BANK OF ENGLAND

Staff Working Paper No. 882

Does bonus cap curb risk taking? An experimental study of relative performance pay and bonus regulation

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August 2020

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Abstract

We conducted a lab experiment with 253 participants to examine how constraints on bonus akin to bonus regulations, such as bonus cap and malus, could affect individuals' risk-taking in the presence of relative performance pay. Participants took greater risks when bonus was linked to investment performance relative to that of their peers (relative performance pay) than when it depended on their own performance only. In the absence of relative performance pay, bonus cap and malus reduced risk-taking. With relative performance pay, the risk-mitigating effects of bonus cap and malus were significantly weakened; but participants took less risk when bonus was made conditional on their team avoiding a loss.

Key words: Bonus cap, malus, bonus regulation, risk choice.

JEL classification: C91, G28, G40, J31, J33, M52.

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ISSN 1749-9135 (on-line)

1. Introduction

After the 2008-09 Global Financial Crisis, financial regulators have identified remuneration practices as a key factor contributing to the culture of excessive risk-taking at large banks (Financial Stability Forum, 2009). Several jurisdictions have since introduced compensation regulations for banks with the aim of discouraging excessive risk-taking and short-termism. The European Union (EU) introduced the so-called "bonus cap" for "material risk takers" (MRTs) at banks, restricting their variable pay to be no more than 100% of their fixed pay, or 200% with shareholders' approval. A proportion of the variable pay also needs to be deferred and is subject to "malus", which enables deferred bonus payments to be forfeited if certain conditions materialise. In the United Kingdom, at least 40% of MRTs' variable pay needs to be deferred for a period of no less than three to seven years, and can be clawed back under certain pre-specified circumstances for a period of seven to ten years after it is awarded.

This paper examines how specific constraints on bonus payments – such as bonus cap and malus – affect individuals' choices of risk in a laboratory experiment. Our aim is to probe whether such bonus restrictions could curb risk-taking as intended, and how they would interact with relative performance benchmarking which is commonly used in the financial sector. While other studies have used experimental methods to examine the impact of specific remuneration structures on incentives (e.g. Cole, Kanz and Klapper, 2015; and Kirchler, Lindner and Weitzel, 2018), ours is the first to examine how bonus restrictions akin to post-crisis remuneration regulations interact with relative performance pay to influence risk-taking behaviour. While strong conclusions on policy should not be drawn based on a lab experiment alone, our findings suggest that bonus cap and malus could indeed reduce risk-taking, but this effect could be weakened substantially once bonus is made conditional on performance relative to peers (relative performance pay). We also find that, while relative performance pay could increase risk-taking, making the bonus conditional on the team avoiding a loss could reduce risk-taking.

In a frictionless world, firms would offer a compensation package which incentivises their employees to take appropriate levels of risk, and thus there would be no need for regulating pay (see Murphy, 1999; and Frydman & Jenter, 2010 for comprehensive surveys of the empirical and theoretical literature on the topic of executive compensation). Indeed, some studies (Rosen, 1981; Gabaix & Landier, 2008; Edmans & Gabaix, 2016) explained how both the rise in the level of executive remuneration and the very large compensation at the top could reflect the efficient outcome of a more competitive labour market for talent against the backdrop of growth, globalisation and technological advances.

But regulating pay is justified if the market-determined pay deviates from the socially optimal outcome (e.g. as shown by Bénabou & Tirole (2016), Bebchuk & Fried (2004)) and regulation can achieve a better outcome. The existing literature suggests that banks that are 'too big to fail' incentivise excessive risk-taking by their executives to maximise the implicit subsidy arising from taxpayer support in the event of failure, but it is nuanced as to whether remuneration regulation can outperform the market outcome. Using a theoretical model, Hakenes and Schnabel (2014) argue that a bonus cap would only improve welfare if the 'too big to fail' effect is very large. Asai (2016) concludes that a bonus cap reduces risk-shifting by bank executives but aggravates underinvestment. Thanassoulis and Tanaka (2018) demonstrate that banks can incentivise excessive risk-taking even in the presence of malus and clawback by offering pay which is convex in shareholder value.

Empirically, Colonnello et al (2018) find that the risk-adjusted performance of EU banks deteriorated following the introduction of the bonus cap. This could reflect the reduced incentive to perform, as banks have increased the share of fixed pay following the introduction of the bonus cap so as to keep the total compensation sufficiently high/ consistent with that prior to the introduction of bonus cap to retain and to recruit staff (Angeli and Gitay, 2015). However, the available evidence is far from conclusive, as the empirical identification of the impact of pay on *risk choice* is hampered by the lack of data; and any empirical study linking *performance* to pay has to address the issue that, as risk is ubiquitous in financial intermediation, there is an element of chance in any observed outcome over a relatively short time horizon.

As remuneration regulations restrict only certain aspects of variable pay, an important question is whether banks can tweak pay parameters to restore risk-taking incentives. Yet, little research has been done to understand how common pay practices, such as relative performance benchmarking, interact with remuneration regulations to affect risk-taking incentives. Relative performance pay, which rewards employees based on performance relative to their peers and competitors, is widely used in financial institutions for a number of reasons (Diamond & Rajan, 2009; Bell et al, 2018). First, there is evidence that relative performance pay, such as a winner-take-all contest, induces higher effort than a proportional-prize contest (e.g., Cason et al, 2018). Second, clients often make investment decisions based on past relative performance of collective investment funds[4] (Rajan, 2006). However, the literature also suggests that highly competitive relative performance pay can induce a variety of undesirable behaviours (Rajan 2006; Diamond & Rajan, 2009; Bénabou & Tirole, 2016), including excessive risk-taking to seek high returns and herding in investment patterns (Kirchler et al, 2018; Rajan, 2006; Albuquerque et al, 2018). Thus, our lab experiment examines both how bonus cap and malus could influence risk-taking, and whether relative performance pay could restore risk-taking incentives even in the presence of these bonus restrictions.

