Getting Lucky:
The Long-Term Consequences of Exam Luck

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Can a good or bad exam draw affect students many years later?

- Exams are never exhaustive.

→ Luck in exam content:

  - Being evaluated on questions/topics that are favorable for one's grade.

- Long-term consequences?

Questions

- Does exam luck impact individuals on the long-run?
  - **Challenges:** measurement and identification.
- Does exam luck at the end of high school matter through:
  - Diploma receipt and access to higher education?
  - GPA and the type of higher education?
  - **Challenge:** in many settings, the GPA determines diploma receipt.

What We Do and Contributions

- Exploit two features of the Norwegian education system:
  1. **Random draw of exam topics.**
     - A and B are equally good in Math and Chemistry, and better in Math.
     - A is randomly assigned to take an exam in Math, B in Chemistry.
  2. **Different criteria for diploma receipt and GPA.**
     - GPA: average of all exam and course grades.
     - Diploma receipt: no “Fail” grade, exam grades trump course grades.

     → A given draw of exam may be good for the GPA but not for the diploma.

- Construct two measures of exam luck: diploma luck and GPA luck.
- Exploit rich panel data covering 8 years after the exams.

→ **First to study exam luck due to variations in exam content.**

→ **First to distinguish the diploma and GPA channels.**

What We Find

- Luck during key exams generate **long-lasting wage differentials.**
- **Main channel:** GPA and upgrade in the quality of students' higher education.
  - A 1 SD increase in GPA luck yields 0.6% higher annual wages 8 years after the exams.

  $\rightarrow$ similar to key inputs in the education production function (teacher quality, parental education).
- Diploma luck does not have long-run effects.
  - Students who fail their diploma due to bad exam luck repeat and graduate later.
  - Students who access higher education due to exam luck do not pursue until getting a degree.

Literature

- **Role of luck for individuals' social and economic success.**
  - Audas, Barmby and Treble (2004); Bertrand and Mullainathan (2001); Frank, (2016); Jenter and Kanaan, (2015); Black and Devereux, (2011); Mogstad and Torsvik, (2021)...

  → The exam lottery can have similar effects as the birth lottery.
  - Cappelen et al. (2013); Konow (2000); Alesina, Stantcheva and Teso (2018); Lefgren, Sims and Stoddard (2016)...

- **Effects of random shocks impacting students' performances.**
  - Ebenstein, Lavy and Roth (2016); Park (2020); Falch Nyhus and Strøm (2014); Bensnes (2020); Andresen and Løkken (2020); Gaggero and Tommasi (2020)...

  → Focuses on a different— non external and not easy to remedy— source of randomness in exam results; distinguish the diploma and GPA channels.

- **Predictive power of students' GPA.**
  - Black, Cortes and Lincove (2016); Cohn et al. (2004); Cyrenne and Chan (2012); French et al. (2015)...

  → GPA may in itself be an important source of success.

The Norwegian Education System

- Since 1994: right to high school education.
  - $\approx$ 95% of students enroll, 80% graduate.
- Two high school tracks: academic and vocational ($\approx$ 50/50).
- **Academic high school track**: 3 years (ages 16-18).
- **End of the final year (13th grade)**: students who passed all courses or exams are awarded a diploma.
- **Grading system**: 1 (worst) to 6 (best); 1 = fail.
- **High school GPA**: average of teachers' and exam grades.
- **Enrollment in higher education**: centralized admission system based on high school GPA.

Examinations in Norwegian High Schools

- **General rules in the academic track (13th grade)**:
  - one written exam in Norwegian, two written exams and one oral exam in **randomly chosen topics**.
- Randomization: delegated to school principals.
- Written exams are centrally set, oral exams are locally set.

- **Two stakes**:
  - **Diploma**: exam grades take precedence over teachers' grades.
  - **GPA**: the higher the exam grades the better.

$\Rightarrow$ Define **two variables depending on the random draw of exams**:

GPA luck and diploma luck.

Data

- Link several administrative registers (2004-2010 until 2012-2018).
- Students' courses, teachers' grades, exam draws, exam grades.
- 13^{th} grade GPA, on-time and overall graduation results.
- Enrollment in higher education and degree completion.
- Employment status and annual gross income.
- Background information: middle school GPA, age, gender, parents' age, parents' educational attainments, and parents' earnings.

