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STUDY-WORK TRADE-OFF IN CONTESTS WITH CAPACITY-CONSTRAINED STUDENTS

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Study-Work Trade-off in Contests With Capacity-Constrained Students[1]

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Abstract

The choice of education and career trajectory plays a crucial role in student behavior and labor market outcomes. This paper investigates how students allocate limited time across academic activities and gaining work experience. We show that in a setting in which student types (or abilities) constitute private information, there are pooling and separating equilibria, which are sustained under a certain state of the job market. Our theoretical model shows how each student's choice between working and studying depends on the contract, and students' abilities and expectations about the benefits of a master's degree. To test the main predictions of the model, we conduct a survey of 122 HSE University economics students, who were completing their bachelor's degree in 2022. Our empirical findings partially confirm what the theory predicts. We also provide possible explanations for the effects that are not in line with our model but observed among the students.

Keywords: contest theory, signaling, contract theory, education trajectories

JEL Codes: D86, D82, I26

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1 Introduction

In many real-life situations agents have to distribute their limited efforts between various activities. For example, workers allocate time across multiple tasks; firms invest in various R&D activities; and students must decide how much they should study and work to enter a certain career trajectory. In this paper, we focus on a "student-university-employer" setting as a specific case of this problem. It is crucial to point out the significance of the baseline model for the solution of other general cases, where agents must decide how to distribute their scarce resources in a competitive environment with multiple tasks to be performed.

Generally, each student has a trade-off. First, they can devote more effort to studying and improve the signal about relative academic performance, or they can focus more on attaining work experience enhancing another dimension of the signal. Altogether, this problem mimics the job-market signaling model of Spence (Spence, 1973), but introduces multidimensional signals.

The question of interest is closely related to students' learning and career preferences, which is widely considered in the literature on the education wage premium (O'Leary & Sloane, 2005) and academic progress scopes (Triventi, 2014). Besides, a lot of detailed data has been collected worldwide on the historical and current preferences of students in the context of the study-work trade-off, which shows that students' choices are changing over time and by wage groups. However, the evolution of preferences is different in the US and Europe: while US youth tend to decrease the duration of education and attain work experience right after their graduation from high-school (The US Department of Education, 2020), European students are more likely to extend their learning track and reduce the attrition ratio (European Commission, 2020).

Hence, the research question in this paper is: "What is the optimal distribution of efforts in multi-stage contests where the agents have effort (or time) constraints, and the agent aims at maximizing their profit function?"

The structure of each student's choice at different stages raises two subquestions: (1) How does the premium for additional years of schooling (here, a master's degree) affect future wages and how can an employer use this under information asymmetry? and (2) How does the ratio between the premiums for education and work experience affect the choice of effort distribution for each student?

Generally speaking, this paper brings together three research fields: contract theory, contest theory, and the choice of educational trajectory. Specifically, we address the job-market signaling model (Spence, 1973), and, unlike the canonical model of Spence, we introduce competition among prospective workers and extend the signaling structure to multidimensional signals aimed at multiple principals.

To study the question of interest, we propose a stylized model where each student faces the problem of optimal effort distribution when getting a bachelor's degree, and the solution to this problem determines their future success in the job market. We assume that students have marginal costs of effort and time constraints which interact with each other in the competitive setting. They decide either to devote more effort to better academic performance or to get some work experience, both of which signal a potential employer.

Students also choose where to apply: either directly to the job market or to a master's course after completing a bachelor's degree; and which university to apply to, to get a better chance of getting a place in a master's program. As all students have effort constraints, they need to choose how to allocate these efforts optimally, taking into account the costs of these actions.

The probability of winning the education contest is based on degree ranking, so there is an incentive to devote more effort to studying in order to get a place in a master's program.

The main theoretical results show that there are two types of equilibria in the job market. The first one is pooling equilibria, where students choose the same level of work experience but differ in their actions taken in the education contest. The second type of equilibria is separating one, where some students prefer to signal the job market by obtaining additional work experience. We show that separating equilibria can be of different signaling structures, and its specific form depends on the initial parameters of the job market. Most importantly, we found that the two types of efforts (or signals) might behave as both complements and substitutes in students' actions, and this relationship depends on the students' valuation of the master's wage premium. Students participate actively in both studies and work, if the wage premium is sufficiently high to motivate them to participate in the education contest, but still not enough to make them stop working.

Based on the effects obtained via our theoretical model, we formalize several testable predictions. Specifically, we summarize the possible relations between students' academic performance, work experience, and their expectations about the wage premium after graduation from a master's program.

To test these predictions, we conducted a survey of 122 HSE University economics students who were in their last year of bachelor study at the time of survey. The data obtained contain information about students' relative rating, work experience, and their expectations about a master's degree.

First, we test the relationship between the probability of winning the education contest and students' work experience, and find that increasing the work experience proxy by 1 raises the probability of winning by 6-7%. Second, we investigate the relation between work experience and expectations about the benefits of a master's degree, and discover that if we increase the proxy for expectations by 1, students' work experience decreases by between 15% and 26%, depending on the specification of the proxy variable.

As our estimation results reveal, students pay attention to both work experience and GPA, and this strongly depends on their willingness to enter a master's program and expectations about their wage premium after attaining a master's degree. In terms of our theory, we find that such behavior is possible under a certain level of expectations about a master's degree.

The paper proceeds as follows. Section 2 describes the literature and outlines its contribution. Section 3 presents the model, theoretical results, and sets testable predictions and hypotheses based on them. Section 4 introduces the application of the theory to the data, presents the results of model estimation, and relates them to previous testable predictions. Section 5 concludes.

2 Literature Review

This paper brings together three research fields: contest theory, signaling and contract theory, and the literature on education trajectories. Specifically, we augment job market signaling theory with a contest environment where capacity-constrained contestants can exert multidimensional efforts (or signals) and these signals are observed by different parties. We also verify the theoretical predictions of our model with survey data.

In contest theory, there are many papers written about information disclosure by designer/contest organizer but little written about the disclosure by contestants themselves. Serena (Serena, 2021) proves that in contests where the principal decides whether to make information partially public, information disclosure might stimulate more effort if there is a high probability of meeting a high-type agent in a group and stimulate less effort otherwise. Unlike Serena (Serena, 2021), we study the effect of information disclosure among students and show that for the contestants, it may be profitable to send stronger signals (or devote more efforts) to the principal even if the related costs are high. Based on the conditions under which these signals are received, it can be better to signal via increasing the probability of winning the education contest. As in our model, winning the education contest is not deterministic, we can appeal to the results of Lagerlöf (Lagerlöf, 2020) who shows that in all-pay contests, the participants with a lower effort cost pay (in our case by being active) more. Hence, we expected and now prove that high-type students are prone to devote more effort to GPA contests.