2. The Experiment

[4] Such behaviour could be explained by the 'Informativeness Principle' (Holmstrom 1979), which suggests that, when the industry as a whole is subject to common shocks, relative performance contains a signal of the unobservable effort of the agent.

The experiment was conducted in a behavioural research lab with a total of 253 participants, most of whom were university students (Table 1). Participants were offered £10 for participating in an hour-long lab experiment, which would also provide an opportunity to earn an additional bonus. Participants were not allowed to communicate with each other for the duration of the experiment.

The lab experiment consisted of the following four parts:

Part 1 (personality and psychology questionnaire) included questions relating to personality and risk preference. The aim of this questionnaire was to collect information about participants' personality traits to allow a separate study on risk-taking and personality traits (Soane and Aufegger, 2020). .

Part 2 (Probability questions and Inheritance Task) included four probability questions and Task I (inheritance task). The probability questions were presented as practice questions to remind participants of the relevant probability concepts that are useful for completing Part 3. It also allows us to test whether there is any relationship between the participants' performance on these probability questions – an indication of how well they understand probability – and risk-taking, and, if warranted, to control for participants' understanding of probability theory in the analysis.

In Task I, "Inheritance", participants were given a hypothetical scenario in which they inherited £100,000 from a distant relative. Participants were asked to choose one asset from the list of nine assets with different risk-return characteristics as shown in Table 2: assets were presented in ascending order of risk, with Asset 1 being risk-free and Asset 9 being the riskiest. No bonus was paid for this task. Participants did not experience any monetary gains or losses from this task. This task was designed to provide some indication on how participants would make a decision when they are exposed to both gains and losses from an investment. We use participants' asset choice in Task I as a proxy for individuals' inherent risk preference.

Part 3 (Investment tasks): Participants were then asked to undertake four distinct investment tasks (Tasks N, R1, R2 and T, in that order) in which they could earn a cash bonus. In these investment tasks, participants were asked to choose one asset from the list of nine assets (Table 2) in which to invest. These tasks are described in detail below. In Task N, participants' bonus depended on the realised return on their investment. There is no relative performance benchmark in Task N. In tasks R1, R2 and T, the participants had to meet an additional relative performance benchmark to receive a bonus. At the end of each session, a (random) realisation of the asset returns is drawn for each task and each session for proportional bonus and bonus cap treatment groups, while two realisations – representing two time periods – were drawn for the malus treatment groups. The participants could earn a cash bonus depending on (1) the realised returns of the assets they chose, (2) the bonus group they were assigned to, and (3) the specificity of the task (e.g., whether they have to meet a specific relative performance benchmark in order to be eligible for a bonus.)

Bonus groups

Before undertaking the investment tasks, participants were randomly assigned into one of the following three bonus groups.

<u>Proportional bonus group (control group, 82 participants):</u> Participants assigned to the proportional bonus group were informed that they would be paid a bonus proportional to the asset return, provided that the realised return at the end of the session was positive. Those in the proportional bonus group could expect to earn up to a maximum of £6 cash bonus per task – if they chose Asset 9 and it succeeded.

Bonus cap treatment group (treatment group 1, 87 participants): Participants assigned to the bonus cap treatment group were informed that they would be paid a bonus proportional to the asset return, if the realised return at the end of the session was positive. They were also informed that the bonus in each task was *capped at £4*. This meant that there was no possibility of earning a higher bonus by choosing an asset which had a higher risk than Asset 6.

Malus treatment group (treatment group 2, 84 participants): Participants assigned to the malus treatment group were informed that they would be paid a bonus proportional to the asset return, if the realised return was positive in *both "Year 1" and "Year 2"* – represented by two independent (random) realisation of the asset returns. The probability of success in each "year" (i.e., realisation) was independent and the same. For example, as Asset 3 has a probability of success of 90%, the probability for Asset 3 to "succeed" in both "years" (i.e., realisations) will be $(90\%)^2 = 81\%$. Participants in the malus treatment group could earn a maximum of £6 bonus per task. However, the probability of earning a bonus was lower than that facing the proportional bonus group for Assets 2-9.

Investment tasks

In Task N, "Without relative performance pay", participants were asked to act as investment managers for the 'ABC Bank'. Participants were shown Table 2, which listed, for each asset choice, the probability of failure and success and the returns in each state. They were also given a description, specific to their bonus group, of how their realised investment return translates into a cash bonus, as described above, e.g., for proportional bonus group participants, they would be paid a bonus proportional to the asset return provided the realised return is positive.

In Task R1 and Task R2, "Relative performance pay", all participants were asked to choose an asset from the same set of nine options (Table 2) to invest as investment managers for the 'ABC Bank'. In Task R1, participants were informed that they would be eligible for a bonus only if the realised return on the asset they selected was positive and higher than the median of the returns achieved by the investors in their team. In Task R2, participants were informed that they would be eligible for a bonus only if the realised return on the asset they chose was positive and among the top 5 highest achieved (including all those who were tied for the 5th place) in their team. In both cases, each team consisted of all the participants in the same experiment session (average 17 people per session). Participants were also given a description, specific to their bonus group, of how their realised investment return translates into a cash bonus.