▸ Summary statistics

GPA Luck

- For each student:
  - S subjects ($s = 1, ..., S$).
  - K subjects among them are drawn for end-of-year exams.
  - C possible combinations of end-of-year exams ($c = 1, ..., |C|$).
    - Example: for 10 subjects and 3 exams, 120 possible combinations.
  - $Course_{i,s}$: his/her teacher assessment score in subject s.
  - $Exam^e_{i,s}$: the score s/he can expect to achieve on an exam in s.
- If student i is randomly assigned to c, s/he can expect the following GPA:

$$GPA^e_{i,c} = \frac{1}{S+K}\left(\sum_{s \in S} Course_{i,s} + \sum_{s \in c} Exam^e_{i,s}\right)$$

GPA Luck

- Denoting $c(i)$ the specific combination of exams that student i is randomly assigned to:

$$Luck_{GPA_i} = \frac{GPA^e_{i,c(i)} - \overline{GPA_i}}{SD_i(GPA)}$$

- If exam draws are random, uncorrelated with students' baseline characteristics.

▸ Graphical representation

Diploma Luck

- For each student:
  - S subjects ($s = 1, ..., S$).
  - K subjects among them are drawn for end-of-year exams.
  - C possible combinations of end-of-year exams ($c = 1, ..., |C|$).
    - Example: for 10 subjects and 3 exams, 120 possible combinations.
  - $Course_{i,s}$: his/her teacher assessment score in subject s.
  - $D^e_{i,s}$: probability that the score s/he can expect to achieve on an exam in s is higher than 1.
- If student i is randomly assigned to c, s/he can expect to graduate with the following probability:

$$Diploma^e_{i,c} = \prod_{s \notin c} \mathbb{1}\{Course_{i,s} > 1\} \times \prod_{s \in c} D^e_{i,s}$$

Diploma Luck

- Denoting $c(i)$ the specific combination of exams that student i is randomly assigned to:

$$Luck_{Diploma_i} = \frac{Diploma^e_{i,c(i)} - \overline{Diploma_i}}{SD_i(Diploma)}$$

- Again, if exam draws are random, uncorrelated with students' baseline characteristics.

▸ Graphical representation

Empirical Strategy

- We estimate versions of the following regression model:

$$Y_i = \alpha + \beta_1 Luck_{Gpa_i} + \beta_2 Luck_{Diploma_i} + \eta_l + u_t + X_i\gamma + \epsilon_i$$

- Y_i: outcomes of interest;
- η_l and u_t: sets of high school and year FE;
- X_i: rich set of demographic controls;
- $epsilon_i$: unobserved determinants of students' success.

- Cluster the se at the school-by-year level.

- **Parameters of interest:** β_1 **and** β_2
- **Identifying assumption:** $Luck_{Gpa_i}$ and $Luck_{Diploma_i}$ are uncorrelated with $epsilon_i$.

Exam Luck and Baseline Characteristics

	Measures of Luck	
	GPA luck	Diploma luck
High school course grades	-0.0035	0.0029
	(0.0053)	(0.0052)
High school course grades, squared	-0.0036	-0.0036
	(0.0039)	(0.0038)
Middle school GPA	-0.0040	-0.0060
	(0.0049)	(0.0050)
Middle school GPA, squared	-0.0008	-0.0005
	(0.0025)	(0.0023)
Female	-0.0074	-0.0098
	(0.0062)	(0.0061)
Age	-0.0035	0.0078
	(0.0390)	(0.0394)
Age, squared	-0.0000	-0.0002
	(0.0008)	(0.0008)
Parents' average age	0.0048	0.0075
	(0.0097)	(0.0093)
Parents' average age, squared	-0.0000	-0.0001
	(0.0001)	(0.0001)
Parents' average years of education	0.0060	0.0013
	(0.0120)	(0.0114)
Parents' average years of education, squared	-0.0002	-0.0001
	(0.0004)	(0.0004)
Parents' average log earnings	-0.0016	0.0002
	(0.0027)	(0.0028)
F-statistic	0.917	0.905
Joint p-value	0.553	0.568
Mean	0.019	0.018
N	92201	92201

NOTE: Both regressions include high school-by-year fixed effects, and the F-tests of joint orthogonality control for these fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

Effect of Exam Luck on High School Outcomes

	Outcomes			
	Exam grades in 3rd year	High School GPA in 3rd year	On time HS diploma	Ever HS diploma
GPA luck	0.0978***	0.0189***	0.0054***	0.0019***
	(0.0026)	(0.0007)	(0.0012)	(0.0007)
Diploma luck	0.0379***	0.0052***	0.0114***	0.0032***
	(0.0024)	(0.0007)	(0.0012)	(0.0007)
Mean	0.092	0.128	0.879	0.965
N	92201	92201	92201	92201

