University of the Basque Country
Department of Foundations of Economic Analysis II

Master in Economics: Empirical Applications and Policies (EAP)

MASTER THESIS
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The role of Locus of Control in economic experiments

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Contents

Abstract In this master thesis I discuss the role of a non-cognitive skill, locus of control, in economic experiments. Locus of control is a psychological concept that captures individuals' beliefs about the controllability of life events and it has been previously used to explain labor market success and other economic outcomes and behaviors. The possibility of using non-cognitive skills to predict individuals' revealed preferences in economic experiments rests on the assumption that these skills are stable over time. Using experimental data, I analyze the change in locus of control to assess the validity of this assumption. I find that changes in locus of control are modest on average, are concentrated among the youngest women, and related to health shocks, and are not related to labor market shocks, except when they are accumulated.

Keywords Locus of Control · Non-cognitive skills · Behavioral preferences · Selection into experiments · Spill-overs · Exogeneity

1. Introduction

The role of personality traits in determining economic behaviors – job search strategies, human capital investment or savings – and economic outcomes – probability of being employed or unemployed, wages, unemployment duration or academic results – has been recently taken into account by several authors. Traditionally, the analysis had been focused on observable variables like education or demographic data. However, in recent times, personality traits or non-cognitive skills have received some attention in the literature. Personality is a potential source of heterogeneity, but the way of measuring it and its effect on individuals' behavior is complex and might be controversial.

Some authors have included a non-cognitive skill, *Locus of Control*, in their models as a measure of personality in order to explain better economic outcomes and decisions. *Locus of Control* refers to individuals' beliefs about the extent to which life's outcomes are under one's control or they are caused by external factors. Rotter (1966) was who firstly proposed the term, defining an external *Locus of Control* when a *reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action*, while a person with an internal *Locus of Control perceives that an event is contingent upon his own behavior or his own relatively permanent characteristics*. The idea is that individuals who believe they are responsible for whatever happening to them might perform better – or worse – than those who believe they cannot affect their life's outcomes.

The goal of this master thesis is to test the validity of using locus of control in economic experiments to explain individuals' behavior. My motivation comes from the fact that locus of control is usually assumed to be stable over time. The reason to take it for granted is that it makes possible to use locus of control as an explicative variable to explain interesting economic outcomes. But if locus of control is not stable, the analyses will be biased, since a common strategy in those studies is to use lead or lagged measures of locus of control. Hence, if locus of control changes over time, those estimated values will

not be correctly measured. It would be a more serious matter if the changes in locus of control, apart from not being fixed over the analysis period, were not exogenous, resulting in simultaneity or reverse causality problems. That is, if locus of control is determined at the same time as the economic outcome we want to explain, or this outcome influence locus of control, the classical assumptions of standard regressions models do not hold any more.

In this regard, Wolfe (2011) conducts an experiment with 90 college students to study the effect of perceived success or failure on the individuals' locus of control. She concludes that perceived feedback does not influence locus of control tendencies, something that contradicts the results of Schmitz and Skinner (1993). In this case, Wolfe finds that locus of control is exogenous, while according to Schmitz and Skinner it is endogenous. Most recently, the study of Cobb-Clark and Schurer (2013) makes an important contribution. They use the Household, Income and Labor Dynamics in Australia (HILDA) Survey for their analysis of the change in locus of control to assess the validity of the assumption on stability of non-cognitive skills. Some of their results are replicated in my study. Since their sample is composed of around 10,000 subjects, my contribution cannot focus on the results, but on the methodology. I have carried out my study in an experimental frame, and comparing to other experiments, this one counts on workers' participation – not only students as usual –, the sample is relatively large, and the data are longitudinal.