Task T, "Relative performance pay with team profitability", built upon Task R2. In Task T, to be eligible for a bonus, a participant needed to achieve an asset return which was positive and among the top 5 highest achieved (including all those who were tied for the 5th place) in their team (as in Task R2), and the team as a whole had to avoid a loss. Participants were also given a description, specific to their bonus group, of how their realised investment return translates into a cash bonus.

Table 3 provides a summary of potential bonuses in different tasks for participants from different bonus groups.

Part 4 (Demographics) included questions on demographic information, such as age, gender, interest in finance, education, work experience, etc. (Table 1). This information was collected in order to enable us to test and if warranted, to control for demographic characteristics which might influence risk choice.

Participants were informed of the outcome of their investment decisions in Tasks N, R1, R2 and T and were paid a cash bonus after everyone in their session completed the experiment.

This experimental design enables us to study the effects of bonus and relative performance pay on risk-taking through 'within-subject' analysis by comparing individuals' choices across different tasks. It also enables us to study the impact of bonus rules and their interactions with relative performance pay through 'between-subject' analysis by comparing the choices of different bonus groups.

3. The Results

For the purpose of statistical analysis, participants' asset choices were grouped into three broader risk levels: low risk assets (Assets 1-3) grouped as Risklevel_1, medium risk assets (Assets 4-6) as 'Risklevel_2' and high risk assets (Assets 7-9) as 'Risklevel_3'. Assets 7-9 represent higher risk level assets while Assets 1-3 represent (comparatively) lower risk level assets: investing in Assets 7-9 represented meaningfully higher risk-taking than investing in Assets 1-3.

Tables 4a-c show the choice of each bonus group in each task. It is striking that, in Task I, a large majority (83%) chose medium risk (Risklevel_2) assets, suggesting that these assets were considered to be 'optimal' by most participants in a scenario where they had to imagine internalising both the gains and losses from their investments (Table 4b).

Table 4c shows that, for all bonus groups, participants were more likely to choose a high risk (Risklevel_3) asset when they were paid a bonus (in Task N) than when they were asked to imagine investing their own inheritance (in Task I). They were also more likely to invest in high risk assets in the presence of relative performance benchmarking (in Tasks R1 and R2) than in its absence (in Task N), with greater risk-taking when the relative performance benchmark was made more competitive in Task R2 (relative to Task R1). This suggests that a bonus scheme which does not penalise for losses leads to greater risk-taking than what participants would consider 'optimal' if they were exposed to both gains and losses; and that relative performance benchmarking exacerbates this tendency.

Table 4a shows that participants in the malus group were *more* likely to choose low risk (Risklevel_1) assets than those in the control group in Task N. Table 4c also shows that participants in the bonus cap and malus groups were *less* likely to choose high risk assets than those in the control group in Task N. However, in the presence of relative performance pay (Tasks R1 and R2), participants were more likely to choose high risk assets across all three bonus groups (Table 4c). Moreover, there was little difference between the bonus cap group and the proportional bonus group (Table 4c). We found that making the individuals' bonus conditional on the profitability of the team (Task T) could lead to participants being more likely to choose low risk assets (Table 4a) and less likely to choose high risk assets (Table 4c).

To test the statistical significance of these observations, we employed the maximum-likelihood multinomial logit models with discrete dependent variables. This is because the dependent variable in our study – the risk level of the asset the participants chose – is categorical. In a multinomial logit model, we nominate one of the categories as a baseline, calculate log-odds for all other categories relative to the baseline, and then let the log-odds be a linear function of the variables (predictors) which might influence the log-odds.

We first examine whether there were any risk preference biases between participants (randomly) assigned to different bonus groups by estimating the following multinomial logit models:

$$ln\frac{Pr(TI\_level = Risklevel\_1)}{Pr(TI\_level = Risklevel\_2)} = C_{10} + C_{11}(Bonus\ cap) + C_{12}(Malus) + C_{13}Age + C_{14}Male + C_{15}InterestInFinance \quad (1)$$

$$ln\frac{Pr(TI\_level = Risklevel\_3)}{Pr(TI\_level = Risklevel\_2)} = C_{20} + C_{21}(Bonus\ cap) + C_{22}(Malus) + C_{23}Age + C_{24}Male + C_{25}InterestInFinance$$

where the dependent variable, TI_level, was the risk levels chosen by participants in Task I. The left hand side is the relative log odds of a Risklevel_1 asset (or Risklevel_3 asset) being selected vs. a Risklevel_2 asset (baseline comparison category) being selected, representing the participants' propensity to choose a Risklevel_1 asset (or a Risklevel_3 asset) over a Risklevel_2 asset. The right-hand side variables included a dummy variable $Bonus\ cap$ which equals one only for the bonus cap treatment group, and a dummy variable $Malus$ which equals one only for the malus treatment group. We also included Age, and dummies $Male$ and $InterestInFinance$ in the regression, where $Male = 1$ only for males, $InterestInFinance = 1$ only for the participants who expressed an interest in finance career. A large body of literature in biology, psychology and sociology documents differences in risk taking between males and females, people of different ages (e.g., Slovic, 1966; Byrnes et al., 1999; Deakin et al., 2004). In addition, we are also interested in whether there is any relationship between an individual's career preference and risk-taking preference: are people who are more interested in a finance career more likely to take more risk?