If we turn to signaling theory, our study is close to the model of Spence (Spence, 1973). Unlike Spence, we introduce a two-dimensional signaling structure where students can signal their types via both GPA and work experience. The introduction of the second signal dimension gives us a non-trivial solution, where both signals can act as complements and substitutes. As each type of student distributes their signals based on the observed distribution of the abilities of other students, the competitiveness of the equilibria decreases between groups if the average effectiveness of the other party increases (if there are many high efficiency students, it is too costly for the low efficiency students to participate in the contest). This means that in multidimensional signaling contests, participants can value the cost of participation and redirect their efforts to a more profitable specialization.

There are mainly empirical papers on educational path choice. These studies show that the outcome of students' effort distribution can be mixed and depends on parameters, such as the job market valuation of a student's talent (based on relative performance between students) (Célérier & Vallée, 2019) and the prestige of their university (Sekhri, 2020). Fényes et al. (Fényes et al., 2021) show that for students with higher efficiency (or "career consciousness") it is more common to perform their best in studying in order to get a higher wage premium, which in our setting means that they will devote more effort to studying and gain less work experience.

We model student choices taking into account the response of their peers and including the impact of this choice on the job market equilibrium. Finally, we test whether more "talented" students tend to have less work experience. This proposition was partially confirmed by the data.

3 Theoretical framework

3.1 Model Setup

There are a number of **students**, I, who can be of 2 types, θ: H high type or L low type:

$$\theta \in \{H, L\}, \text{ where } H > L > 0.$$

These types can be seen as students' efficiencies.[2] Before the game starts, Nature decides on the type of student. The probability of a student to be of a high type is equal to p:

$$\mathbb{P}(\theta = H) = p, \quad \mathbb{P}(\theta = L) = 1 - p.$$

All students know the type of the others as we suppose that this information is effectively revealed during their studies. However, both principals: **the university** and the **job market** can only observe signals. For the university, the signal is GPA; for the job market, it is Work Experience (WE). Principals update their priors based on their beliefs about the type of each student.

[2] "Efficiency" might also be called productivity, cost of efforts, etc.

Each student exerts 2 types of efforts: e_{si} and e_{wi}, where e_{si} is effort on study, and e_{wi} is effort on work. These efforts are costly and the cost function is decreasing in efficiency of the type:

$$c(e_{si}, e_{wi}, \theta) = \frac{e_{si}}{\theta} + \frac{e_{wi}}{\theta}.$$

Students' efforts are constrained and normalized to 1: $e_{si} + e_{wi} \leq 1$.

For each student there is a chance either to get placed in a master's program and get a guaranteed wage equal to $(H + \Delta)$ or to get a job with the proposed wage (w_i), where Δ is the wage premium for a master's degree and is strictly positive. This assumption follows from the idea that the job market gets a strong signal of student's abilities and directly distinguishes the type of master's graduate as H, meaning that $\mathbb{P}(\theta = H|MA) = 1$.

Based on the efforts there are two types of signals formed. The first type of signal is $GPA_i = \frac{e_{si}}{\sum_{j\in I} e_{sj}}$.

This signal might be seen as a probability of winning the contest of GPA for a place in a master's program, $\mathbb{P}(\text{win})$. It is formed by a standard Tullock's contest success function (Tullock et al., 1980) and is strictly increasing in e_{si}; however, there is still no guarantee of winning the contest even with the greatest effort (conditional on other contestants' participation).

In our model, the university is inactive as the winning rule is set beforehand and is known to all the participants. The only parameter that the university could change is a number of students who can be placed in a master's program. For simplicity we assume there is only one place.[3]

The second type of signal that is observed only by the job market, is $WE_i = e_{wi}$. After this signal is observed by the job market, a student gets a wage offer, which is equal to their expected efficiency:

$$w_i = E[\theta_i|WE_i] = \mathbb{P}(\theta = H|e_{wi}) \cdot H + \mathbb{P}(\theta = L|e_{wi}) \cdot L$$

[3]This assumption is planned to be extended in further research.

Hence, each student solves

$$\max_{e_{si},e_{wi}\geq 0}\left\{EU_i=\frac{e_{si}}{\sum_{j\in I}e_{sj}}\cdot(H+\Delta)+\left(1-\frac{e_{si}}{\sum_{j\in I}e_{sj}}\right)\cdot\right.$$
$$\left.\cdot\left(\mathbb{P}(\theta=H|e_{wi})\cdot H+\mathbb{P}(\theta=L|e_{wi})\cdot L\right)-\frac{e_{si}}{\theta}-\frac{e_{wi}}{\theta}\right\}$$
$$\text{s.t.}\qquad e_{si}+e_{wi}\leq 1\qquad\text{and}\qquad\text{equilibrium specific constraints}^4$$

The timing of the game is as follows:

1. Each student chooses the level of both types of effort.

2. The outcomes (namely, GPA and WE) are revealed and observed by the parties under information revealing conditions stated above.

   The university announces the winner, while the job market proposes the contract based on its updated beliefs.

   Each student gets either a place in a master's program and hence will get guaranteed payment of $(H+\Delta)$ or receives an expected wage, which is proposed to them by the job market.

We solve the game by backward induction.

3.2 Solution Approach

There are two possible types of equilibria to consider: pooling, when the job market observes the same signals and proposes the same contracts for all students, and separating, when students choose to make the signals distinguishable and get their own contract. In our model, e_{wi} is determined by the contract with the job market, hence the following pooling and separating equilibria determines the choice of (1) contract scheme and (2) student effort distribution in only one dimension: e_{si}.

[4] These constraints will be further specified in each type of equilibria. It may include incentive compatibility and participation constraints.

3.2.1 Pooling equilibria

The pooling equilibria must feature $e_{wH} = e_{wL} = e_{pool}$. The job market observes only e_{wH} and e_{wL} and cannot distinguish between the types of students. Hence, the wage offer is the same for both types of students and is equal to the expected efficiency:

$$w_{pool} = E[\theta|WE_i] = p \cdot H + (1-p) \cdot L$$

Both types of students maximize their utility, taking into account w_{pool}:

$$\max_{e_{si}, e_{wi} \geq 0} \left\{ EU_i = \frac{e_{si}}{\sum_{j \in I} e_{sj}} \cdot (H + \Delta) + \left(1 - \frac{e_{si}}{\sum_{j \in I} e_{sj}}\right) \cdot w_{pool} - \frac{e_{si}}{\theta} - \frac{e_{wi}}{\theta} \right\}$$

$$\text{s.t.} \qquad e_{si} + e_{wi} \leq 1$$

As there is no incentive in this setting to devote any $e_{wi} > 0$ for all types of students then $e_{pool} = 0$. We look at a symmetric equilibrium in this contest, meaning that all students of each type are acting identically as they have the same utility functions and constraints. The solution of the education contest (e^*_{sH}, e^*_{sL}) follows from the FOC solution, which can be found in the Appendix A. Proposition 1 shows what this solution for pooling contracts looks like depending on the parameters of the model and the prior beliefs about students' types.

