

The impacts of studying abroad: evidence from a massive government-sponsored scholarship program in Brazil

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Disclaimer

All opinions and results from this work do not represent the UN view about this or any students abroad program.

Preliminary version: please do not circulate.

Motivation

- International student mobility programs have risen in the world in the last decades.
 - **Goals:** boost students' human capital, increase their cultural perspectives and create international networks among partner countries.
 - The most famous policy worldwide is the ERASMUS program in Europe
 - It is well known that ERASMUS increases the probability of students working abroad after the program

Motivation

- In developing countries with low science and education investments, these programs are even more important to enhance the quality of human capital in technical fields
- Although many developing countries (such as: Mexico, Colombia, Chile, Saudi Arabia) have launched international students mobility programs little is known about the impacts of these policies.

Paper in a nutshell

- We estimate the impacts of the program on:
 - Enrollment on Masters and Ph.D. programs in Brazil
 - Formal employment, wages and entrepreneurship

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 - Add to the few pool of papers estimating causal effects of those programs
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 - We propose a new IV using the competitiveness of each scholarship call as instrument
- **Main results:** Negative impacts on post-graduation and probability of having a formal job. No impacts on wages and entrepreneurship.
- Mechanism: **higher** delayed graduation and **lower** probability of brain drain

Literature

There are 4 literature reviews about studying abroad programs.
Main evidence:

- Papers do not provide reliable causal estimates
 - Exception: Parey and Waldinger (2011)
 - compares movers versus non-movers using survey data
- All papers studied European countries, most of them the ERASMUS program
- Most of the studies focuses on migration, and employment.
More recently, wages (Giorgio, 2021; Netz and Cordua, 2021)

The Science Without Borders program

- Created by the Brazilian Ministry of Education in July 2011
 - **Goal:** Send students for 6-12 months exchange period.
- **Focus on undergraduates**, which accounted for 79% (73,353) of the scholarships between 2011 and 2016.
 - Between 1987 and 2000, CAPES and CNPQ offered 13,819 scholarships (for undergrad, Ph.D. and post-doc).

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 - Between 1987 and 2000, CAPES and CNPQ offered 13,819 scholarships (for undergrad, Ph.D. and post-doc).
- CAPES and CNPq (Ministry of Science, Technology and Innovation) were responsible for selecting scholarship recipients, priority areas, scholarship values, and higher education institutions in partner countries.
- Only students from the **priority areas (mostly the majors in STEM-related fields)** were eligible for a scholarship

The Science Without Borders program

- **Benefits:** monthly stipend, airfare, housing allowance, health insurance, installation aid, and aid for educational materials.
- **Very high costs:** US\$ 2.72 billion (BRL 15 billion in 2022) or US\$ 27.2 thousand (BRL 150 thousand) per recipient on average (FAPESP, 2017). EU spent EU 14bi on ERASMUS between 14-20.
- It represents at least **5x the average expenditure necessary to maintain a student in a public university during one year in Brazil**. It is almost **15x the budget of CNPq in 2016**. Or the same cost of a school meal program that attends 39 million of children.

Figure: Government spending with science and technology in Brazil (in BRL millions)

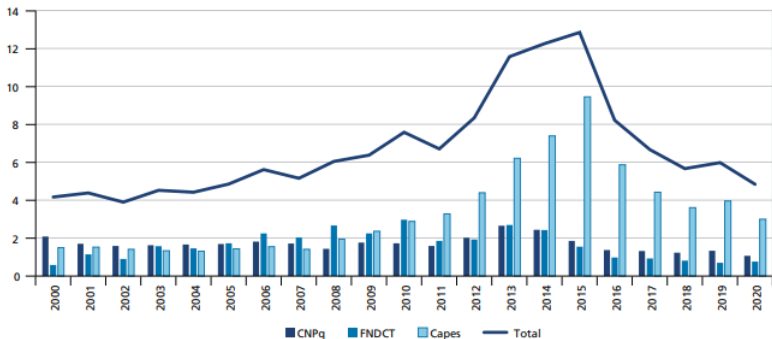
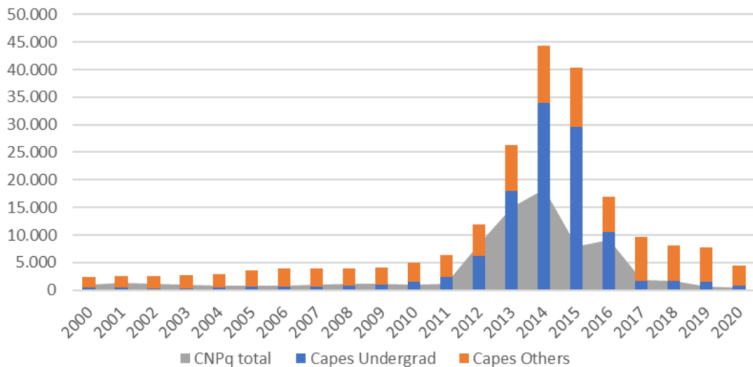