Results are shown in Table 5. Neither $Bonus\ cap$ nor $Malus$ was significant, confirming that there were no statistically significant differences in inherent risk preferences among the three bonus groups. $Male$ was the only statistically significant variable: other things being equal, male participants were more likely to choose high risk assets than female participants, consistent with the existing literature on gender differences in risk-taking (see for example Byrnes et al. (1999) for a meta-analysis). We did not find statistically significant differences in risk-taking preferences in this task between young and old participants. This could be because the participants are predominantly young university students (Table 1). We also did not find statistically significant differences in risk-taking preferences in this task between those who are more interested in a finance career and those who are less interested in a finance career.

Result 1: Proportional bonus encourages greater risk-taking

To assess the impact of proportional bonus on risk-taking using a within-subject approach, we compare the asset choices in Task I and Task N made by the proportional bonus group by estimating the following multinomial logit models:

$$ln\frac{Pr(TI\_or\_TN\_level = Risklevel\_1)}{Pr(TI\_or\_TN\_level = Risklevel\_2)} = C_{10} + C_{11}Bonus + C_{12}Male + C_{13}InterestInFinance$$

$$ln\frac{Pr(TI\_or\_TN\_level = Risklevel\_3)}{Pr(TI\_or\_TN\_level = Risklevel\_2)} = C_{20} + C_{21}Bonus + C_{22}Male + C_{23}InterestInFinance \quad (2)$$

where the dependent variables $TI\_or\_TN\_level$ were the risk levels chosen in Tasks I and N. The right-hand side variables included a dummy $Bonus$, which equals one if the asset choice was made in Task N, zero if the choice was made in Task I.

Table 6 summarises the results. The $Bonus$ dummy was significant and positive in the 2nd equation (Risklevel_3 assets), but not significant in the 1st equation (Risklevel_1 assets). This suggests that proportional bonus which rewards positive performance, but does not penalise negative performance encourages greater risk-taking relative to what individuals considered "optimal" when investing their own money. We also found that male participants and participants who expressed an interest in working in finance were marginally more likely to choose high risk assets.

Result 2: Without relative performance pay, bonus cap and malus can mitigate risk-taking

We now examine the impact of bonus cap and malus on risk choices. Using between-subject approach, we compare the Task N asset choices made by the different bonus groups by estimating the following multinomial logit models:

$$ln\frac{Pr(TN\_level = Risklevel\_1)}{Pr(TN\_level = Risklevel\_2)} = C_{10} + C_{11}(Bonus\ cap) + C_{12}(Malus) + C_{13}TI\_level + C_{14}Male + C_{15}InterestInFinance$$

$$ln\frac{Pr(TN\_level = Risklevel\_3)}{Pr(TN\_level = Risklevel\_2)} = C_{20} + C_{21}(Bonus\ cap) + C_{22}(Malus) + C_{23}TI\_level + C_{24}Male + C_{25}InterestInFinance \tag{3}$$

where TN_level denotes the risk level of the assets that the participants chose in Task N. The right-hand side variables included dummy variables $Bonus\ cap$ and $Malus$ as defined in Equation (1), and TI_level – the participants' inherent risk preferences represented by the risk level chosen in Task I.

Table 7, column (1) summarises the results. While the coefficients of both $Bonus\ cap$ and $Malus$ dummies were negative and significant in the 2nd equation (Risklevel_3 assets), only the $Malus$ dummy was significant and positive in the 1st equation (Risklevel_1 assets). These suggest that, in the absence of relative performance pay, both bonus cap and malus reduce participants' propensity to invest in high risk assets. However, while malus also increases participants' propensity to invest in low risk assets, bonus cap does not. This result is intuitive, as bonus cap only affects the expected bonus from investing in high risk, high return assets while malus affects the expected bonus from investing in all assets. In addition, participants with relatively high inherent risk preference were more likely to choose high risk assets and less likely to choose low risk assets. Male participants were marginally less likely to choose low risk assets and those who were interested in finance career were more likely to choose high risk assets.

Result 3: Relative performance pay increases risk-taking further

Next, we assess the impact of relative performance pay on risk-taking. We use a within-subject approach to compare the risk choices made by different bonus groups in Tasks R1, relative to their choices in Task N by estimating the following multinomial logit models:

$$\begin{aligned} ln\frac{Pr(TN\_or\_TR1\_level = Risklevel\_1)}{Pr(TN\_or\_TR1\_level = Risklevel\_2)} &= C_{10} + C_{11}Relative + C_{12}TI\_level + C_{13}(Bonus\ cap) \\ &+ C_{14}(Malus) + C_{15}Male + C_{16}InterestInFinance \\ ln\frac{\Pr(TN\_or\_TR1\_level = Risklevel\_3)}{\Pr(TN\_or\_TR1\_level = Risklevel\_2)} &= C_{20} + C_{21}Relative + C_{22}TI\_level + C_{23}(Bonus\ cap) \\ &+ C_{24}(Malus) + C_{25}Male + C_{26}InterestInFinance \end{aligned} \tag{4}$$

where the dependent variables $TN\_or\_TR1\_level$ were the risk levels chosen in Tasks N and R1. The right-hand side variables included a dummy $Relative$, which is equal to one if the choice was made in Task R1, and zero if the choice was made in Task N. We also estimated the same model for Task R2.

Results for Tasks R1 and R2 are shown in Table 8, columns 1 and 2, respectively. The dummy $Relative$ was positive and highly significant in the 2nd equation (propensity to choose Risklevel_3 assets) for both regressions. This suggests that relative performance pay encourages greater risk-taking. In addition, the coefficient for the dummy $Relative$ in the Risklevel_3 assets equation was larger in the regression for Task R2 than that for Task R1, suggesting that risk-taking increases when the relative performance benchmark was made more competitive.