Proposition 1: Pooling contracting

Let $c = \Delta + (1-p)(H-L) > 0$.

The working effort of both types is zero, i.e., $e_{wH} = e_{wL} = 0$.

1. *If* p *is sufficiently low, i.e.,* $p \in \left(0; 1 - \frac{1}{H-L}\left(\frac{H^2}{L(H+L)^2} - \Delta\right)\right]$,

   the pooling equilibrium of the contest game looks as follows:

$$e^*_{sH} = \left(\frac{L}{H} + 1\right)^{-2} \cdot \frac{1}{Lc}, \quad e^*_{sL} = \left(\frac{H}{L} + 1\right)^{-2} \cdot \frac{1}{Hc},$$

where

$$EU_H^* = \frac{e_{sH}^*}{e_{sH}^* + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{e_{sL}^*}{e_{sH}^* + e_{sL}^*}\right) \cdot w_{pool} - \frac{e_{sH}^*}{H} \geq w_{pool}$$

$$EU_L^* = \frac{e_{sL}^*}{e_{sH}^* + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{e_{sH}^*}{e_{sH}^* + e_{sL}^*}\right) \cdot w_{pool} - \frac{e_{sL}^*}{L} \geq w_{pool}$$

2. *If*

$$p \in \left(1 - \frac{1}{H-L}\left(\frac{H^2}{L(H+L)^2} - \Delta\right); 1 - \frac{1}{H-L}\left(\frac{L^2}{H(H+L)^2} - \Delta\right)\right],$$

this equilibrium looks as follows:

$$e_{sH}^* = 1, \quad e_{sL}^* = \left(\frac{H}{L} + 1\right)^{-2} \cdot \frac{1}{Hc},$$

where

$$EU_H^* = \frac{1}{1 + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{e_{sL}^*}{1 + e_{sL}^*}\right) \cdot w_{pool} - \frac{1}{H} \geq w_{pool}$$

$$EU_L^* = \frac{e_{sL}^*}{1 + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{1}{1 + e_{sL}^*}\right) \cdot w_{pool} - \frac{e_{sL}^*}{L} \geq w_{pool}$$

3. *If p is sufficiently high, i.e.,*

$$p \in \left(1 - \frac{1}{H-L}\left(\frac{L^2}{H(H+L)^2} - \Delta\right); 1\right),$$

this equilibrium looks as follows:

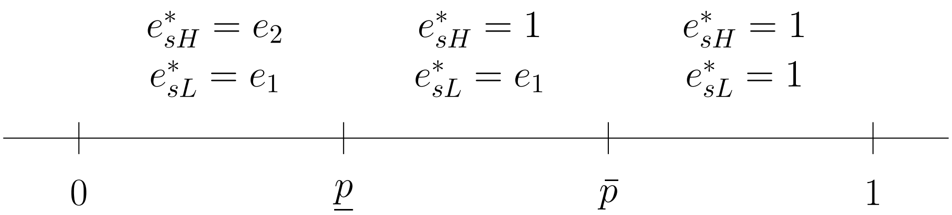
$$e_{sH}^* = 1, \quad e_{sL}^* = 1,$$

where

$$EU_H^* = \frac{1}{2} \cdot (H + \Delta + w_{pool}) - \frac{1}{H} \geq w_{pool}$$

$$EU_L^* = \frac{1}{2} \cdot (H + \Delta + w_{pool}) - \frac{1}{L} \geq w_{pool}$$

The set of possible equilibria can be illustrated as follows[5]:



In order to prove that this set of equilibria is sustainable, we check whether it satisfies the Intuitive Criterion proposed by Cho & Kreps (Cho & Kreps, 1987). In other words, there must be no possible deviations to off-the-equilibrium signals for each student type, holding the strategies of all other types fixed, which makes it possible to dominate the initial equilibrium.

Let us note that $w_{pool} \in (L, H)$. It is obvious that there is no profitable deviations for L-type students, while for H-type students it is possible to increase their expected payoff if they find the signal $e_{wH} > 0$, which allows them to change the belief of the job market about their type: $b(H|e_{wH}) = 1$. So, our goal is to check if there exists any $e_{\bar{w}H} > 0$, such that:

$$EU_H(e_{\bar{w}H}, H) \geq EU_H(0, w_{pool})$$

As Appendix A shows for any $e_{\bar{w}H}$ sufficiently small, i.e.,

$$e_{\bar{w}H} \leq \frac{e^*_{sL}}{e^*_{sL} + e^*_{sH}} H(1-p)(H-L),$$

the deviation for the H-type students is profitable and hence, the set of equilibria found does not satisfy the Intuitive Criterion.

Based on the prior beliefs about the distribution of student types, there are three possible equilibria. If p is sufficiently high, students devote more

[5]where $\underline{p} = 1 - \frac{1}{H-L}\left(\frac{H^2}{L(H+L)^2} - \Delta\right)$ and $\bar{p} = 1 - \frac{1}{H-L}\left(\frac{L^2}{H(H+L)^2} - \Delta\right)$; $e_1 = \left(\frac{H}{L}+1\right)^{-2} \cdot \frac{1}{Hc}$ and $e_2 = \left(\frac{L}{H}+1\right)^{-2} \cdot \frac{1}{Lc}$

effort to studying until they meet their total effort restriction. It also shows that H-type students devote more efforts than L-type, as in pooling equilibrium they can only signal their efficiency by academic performance and for L-type students it is more costly to compete in this education contest. These relations appear in highly competitive settings as it is harder to attain a certain level of GPA and increase the chances to get a place in a master's program.

Finally, we check how equilibrium effort depends on H, L and Δ for both types of students:

$$\frac{de_{sL}}{dL} > 0, \qquad \frac{de_{sL}}{dH} < 0$$

If $(H - L)$ is big enough then $\frac{de_{sH}}{dL} < 0$ and $\frac{de_{sH}}{dH} < 0$ hold.

These induce the following conclusions about the pooling equilibria. Under a high efficiency gap, i.e., $(H - L)$, both types of students reduce their efforts on studies when H is high, as for H-type students this means lower competition inside the group and for L-type students it is too costly to compete with H-type students. When L is high, for H-type students this means reducing the costs for competition with L-type students and for L-type students it is worth competing actively in the education contest.

3.2.2 Separating equilibria

There are two possible cases of the separating equilibria in our contest: with H-type signaling, where $e_{wH} > e_{wL}$ holds, and with L-type signaling.