While there is an extensive literature on the effects of personality traits on individuals' economic outcomes, there has been very little quantitative behavioral and experimental work on whether and how personality affects individual behavioral tendencies. To help to fill this gap in the literature, the question I try to answer is whether a measure of locus of control can be used to predict individuals' revealed preferences in economic experiments. It is needed to point out that my contribution here is purely methodological. In contrast to those earlier papers, the innovation in this paper is not to study the stability and exogeneity of locus of control, but doing it within an experimental context involving not only students. By examining the stability and exogeneity of locus of control measured within a laboratory experiment, I aim to answer the research question. Its relevance lies in proving an assumption that would allow us to study whether individuals endowed with different non-cognitive skills behave different and obtain unequal life's results.

The outline of the work is as follows. Section 2 reviews some previous studies related to locus of control and to revealed preferences in economic experiments. Section 3 describes the experiment design and the data resulting from it, and states the empirical methodology used during the study. Section 5 presents the results. And section 6 concludes, analyzing the main findings, the caveats and some possible future research.

2. Literature review

In this section I review previous evidence that either analyzes the stability and exogeneity of locus of control or connects locus of control with economic behavior and outcomes. Three papers about methodological matters are taken into account as well.

I first describe literature directly related to my work in order to show what prior research suggests and to point out the agreements and discrepancies between them. Then I present evidence from studies that assume locus of control to be stable and use it to predict different labor market outcomes and behaviors. These ones serve to illustrate with examples the usefulness of non-cognitive skills if they hold the conditions to be used as explicative variables. Lastly, I address two practical problems that might arise when working on experiments.

2.1. Stability of Locus of Control

Rotter (1966) proposed in his seminal paper that after a success people show more internal locus of control tendencies, while tend to become more external after a failure. He presents a long summary of different experiments, pointing out differences in behavior between internal oriented and external oriented subjects.

Wolfe (2011) conducted an experiment with 90 students in the University of Minnesota Duluth, in order to verify whether a perceived success or failure could affect locus of control orientation in college students. Her conclusion is that locus of control does not change as a consequence of the feedback individuals receive, either it is a success or a failure. This result contradicts what Schmitz and Skinner (1993) had found before, which supported the idea that locus of control is not a constant personality trait and is dependent on perceived successes or failures.

More recently, Cobb-Clark and Schurer (2013) have made use of the Household, Income and Labor Dynamics in Australia Survey so as to check the validity assumption that non-cognitive skills are stable, fixed over time and exogenous. They find that changes in locus of control orientation are modest and concentrated among young and old people, are not related to external shocks and seem not to be economically meaningful, although they do not find evidence that locus of control is not truly time-invariant.

2.2. Locus of Control and economic behavior/outcomes

Literature that connects locus of control with labor market outcomes assumes the conditions whose validity has been checked by Cobb-Clark and Schurer (2013). The authors whose research I present here use different national surveys with panel data for their purposes. Andrisani (1977) establishes that individuals with an internal locus of control have significantly higher hourly wages two years later. Coleman and DeLeire (2003) set that one's locus of control orientation influences education decisions through the expectations of the return to human capital investments. Cebi (2007) revisits that study concluding that locus of control orientation does not predict the educational attainment. Gallo et al. (2004) find that more internal oriented unemployed individuals have higher probabilities of reemployment than those who show more external locus of control dispositions. Along the same lines, Uhlendorff (2004) connects internal locus of control trends with shorter periods of unemployment. And lastly, regarding job search strategies, McGee (2010) and Caliendo, Cobb-Clark and Uhlendorff (2010) detects that unemployed individuals search more intensively and have higher reservation wages the more internal they are.

2.3. Methodological literature

Kormanik and Rocco (2009) reviewed the possible ways to measure locus of control. They infer that rather than the likert-type questionnaires, the forced-choice format ones have tended to be used more consistently by researchers. In our experiment we have one of each type, so I rely on that conclusion to select the forced-choice questionnaire to measure locus of control in my analysis.