Result 4: Relative performance pay weakens the risk mitigation effect from bonus cap and malus

We now assess the interaction between relative performance pay and remuneration regulations such as bonus cap and malus. Using between-subject approach, we compared the risk choices in Task R1 and Task R2 made by the three bonus groups by estimating the multinomial logit models as described by Equation (3) with risk level choices in Task R1 (and R2) on the left-hand side.

Results are shown in Table 7, columns (2) and (3). We found that in the presence of competitive relative performance pay, compared with the proportional bonus group, bonus cap had no statistically significant effect on participants' propensity to choose high risk or low risk assets; malus no longer affected participants' propensity to choose low risk assets while its effect on their propensity to choose high risk assets was inconclusive (significant in Task R2, but not in Task R1). Interestingly, compared with Task N, participants' inherent risk preferences (their choices in Task I) had much less impact on their risk choices in Task R1 or Task R2. This suggests that competitive relative performance pay could create risk-taking incentives that are strong enough to override both individuals' inherent risk preferences and bonus rules, such as bonus cap and malus.

Result 5: Making the bonus conditional on the team's overall profitability can reduce risk-taking

Typically, bankers' bonuses are not only influenced by their performance relative to peers, but also by the overall profitability of the firm and the team to which they belong. This creates an additional uncertainty over how their own choice influences pay. We designed Task T to examine how conditioning bonus on team performance affects risk choice: Task T built on Task R2, except that participants were eligible for bonus in Task T only if the team as a whole did not make a loss. As in all previous tasks, participants were not allowed to speak to or interact with each other in other ways.

Using the within-subject approach, we compare the asset choices in Task R2 and Task T by estimating the following multinomial logit models:

$$\begin{aligned} ln\frac{Pr(TR2\_or\_TT\_level = Risklevel\_1)}{Pr(TR2\_or\_TT\_level = Risklevel\_2)} &= C_{10} + C_{11}Team + C_{12}\ (Bonus\ cap) + C_{13}(Malus) + C_{14}TI\_level \\ &+ C_{15}Male + C_{16}InterestInFinance \\ ln\frac{Pr(TR2\_or\_TT\_level = Risklevel\_3)}{Pr(TR2\_or\_TT\_level = Risklevel\_2)} &= C_{20} + C_{21}Team + C_{22}\ (Bonus\ cap) + C_{23}(Malus) + C_{24}TI\_level \\ &+ C_{25}Male + C_{26}InterestInFinance \end{aligned} \quad (5)$$

where the dependent variables were the risk levels chosen in Tasks R2 and T. The right hand side variables included a dummy $Team = 1$ if the asset choice was made in Task T, and $Team = 0$ if the asset choice was made in Task R2.

We found that the $Team$ dummy was significant and positive in the 1st equation and significant and negative in the 2nd equation. The results suggest that, other things being equal, making bonus conditional on the team's loss avoidance can reduce risk-taking across all bonus groups (Table 9).

There were no statistically significant differences in asset selections in Task T between bonus cap and proportional groups (Table 10). Malus appeared to reduce participants' propensity to choose high risk assets (Table 10), a result we observed in Task R2 (Table 8, column (3)), although not in Task R1 (Table 8, column (2)).

To help understand the differences in participants' investment decisions between Task T and Task R2, we compared the participants' stated motivation. Table 11 compares the participants' stated consideration when making the asset selections in Task R2 and Task T. Compared with Task R2, in Task T, more participants identified that their investment decisions were (mainly) motivated by bank considerations (48%) rather than (personal) bonus considerations (37%). In addition, among those who cited bonus consideration as the main drive, they were more likely to "balance risk and rewards" than going for "high bonus" in Task T (vs. Task R2).

4. Conclusion

Our study examined how specific restrictions on bonus could influence risk-taking and how these restrictions may interact with common features of bonus structures in the banking sector – such as relative performance pay – to affect risk-taking. While strong conclusions on policy should not be drawn based on a lab experiment alone, our study highlights a number of ways in which bonus structure could affect risk taking. First, a bonus structure that rewards positive returns but does not penalise negative returns could lead to greater risk-taking than what individuals consider optimal when they are exposed to both gains and losses from their investment. Second, without relative performance pay, bonus cap and malus could reduce risk-taking. Third, relative performance pay may increase risk-taking. The more competitive the relative performance pay is, the more risk-taking it might lead to. Fourth, the presence of relative performance pay could undermine the risk-mitigating effects of bonus cap and malus. Finally, making individuals' bonus payments conditional on their team avoiding a loss could rein in some risk-taking.

Despite the modest stakes offered to the participants, our study demonstrates that bonus schemes may affect risk choices, and certain restrictions on bonus payments might reduce risk-taking. This finding supports the view that some appropriately designed restrictions on bonus payments could mitigate excessive risk-taking. However, our findings suggest that commonly used bonus practices – such as relative performance benchmarking – might undermine the risk-mitigating effects of regulatory bonus restrictions. Other existing papers have also noted that bonus payments which are convex in the bank's market value (Thanassoulis and Tanaka, 2018) or conditional on achieving high absolute performance targets (Harris et al., 2018) could also undermine the risk-mitigating effects of restrictions such bonus caps and malus. Our study therefore suggests that the efficacy of bonus caps and malus in mitigating risk taking could also depend on features of bonus contracts that banks are free to design.