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

▸ Effect of exam luck on students' longer-run GPA

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Effect of Exam Luck on Higher Education Outcomes

	Outcomes			
	Any college	Share of available HE programs	Selectivity of HE enrollment	Number of completed years in HE
GPA luck	-0.0004	0.0015***	0.2331**	0.0012
	(0.0009)	(0.0002)	(0.1149)	(0.0064)
Diploma luck	0.0017*	-0.0002	-0.0610	0.0040
	(0.0009)	(0.0002)	(0.1184)	(0.0063)
Mean	0.944	0.894	34.585	2.879
N	92201	87054	87054	92201

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Effect of Exam Luck on Labor Market Outcomes

	Outcomes				
	Ever employed	First job annual labor income (log)	Employed 8 years after the exams	Annual labor income 8 years after the exams (log)	Annual labor income 8 years after the exams (rank)
GPA luck	0.0007	0.0085**	0.0006	0.0064**	0.2461**
	(0.0016)	(0.0035)	(0.0018)	(0.0028)	(0.1254)
Diploma luck	0.0000	0.0021	0.0003	0.0032	0.1388
	(0.0015)	(0.0035)	(0.0018)	(0.0028)	(0.1258)
Mean	0.825	12.312	0.744	12.679	51.538
N	92201	76045	92201	68638	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

▸ Effect of exam luck on firm characteristics ▸ 2SLS estimates ▸ High- vs. low-stakes students: heterogeneity in luck effects ▸ Heterogeneity by baseline ability
▸ Heterogeneity by gender ▸ Robustness tests ▸ Asymmetry of exam luck effects?

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Conclusion

- **Random variation in exams subjects and contents create long-lasting and sizeable wage differences.**
- Lucky students earn significantly higher wages 8 years later.
- Exam luck matters mostly through its effect on high school GPA.
- Exam luck impacting diploma probability does not have similar long-run effects.
- **Policy implications:**
  - The use of high-stakes exams as a primary selection criterion may be unfair but not inefficient.
  - Our findings suggest promoting measures of student ability that are less random and with more frequent revisions over time.

Appendix

Summary Statistics

Variables	Mean	SD	Observations
Outcomes			
Exam grades in 3rd year	0.092	0.925	92201
High school GPA in 3rd year	0.128	0.846	92201
On time HS diploma	0.879	0.326	92201
Ever HS diploma	0.965	0.184	92201
Any college	0.944	0.230	92201
Share of available HE programs	0.894	0.128	87054
Selectivity of HE enrollment	34.585	29.870	87054
Number of completed years in HE	2.879	1.835	92201
Ever employed	0.825	0.380	92201
First job labor income (log)	12.312	0.829	76045
Position in the dist. of first job labor income	52.547	28.461	76045
Employed 8 years after the exams	0.744	0.436	92201
Labor income 8 years after the exams (log)	12.679	0.600	68638
Position in the dist. of labor income 8 years after the exams	51.538	28.675	68638
Demographics			
High school course grades	0.126	0.840	92201
Middle school GPA	0.115	0.917	92201
Female	0.555	0.497	92201
Age	19.035	0.355	92201
Parents' average age	48.275	4.733	92201
Parents' average years of education	13.992	2.466	92201
Parents' average log labor income	12.633	1.163	92201

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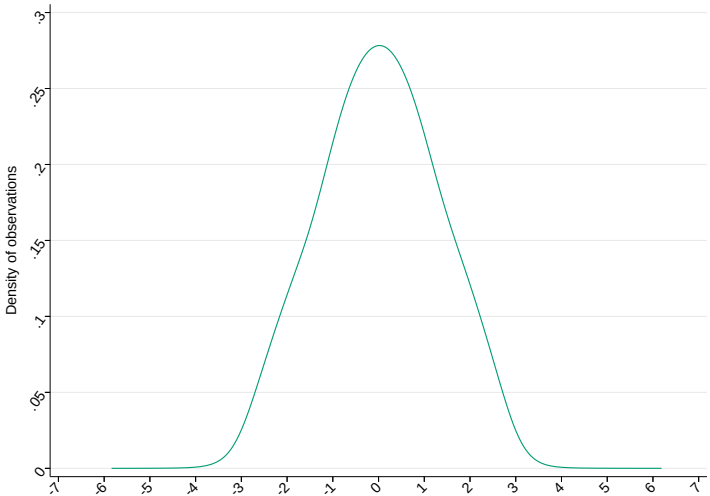
Distribution of Students' GPA Luck