Let us first assume $e_{wH} > e_{wL}$ in equilibrium. The job market observes the signal from H-type students and updates its beliefs, which leads to the perfect separation of students: $b(\theta|WE_i) = \mathbb{P}(\theta = H|e_{wi} > 0) = 1$. The wage scheme proposed by the job market in this case is as follows:

$$w(e_{wi} > 0) = H, \qquad w(0) = L$$

It is obvious that $e^*_{wL} = 0$ (following from the cost function properties [10]). Yet, our problem has extended, as now we also have to find $e^*_{wH} = \bar{e}$ such that H-type students are willing to gain some work experience and L-type students do not want to do so:

$$e_{wH} = \bar{e} \in (0; 1], \qquad e_{wL} = 0.$$

The solution of the education contest (e^*_{sH}, e^*_{sL}) now follows from FOC and compatibility constraints, i.e., $EU_\theta(e_{s\theta}, e_{w\theta}, \theta) \geq EU_\theta(e_{s\theta}, e_{w\bar{\theta}}, \bar{\theta})$ (Solution in Appendix A).

The second case of the separating equilibrium must feature $e_{wH} < e_{wL}$.

There is also a possible situation when the wage scheme stimulates $e^*_{wH} = 0$ and $e^*_{wL} > 0$. Then, the *a posteriori* beliefs of the job market are formed: $(b(\theta|WE_i) = \mathbb{P}(\theta = H|e_{wi} > 0) = 0)$ and produces a following wage scheme:

$$w(e_{wi} > 0) = L, \qquad w(0) = H,$$

and

$$e_{wL} = \bar{e} > 0, \qquad e_{wH} = 0.$$

It is clear that the best responses of both types of students in this type of equilibria stay the same. There is only a change in the cost term, $c(e_{wi})$, which is independent of the control variable, e_{si}. However, we need to adjust the optimal e_{si} to satisfy the effort constraint, i.e., $e_{si} + e_{wi} \leq 1$, and change the set of possible $\bar{e}$ (conditions formalized in Proposition 2).

Based on observable information: $p, H, L, and\Delta$, the job market proposes one of the contracts to students of both types, presented above. Proposition

2 shows what this type of contracting looks like depending on the parameters of the model and the prior beliefs about student types.

Proposition 2: Separating contracting

Let $q = \dfrac{e^*_{sH}}{e^*_{sH} + e^*_{sL}}$ *and* $b = (H - L + \Delta) > \Delta > 0.$

1. *For q sufficiently high, i.e.,* $q \geq \dfrac{L}{H+L}$, *a separating equilibrium of the contest game looks as follows:*

$$e_{wL} = 0, e_{wH} = \bar{e}, e^*_{sL} = \min\left\{1; \frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2}\right\}$$

$$e^*_{sH} = \min\left\{(1-\bar{e}); \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)\right\}$$

and the set of possible $\bar{e}$:

$$\bar{e} \in \left[q(H-L)L; (1-q)(H-L)H\right],$$

where

$$EU^*_H = \frac{e^*_{sH}}{e^*_{sH} + e^*_{sL}} \cdot (H + \Delta) + \left(\frac{e^*_{sL}}{e^*_{sH} + e^*_{sL}}\right) \cdot H - \frac{e^*_{sH}}{H} - \frac{\bar{e}}{H} \geq H - \frac{\bar{e}}{H}$$

$$EU^*_L = \frac{e^*_{sL}}{e^*_{sH} + e^*_{sL}} \cdot (H + \Delta) + \left(\frac{e^*_{sH}}{e^*_{sH} + e^*_{sL}}\right) \cdot L - \frac{e^*_{sL}}{L} \geq L$$

2. *Otherwise:*

$$e_{wL} = \bar{e}, e_{wH} = 0, e^*_{sL} = \min\left\{(1-\bar{e}); \frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2}\right\}$$

$$e^*_{sH} = \min\left\{1; \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)\right\}$$

and the set of possible $\bar{e}$:

$$\bar{e} \in \left[(1-q)(H-L)L; q(H-L)H\right],$$

where

$$EU_H^* = \frac{e_{sH}^*}{e_{sH}^* + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{e_{sL}^*}{e_{sH}^* + e_{sL}^*}\right) \cdot H - \frac{e_{sH}^*}{H} \geq H$$

$$EU_L^* = \frac{e_{sL}^*}{e_{sH}^* + e_{sL}^*} \cdot (H + \Delta) + \left(\frac{e_{sH}^*}{e_{sH}^* + e_{sL}^*}\right) \cdot L - \frac{e_{sL}^*}{L} - \frac{\bar{e}}{H} \geq L - \frac{\bar{e}}{L}$$

Based on the probability of winning the education contest for each type of student, there are two possible equilibria. If an H-type student observes all prior information and forms a sufficiently high expectation of winning, then they enter the job market with more work experience, while L-type student focuses more on gaining a higher GPA. This case is possible for a high efficiency gap, when $H >> L$, and vice versa for the case where L-type students gain some work experience as the distribution of efficiencies distinguishes them less from H-type students and hence, they expect their chances of winning the education contest to be sufficiently high.

The behavior of the target variables is similar for both types of students up to the signs of the following derivatives:

$$\frac{de_{sH}}{dH} > 0, \qquad \frac{de_{sH}}{d\Delta} > 0$$

$$\frac{de_{sL}}{dL} > 0, \qquad \frac{de_{sL}}{d\Delta} > 0.$$

This provides us with two main points. First, for both types of students, the more efficient they are, the greater their efforts devoted to studying, since the competitiveness among them increases. Secondly, we see that for all students, the higher the wage premium for a master's degree, the more effort they are willing to devote to the education contest as its benefits outweigh the costs of these efforts.

All the equilibria show us that at least one type of student prefers not to have any work experience during their bachelor's studies. In order to make the results of our model more realistic and verify them via real data (see below), we can suppose that all students have some default level of work experience, $\underline{e_w}$, which they find optimal. This assumption will not change the results as in this case this default is not included in the constraints and consequently in optimization problems. In such a setting, we can think about e^*_{sH}, e^*_{sL} chosen as additional signaling efforts only.

3.3 Testable Predictions

Our model provides us with a number of predictions which can be tested empirically. We are particularly interested in the effects taking place between the job market and the master's degree programs, which in our setting is transmitted via student choice.

Based on the theoretical model, we can observe certain characteristics of the interconnection of the variables. Firstly, the restriction of each student's total efforts shows us that there should exist a negative correlation between efforts devoted to work and studies,[6] and we use this premise for our main hypothesis. However, under a certain structure of the wage premium in our theoretical model, we can observe the opposite situation when the two types of efforts act as complements, and this case can be implemented in two scenarios.

If the signaling party is represented by H-type students, they gain more work experience make more effort in their studies when the expected wage premium for the master's degree is sufficiently low, i.e., $\Delta \leq L$. In this case, L-type students are under-motivated to participate actively in the education

[6] We can say that efforts behave as substitutes in this case.

contest and make less effort: $e_{wL} = 0, e_{wH} = \bar{e}, e_{sL} < e_{sH}$.