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Tables

Table 1: Sample characteristics

	Proportional	Bonus cap	Malus	Total
Number of participants	82	87	84	253
Gender				
Female (%)	64.6%	69.0%	60.7%	64.8%
Male (%)	35.4%	31.0%	39.3%	35.2%
Age				
Min (years)	18	18	18	18
Max (years)	58	36	65	65
Mean (years)	22.2	22.1	24.0	22.7
St dev (years)	5.0	3.2	8.0	5.8
Student?				
Yes (%)	93.9%	94.3%	89.3%	92.5%
No (%)	6.1%	5.8%	10.7%	7.5%
Interest in finance?				
Yes (%)	65.8%	62.1%	53.6%	60.5%
No (%)	34.2%	37.9%	46.4%	39.5%

Table 2: 9-asset choice task[5]

	Probability of failure	Probability of success	Return when failure	Return when success	Expected return
Asset 1	0%	100%	0.00	0.50	0.50
Asset 2	5%	95%	-0.25	1.00	0.94
Asset 3	10%	90%	-0.50	1.50	1.30
Asset 4	15%	85%	-1.00	2.00	1.55
Asset 5	25%	75%	-2.00	3.00	1.75
Asset 6	35%	65%	-3.00	4.00	1.55
Asset 7	40%	60%	-3.50	4.50	1.30
Asset 8	45%	55%	-4.00	5.00	0.95
Asset 9	50%	50%	-4.50	6.00	0.75

[5] Columns 4-6 were given in units of £ thousand in Task I, in which they were asked to invest £100,000 inheritance. In Tasks N, R1, R2 and T, participants were asked to invest £100 million on behalf of 'ABC Bank', and columns 4-6 were given in units of £ million.

Table 3: Control groups, treatment groups and tasks

	Proportional bonus (Control group)	**Bonus cap (Treatment group 1)**	**Malus (Treatment group 2)**
Task I	Hypothetical task of investing £100,000 of inheritance; unpaid.		
Task N (no relative performance pay)	Bonus paid proportionally to the (positive, realised) return on the chosen asset.		
		and subject to a maximum.	and if that asset yields a positive return both in Year 1 and Year 2.
Task R1 (beat the median)	Bonus paid proportionally to the (positive) return on the chosen asset, if the realised return is higher than the median of the team.		
		and subject to a maximum.	and if that asset yields a positive return both in Year 1 and Year 2.
Task R2 ("top 5")	Bonus paid proportionally to the (positive) return on the chosen asset, if the realised return is amongst the top 5 returns in the team.		
		and subject to a maximum.	and if that asset yields a positive return both in Year 1 and Year 2.
Task T (team performance)	Bonus paid proportionally to the (positive) return on the chosen asset, if the realised return is amongst the top 5 returns in the team, and the team as a whole does not make a loss.		
		and subject to a maximum.	and if that asset yields a positive return both in Year 1 and Year 2.

Table 4a: Percentage of participants who chose Risklevel_1 (low risk) assets

% Risklevel_1 assets (Assets 1-3)	Proportional (subtotal=82)	Bonus cap (subtotal=87)	Malus (subtotal=84)
Task I (Inheritance)	12%	14%	14%
Task N (without relative performance)	11%	14%	33%
Task R1 (beat the median)	10%	7%	17%
Task R2 (Top 5)	11%	10%	12%
Task T (Top 5+ team not losing money)	21%	20%	25%

Table 4b: Percentage of participants who chose Risklevel_2 (medium risk) assets

% Risklevel_2 assets (assets 4-6)	Proportional (subtotal=82)	Bonus cap (subtotal=87)	Malus (subtotal=84)
Task I (Inheritance)	83%	83%	82%
Task N (without relative performance)	71%	78%	61%
Task R1 (beat the median)	55%	57%	61%
Task R2 (Top 5)	49%	48%	60%
Task T (Top 5+ team not losing money)	49%	59%	56%

Table 4c: Percentage of participants who chose Risklevel_3 (high risk) assets

% Risklevel_3 assets (assets 7-9)	Proportional (subtotal=82)	Bonus cap (subtotal=87)	Malus (subtotal=84)
Task I (Inheritance)	5%	3%	4%
Task N (without relative performance)	18%	8%	6%
Task R1 (beat the median)	35%	36%	23%
Task R2 (Top 5)	40%	41%	29%
Task T (Top 5+ team not losing money)	30%	22%	19%

Table 5: Inherent risk preference

(All participants, Task I)

	TI_level	
Risklevel_1		
Bonus cap	0.0921	(0.463)
Malus	0.116	(0.469)
Age	0.0103	(0.0317)
Male	-0.437	(0.428)
InterestInFinance	-0.421	(0.388)
Constant	-1.756**	(0.854)
Risklevel_2 (base case)		
Risklevel_3		
Bonus cap	-0.281	(0.795)
Malus	-0.265	(0.803)
Age	-0.00216	(0.0648)
Male	1.483**	(0.711)
InterestInFinance	0.921	(0.860)
Constant	-4.254**	(1.884)
Observations	253	
Pseudo R^2	0.035	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We examine the drivers of individuals' inherent risk preferences by evaluating what are the factors and how they are affecting the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case). This table reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TI\_level = Risklevel\_1)}{Pr(TI\_level = Risklevel\_2)} = C_{10} + C_{11}(Bonus\ cap) + C_{12}(Malus) + C_{13}Age + C_{14}Male + C_{15}InterestInFinance$$

$$ln\frac{Pr(TI\_level = Risklevel\_3)}{Pr(TI\_level = Risklevel\_2)} = C_{20} + C_{21}(Bonus\ cap) + C_{22}(Malus) + C_{23}Age + C_{24}Male + C_{25}InterestInFinance$$

where the dependent variable, TI_level , was the risk levels chosen by participants in Task I. The right-hand side variables included a dummy variable $Bonus\ cap$ which equals one only for the bonus cap treatment group, and a dummy variable $Malus$ which equals one only for the malus treatment group We also included Age, and dummies $Male$ and $InterestInFinance$ in the regression.