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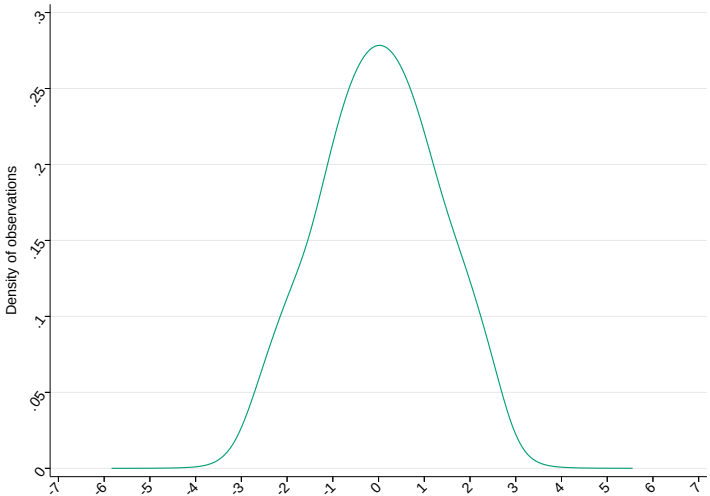
Distribution of Students' Diploma Luck



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Effect of Exam Luck on Students' Longer-run GPA

	Exam grades in 3rd year	High School GPA in 3rd year	Overall HS GPA in 3rd year	Long run HS GPA
GPA luck	0.0996***	0.0200***	0.0104***	0.0102***
	(0.0030)	(0.0009)	(0.0011)	(0.0012)
Diploma luck	0.0406***	0.0054***	0.0034***	0.0027**
	(0.0027)	(0.0008)	(0.0011)	(0.0012)
Mean	0.097	0.131	0.141	0.138
N	70903	70903	70903	70903

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Effect of Exam Luck on Firm Characteristics

	Outcomes					
	First job			Job 8 years after the exams		
	Public sector	Size	Coworkers with HE (%)	Public sector	Size	Coworkers with HE (%)
GPA luck	-0.0012	-7.5631	0.0024**	0.0004	-11.3772	0.0021*
	(0.0022)	(11.7856)	(0.0012)	(0.0022)	(15.2236)	(0.0012)
Diploma luck	0.0008	7.1251	-0.0016	-0.0004	17.8651	-0.0007
	(0.0021)	(11.2641)	(0.0012)	(0.0022)	(14.6329)	(0.0012)
Mean	0.392	651.796	0.544	0.410	781.105	0.595
N	76045	76045	76045	68638	68638	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Two-Stage Least Squares Estimates

	Outcomes			
	Log annual labor income 8 years after the exams (2SLS)	Log annual labor income 8 years after the exams (OLS)	Log annual job annual 8 years after the exams (2SLS)	Log annual labor income 8 years after the exams (OLS)
High school GPA	0.381***	0.111***		
	(0.131)	(0.003)		
High school GPA × HS diploma			0.396**	0.099***
			(0.201)	(0.003)
HS diploma			0.416***	0.121***
			(0.156)	(0.009)
N	64510	64510	68638	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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	(0.131)	(0.003)		
High school GPA × HS diploma			0.396**	0.099***
			(0.201)	(0.003)
HS diploma			0.416***	0.121***
			(0.156)	(0.009)
N	64510	64510	68638	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Heterogeneity by Students' Baseline Ability

High School Outcomes

	Outcomes			
	Exam grades in 3rd year	High School GPA in 3rd year	On time HS diploma	Ever HS diploma
Panel A: High Ability, Above Median Course Grades				
GPA luck	0.0911***	0.0183***	-0.0009	-0.0004
	(0.0035)	(0.0010)	(0.0011)	(0.0004)
Diploma luck	0.0370***	0.0056***	0.0021*	-0.0006
	(0.0033)	(0.0009)	(0.0011)	(0.0004)
Mean	0.659	0.807	0.953	0.994
N	46042	46042	46042	46042
Panel B: Low Ability, Below Median Course Grades				
GPA luck	0.1047***	0.0195***	0.0118***	0.0043***
	(0.0035)	(0.0011)	(0.0021)	(0.0015)
Diploma luck	0.0379***	0.0046***	0.0205***	0.0067***
	(0.0033)	(0.0010)	(0.0021)	(0.0014)
Mean	-0.473	-0.548	0.806	0.936
N	46159	46159	46159	46159