L-type students can distinguish themselves via more work experience and make more effort to study, if the wage premium for the master's degree is high enough, i.e., $\Delta \geq L$. L-type students are then motivated to participate actively in the education contest and increase their chances to get a place in the master's program: $e_{wL} = \bar{e}, e_{wH} = 0, e_{sL} > e_{sH}$.

Detailed solutions for these equilibrium conditions on the wage premium are shown in the Appendix A. If our main hypothesis is not confirmed, we will be able to check whether students' signals in equilibrium behave as complements and make an assumption about the parameters of the equilibrium observed.

As GPA is a signal which indicates the relative education performance of a student, we can formulate a new metric – the probability of winning the education contest – which will be more convenient for further empirical application. For student i this probability can be simplified:

$$\mathbb{P}(win) = \mathbb{P}(GPA \geq \frac{1}{2}) = \mathbb{P}(e_{si} \geq e_{sj}).$$

As noted, we suppose that the more effort devoted by a student to gaining work experience, the less effort remains for academic performance, and hence, the probability of winning the education contest decreases.

Secondly, if we assume that the equilibrium in the actual job market for students corresponds to our model, there should exist an inverse relationship between the work experience gained by a student and their valuation of the master's degree wage premium. In our model this relation is captured by $\frac{de_s}{d\Delta} > 0$, and with the trade-off for effort distribution under the assumed effort allocation constraint, we get $\frac{de_w}{d\Delta} < 0$. Empirically, we can observe multiple proxies for wage premium, Δ, which includes the expectation about the master's degree wage premium and the intention to enter a master's program. Let us generalize all the possible (not only optimal) choices of effort devoted to work for each student by career path choices, k, we also generalize each student's expectations about a master's degree by single proxy, Δ, the specification of which is given in Subsection 4.1.

Specifically, we formulate two testable predictions based on these considerations:

Hypothesis 1: Effects on GPA

Assume e_{wk} includes all available information about each student's work experience during their bachelor's studies for all possible states of their career path choices, k. Then, the probability of winning the education contest for each student must be negatively dependant on e_{wk}:

$$H_1: \quad \mathbb{P}(win|e_{wi}) \leq \mathbb{P}(win|e_{wj}), \quad \textit{where } e_{wi} \geq e_{wj}$$

Hypothesis 2: Effects on WE

Assume that variable Δ_k includes all available information about each student's expectations about a master's degree for all possible states of their future academic path choices, k. Then, the probability of having a certain level of work experience e_w for each student must be negatively dependent on Δ_k:

$$H_2: \quad \mathbb{P}(e_w|\Delta_i) \leq \mathbb{P}(e_w|\Delta_j), \quad \textit{where } \Delta_i \geq \Delta_j$$

4 Empirical Application

4.1 The Data

To map the data into the model's primitives, we must find proxies for the following variables: e_w, Δ and $\mathbb{P}(win)$. For this purpose, we conduct a survey of HSE University students to reveal their academic and work preferences, professional experience, and their relative academic performance in the group. We collected the data from 122 HSE University students at the Faculty of Economic Sciences, who were graduating in 2022.

The questions asked during the survey are presented in Russian (as it was used for the student's survey) in the Appendix B.

There are three main groups of observed variables: students' work experience – e_w; their expectations about future a master's degree and its wage premium – Δ; and their relative position in the student ranking – $\mathbb{P}(win)$.

As we can observe neither the true ability of students nor their real rating (the survey is anonymous), the only way to model the proxy for the latter variable is to take the ranking, reported by students, and make the variable *probability to enter this group in ranking* (for 2 groups it will be simplified to "top 50%" and "bottom 50%"). This probability is directly proportional to our $\mathbb{P}(win)$ and is connected to the efforts devoted by students to their studies in the theoretical equilibria found, hence the further hypotheses statements directly rely on the theory and verify its sustainability.

There are 9 variables:

- *working* – dummy-variable, $= 1$ if a student has any work experience, $= 0$ otherwise;

- *wex* – categorical variable, $= 4$ for work experience > 1 year, $= 3$ for work experience between 6 month and 1 year, $= 2$ for work experience between 3 and 6 months, $= 1$ for work experience < 3 months, $= 0$ otherwise;

- *rank* – categorical variable, $= 4$ for students reporting their ranking to be in top 25% of the course, $= 3$ for those reporting "25-50%", $= 2$ for those reporting "50-75%", $= 1$ otherwise;

- *top* – dummy-variable, = 1 if a student has position in rating higher than the median in the sample, = 0 otherwise;

For our empirical verification, we can use the sample of students surveyed as a subset of all students in the education program. However, for the hypotheses formulated in the previous section, we use student responses about their relative academic performance as the general set of the student ranking. Meaning that the variable "top" is formed as $\mathbb{1}_4(rank)$ for our subset where there are 45% students reporting their ranking to be in the "top 25%". All students who decided not to reveal their ranking (there was an option "Don't want to answer", which 3 students out of 109 chose), were classified as the lowest ranking group.

We assume that student expectations about the masters' wage premium can be indirectly revealed by (1) their intentions to enter a master's program and hence get a wage premium in the job market (with a direct signal of their high abilities) and (2) their direct expectations about the wage premium. There are also two types of master's degree intentions: to get a master's degree inside and outside Russia. We distinguish these two types of proxies in order to detail students' characteristics and see whether these types of expectations add differences to the results of the model.

- *masters* – categorical variable, = 2 for students wanting to apply for master's programs outside of Russia, = 1 for those wanting to apply for master's programs in Russia, = 0 otherwise;

- *mast_all* – dummy-variable, = 1 if a student intends to apply for a master's program, = 0 otherwise;

- *mast_ext* – dummy-variable, = 1 if a student intends to apply for a master's program outside Russia, = 0 otherwise;

- *expect* – categorical variable, $= 2$ for students expecting a significant wage premium, $= 1$ for those expecting an insignificant wage premium, $= 0$ otherwise;

- *expect*2 $= 1$ if a student expects a wage premium after obtaining a master's degree, $= 0$ otherwise.

Summary statistics for these variables can be found in Table 3 in the Appendix C.

4.2 Identification

There are two main broad questions formulated in Hypotheses 1 and 2: (1) How does the *probability of entering the "top 50%"* depend on *work experience* – e_w and its proxies? and (2) How does *work experience* depend on *expectations about the master's degree* – Δ and its proxies?