Table 6: Impact of proportional bonus on risk choices
(Task I and Task N, proportional bonus group)

	TI_or_TN_level	
Risklevel_1		
Bonus	0.0506	(0.494)
Male	0.185	(0.513)
InterestInFinance	-0.263	(0.501)
Constant	-1.819***	(0.496)
Risklevel_3		
Bonus	1.539**	(0.601)
Male	0.905*	(0.519)
InterestInFinance	1.158*	(0.672)
Constant	-4.124***	(0.830)
Observations	164	
Pseudo R^2	0.064	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We assess the impact of proportional bonus on risk choices by evaluating whether and how the presence of proportional bonus (the dummy $Bonus$) affected the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case).This table reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TI\_or\_TN\_level = Risklevel\_1)}{Pr(TI\_or\_TN\_level = Risklevel\_2)} = C_{10} + \ C_{11}Bonus + C_{12}Male + C_{13}InterestInFinance$$

$$ln\frac{Pr(TI\_or\_TN\_level = Risklevel\_3)}{Pr(TI\_or\_TN\_level = Risklevel\_2)} = C_{20} + \ C_{21}Bonus + C_{22}Male + C_{23}InterestInFinance$$

where the dependent variables $TI\_or\_TN\_level$ were the risk levels chosen in Task I (82 entries) and Task N (82 entries). The right-hand side variables included a dummy $Bonus$, which equals one if the asset choice was made in Task N, zero if the choice was made in Task I.

Table 7: Impact of bonus regimes on risk choices under different relative performance benchmarks

(All bonus groups, Task N, Task R1 and Task R1)

	(1)		(2)		(3)	
	TN_level		TR1_level		TR2_level	
Risklevel_1						
Bonus cap	0.0509	(0.523)	-0.425	(0.581)	-0.165	(0.538)
Malus	1.490***	(0.478)	0.434	(0.493)	-0.307	(0.523)
TI_level	-2.272***	(0.443)	0.201	(0.530)	-1.042**	(0.480)
Male	-0.701*	(0.417)	-0.528	(0.477)	-0.0351	(0.474)
InterestInFinance	-0.269	(0.368)	-0.193	(0.421)	-1.080**	(0.437)
Constant	2.491***	(0.858)	-1.825*	(1.077)	1.102	(0.962)
Risklevel_2						
Risklevel_3						
Bonus cap	-1.034*	(0.539)	0.0106	(0.342)	0.0426	(0.331)
Malus	-1.138*	(0.614)	-0.542	(0.373)	-0.630*	(0.349)
TI_level	2.406***	(0.704)	1.569***	(0.466)	0.0382	(0.357)
Male	0.606	(0.468)	0.172	(0.303)	0.484*	(0.289)
InterestInFinance	1.697**	(0.673)	0.135	(0.303)	-0.442	(0.288)
Constant	-7.811***	(1.621)	-3.665***	(0.957)	-0.142	(0.738)
Observations	253		253		253	
Pseudo R^2	0.213		0.056		0.042	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We assess the impact of bonus regulation on risk choices by evaluating how different bonus regimes (bonus cap, malus vs. proportional bonus) affected the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case).

The first column (TN_level) reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TN\_level = Risklevel\_1)}{Pr(TN\_level = Risklevel\_2)} = C_{10} + C_{11}(Bonus\ cap) + C_{12}(Malus) + C_{13}TI\_level + C_{14}Male + C_{15}InterestInFinance$$

$$ln\frac{Pr(TN\_level = Risklevel\_3)}{Pr(TN\_level = Risklevel\_2)} = C_{20} + C_{21}(Bonus\ cap) + C_{22}(Malus) + C_{23}TI\_level + C_{24}Male + C_{25}InterestInFinance$$

where TN_level denotes the risk level of the assets that the participants chose in Task N (no relative performance pay). The right-hand side variables included dummy variables $Bonus\ cap$ and $Malus$; and TI_level – the participants' inherent risk preferences represented by the risk level chosen in Task I.

The second (TR1_level) and the third (TR2_level) columns report the results for Task R1and Task R2 respectively.

Table 8: Impact of relative performance pay on risk choices
(Task R1 vs. Task N; Task R2 vs. Task N, all participants)

	Task R1		Task R2	
	TN_or_TR1_level		TN_or_TR2_level	
Risklevel_1				
Relative	-0.510*	(0.276)	-0.418	(0.282)
TI_level	-1.178***	(0.305)	-1.597***	(0.304)
Bonus cap	-0.169	(0.375)	-0.0803	(0.369)
Malus	0.952***	(0.331)	0.698**	(0.336)
Male	-0.589*	(0.306)	-0.403	(0.307)
InterestInFinance	-0.230	(0.269)	-0.564**	(0.272)
Constant	0.836	(0.627)	1.813***	(0.625)
Risklevel_3				
Relative	1.422***	(0.264)	1.594***	(0.252)
TI_level	1.752***	(0.403)	0.526*	(0.319)
Bonus cap	-0.268	(0.280)	-0.230	(0.268)
Malus	-0.692**	(0.313)	-0.655**	(0.293)
Male	0.297	(0.250)	0.476**	(0.236)
InterestInFinance	0.470*	(0.261)	0.0662	(0.240)
Constant	-5.611***	(0.885)	-2.914***	(0.696)
Observations	506		506	
Pseudo R^2	0.133		0.126	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We assess the impact of relative performance pay on risk choices by evaluating whether and how the presence of relative performance pay (the dummy $Relative$) affected the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case).