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Heterogeneity by Students' Baseline Ability

Labor Market Outcomes

	Outcomes				
	Ever employed	First job annual labor income (log)	Employed 8 years after the exams	Annual labor income 8 years after the exams (log)	Annual labor income 8 years after the exams (rank)
Panel A: High Ability, Above Median Course Grades					
GPA luck	-0.0011	0.0059	-0.0022	0.0075*	0.1064
	(0.0022)	(0.0048)	(0.0025)	(0.0040)	(0.1841)
Diploma luck	0.0000	0.0040	-0.0001	0.0044	0.2029
	(0.0022)	(0.0047)	(0.0025)	(0.0039)	(0.1877)
Mean	0.815	12.443	0.743	12.736	56.371
N	46042	37513	46042	34206	34206
Panel B: Low Ability, Below Median Course Grades					
GPA luck	0.0027	0.0110**	0.0035	0.0054	0.4012**
	(0.0022)	(0.0051)	(0.0025)	(0.0038)	(0.1754)
Diploma luck	0.0001	0.0004	0.0008	0.0024	0.0768
	(0.0021)	(0.0053)	(0.0025)	(0.0039)	(0.1776)
Mean	0.835	12.185	0.746	12.621	46.737
N	46159	38532	46159	34432	34432

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Heterogeneity by Gender

High School Outcomes

	Outcomes			
	Exam grades in 3rd year	High School GPA in 3rd year	On time HS diploma	Ever HS diploma
Panel A: Girls				
GPA luck	0.0939***	0.0182***	0.0072***	0.0020**
	(0.0032)	(0.0009)	(0.0014)	(0.0009)
Diploma luck	0.0358***	0.0048***	0.0074***	0.0018**
	(0.0031)	(0.0009)	(0.0014)	(0.0008)
Mean	0.176	0.227	0.901	0.972
N	51149	51149	51149	51149
Panel B: Boys				
GPA luck	0.1029***	0.0199***	0.0034*	0.0017
	(0.0037)	(0.0011)	(0.0020)	(0.0012)
Diploma luck	0.0402***	0.0058***	0.0161***	0.0049***
	(0.0035)	(0.0010)	(0.0019)	(0.0013)
Mean	-0.013	0.006	0.852	0.956
N	41052	41052	41052	41052

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Heterogeneity by Gender

Labor Market Outcomes

	Outcomes				
	Ever employed	First job annual labor income (log)	Employed 8 years after the exams	Annual labor income 8 years after the exams (log)	Annual labor income 8 years after the exams (rank)
Panel A: Girls					
GPA luck	0.0015	0.0075*	0.0003	0.0071**	0.1849
	(0.0020)	(0.0042)	(0.0023)	(0.0034)	(0.1516)
Diploma luck	0.0028	0.0037	0.0026	0.0029	0.1815
	(0.0020)	(0.0041)	(0.0023)	(0.0034)	(0.1554)
Mean	0.837	12.357	0.756	12.646	47.994
N	51149	42812	51149	38689	38689
Panel B: Boys					
GPA luck	-0.0006	0.0103*	0.0007	0.0055	0.3183
	(0.0024)	(0.0060)	(0.0027)	(0.0045)	(0.2154)
Diploma luck	-0.0034	-0.0016	-0.0025	0.0028	0.0475
	(0.0023)	(0.0060)	(0.0027)	(0.0046)	(0.2101)
Mean	0.810	12.254	0.730	12.721	56.117
N	41052	33233	41052	29949	29949