Figure: Number of government-sponsored undergraduate scholarships per year in Brazil

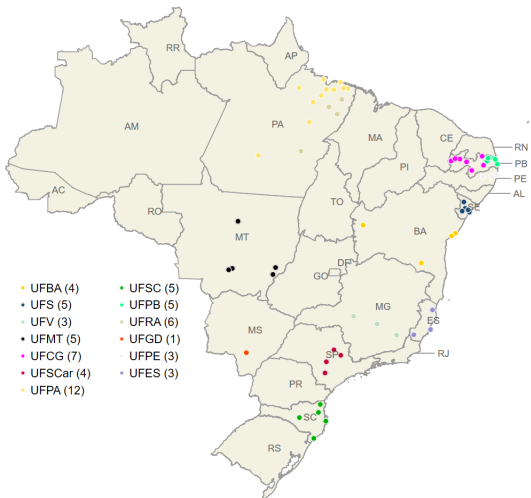


Empirical Strategy: Data

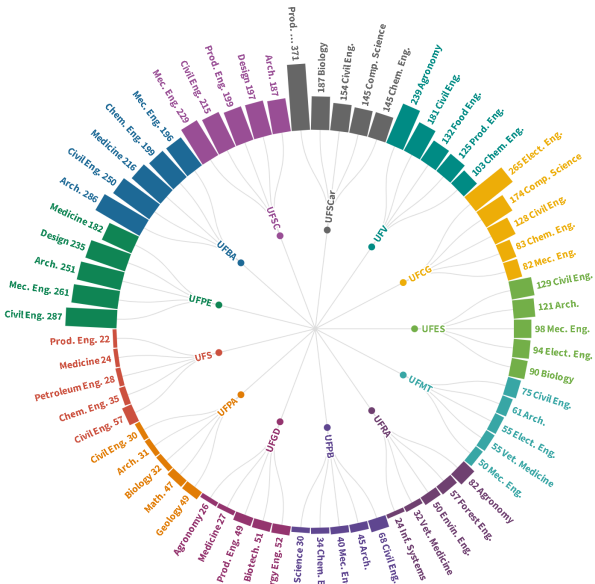
We build a novel data set comprising public and non public registries. We merged the data sets using probabilistic linkages using the Brazilian social security number (e.g., ***-123-456-**) and complete names.

- Non public:
 - **CSF candidates registry:** applicants x approved. Provided by CNPQ and CAPES.
 - **University records:** entrance exam score, enrollment year, major provided by each university
 - **Formal Labor Market (RAIS):** painel data with employment status and wages.
- Public:
 - **Post graduation:** enrollment in a graduate program in Brazil.
 - **Formal entrepreneurship:** firm registry as a partner.
- Add non-public: detailed students history at UFBA.

