

IS GENDER BIAS A COST OF FAILURE ISSUE?

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Abstract

We provide evidence on a gender bias in risk aversion among students of economics in Spain. In a sample of 2278 multiple choice exams with penalization for errors, women consistently answer less questions, what could damage females' scores. We also provide evidence on a different gender bias pattern between ordinary and resit exams, what could be related to the performance expectative of students. A lower cost of error could reduce the effect of risk aversion and improve the scores of women. Thus these exams may create a disadvantage for women.

Keywords: gender differences, risk aversion, multiple choice

JEL Codes: A22, I21, J16

1. Introduction

Multiple choice tests are widely used as an easy and objective mean to grade students. Different studies have remarked however that test performance is not independent of its design. Some usual penalties, in which wrong answers decrease scores, could potentially induce a gender bias as men and women have shown different risk patterns. However, in multiple choice test, decisions about answering or not a question are different from standard lotteries. In multiple choice exams, the cost of risk (given objectively equal to all students) can be differently perceived by students with different level of preparation. In this sense, students' response when taking a risk could vary depending on the effort devoted to prepare the exam. In this paper we intend to contribute to this literature, studying how the test structure affected our students' behavior and performance, and its potential relation to the probability of succeeding.

We analyze several exams completed by undergraduate students of the subject Political Economy, taught in the Business Degree of the Universidad de Murcia. Our sample consists of 2278 individual multiple choice tests, in which the existence of a gender difference is explored. Consistently across all regular exams, males tend to answer a higher number of questions than females, which is in line with the empirical and experimental evidence on the higher risk aversion observed in women. On the contrary, this difference turns into statistically insignificant in the case of resit exams, an assessment in which students are often ill prepared. With regard to a possible bias in score output, the data show only mixed evidence by subsamples but significant evidence when the whole sample is analyzed. In this case the results point out that the bias in the number of answered questions may result in a slight disadvantage for women. These outcomes are all consistent with previous evidence on scores, and we add two new insights: a link between test behavior and the higher risk aversion of females as well as a gender bias dependence on the student's level of preparation that could mainly determine the subjective cost of failure.

The possibility of a gender bias in Economy test scores has been studied for years (Siegfried, 1979; Ballard and Johnson, 2005). This literature has usually identified a

higher score for males¹, which is also in line with the gender gap in favor of men in math scores (Hedges and Nowell, 1995). Empirical evidence shows that this bias is correlated with the level of gender equality in the country, and seems to decrease across years (Guiso et al., 2008)². In our sample, we find some partial results of this type when analyzing the whole set of exams. Moreover, we find that males improve upon the scores of females in 5 of the 7 regular exams, although the difference was significant only in one case, and only in 2 of the 4 resit exams, being insignificant all of them. This outcome is in line with the weak gender bias in scores that would favor males facing this kind of exams.

Our main contribution is two-fold. On one hand, we report evidence of a higher degree of risk aversion in females, measured as the number of answered questions: in ordinary exams females answered around 4% less questions than males. Our exams included a penalty designed to give an expected zero score to a random answer. This method widely used seems to penalize those agents who are more risk averse (Burgos, 2005), so our observed differences can therefore be explained by a gender bias in risk aversion. Thus, we provide new data that support the evidence on a higher risk aversion for women (Croson and Gneezy, 2009). Our results also support the theoretical analysis by Espinosa and Gardeazábal (2010) that predicts high differences in number of answered questions but low differences in scores for agents with different risk aversion.

We show, on the other hand, differences on gender bias behavior between ordinary and resit exams. In our sample, the quantified bias in resit examinations has proved to be half than that of regular examinations. This suggests that when women confront exams with less opportunity costs, they have risk aversion patterns closer to men behavior. In the psychological literature, it has been described the existence of a gender difference in test anxiety (McCarthy and Goffin 2005). The lower cost of failing in our resit exams may lower test anxiety, decreasing the gender differences in behavior. In this case, moreover, our data suggest that the disadvantage of women compared to men in relation to scores disappears with the reduction of the risk patterns differences.