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Robustness Tests

	Outcomes			
	High school GPA in 3rd year	On time HS diploma	Employed 8 years after the exams	Annual labor income 8 years after the exams (log)
Panel A: Controls for Students' Baseline Characteristics Selected by Double Lasso				
GPA luck	0.0189***	0.0054***	0.0005	0.0065**
	(0.0007)	(0.0012)	(0.0018)	(0.0028)
Diploma luck	0.0052***	0.0114***	0.0004	0.0032
	(0.0007)	(0.0012)	(0.0018)	(0.0028)
Panel B: P-values for GPA and Diploma Luck Computed with Permutation Tests				
P-values for GPA luck	0.000	0.000	0.717	0.008
P-values for diploma luck	0.000	0.000	0.832	0.214
Panel C: Non-winsorized Measures of Luck				
GPA luck (non-winsorised)	0.0185***	0.0052***	0.0005	0.0060**
	(0.0007)	(0.0012)	(0.0018)	(0.0027)
Diploma luck (non-winsorised)	0.0050***	0.0112***	0.0002	0.0032
	(0.0007)	(0.0012)	(0.0017)	(0.0027)
Panel D: Measures of Payoff				
GPA payoff	0.0238***	0.0018	0.0001	0.0067**
	(0.0008)	(0.0013)	(0.0017)	(0.0028)
Diploma payoff	0.0022***	0.0280***	0.0020	0.0053*
	(0.0007)	(0.0018)	(0.0019)	(0.0031)
Panel E: Including Students with Zero Exam Draw Variance				
GPA luck	0.0191***	0.0045***	0.0009	0.0068**
	(0.0007)	(0.0011)	(0.0017)	(0.0026)
Diploma luck	0.0052***	0.0124***	0.0001	0.0029
	(0.0007)	(0.0012)	(0.0017)	(0.0027)
Mean	0.020	0.820	0.736	12.662
N	129917	129917	129917	95651
Panel F: Excluding Students with a Failing Course Grade				
GPA luck	0.0181***	0.0085***	0.0009	0.0061**
	(0.0008)	(0.0012)	(0.0018)	(0.0028)
Diploma luck	0.0061***	0.0078***	0.0001	0.0032
	(0.0007)	(0.0011)	(0.0018)	(0.0029)
Mean	0.170	0.897	0.746	12.684
N	89493	89493	89493	66750

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High- vs. Low-Stakes Students

Heterogeneity in Luck Effects

	Outcomes			
	High school GPA in 3rd year	On time HS diploma	Share of available HE programs	Labor income 8 years after the exams (log)
GPA luck	0.0193***	0.0028**	0.0016***	0.0062**
	(0.0007)	(0.0012)	(0.0002)	(0.0028)
GPA luck* $\frac{SD_1(GPA)-SD_0(GPA)}{SD_0(GPA)}$	0.0194***	0.0015	0.0019***	0.0030
	(0.0011)	(0.0020)	(0.0003)	(0.0041)
Diploma luck	0.0029***	0.0120***	-0.0005**	0.0029
	(0.0007)	(0.0013)	(0.0002)	(0.0028)
Diploma luck* $\frac{SD_1(Diploma)-SD_0(Diploma)}{SD_0(Diploma)}$	-0.0001	0.0165***	-0.0003*	0.0020
	(0.0005)	(0.0011)	(0.0002)	(0.0020)
Mean	0.128	0.879	0.894	12.679
N	92201	92201	87054	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school and year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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Asymmetry of Exam Luck Effects

- Positive GPA luck increases students' access to more selective university programs.
- Students with a GPA luck > 0 substitute students with GPA luck < 0.
- Is this substitution socially inefficient?
- We estimate the following model:

$$Y_i = \alpha + \beta_1 Luck_{Gpa_i} + \alpha_1 |Luck_{Gpa_i}| + \beta_2 Luck_{Diploma_i} + \alpha_2 |Luck_{Diploma_i}| + \eta_l + u_t + X_i\gamma + \epsilon_i$$

- α_1 captures the differential effects of good vs. bad GPA luck.

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Bad Luck vs. Good Luck: Asymmetry in Luck Effects

	Outcomes			
	High school GPA in 3rd year	On time HS diploma	Share of available HE programs	Labor income 8 years after the exams (log)
Luck GPA	0.0189***	0.0054***	0.0015***	0.0064**
	(0.0007)	(0.0012)	(0.0002)	(0.0028)
| Luck GPA |	-0.0019	-0.0021	-0.0006	0.0011
	(0.0016)	(0.0029)	(0.0005)	(0.0066)
Luck diploma	0.0050***	0.0113***	-0.0002	0.0033
	(0.0007)	(0.0012)	(0.0002)	(0.0028)
| Luck diploma |	-0.0039**	-0.0008	0.0002	0.0027
	(0.0018)	(0.0029)	(0.0005)	(0.0068)
Mean	0.128	0.879	0.894	12.679
N	92201	92201	87054	68638

NOTE: Each regression includes a rich set of baseline demographic controls, as well as high school-by-year fixed effects. Standard errors clustered at the high school-by-year level are in parentheses. * significant at 10%. ** significant at 5%. *** significant at 1%.

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