Bearing in mind two different problems that could bias experimental results, it is important to consider some methodological literature. Cleave, Nikiforakis and Slonim (2013) are interested in seeing if there is a selection bias in laboratory experiments. They conduct an experiment during the tutorials of Introductory Microeconomics at the University of Melbourne and they conclude that participants' social and risk preferences are representative of those in the population from they were recruited. Hence, they do not find any selection bias. On the other hand, Matthey and Regner (2013) verify if having participated in previous experiments could give participants some experience that generates spill-overs between experiments. They analyze data from four different experimental studies that involve allocation decisions and discover individuals becoming more selfish when they participate in a higher number of experiments.

3. Experimental design and method

3.1. Experimental design

The data used in this study come from an experiment conducted in Córdoba and Bilbao during 2013 and 2014. Participants were students, unemployed and employed people between 18 and 35 years old. In each period we have observable variables (age, gender, employment status…), the experiments' outcomes, scores from a health questionnaire and two measures of the locus of control.

The experiment aimed to demonstrate the usefulness of a newly designed series of behavioral experiments as a device for identifying individuals' principles of distributive justice, and to compare values related to the notions of fairness, desert and inequality in two regions which show very different economic and employment indicators.

For those purposes, firstly they set up online recruitment system and surveys. Once recruited, individuals are invited to participate in different experimental sessions. In the course of each session, 4-person groups are formed; the participants know that they belong to one of those groups but do not know who the other members are. A real effort task has to be individually performed and they are told that the money will be divided among the members of each group in accordance with their performance in the task. In actual fact, there are two different treatments: sometimes the money (tokens) is distributed among the members according their performance but other times it is done randomly. After the task, they are given a tray containing four sections. Each section contains the tokens that match each member of the group according with their performance (the blue-colored section belongs to oneself, and the rest are white-colored). Each individual can distribute the

money however he wants (leaving the tokens as received or changing them from one section to another). Then the trays are collected and one of the distributions is randomly selected, so that every distribution has the same probability of being selected. In the end, the money is given to each subject according to the selected distribution.

Before receiving the money, the individuals fill a survey containing education, labor and demographic data. They also fill a health questionnaire and two more questionnaires aimed to measure their locus of control tendencies – a likert-type and a forced-choice format, presented in the next section –.

3.2. Measuring Locus of Control

What Rotter originally proposed was a 29-item questionnaire with forced-choice format. Factor-analytic empirical research of this Rotter's 29-item scale has produced several subscales afterwards, with statistically significant criterion validity for measuring locus of control (Kormanik and Rocco 2009). One 13-item subscale resulting from those factor analyses has been used in our experiment (see table 1). Specifically, the internal locus of control scale that I am going to use in this study comes from the questionnaire published by Paula Goolkasian in the University of North Carolina at Charlotte website[1]. In each question, option (a) and (b) correspond to an internal or an external orientation, and adding the internal ones we have an Internal Locus of control scale that takes values from 0 to 13, being the individuals with a punctuation of 13 the most internal.

Table 1 Questionnaire to measure locus of control [2]

Read each pair of sentences and select the one that best describes how you feel.

1.
   a. Many of the unhappy things in people's lives are partly due to bad luck.
   b. People's misfortunes result from the mistakes they make.
2.
   a. One of the major reasons why we have wars is because people don't take enough interest in politics.
   b. There will always be wars, no matter how hard people try to prevent them.
3.
   a. In the long run, people get the respect they deserve in this world.
   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.
4.
   a. The idea that teachers are unfair to students is nonsense.
   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.
5.
   a. Without the right breaks, one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.
6.

[1] http://www.psych.uncc.edu/pagoolka/LC.html
[2] Internal responses: 1.b, 2.a, 3.a, 4.a, 5.b, 6.b, 7.b, 8.a, 9.a, 10.a, 11.a, 12.a, 13.a

a. No matter how hard you try, some people just don't like you.
b. People who can't get others to like them don't understand how to get along with others.

7.
a. I have often found that what is going to happen will happen.
b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

8.
a. In the case of the well prepared student, there is rarely, if ever, such a thing as an unfair test.
b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

9.
a. Becoming a success is a matter of hard work; luck has little or nothing to do with it.
b. Getting a good job depends mainly on being in the right place at the right time.