The first column (TN_or_TR1_level) reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TN\_or\_TR1\_level = Risklevel\_1)}{Pr(TN\_or\_TR1\_level = Risklevel\_2)} = C_{10} + C_{11}Relative + C_{12}TI\_level + C_{13}(Bonus\ cap) + C_{14}(Malus) + C_{15}Male + C_{16}InterestInFinance$$

$$ln\frac{\Pr(TN\_or\_TR1\_level = Risklevel\_3)}{\Pr(TN\_or\_TR1\_level = Risklevel\_2)} = C_{20} + C_{21}Relative + C_{22}TI\_level + C_{23}(Bonus\ cap) + C_{24}(Malus) + C_{25}Male + C_{26}InterestInFinance$$

where the dependent variables $TN\_or\_TR1\_level$ were the risk levels chosen in Task N (253 entries) and Task R1 (253 entries). The right-hand side variables included a dummy $Relative$, which is equal to one if the choice was made in Task R1, and zero if the choice was made in Task N.

The second column (TN_or_TR2_level) reports the results for estimating the multinomial logit models for risk levels chosen in Task N and Task R2.

Table 9: Impact on risk choices when making bonus conditional on the team's profitability

(All bonus groups, Task R2 and Task T)

	TR2_or_TT_level	
Risklevel_1		
Team	0.680**	(0.268)
Bonus cap	-0.241	(0.326)
Malus	-0.0965	(0.316)
TI_level	-0.866***	(0.298)
Male	-0.371	(0.296)
InterestInFinance	-0.576**	(0.261)
Constant	0.546	(0.613)
Risklevel_2		
Risklevel_3		
Team	-0.527**	(0.211)
Bonus cap	-0.186	(0.249)
Malus	-0.667**	(0.265)
TI_level	0.747**	(0.291)
Male	0.597***	(0.215)
InterestInFinance	-0.373*	(0.217)
Constant	-1.521**	(0.604)
Observations	506	
Pseudo R^2	0.065	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We assess the impact of making individuals' bonus conditional on the team's profitability on risk choices by evaluating whether and how the presence of team's profitability as a bonus criterion (the dummy $Team$) affected the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case).

The table reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TR2\_or\_TT\_level = Risklevel\_1)}{Pr(TR2\_or\_TT\_level = Risklevel\_2)} = C_{10} + C_{11}Team + C_{12}\,(Bonus\ cap) + C_{13}(Malus) + C_{14}TI\_level + C_{15}Male + C_{16}InterestInFinance$$

$$ln\frac{Pr(TR2\_or\_TT\_level = Risklevel\_3)}{Pr(TR2\_or\_TT\_level = Risklevel\_2)} = C_{20} + C_{21}Team + C_{22}\,(Bonus\ cap) + C_{23}(Malus) + C_{24}TI\_level + C_{25}Male + C_{26}InterestInFinance$$

where the dependent variables were the risk levels chosen in Task R2 (253 entries) and Task T (253 entries). The right hand side variables included a dummy $Team = 1$ if the asset choice was made in Task T, and $Team = 0$ if the asset choice was made in Task R2.

Table 10: Impact of bonus regulation on risk choices when making bonus conditional on the team's profitability

(All bonus groups, Task T)

	TT_level	
Risklevel_1		
Bonus cap	-0.305	(0.410)
Malus	0.0183	(0.399)
TI_level	-0.745*	(0.391)
Male	-0.550	(0.379)
InterestInFinance	-0.285	(0.331)
Constant	0.845	(0.783)
Risklevel_2		
Risklevel_3		
Bonus cap	-0.523	(0.392)
Malus	-0.769*	(0.416)
TI_level	2.194***	(0.643)
Male	0.788**	(0.335)
InterestInFinance	-0.349	(0.342)
Constant	-4.920***	(1.315)
Observations	253	
Pseudo R^2	0.089	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We assess the impact of bonus regulation on risk choices under the presence of relative performance pay and the condition on team's profitability by evaluating whether and how different bonus regimes (bonus cap, malus vs. proportional bonus) affected the propensity to choose low risk (Risklevel_1) assets and high risk (Riklevel_3) assets vis-à-vis the propensity to choose Risklevel_2 assets (base case) when the bonus is both subject to relative performance benchmark and conditional on the team's overall profitability.

The table reports the results of estimating the following multinomial logit models:

$$ln\frac{Pr(TT\_level = Risklevel\_1)}{Pr(TT\_level = Risklevel\_2)} = C_{10} + C_{11}(Bonus\ cap) + C_{12}(Malus) + C_{13}TI\_level + C_{14}Male + C_{15}InterestInFinance$$

$$ln\frac{Pr(TT\_level = Risklevel\_3)}{Pr(TT\_level = Risklevel\_2)} = C_{20} + C_{21}(Bonus\ cap) + C_{22}(Malus) + C_{23}TI\_level + C_{24}Male + C_{25}InterestInFinance$$

where the dependent variables were the risk levels chosen in Task T (253 entries).

Table 11: Main motivation of investment decision, Task T vs Task R2 (All participants, total =253)

	Task R2		Task T	
Motivation	Frequency	percentage	Frequency	percentage
Bank: reduce loss	11	4%	21	8%
Bank: risk and return	48	19%	75	30%
Bank: high return	35	14%	26	10%
Bonus: risk and reward	96	38%	90	36%
Bonus: high bonus	63	25%	41	16%
Total	253	100%	253	100%