To formalize our predictions and relate them to the observables from the previous section, we look at multiple linear regressions with different proxies. For the first hypothesis, we check the dependence of students' relative performance on their reported work experience. Our theoretical model shows that there should be one more variable which potentially affects a student's probability of winning the education contest – expectations about the master's wage premium. Thus, we include both these variables into our first baseline regression equation, although we hypothesize only the effects for work experience. Namely, we estimate the following equation:

$$\mathbb{P}(win|WE) = \beta_0 + \beta_1 \cdot W + \beta_2 \cdot Ex + \varepsilon, \tag{1}$$

where W is the set of work experience proxies:
$W \in \{working; wex\}$, and Ex is the set of master's program expectation proxies: $Ex \in \{expect; expect2\}$.

For the second hypothesis we verify the relationship between both the existence and the duration of students' work experience and the set of proxies for expectations about the master's degree. These proxies include willingness to apply for master's programs in Russia and overseas, expectations about master's wage premium, and their combinations. Namely, we estimate the following equations:

$$\mathbb{P}(working|EM) = \gamma_0 + \gamma_1 \cdot mast\_all + \\ + \gamma_2 \cdot mast\_all \cdot mast\_ext + \gamma_3 \cdot MEx + \gamma_4 \cdot Ex + \varepsilon, \quad (2)$$

where $MEx \in \{mast\_all \cdot expect; 0\}$, $Ex \in \{expect; expect2\}$.

$$\mathbb{P}(wex|EM) = \sigma_0 + \sigma_1 \cdot mast\_all + \\ + \sigma_2 \cdot mast\_all \cdot mast\_ext + \sigma_3 \cdot MEx + \sigma_4 \cdot Ex + \varepsilon \quad (3)$$

.

Then, our hypotheses look as follows:

Hypothesis 1:

$$\mathbb{P}(win|WE) \text{ is decreasing in } W:$$
$$H_1: \quad \beta_1 < 0.$$

Hypothesis 2.1:

$$\mathbb{P}(working|EM) \text{ is decreasing in either } mast\_all,$$
$$\text{or } mast\_all \cdot mast\_ext, \text{ or } MEx, \text{ or } Ex:$$
$$H_{2.1}: \quad \gamma_1 < 0,$$
$$\text{or} \quad \gamma_2 < 0,$$
$$\text{or} \quad \gamma_3 < 0,$$
$$\text{or} \quad \gamma_4 < 0.$$

Hypothesis 2.2:

$$\mathbb{P}(wex|EM) \text{ is decreasing in either } \sigma_1, \text{ or } \sigma_2, \text{ or } \sigma_3, \text{ or } \sigma_4:$$

$$\begin{aligned} H_{2.2}: \quad & \sigma_1 < 0, \\ \text{or} \quad & \sigma_2 < 0, \\ \text{or} \quad & \sigma_3 < 0, \\ \text{or} \quad & \sigma_4 < 0. \end{aligned}$$

4.3 Estimation Results

Table 1 reports the estimation results for regression (1). The coefficients for work experience are positive and significant at the 5% level for the modifications with the *wex* proxy. If *wex* increases by 1, the student's probability of winning the education contest increases by 6-7%.[7]

This means that students' GPA and work experience behave as complements, which contradicts our Hypothesis 1. Yet, under the conditions described in Section 3.3, such a pattern can be observed in our theoretical model. If we turn to the separating equilibria, there are two cases of the internal solution, which display such a pattern: for H-type signaling, the efficiency gap has to be sufficiently high, while for L-type signaling, this gap has to be small enough.

For all the modifications of the first regression equation, the constant β_0 is positive, stable, and significant at the 5% level. This means that there is some default level of $\mathbb{P}(win)$, regardless of work experience and expectations about the master's degree wage premium. With respect to our model this means that each student devotes some effort to their studies and can win the education contest with a 20-30% probability even if other regressors remain at

[7] The magnitude of this effect depends on the identification of the variables.

Table 1: *Hypothesis 1: Estimation Results*

	(1)	(2)	(3)	(4)
working	0.150	0.156		
	(0.131)	(0.118)		
wex			0.0626**	0.0654**
			(0.028)	(0.024)
expect	0.0605		0.0712	
	(0.302)		(0.223)	
expect2		0.0822		0.107
		(0.371)		(0.247)
β_0	0.262**	0.258**	0.227**	0.215**
	(0.008)	(0.015)	(0.015)	(0.033)
Obs	122	122	122	122
F-stat	1.625	1.489	2.963	2.886

Note: *p*-values in parentheses: * $p<0.1$, ** $p<0.05$, *** $p<0.001$

zero. Other variables are not significant, although we have not hypothesized these effects.

Table 2 shows the tests for Hypothesis 2, regression (2). Here, we see that there is a substantial negative correlation between students' work experience and their intention to enter a master's program. Specifically, the coefficient before *mast_all* is significant at the 5% level for all variations of the regression equation for the second hypothesis and shows that Hypothesis 2 cannot be rejected for this variable. Furthermore, there is one more variable, which adds to this negative effect, – expectations of the master's

Table 2: *Hypothesis 2.1: Estimation Results*

	(1)	(2)	(3)	(4)
mast_all	-0.199**	-0.193**	-0.263**	-0.264**
	(0.031)	(0.037)	(0.044)	(0.046)
mast_all * mast_ext	0.430**	0.284**	0.319	0.111
	(0.010)	(0.019)	(0.163)	(0.667)
mast_all * expect			0.122	0.139
			(0.484)	(0.449)
expect	-0.147*		-0.191*	
	(0.080)		(0.070)	
expect2		-0.149		-0.208*
		(0.102)		(0.085)
γ_0	0.854***	0.849***	0.875***	0.875***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	122	122	122	122
F-stat	3.231	3.090	2.536	2.453

Note: *p*-values in parentheses: * p<0.1, ** p<0.05, *** p<0.001

wage premium. The coefficient for *expect* has a 10% level of significance for both regression modifications where it is included, hence, it is also a confirmation of the second hypothesis. These statistically significant coefficients show that the students who expect benefits from a master's degree tend to have less work experience. If *mast_all* increases by 1, the probability that a student has some work experience decreases by 20–26%; if the value of the regressor *expect* increases by 1, this probability decreases by 15–19%. The regressors $expect2$ and the product of $mast\_all$ and $expect$ are statistically insignificant in our estimated equations. However, the positive coefficient for the composition of $mast\_all$ and $mast_est$, which we find to be significant at the 5% level, represents that the students who are planning to get a master's degree outside of Russia gain more work experience during their bachelor's studies. This effect contradicts our expected results and might be explained by the effects which appear in this subset of students and were not caught by the regressors in our basic estimation.

Overall, we may claim that **Hypothesis 2 cannot be rejected** as we formulate it in terms of any wage premium proxy being negative and we find at least two of them to satisfy this criterion.

If we look at the constant γ_0, we observe that for all modifications of the second regression equation it is negative, stable, and significant at the 1% level. This proves the assumption made at the end of Section 3.2 – that there is some basic level of work experience each student gains during their bachelor's degree irrespective of their expectations about a master's degree.