10.
a. The average citizen can have an influence in government decisions.
b. This world is run by the few people in power, and there is not much the little guy can do about it.

11.
a. When I make plans, I am almost certain that I can make them work.
b. It is not always wise to plan too far ahead because many things turn out to be a matter of luck anyway.

12.
a. In my case, getting what I want has little or nothing to do with luck.
b. Many times we might just as well decide what to do by flipping a coin.

13.
a. What happens to me is my own doing.
b. Sometimes I feel that I don't have enough control over the direction my life is taking.

3.3. Data

Last year 530 individuals came to the experiment, and 275 of them have repeated this year, when other 136 individuals have come as well. Sample is well balanced between men and women (see Tables 2 and 3). I center the analysis in those who participated both years, denominated “comebackers”.

Table 2 Distribution by gender (2013): number of observations (%)

Gender	Comebackers		Total
	No	Yes	
Male	119	121	240
	(46.67)	(44)	(45.28)
Female	136	154	290
	(53.33)	(56.00)	(54.72)
Total	255	275	530
	(100)	(100)	(100)

Table 3 Distribution by gender (2014): number of observations (%)

Gender	Comebackers		Total
	No	Yes	
Male	70	121	191
	(51.47)	(44)	(46.47)
Female	66	154	220
	(48.53)	(56.00)	(53.53)
Total	136	275	411
	(100)	(100)	(100)

3.4. Empirical methodology

Before analyzing the stability of locus of control, I check whether there has been any self-selection that could bias the results; and after the stability analyses I study if the experience suffered in the 2013 experiment has affected the locus of control reported in 2014. The core of this master thesis will focus on the study of these two latter questions, but also will provide some preliminary results of the relationship between locus of control and behavioral preferences.

Inside each step – except for the last one – I make both descriptive and regression analyses. In the next subsection I explain in detail the econometrics I will use to analyze the data.

Descriptive analysis

I use the following tests to compare the relevant subsamples in each case. The Kolmogorov-Smirnov test is a non-parametric test used to compare the distribution of two samples; the null hypothesis establishes the equality of distribution functions of the two samples. The Kruskal-Wallis test is similar to the previous one, but it compares more than two samples. The T-test with equal variances brings the mean of a variable in one subsample into comparison with the mean of that variable in another subsample; the null hypothesis sets that both means are statistically equal. The Wilcoxon rank-sum – Mann-Whitney – test for equality of unmatched observations compares values of the variable one by one, taking one observation from one subsample and linking it randomly with one observation from the other subsample; the null hypothesis holds when both observations are equal. The Wilcoxon signed-rank test for equality of matched observations is useful when we want to compare one observation with itself, for example in two different periods; its mechanism is similar to the Mann-Whitney's one, but here each observation is linked with itself.

The results of these tests are showed in the fourth section, but I explain here what subsamples are compared in each step – it will be reminded when exposing the results –.

Regarding the selection bias I compare the locus of control of the "comebackers" with locus of control of the rest of participants in 2013. If locus of control tendencies of "comebackers" differs from the tendencies of the other participants, there

might be a self-selection process, so that individuals with a specific locus of control orientation would have a higher probability to come back to subsequent experiments.

In order to measure the stability of locus of control I analyze the changes occurred in locus of control for the overall sample and by gender and age. Hence, the two subsamples to be compared are the 2013 and 2014 values of locus of control.

During the experiment, the individuals are asked to set the amount of money they believe they will earn due to their performance on the tasks involved in it. A positive previous experience is considered if the individual earned a bigger amount than expected, a neutral previous experience if he earned exactly what he thought he would earn, and a negative previous experience if he earned less than expected. Locus of control of those who had negative, neutral and positive experiences is compared to discard possible spill-overs generated by experimental experience.