2. The Data

We analyze a set of eleven exams of the subject Political Economy across a period of five academic years. The sample includes those periods where we were able to recover all students' marks (exam dates of June and September 2005, 2008 and 2009, September 2007 and February 2006, 2008, 2009 and 2010). The course was taught between February and June, and there were three periods of exams: June, September and February. The students in their first year could do their exam in June or September, while the exam of February was written only by students who had failed the subject previously. From now on, we refer as "Ordinary exams" to the exams in June and September, and as "Resit exam" to the exam in February. In our University, there is proven evidence that the calls to exam placed outside the regular teaching semester collect students significantly worse prepared than the rest of the calls. In this regard, this paper intends to provide some insights about differences in students' behavior between the ordinary and resit examinations. Nevertheless, the possibility of a different pattern between June and

¹ But Makridou-Bossiou (2003) provides the opposite evidence for Greek students.

² Although differences in mean seem to be correlated with cultural factors, variability seems to be worldwide larger in the case of males (Machin and Pekkarinen, 2008).

September is also checked. The results are summarized in the Annex and show no significant difference between the exams settled into the regular teaching semester.

The subject under study was taught in the first of the 3-years Degree in Business of the Universidad de Murcia and was a typical introductory course to Microeconomics. The final exam included a multiple choice test with 20 questions accounting for the 40% of the final mark that the student had to pass in order to be evaluated. Each of the test questions consisted of three possible options, being correct only one of them. Each wrong answer penalized 0.5 correct answers, so that the expected score of a random answer was zero.³ There was no penalty for unanswered questions. In this type of exam, if students assign to each option a positive probability of being correct, they have in fact to decide whether to participate or not in a lottery with positive expected value (if the true answer is answered with higher probability). In that case risk aversion matters, since more averse students are expected to answer less questions. In fact, there is abundant evidence in psychology (McCarthy and Goffin, 2005) on the existence of a gender bias in test anxiety that affects more to women during the tests.

Exams were distributed to students in four versions that only differed in the order of questions. Type 1 exams presented questions in the same order they had been taught during the semester. Types 2, 3 and 4 presented questions in a randomized order. This is relevant because the literature has emphasized that test scrambling could yield different results, making the exams more difficult to understand for student. Typically, non-significant (or very slight) differences are found between those students who solve exams with questions in a randomized order against those students who solve them according with the sequence of topics taught in class (Gohmann and Spector, 1989). Following this research, we control by a possible scrambling test effect.

Tables 1 and 2 report some descriptive statistics of the exams.

TABLE 1. Ordinary Exams Statistics

	J05	S05	S07	J08	S08	J09	S09	Total
Number of Exams	485	161	195	343	210	318	235	1947
% Females	60.8	61.5	56.4	51.2	53.8	52.5	56.6	56.3
% Type 1	25.2	31.7	29.2	28.9	28.6	26.4	25.1	27.3
Female Score (Max=10)	6.10	5.17	4.54	4.45	3.59	4.12	4.78	4.68
Male Score (Max=10)	6.13	5.04	5.02	4.81	3.28	4.08	4.89	4.75
Female: % Answered Questions	81.5	79	74.5	72	72.5	74.5	74.5	75.5
Male: % Answered Questions	84.5	81.5	79.5	77.5	77.5	78	78	79.5
Type 1 Score (Max=10)	6.02	5.10	4.39	4.49	3.63	4.24	4.81	4.67
Other Types Score (Max=10)	6.15	5.13	4.89	4.67	3.38	4.06	4.83	4.73
Type 1: % Answered Questions	82.1	79.5	75.8	74.7	73.6	75.7	74.7	76.4
Other Types: % Answered Questions	82.9	80.7	76.9	74.4	75.5	76.3	76.4	77.6

³ Being three possible choices, a random respondent would have a probability of 1/3 of guessing the answer and of 2/3 of failing. With a penalty of 0.5 correct questions for each wrong question, the expected score of a random answer is 0.

