	0.039	0.181*	0.073	0.057	0.034	0.053
	(0.042)	(0.043)	(0.040)	(0.072)	(0.044)	(0.046)	(0.039)	(0.049)
1b. High school	0.054	0.056	0.063	0.082*	0.079*	0.093*	0.072*	0.073*
	(0.035)	(0.036)	(0.035)	(0.037)	(0.035)	(0.038)	(0.034)	(0.035)
1c. More than high school	0.151*	0.125*	0.115	0.184**	0.155**	0.133	0.170*	0.099
	(0.059)	(0.056)	(0.062)	(0.062)	(0.057)	(0.076)	(0.075)	(0.054)

Go back

Heterogeneity - Further Results

Table: Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
2. By Emp Status								
2a. Unemployed	-0.067	-0.149	-0.005	0.117	-0.218	0.171	0.050	0.122
	(0.105)	(0.084)	(0.073)	(0.073)	(0.118)	(0.116)	(0.068)	(0.088)
2b. Self-Employed	0.005	0.102*	0.088	0.155*	0.093*	0.211**	0.118*	0.200**
	(0.037)	(0.048)	(0.064)	(0.069)	(0.043)	(0.069)	(0.057)	(0.068)
2c. Salaried Worker	0.100**	0.097*	0.086*	0.141***	0.122***	0.106**	0.105**	0.101**
	(0.037)	(0.039)	(0.036)	(0.035)	(0.035)	(0.034)	(0.034)	(0.034)

Go back

Heterogeneity - Further Results

Table: Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
3. By Tenure								
3a. Less than 3 Years	0.025	0.028	-0.068	0.062	0.035	0.021	-0.022	-0.021
	(0.041)	(0.046)	(0.060)	(0.047)	(0.051)	(0.053)	(0.064)	(0.067)
3b. 3 or More Years	0.112**	0.103**	0.120***	0.150***	0.139***	0.107**	0.114**	0.108**
	(0.039)	(0.038)	(0.035)	(0.037)	(0.040)	(0.033)	(0.036)	(0.035)
4. By Firm Size								
4a. 1 to 50 Workers	0.076	0.135	0.064	0.113	0.189	0.254	0.166	0.267
	(0.094)	(0.084)	(0.140)	(0.127)	(0.120)	(0.140)	(0.104)	(0.170)
4b. > 50 Workers	0.111**	0.063	0.081*	0.143***	0.115***	0.085*	0.086*	0.085*
	(0.038)	(0.043)	(0.039)	(0.035)	(0.035)	(0.034)	(0.035)	(0.034)

Go back

Mechanisms - Advanced Certificate - Initially Unemployed

Table: Sharp RD Estimates of the Effects of Obtaining an Advanced Certificate

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Ln(Income)	-0.067	-0.149	-0.005	0.117	-0.218	0.171	0.050	0.122
	(0.105)	(0.084)	(0.073)	(0.073)	(0.118)	(0.116)	(0.068)	(0.088)
# of Observations	7,676	8,156	8,378	8,521	8,800	8,936	8,967	8,158
Bandwidth	3.056	2.945	5.326	3.395	2.594	5.445	3.429	5.248
Salaried Work	0.181	0.046	0.084	-0.005	0.070	-0.058	-0.046	-0.087
	(0.132)	(0.104)	(0.105)	(0.080)	(0.106)	(0.080)	(0.140)	(0.122)
# of Observations	14,851	14,851	14,851	14,851	14,851	14,851	14,851	13,485
Bandwidth	2.593	2.715	2.612	3.937	2.521	3.568	2.402	2.694

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