Sample distribution



Candidates by home university



Descriptive Statistics

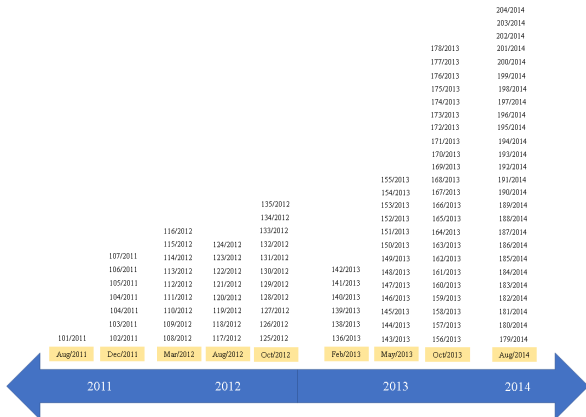
Call's year/ University (1)	# students (2)	Approved (%) (3)	Prop. (4)	Labor market		Post-grad educ.		Entrepreneurship		Neither/nor	
				No. (5)	% (6)	No. (7)	% (8)	No. (9)	% (10)	No. (11)	% (12)
<i>Panel A. Number of candidates by first call's year</i>											
Total	19,245	50	-	6,366	33.1	4,509	23.4	4,955	25.7	6,929	36
2011	639	60.4	3.3	226	35.4	145	22.7	217	34	196	30.7
2012	6,371	47.6	33.1	2383	37.4	1,478	23.2	2,099	32.9	1,950	30.6
2013	8,429	55.1	43.8	2660	32	1,958	23.2	1,983	23.5	3,168	37.6
2014	3,806	41.1	19.8	1,097	29	928	24.4	656	17.2	1,615	42.4
<i>Panel B. Number of candidates by home university</i>											
UFBA	2,825	48.9	Northeast	848	30	765	27.1	581	20.6	1,094	38.7
UFCG	1,250	48.5	Northeast	366	29.3	237	19	412	33	469	37.5
UFES	1,431	46.4	Southeast	458	32	355	24.8	399	27.9	488	34.1
UFGD	273	41.4	Central West	103	37.7	58	21.2	94	34.4	78	28.6
UFMT	742	35.2	Central West	253	34.1	212	28.6	189	25.5	237	31.9
UFPA	506	46.4	North	143	28.3	72	14.2	181	35.8	186	36.8
UFPB	501	56.9	Northeast	123	24.6	105	21	125	25	223	44.5
UFPE	3,181	49.2	Northeast	1,095	34.4	729	22.9	788	24.8	1,175	36.9
UFRA	285	33.7	North	80	28.1	46	16.1	139	48.8	76	26.7
UFS	477	47	Northeast	128	26.8	92	19.3	127	26.6	203	42.6
UFSC	3,537	49.4	South	1,220	34.5	1,005	28.4	863	24.4	1,197	33.8
UFSCar	2,282	58.5	Southeast	894	39.2	466	20.4	529	23.2	787	34.5
UFV	1,955	57.1	Southeast	655	33.5	367	18.8	528	27	716	36.6

Empirical Strategy:

$$Y_{i,c} = \beta_0 + \beta_1 \text{Approved}_{i,c} + \beta_2 \text{Entrance_Exam}_{i,c} + \beta_3 \text{Male}_i + \beta_4 \text{Dup_Major}_i + \alpha_s + \pi_u + \theta_m + \mu_y + \psi_d + \varepsilon_{i,c} \quad (1)$$

- $Y_{i,c,s,m,u,y,d}$ is one of the outcomes
- $\text{Approved}_{i,c,y,d}$ is a dummy if the student received the sch.
- $\text{Entrance_Exam}_{i,m,s,u}$ is the vestibular score
- α_s , π_u , θ_m , μ_y and ψ_d are admission year, major, university, and call fixed effect
- Standard errors clustered at call level

Instrument: Program calls



- **Important for the IV validity:** No one knew the program call schedule.

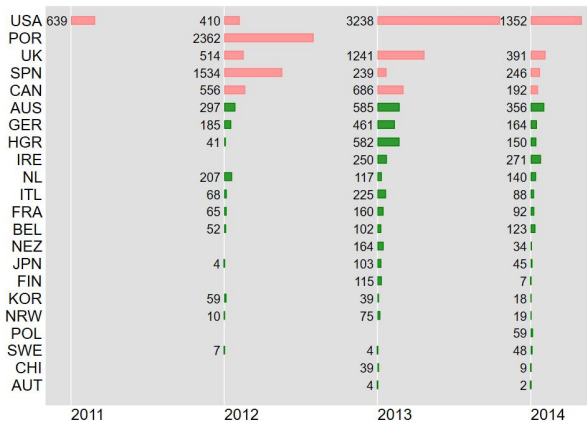
Program selection and IV

- Program selection:
 - 1) CSF launch the call (e.g. UK, March 2013)
 - 2) Students apply in their university
 - 3) Each university send a shortlist to CNPQ and CAPES
 - 4) CNPQ and CAPES select students based on the entrance exam score and to guarantee geographical diversity