Estimation results of the second modification of Hypothesis 2, regression (3), can be found in Table 4 in Appendix C. They mainly verify the results of the first set of modifications for Hypothesis 2 – the signs and significance levels of the effects observed remain the same. Yet, the magnitudes of these effects increase approximately three-fold, which corresponds with the change of the target variable's dimension: the mean of the variable $working$ is equal to 0.7, while the mean of wex is equal to 2.1 (see Table 3 in Appendix C).

5 Conclusion

This paper studies how students distribute their efforts between studying and working in the presence of capacity constraints. The solution of the baseline model allows us to understand the motives of the choice and effectively adjust the contracts (wage schemes) in order to reveal the true value of the skills of graduates. It also shows how this choice depends on the conditions of the job market, the actions of other students, and their beliefs about the profitability of a master's degree.

There are two possible types of equilibria in the model. In pooling equilibria, students send the same signal to the job market, while in separating equilibria, students differ in work experience and the job market can perfectly distinguish them. Hence, in the first, the wage scheme is unified, in the second the wage is equal to each student's efficiency.

Depending on the type of equilibria there are multiple effects on the optimal effort distribution. In *pooling equilibria*, the effects of other students' abilities may either increase or decrease the motivation to compete harder, and it is the prior beliefs of the job market, which determines the wage scheme in these equilibria. In *separating equilibria*, the *a posteriori* beliefs of the students and their expectations about the master's degree wage premium play the main role in students' motivation.

Based on the theoretical predictions, we investigate whether students with higher efficiency (productivity) pay more attention to studies than to work experience. We also test if there is a negative effect on the presence and duration of a student's work experience from the side of more optimistic expectations about the benefits of a master's degree. For this purpose we conducted a survey of 122 HSE University pre-graduate economics students to learn their relative performance, work experience, and expectations about a master's degree, which we then use to test our hypotheses. Our theoretical results are mainly confirmed and the empirical effects correspond to what we expect under certain conditions. Specifically, we find that students on average perceive the two signals as complementary and devote more effort to both dimensions at the same time. They also value the opportunities after a master's degree and invest more effort in education if the wage premium is sufficiently high.

In further research on this topic it is crucial to model more complicated signaling structures, for instance, by making both signals visible for the university and the job market.[8] There is also a possible modification of our baseline model for the case of a more complex student efficiency distribution, which might show meaningful results for the equilibrium structure of the job market. A part of the effects could be left unexplored as it is possible to also include some control variables (such as socio-demographic and current state variables) in our estimation equations, which will require conducting a more detailed students survey.

[8] This may be too complex to solve and our model still catches the effects of the main signals which each party is particularly interested in.

A Appendix: Proofs

- Proof of Proposition 1:

  Pooling Equilibria conditions:

$$\begin{cases} \dfrac{e_{sH}}{e_{sH}+e_{sL}}(H+\Delta)+\dfrac{e_{sL}}{e_{sH}+e_{sL}}(pH+(1-p)L)-\dfrac{e_{sH}}{H}\to\max\limits_{e_{sH}}, \\ \\ \dfrac{e_{sL}}{e_{sH}+e_{sL}}(H+\Delta)+\dfrac{e_{sH}}{e_{sH}+e_{sL}}(pH+(1-p)L)-\dfrac{e_{sL}}{L}\to\max\limits_{e_{sL}}, \\ s.t. \\ e_{sH}\le 1, e_{sL}\le 1 \end{cases}$$

  FOC:

$$\begin{cases} \dfrac{(\Delta+(H-L)(1-p))e_{sL}}{(e_{sH}+e_{sL})^2}=\dfrac{1}{H} \\ \\ \dfrac{(\Delta+(H-L)(1-p))e_{sH}}{(e_{sH}+e_{sL})^2}=\dfrac{1}{L}, \\ s.t. \\ e_{sH}\le 1, e_{sL}\le 1 \end{cases}$$

$$\begin{cases} e_{sH}=\sqrt{He_{sL}(\Delta+(H-L)(1-p))}-e_{sL} \\ e_{sL}=\sqrt{Le_{sH}(\Delta+(H-L)(1-p))}-e_{sH} \\ s.t. \\ e_{sH}\le 1, e_{sL}\le 1 \end{cases}$$

  By SOC for $H>L$:

$$\begin{cases} e^*_{sH} = \left(\dfrac{L}{H}+1\right)^{-2} \cdot \dfrac{1}{L(\Delta+(H-L)(1-p))}, \\ e^*_{sL} = \left(\dfrac{H}{L}+1\right)^{-2} \cdot \dfrac{1}{H(\Delta+(H-L)(1-p))}. \end{cases}$$

- Intuitive Criterion:

$$EU_H(e_{\bar{w}H}, H) \geq EU_H(0, w_{pool})$$

$$\frac{e_{sH}}{e_{sH}+e_{sL}}(H+\Delta)+\frac{e_{sL}}{e_{sH}+e_{sL}}H-\frac{e_{sH}}{H}-\frac{e_{\bar{w}H}}{H} \geq \frac{e_{sH}}{e_{sH}+e_{sL}}(H+\Delta)+\frac{e_{sL}}{e_{sH}+e_{sL}}w_{pool}-\frac{e_{sH}}{H}$$

$$\frac{e_{sL}}{e_{sH}+e_{sL}}H-\frac{e_{\bar{w}H}}{H} \geq \frac{e_{sL}}{e_{sH}+e_{sL}}w_{pool}$$

$$\frac{e_{\bar{w}H}}{H} \leq \frac{e_{sL}}{e_{sH}+e_{sL}}H(H-w_{pool})$$

$$e_{\bar{w}H} \leq \frac{e^*_{sL}}{e^*_{sL}+e^*_{sH}}H(1-p)(H-L)$$

- Proof of Proposition 2:

  Separating Equilibria conditions (High-type signaling):

$$\begin{cases} \dfrac{e_{sH}}{e_{sH}+e_{sL}}(H+\Delta)+\dfrac{e_{sL}}{e_{sH}+e_{sL}}H-\dfrac{e_{sH}}{H}-\dfrac{e^*_{wH}}{H} \to \max\limits_{e_{sH}}, \\ \\ \dfrac{e_{sL}}{e_{sH}+e_{sL}}(H+\Delta)+\dfrac{e_{sH}}{e_{sH}+e_{sL}}L-\dfrac{e_{sL}}{L} \to \max\limits_{e_{sL}}, \\ s.t. \\ EU_H(e_{sH}, e^*_{wH}, H) \geq EU_H(e_{sH}, 0, L), \\ EU_L(e_{sL}, 0, L) \geq EU_L(e_{sL}, e^*_{wH}, H), \\ e_{sH}+e^*_{wH} \leq 1, e_{sL} \leq 1 \end{cases}$$