TABLE 2. Re-sit Exams Statistics

	F06	F08	F09	F10	Total
Number of Exams	35	63	66	167	331
% Females	77.1	54	59.1	52.1	56.5
% Type 1	31.4	30.2	30.3	28.1	29.3
Female Score (Max=10)	3.98	4	4.85	4.61	4.5
Male Score (Max=10)	4.65	4.6	4.51	4.88	4.7
Female: % Answered Questions	72.6	74.6	71.4	73.79	73.3
Male: % Answered Questions	77.5	76.2	79.8	73.69	75.6
Type 1 Score (Max=10)	3.6	4.5	4.76	4.80	4.76
Other Types Score (Max=10)	4.4	4.2	4.69	4.71	4.84
Type 1: % Answered Questions	73.2	75.5	71.25	75.11	76.42
Other Types: % Answered Questions	74.0	75.2	76.41	73.21	77.46

There are a total of 2278 individual tests, ranging from a minimum of 35 in the resit exam of February 2006 to a maximum of 485 in June 2005. We have a 56.3% done by women and a 27.6% type 1 exams. Gender differences in score are very small, while differences between males and females in answered questions are stronger. Differences between individuals facing type 1 exam and the rest, both in number of answered questions and in scores, is unclear.

The most notorious dissimilarity between the ordinary and resit exams statistics is in the difference between men and female related to the percentage of answered questions. On this subject, data suggests closer gender behavior patterns in resit than in ordinary exams.

3. Empirical Evidence

In order to disentangle if there is a gender bias in students' behavior, we have regressed the number of blank (unanswered) questions against a set of explicative variables. In particular, we include the variables *W* (0 for men, 1 for women) and *Type* (0 for the exam in a randomized order, 1 for the ordered exam). The specific characteristics of the exams were controlled using dummies for each particular exam (summarized in the variable named *Dummies* in the estimation results). We introduce also the score quartile to which the students have belonged in each examination, in order to separate the effects of explanatory variables between students with higher and lower scores. To do that, we introduce three dummy variables, Q_i , $i=1,2,4$, where $Q_i=1$ if the individual belongs to the quartile i and $Q_i=0$ if she does not belong to quartile i (the 3rd quartile is the one with the highest level of blank answers and we take it as the baseline). For ordinary exams, table 3 shows the estimation results.

TABLE 3. Ordinary Exams Estimations for Blanks

Dependent Variable: Blank N=1947		
Included Observations: 1947		
Variable	Coefficients	Significant Coefficients
C	17.657*** (0.665)	18.002*** (0.598)
Type	0.764 (0.482)	
W	4.147*** (0.640)	3.873*** (0.433)
W*(Q1+Q2)	-0.522 (0.868)	
Q1	-7.225*** (0.591)	-7.250*** (0.591)
Q1+Q2	-1.782** (0.754)	-2.067*** (0.570)
Q4	-1.842*** (0.639)	-1.835*** (0.639)
DUMMIES	1.000*** (0.064)	1.000*** (0.064)
R ²	0.226	0.225
Adjusted R ²	0.223	0.223

Variables are significant at *** 1%, ** 5%, * 10%

Women answered significantly less questions than men. Specifically girls left around 4% more unanswered questions than boys. The type of exam points out that individuals doing the non-scrambled version answered less questions, but the coefficient is not significant. Interestingly, people in the fourth quartile (Q4) answered more questions than those in the third one, so they made more mistakes. The interaction of woman with quartiles is not significant; meaning the gender effect for women was not different between people with high and low scores. We point also that the variable “Dummies” is significant. This was expected, since the number of blank questions is likely to be related with the different set of questions used in each different exam (remember that “Dummies” is a variable that summarizes the dummy variables for each particular exam).

If we study each exam independently, W is strongly significant across all the estimations, while type is not significant in any of the seven exams. Table 4 shows these results.

TABLE 4. Ordinary Exams Sub-sample Estimations for Blanks

	JUN 05	SEP 07	JUN 08	SEP 08	JUN 09	SEP 09	Full Sample
Woman	Yes***	Yes***	Yes***	Yes***	Yes***	Yes***	Yes***

Variables are significant at *** 1%, ** 5%, * 10%

This outcome suggests a significant difference in men and women's behavior in our ordinary exams. Given the increasing evidence of risk aversion differences between genders, we argue that risk aversion is a potential explanation for this divergence. If it is the case, following Espinosa and Gardeazábal (2010) we should observe only small

differences in marks. Table 5 shows the results of regressing marks against gender, using the same set of independent variables.