Program selection and IV

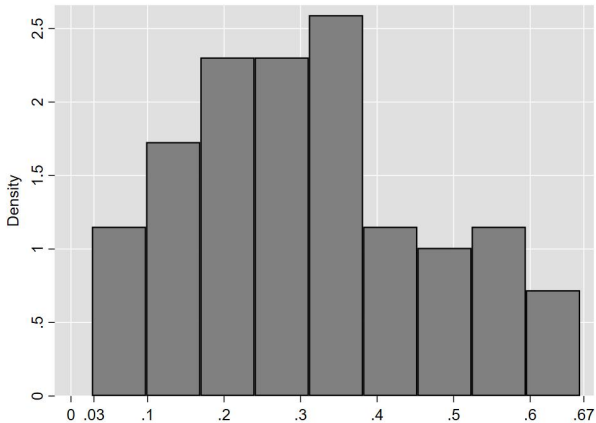
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- We created a measure of each program call competitiveness:
 - Discounted call approval rate: share of approved per-call excluding the candidates from the 13 universities in the sample.
 - Intuition: more students from other university approved in a given call, less competitive is the call
 - More competitive a call is, the less likely it is for a given applicant from one of the thirteen universities in the sample to receive a scholarship scholarship.

candidates by destination country and launching year



Important: candidates did not know the number of slots available and if there would be new calls for the same destination country

Call approval rate distribution:



Year	Dest. country	Call no.	No. approved	No. applicants	Approval rate	Disc. approval rate	ENEM's threshold score
2011	USA	101/2011	930	7,997	11.6%	10.3%	241
		102/2011	864	16,256	5.3%	3.4%	-
2012	Australia	112/2012	611	1,560	39.2%	39.1%	527
		119/2012	713	1,176	60.6%	59.9%	-
		125/2012	35	117	29.9%	30.0%	-
	Belgium	110/2012	28	163	17.2%	17.2%	686
		111/2012	30	183	16.4%	17.7%	623
	Canada	108/2012	179	1,022	17.5%	17.0%	393
		109/2012	765	1,350	56.7%	56.4%	465
		120/2012	1,538	2,564	60.0%	60.2%	420
	Netherlands	124/2012	67	447	15.0%	15.4%	-
		116/2012	366	1,057	34.6%	35.4%	574
		122/2012	373	661	56.4%	61.0%	-
		113/2012	1,541	12,126	12.7%	12.8%	679
	Portugal	127/2012	8,215	28,191	29.1%	25.5%	-
		114/2012	173	464	37.3%	36.4%	568
South Korea	121/2012	132	252	52.4%	54.1%	-	
	115/2012	1,678	9,918	16.9%	17.1%	269	
Spain	126/2012	443	1,524	29.1%	28.5%	462	
	117/2012	1,565	4,272	36.6%	33.8%	-	
USA	131/2012	120	616	19.5%	18.4%	-	
	132/2012	158	748	21.1%	18.3%	536	

Year	Dest. country	Call no.	No. approved	No. applicants	Approval rate	Disc. approval rate	ENEM's threshold score
2013	Australia	148/2013	614	1,877	32.7%	31.6%	646
		153/2013	193	1,208	16.0%	15.6%	497
		167/2013	682	1,306	52.2%	53.0%	546
	Austria	172/2013	405	1,117	36.3%	35.4%	628
		139/2013	14	135	10.4%	7.6%	613
		166/2013	15	64	23.4%	20.3%	551
	Belgium	140/2013	72	421	17.1%	16.3%	629
		141/2013	11	177	6.2%	5.7%	-
		175/2013	23	160	14.4%	15.6%	-
	Canada	176/2013	42	113	37.2%	38.1%	-
		147/2013	716	1,897	37.7%	36.3%	-
		149/2013	608	2,431	25.0%	25.5%	581
		152/2013	49	705	7.0%	7.1%	636
		168/2013	667	1,259	53.0%	52.8%	585
	China	171/2013	72	562	12.8%	12.1%	-
		136/2013	226	664	34.0%	30.7%	243
		163/2013	80	383	20.9%	18.8%	600
	Finland	142/2013	58	304	19.1%	18.7%	672
		154/2013	20	359	5.6%	5.4%	-
	Germany	173/2013	32	136	23.5%	22.0%	-
		144/2013	959	1,827	52.5%	49.5%	-
	Hungary	157/2013	1,474	2,388	61.7%	58.7%	-
		146/2013	1,443	3,097	46.6%	43.6%	545
		164/2013	337	2,540	13.3%	12.7%	603
	Ireland	138/2013	532	1,739	30.6%	25.7%	236
		162/2013	983	2,200	44.7%	40.9%	288
Japan	145/2013	220	532	41.4%	37.8%	601	
	165/2013	135	751	18.0%	16.4%	600	
New Zealand	155/2013	64	1,155	5.5%	5.3%	667	
	174/2013	97	368	26.4%	25.6%	662	
South Korea	150/2013	56	219	25.6%	24.6%	-	
	169/2013	78	166	47.0%	48.3%	635	
UK	151/2013	1,864	4,775	39.0%	39.1%	403	