FOC:

$$\begin{cases} \Delta H e_{sL} = (e_{sH} + e_{sL})^2 \\ L(\Delta + H - L) e_{sH} = (e_{sH} + e_{sL})^2, \\ s.t. \\ \dfrac{e_{sL}}{e_{sL} + e_{sH}}(H - L) \geq \dfrac{\bar{e}}{H}, \\ \dfrac{e_{sH}}{e_{sL} + e_{sH}}(H - L) \leq \dfrac{\bar{e}}{L}, \\ e_{sH} \leq 1 - \bar{e}, e_{sL} \leq 1 \end{cases}$$

If $q = \dfrac{e_{sH}}{e_{sL} + e_{sH}}$; $(1 - q) = \dfrac{e_{sL}}{e_{sL} + e_{sH}}$ then:

$$\bar{e} \in [q(H - L)L; (1 - q)(H - L)H]$$

and by SOC for $H > L$:

$$e^*_{sL} = \min\left\{1; \frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2}\right\}$$

$$e^*_{sH} = \min\left\{(1 - \bar{e}); \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)\right\}$$

and

$$e^*_{wL} = 0, \quad e^*_{wH} = \bar{e}.$$

- Separating Equilibria conditions (Low-type signaling):

$$\begin{cases} \dfrac{e_{sH}}{e_{sH} + e_{sL}}(H + \Delta) + \dfrac{e_{sL}}{e_{sH} + e_{sL}} H - \dfrac{e_{sH}}{H} \to \max\limits_{e_{sH}}, \\ \\ \dfrac{e_{sL}}{e_{sH} + e_{sL}}(H + \Delta) + \dfrac{e_{sH}}{e_{sH} + e_{sL}} L - \dfrac{e_{sL}}{L} - \dfrac{e^*_{wL}}{L} \to \max\limits_{e_{sL}}, \\ s.t. \\ EU_H(e_{sH}, 0, H) \geq EU_H(e_{sH}, e^*_{wL}, L), \\ EU_L(e_{sL}, e^*_{wL}, L) \geq EU_L(e_{sL}, 0, H), \\ e_{sL} + e^*_{wL} \leq 1, e_{sH} \leq 1 \end{cases}$$

FOC:

$$\begin{cases} \Delta H e_{sL} = (e_{sH} + e_{sL})^2 \\ L(\Delta + H - L) e_{sH} = (e_{sH} + e_{sL})^2, \\ s.t. \\ \frac{e_{sL}}{e_{sL} + e_{sH}}(H - L) \geq \frac{\bar{e}}{L}, \\ \frac{e_{sH}}{e_{sL} + e_{sH}}(H - L) \leq \frac{\bar{e}}{H}, \\ e_{sL} \leq 1 - \bar{e}, e_{sH} \leq 1 \end{cases}$$

If $q = \frac{e_{sH}}{e_{sL} + e_{sH}}$; $(1 - q) = \frac{e_{sL}}{e_{sL} + e_{sH}}$ then:

$$\bar{e} \in [(1 - q)(H - L)L; q(H - L)H]$$

and by SOC for $H > L$:

$$e^*_{sL} = \min\left\{(1 - \bar{e}); \frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2}\right\}$$

$$e^*_{sH} = \min\left\{1; \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)\right\}$$

and

$$e^*_{wH} = 0, e^*_{wL} = \bar{e}.$$

- Solution for the empirical separating equilibria case

  If the signaling party is the set of H-type students, then:

$$e_{wL} = 0, e_{wH} = \bar{e}, e^*_{sL} \leq e^*_{sH}$$

$$\frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2} \leq \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)$$

$$\frac{2\Delta H}{Lb + \Delta H} \leq 1$$

$$\Delta H \leq L(H_L + \Delta)$$

$$\Delta \leq L$$

If the signaling party is the set of L-type students, then:

$$e_{wL} = \bar{e}, e_{wH} = 0, e^*_{sL} \geq e^*_{sH}$$

$$\frac{\Delta^2 H^2 Lb}{(Lb + \Delta H)^2} \geq \left(\frac{\Delta H Lb}{Lb + \Delta H}\right)\left(1 - \frac{\Delta H}{Lb + \Delta H}\right)$$

$$\Delta \geq L$$

B Appendix: Survey Questions

1. Есть ли у вас опыт работы по специальности (экономика, финансы, аналитика, data science)?
   - Да
   - Нет
2. Совпадал ли ваш период работы с периодом учебы?
   - Да, полностью совпадал
   - Да, совпадал частично
   - Нет, я работал на выходных или на каникулах
   - Нет опыта работы
3. Какой ваш общий опыт работы на данный момент?
   - Меньше 3 месяцев
   - От 3 до 6 месяцев
   - От 6 месяцев до 1 года
   - Больше 1 года
   - Нет опыта

4. Собираетесь ли вы поступать в магистратуру сразу после выпуска из бакалавриата?
   - Да
   - Нет
5. Собираетесь ли вы поступать в магистратуру ЗА РУБЕЖ сразу после выпуска из бакалавриата?
   - Да
   - Нет
   - Не собираюсь поступать в магистратуру
6. Считаете ли вы, что ваша зарплата будет выше после получения диплома магистра, чем без него?
   - Да, существенно выше
   - Да, несущественно выше
   - Останется такой же
7. Какое у вас место в текущем рейтинге ВШЭ?
   - Топ 25%
   - 25-50%
   - 50-75%
   - 75-100%
   - Не хочу отвечать на этот вопрос

C Appendix: Tables

Table 3: Summary table

	mean	sd	min	max
working	.7131148	.4541727	0	1
wex	2.139344	1.586699	0	4
masters	.6803279	.7072984	0	2
mast_all	.5409836	.5003724	0	1
mast_ext	.2131148	.4111968	0	1
top	.4180328	.4952696	0	1
rank	3.008197	1.008197	1	4
expect	.8032787	.7675155	0	2
expect2	.5901639	.4938313	0	1
Obs	122			

Table 4: *Hypothesis 2.2: Estimation Results*

	(1)	(2)	(3)	(4)
mast_all	-0.709**	-0.674**	-0.610	-0.639
	(0.026)	(0.035)	(0.178)	(0.161)
mast_all * mast_ext	1.525**	0.900**	1.694**	0.986
	(0.008)	(0.032)	(0.034)	(0.271)
mast_all * expect			-0.186	-0.0694
			(0.758)	(0.913)
expect	-0.659**		-0.592	
	(0.024)		(0.106)	
expect2		-0.738**		-0.708*
		(0.020)		(0.091)
σ_0	2.753***	2.763***	2.721***	2.750***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	122	122	122	122
F-stat	3.861	3.986	2.897	2.968

Note: *p*-values in parentheses: * p<0.1, ** p<0.05, *** p<0.001

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