TABLE 5. Ordinary Exams Estimations for Marks

Dependent Variable: Mark		N=1947	
Variable	Coefficients	Variable	Significant Coefficients
C	5.333*** (0.046)	C	5.340*** (0.036)
Type	0.015 (0.034)	Type	
W	-0.005 (0.045)	W	
W*(Q1+Q2)	-0.095 (0.061)	W*(Q1+Q2)	-0.090** (0.041)
Q1	1.670*** (0.041)	Q1	1.669*** (0.041)
Q1+Q2	1.482*** (0.053)	Q1+Q2	1.479*** (0.046)
Q4	-2.124*** (0.045)	Q4	-2.124*** (0.045)
DUMMIES	1.000*** (0.018)	DUMMIES	1.000*** (0.018)
R ²	0.900	R ²	0.900
Adjusted R ²	0.900	Adjusted R ²	0.900

Variables are significant at *** 1%, ** 5%, * 10%

In this case we reject women obtained lower scores, since the coefficient of W is non-significant, what is consistent with the explanation of risk aversion as the cause of gender gap. Interestingly, although the higher risk aversion by women is not significant in general, it do have a consequence on female students belonging to the two fist quartiles of mark. For this group of students risk aversion undermines scores. Once more, we observe differences between exams, since the variable “Dummies” is significant.

Table 6 shows that, across all the sub-samples, there is a significant effect for gender (with men obtaining a higher score than women) only in one of seven cases.

TABLE 6. Ordinary Exams Sub-sample Estimations for Marks

	JUN 05	SEP 07	JUN 08	SEP 08	JUN 09	SEP 09	Full Sample
Woman	No	No	No	No	Yes**	No	No

Variables are significant at *** 1%, ** 5%, * 10%

We perform now the same estimation but for resit exams. In tables 7 and 8 we provide the coefficients of the regression for all the resit exams, and the significativity of W for each of the exams.

TABLE 7. Resit Exams Estimations for Blanks

Dependent Variable: Blank		N=331
		Included Observations: 1947
Variable	Coefficients	Significant Coefficients
C	26.905*** (1.310)	26.881*** (1.118)
Type	0.332 (1.155)	
W	1.425 (1.537)	1.763* (1.061)
W*(Q1+Q2)	0.750 (2.127)	
Q1	-4.143*** (1.486)	-4.072*** (1.483)
Q1+Q2	-3.895** (1.793)	-3.516*** (1.351)
Q4	3.024* (1.561)	2.947* (1.552)
DUMMIES	1.000 (0.684)	
R ²	0.144	0.138
Adjusted R ²	0.126	0.127

Variables are significant at *** 1%, ** 5%, * 10%

TABLE 8. Resit Exams Sub-sample Estimations for Blanks

	FEB 06	FEB 08	FEB 09	FEB 10	Full Sample
W	No	No	Yes***	No	Yes*

Variables are significant at *** 1%, ** 5%, * 10%

From the new results it is noteworthy how the gender disparity decreases considerably its significance (p-value 0.0976) as well as the size of the coefficient (decreases from 4.15 to 1.76). In the same way, going to the analysis of each exam, only in one out of four is found to be significant versus the significance in all sub-samples (at 1% level) in the case of the ordinary exams.

For resit exams tables 9 and 10 show the estimation when using Score as dependent variable.