First stage

Dependent variable: Approved	First call		Last call		Single-call candidates	
	(1)	(2)	(3)	(4)	(5)	(6)
Ratio	1.183*** [0.208] (4.829)		1.165*** [0.173] (4.835)		1.206*** [0.183] (4.513)	
Ratio top 25th pctl.		0.143*** [0.041] (2.243)		0.154*** [0.039] (2.714)		0.154*** [0.040] (2.618)
Entrance exam score	0.186*** [0.018]	0.187*** [0.018]	0.203*** [0.017]	0.205*** [0.017]	0.215*** [0.018]	0.218*** [0.017]
Obs	17,007	17,007	16,999	16,999	14,271	14,271
No. clusters	98	98	97	97	97	97
F-stat of Instrument	32.49	12.45	45.43	15.40	43.21	14.77

Inference: Lee, D., J. McCrary, M. Moreira, and J. Porter (2021): "Valid t-ratio Inference for IV," Tech. rep., NBER Working Paper No. 29124.

First stage - Other specifications

Dependent variable: Approved								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel A. Single-call candidates</i>								
Ratio	1.043*** [0.226] (3.528)	0.959*** [0.221] (3.245)	0.720*** [0.174] (3.022)	1.085*** [0.238] (3.474)	1.206*** [0.183] (5.017)	0.669*** [0.155] (3.238)	1.284*** [0.234] (4.563)	1.386*** [0.463] (1.606)
Entrance exam score		0.223*** [0.033]	0.236*** [0.023]	0.248*** [0.020]	0.215*** [0.018]	0.274*** [0.023]	0.253*** [0.020]	0.234*** [0.037]
Admission year (cohort) FE	No	No	Yes	Yes	Yes	No	No	No
Major FE	No	No	Yes	Yes	Yes	No	No	No
Home university (HEI) FE	No	No	Yes	Yes	Yes	No	No	No
Dest. country FE	No	No	No	Yes	Yes	No	No	No
Call year FE	No	No	No	No	Yes	No	No	No
Cohort-major-HEI FE	No	No	No	No	No	Yes	Yes	No
Dest. country-call year FE	No	No	No	No	No	No	Yes	No
Cohort-major-HEI-dest. country-call year FE	No	No	No	No	No	No	No	Yes
Obs	16,151	14,272	14,271	14,271	14,271	14,215	14,215	9,489
No. clusters	97	97	97	97	97	97	97	82
F-stat of Instrument	21.24	18.85	17.18	20.81	43.21	18.65	30.08	8.97

Effects of Science Without Borders on post-graduation

	+1 year	+2 years	+3 years	+4 years	+5 years	Pooled
Panel A: Probability of enroll in a post graduation program						
Approved	-0.028** [0.013]	-0.087*** [0.024]	-0.126*** [0.037]	-0.097** [0.040]	-0.075** [0.034]	-0.066** [0.028]
Mean dep. var	0.02	0.08	0.15	0.21	0.26	0.28
Obs	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97

	Excellent postgrad. program	Other state	Academic production >0	Manuscript authorship	Technical production >0	Project membership
Panel B: Academic Quality outcomes (Pooled post-call period)						
Approved	0.008 [0.015]	-0.069** [0.028]	-0.027 [0.023]	-0.004 [0.018]	0.002 [0.005]	-0.013 [0.020]
Mean dep. var	0.03	0.28	0.16	0.10	0.01	0.11
Obs	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97

Effects of Science without Borders on having a formal job

	+1 year	+2 years	+3 years	+4 years	+5 years	+6 years	Pooled post-call
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Only with formal jobs after the call							
Approved	-0.012	-0.044***	-0.022	-0.034**	0.011	-0.084***	-0.060*
	[0.008]	[0.014]	[0.017]	[0.015]	[0.022]	[0.025]	[0.030]
Mean dep. var	0.02	0.06	0.09	0.10	0.13	0.17	0.33
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97
Panel B. If the candidate had a formal job no matter if before or after the call							
Approved	-0.017	-0.049***	-0.026	-0.036**	0.006	-0.083***	-0.072**
	[0.012]	[0.015]	[0.018]	[0.017]	[0.023]	[0.024]	[0.031]
Mean dep. var	0.04	0.07	0.10	0.10	0.13	0.17	0.34
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97

Effects of Science without Borders on other labor outcomes

	Monthly wage (1)	Hourly wage (2)	ln(Hourly wage +1) (3)	Job tenure (in months) (4)	Open-ended contract (5)	Technical occupation (6)	Public contract (7)	Public institution (8)
Panel A. Only contracts started after the call's year								
Approved	-97.635 [259.153]	-22.944 [28.289]	-0.145 [0.133]	-4.031*** [0.961]	-0.001 [0.021]	-0.039 [0.030]	-0.027** [0.011]	-0.029 [0.020]
Mean dep. var	1,547.12	88.66	1.17	8.57	0.06	0.28	0.03	0.07
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97	97
Panel B. All contracts independently of when they started								
Approved	-117.652 [262.365]	-3.841 [32.027]	-0.191 [0.129]	-4.694*** [1.082]	-0.001 [0.021]	-0.055* [0.030]	-0.027** [0.012]	-0.030 [0.020]
Mean dep. var	1589.66	90.65	1.21	9.62	0.06	0.29	0.04	0.08
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97	97

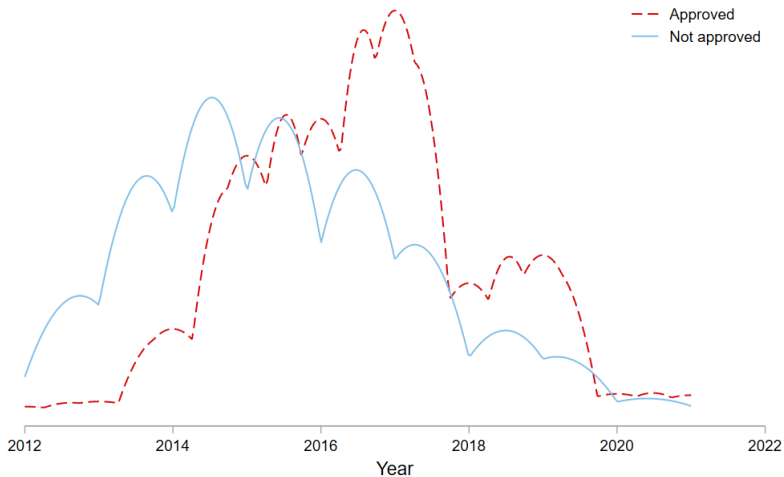
Effects of Science without Borders on entrepreneurship

	+1 year	+2 years	+3 years	+4 years	+5 years	+6 years	Pooled post-call period
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Only firms started up after the call's year							
Approved	-0.006 [0.007]	-0.021*** [0.007]	-0.011 [0.011]	-0.012 [0.013]	-0.021 [0.015]	0.017 [0.015]	-0.039 [0.025]
Mean dep. var	0.01	0.02	0.02	0.03	0.04	0.05	0.22
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97
Panel B. All types of firms independently of when they started							
Approved	-0.006 [0.007]	-0.021*** [0.007]	-0.011 [0.011]	-0.012 [0.013]	-0.021 [0.015]	0.017 [0.015]	-0.039 [0.025]
Mean dep. var	0.01	0.02	0.02	0.03	0.04	0.05	0.22
Obs	14,271	14,271	14,271	14,271	14,271	14,271	14,271
No. clusters	97	97	97	97	97	97	97