TABLE 9. Resit Exams Estimations for Scores

Dependent Variable: Score		N=331
		Included Observations: 1947
Variable	Coefficients	Significant Coefficients
C	3.677*** (0.094)	3.664*** (0.074)
Type	-0.035 (0.068)	
W	-0.005 (0.091)	
W(Q1+Q2)	0.007 (0.126)	
Q1	1.494*** (0.088)	1.494*** (0.088)
Q1+Q2	1.298*** (0.106)	1.300*** (0.080)
Q4	-1.794*** (0.093)	-1.797*** (0.092)
DUMMIES	0.998*** (0.183)	1.000*** (0.181)
R ²	0.885	0.884
Adjusted R ²	0.882	0.883

Variables are significant at *** 1%, ** 5%, * 10%

TABLE 10. Resit Exams Sub-sample Estimations for Marks

	FEB 06	FEB 08	FEB 09	FEB 10	Full Sample
Woman	No	No	No	No	No

Variables are significant at *** 1%, ** 5%, * 10%

Neither the independent exams nor the full sample estimations show evidence of a gender bias in the scores obtained by the students for the resit exams.

The comparison between ordinary and resit examinations suggests that, in the latter case, the gap between men and women decreases considerably. It seems that a different effect exists in each type of exam. In order to study if differences between ordinary and resit exams are significant, we study now the full sample.

For the joint sample, Table 11 shows the results of the blank and Table 12 of the score equation. All the explicative variables are defined as before, but we include now a new dummy variable and its interactions to study the difference between ordinary and resit exams. CO is 1 if the exam belongs to an ordinary call and 0 otherwise, and we define CE=1-CO. Both tables 11 and 12 show only the significant coefficients, where all equality restrictions that parameters suggested have been also included.

TABLE 11. Ordinary vs Resit Exams Estimations for Blanks

Dependent Variable: Blank		N=2278
Variable	Significant Coefficients	
C	17.709***	(0.452)
CE	10.598***	(0.694)
$W*(1+CO)-(Q1+Q2)*(1+CE)$	1.941***	(0.189)
Q1	-6.812***	(0.505)
Q4	-1.128**	(0.532)
DUMMIES	1.000***	(0.065)
R^2	0.219	
Adjusted R^2	0.217	

Variables are significant at *** 1%, ** 5%, * 10%

TABLE 12. Ordinary vs Resit Exams Estimations for Marks

Dependent Variable: Score		N=2278
Variable	Significant Coefficients	
C	6.861***	(0.030)
Q3+Q4	-1.531***	(0.039)
$(Q3+Q4)*CE$	0.431***	(0.066)
$W*(Q1+Q2)*CO$	-0.104***	(0.038)
$Q1 - CE$	1.625***	(0.032)
Q4	-2.077***	(0.040)
DUMMIES	1.001***	(0.017)
R^2	0.898	
Adjusted R^2	0.898	

Variables are significant at *** 1%, ** 5%, * 10%

Several conclusions are derived from the regression analysis. In first place, data support the existence of a gender bias in the number of answered questions both in ordinary and resit exams. The estimations also confirm that in the ordinary exams women tend to answer 4% less questions than men. Moreover, in resit exams students tend to

answer fewer questions than in the regular ones, what in mean damages their marks. An important result is that the increment of unanswered questions from ordinary to resit exams is lower in women than in men. The consequence is that the difference between women and men in number of unanswered questions decreases to be the half the one in the regular exams. That is, in resit exams women answer around 2% less questions than men compared to the previous 4%.

Moreover, our results suggest that a lower risk aversion –so that more questions are answered– tend to favor grades of students with marks over the mean. If so, that is why women with marks over the mean (belonging to the 1st or 2nd quartile) improve its grades differential with respect to men when their pattern of unanswered questions is closer to them.

A limitation of our analysis is that we do not have a control for ability of students. Potentially, the results observed in scores could be generated not by the difference in risk aversion but by the difference in abilities between students. However, the differences observed in the number of answered questions can be hardly explained by ability, while risk is a fair explanation for this observation.

4. Conclusion

In our multiple choice tests, males and females mainly differ in the level of non-answered questions, which can be the consequence of a higher risk aversion of women. *Ceteris paribus*, a lower degree of risk aversion can generate a higher expected mark. For risk averse agents, Espinosa and Gardeazábal (2010) show that the level of answered questions should be relevant, although the differences in scores are expected to be small. Consistently with this prediction, we find that women answered fewer questions in our exams while the difference in scores between genders was very small and mostly non-significant. Still, this is the result only when analyzing the whole sample, however, including a partition by students with marks over and below the mean, the higher risk aversion of women seems to clearly damage the grades of those with marks over the mean.