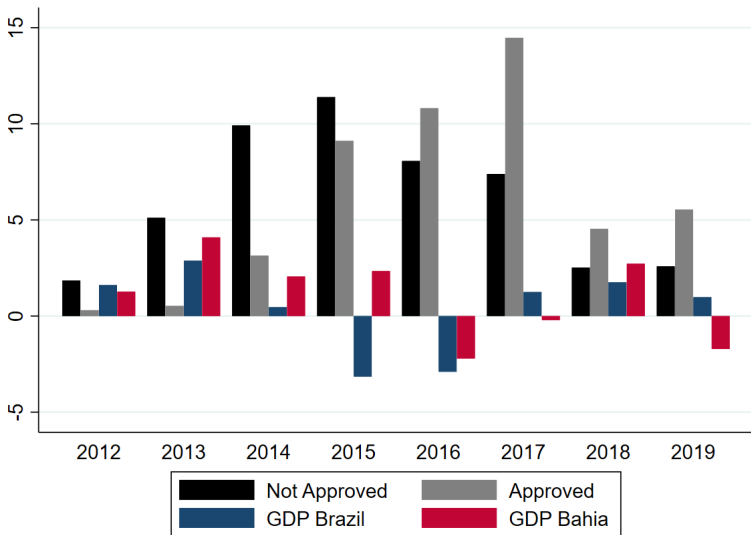
Mechanism: Delayed graduation

	All candidates		All students			Only graduated students		
	Graduation	On-time grad.	Postgrad	Formal emp.	Firm owner	Postgrad	Formal emp.	Firm owner
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Second stage								
Approved	0.185*	-0.231***	-0.053	-0.228**	-0.015	-0.042	-0.191	-0.015
	[0.104]	[0.051]	[0.065]	[0.099]	[0.086]	[0.064]	[0.120]	[0.085]
Mean dep. var	0.78	0.18	0.23	0.32	0.27	0.24	0.32	0.27
Obs	2,044	2,040	2,040	2,040	2,040	1,647	1,647	1,647
No. clusters	85	85	85	86	87	76	76	76
Panel B. First stage								
Ratio	1.051***	1.055***	1.051***	1.051***	1.051***	1.072***	1.072***	1.072***
	[0.157]	[0.159]	[0.157]	[0.157]	[0.157]	[0.152]	[0.152]	[0.152]
F-stat of Instrument	44.54	43.98	44.54	44.54	44.54	49.85	49.85	50.85

Mechanism: Delayed graduation



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Mechanism: Brain drain

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Mechanism: Brain drain

- We found 64% of the approved candidates in the (outcome) data
- Where are the other 36%?
 - Unemployed and looking for "something"
 - Unemployed by choice
 - Finishing undergrad
 - Moved to another country! **However, there are mobility constraints:**
 - Brazilians do not have work permit in Europe, U.S. or Australia
 - Brazilians need to pay higher fees for post-grad than European and U.S. citizens
 - No students loans programs

Discussion

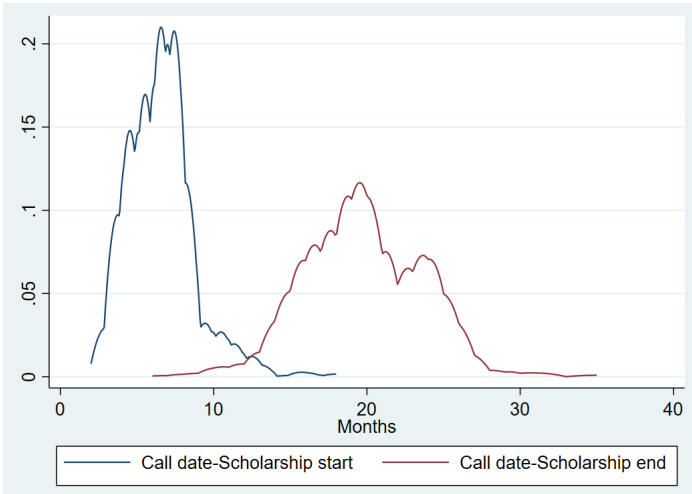
- The program did not achieve the main results in the short and medium term
 - Program implementation and design are controversial
 - Long-term effects may differ
- Delayed graduation and labor market conditions when graduating seems to be an important mechanism, at least for UFBA.
- We are not able to identify many impacts: cultural capital, perceptions about other cultures and the world, political views, etc.
 - Spillovers/peer effects may also be important
- Current work: identifying the students not found in the available data

Thank you!
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Effects of Science Without Borders on being found in any of the data sets

Table: Effects of Science without Borders on the probability of finding the candidate in any of the administrative data sets

Dep. var: Not found in any of the situations	
Approved	-0.073** [0.030]
Male	0.036*** [0.039]
Dup_Major	-0.001 [0.012]
Entrance exam score	00.040*** [0.014]
Mean dep. var	0.43
Obs	14,271
No. clusters	97



return