Another potential reason that could affect risk aversion is the level of preparation previous to the exam. The expectation of successfully passing the test could increase the cost of error for a risk averse agent. Our results support that, in resit exams, an assessment when the students are often ill prepared, women prove to be closer to men's behavior in terms of risk patterns. Moreover, this benefits grades of women with marks over the mean. These results can also be explained by a reduction in test anxiety in resit exam, an element more relevant for women.

With respect to the effect of test scrambling, we obtain a very small effect and only with regard to the number of answered questions when using the full sample of exams.

Therefore, we find consistent evidence of different men and women behavior in multiple choice tests, being differences of risk aversion and test anxiety a robust explanation for this fact. However, there are relevant factors that we do not include in our study. Controlling for ability would be a nice way of completing our analysis in a future research, especially when exploring gender differences in the scores of multiple choice tests.

Although the differences in scores are small, an effective discrimination against women due to their higher risk aversion can be in place. Potential ways of modifying this result are to increase the number of questions, avoid the penalization for the wrong answers or implement compulsory answers exams.

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Annex.

Tables 13 and 14 show the estimation results of the blank and score variables respectively for the joint sample of "Ordinary exams". In the regression a dummy is introduced to consider the possible difference in students' behaviour between the June and September examinations. CS is 1 if the exam belongs to a September call and 0 otherwise, and we define CJ=1-CS. All the rest of explicative variables are defined as before. The estimations include all the equality restrictions than parameters suggested.

TABLE 13. June vs September Exams Estimations for Blanks

Dependent Variable: Mark		N=1947	
Variable	Coefficients	Variable	Significant Coefficients
C	19.327*** (0.875)	C	18.904*** (0.505)
Type	0.736 (0.482)		
W	3.992*** (1.014)	W	3.877*** (0.433)
CJ	-1.033 (0.987)		
W*CJ	0.274 (1.306)		
(Q1+Q2)*CJ	-1.888 (1.328)	(Q1+Q2)*CJ	-3.183*** (0.505)
W*(Q1+Q2)	-0.003 (1.358)		

W*(Q1+Q2)*CJ	-0.915 (1.765)		
Q1	-7.236*** (0.591)	Q1	-7.320*** (0.547)
(Q1+Q2)	-0.621 (1.101)		
Q4	-1.767*** (0.639)	Q4	-1.653*** (0.580)
DUMMIES	1.000*** (0.068)	DUMMIES	1.000*** (0.067)
R ²	0.228	R ²	0.227
Adjusted R ²	0.224	Adjusted R ²	0.225

Variables are significant at *** 1%, ** 5%, * 10%

TABLE 14. June vs September Exams Estimations for Marks

Dependent Variable: Mark		N=1947	
Variable	Coefficients	Variable	Significant Coefficients
C	5.305*** (0.052)	C	5.295*** (0.038)
Type	0.017 (0.034)		
W	-0.023 (0.057)		
CS	-0.904*** (0.069)	CS	-0.861*** (0.046)
W*CS	0.068 (0.091)		
(Q1+Q2)*CS	-0.211** (0.093)	(Q1+Q2)*CS	-0.214*** (0.061)
W*(Q1+Q2)	-0.092 (0.079)	W*(Q1+Q2)	-0.089** (0.041)
W*(Q1+Q2)*CS	-0.007 (0.123)		
Q1	1.671*** (0.041)	Q1	1.670*** (0.041)
(Q1+Q2)	1.564*** (0.064)	(Q1+Q2)	1.563*** (0.052)
Q4	-2.129*** (0.045)	Q4	-2.130*** (0.045)
DUMMIES	1.000*** (0.020)	DUMMIES	1.000*** (0.020)
R ²	0.900	R ²	0.901
Adjusted R ²	0.900	Adjusted R ²	0.900

Variables are significant at *** 1%, ** 5%, * 10%

In both cases, the estimations for blanks and score variables does not show a different risk pattern for woman in the June and September examinations.