Lastly, I make a preliminary descriptive analysis about how internal or external are the individuals in relation to their behavior in the experiments. The different behaviors in dividing the money after the tasks involved in the experiment are the base to form the subsamples. I do not go into detail about this part of the work, so no regression analysis is done in this regard.

Regression analysis

In addition to the non-parametric tests, I investigate the different concerns through regression analysis. I apply this method to the first step by two different regressions used to prove the existence of self-selection in locus of control values:

$$\text{Prob(comeback)}_{i,14} = \text{LOC}_{i,13}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\delta} + \varepsilon_i \qquad (1)$$

$$\text{LOC}_{i,13} = D_{i,14}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\delta} + \varepsilon_i \qquad (2)$$

The first one is a probit measuring the probability of having come back to the 2014 experiment, depending on the locus of control they reported in 2013 ($\text{LOC}_{i,13}$), and controlling for age, gender, years of education and economic status ($\boldsymbol{X}_{i,13}$).

The second one is an OLS (Ordinary Least Squeares) regression with locus of control in 2013 ($\text{LOC}_{i,13)}$ as the dependent variable and a dummy taking value one if the individual has participated in both years ($D_{i,14)}$ as an independent variable. Vector $\boldsymbol{X}_{i,13}$ contains the same controls as the previous regression.

With respect to the stability, I replicate the model proposed by Cobb-Clark and Schurer (2013), in which the dependent variable is the differential in locus of control between 2013 and 2014 ($\Delta LOC^{j}_{i,14/13}$), depending on the shocks suffered from 2013 to 2014 ($S^{\boldsymbol{j}}_{i,14/13}$) and controlling again for age, gender, years of education and economic status ($\boldsymbol{X}_{i,13}$):

$$\Delta LOC^{j}_{i,14/13} = S^{\boldsymbol{j}}_{i,14/13}\gamma^{j} + \boldsymbol{X}^{j}_{i,13}\boldsymbol{\beta}^{j} + \varepsilon^{j}_{i}\ , \qquad (3)$$

where each $S^{j}_{i,14/13}$ represents the different shocks I take into account, namely, positive and negative different shocks individually – employment status, wage and health –, the number of positive and negative shocks and the persistence of one shock (unemployment), including a dummy variable which takes value one if the individuals have been unemployed for twelve months or more.

The equation for studying the experimental experience is similar to the previous one, but here we have rather than an external shock, an internal one, occurred inside the experiment:

$$\Delta LOC_{i,14/13} = E_{i,13}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\alpha} + \varepsilon_i \qquad (4)$$

Where $E_{i,13}$is the difference between the amount they actually earn because of their participation in the "game" and the amount they had kept for themselves when dividing the money contained in the trays. If the individual gets more money than the amount he wanted to earn – the amount he would have earned in case that his tray had been selected – $E_{i,13}$ will be positive. If the individual gets a bigger amount of money than wanted, $E_{i,13}$ will be negative. And if he finally earns exactly what he had kept for himself, $E_{i,13}$ will be zero. In other words, when an individual's "rule of distributive justice" does not hold – his tray is not (randomly) selected – he can suffer a positive shock if he sees himself benefitting or a negative shock if he loses out. Once more, vector $\boldsymbol{X}^{j}_{i,13}$ contains age, gender, years of education and economic status controls.

4. Results

In section 4.1, I start by examining the data in order to discard any selection bias, which would impede from continuing the analysis. In section 4.2 the main results of my study are presented, addressing the stability and exogeneity concerns. Section 4.3 deals with the conceivable existence of spill-overs between consecutive experiments caused by what is called experimental experience. Finally, section 4.4 provides descriptive analysis relating locus of control and behavioral preferences.

4.1. Selection bias

As explained before, I apply the pertinent non-parametric tests and regressions in order to compare locus of control of the "comebackers" with locus of control of the rest of participants in 2013. We do not find evidence that locus of control tendencies of "comebackers" differs from the tendencies of the other participants, so that individuals participating in 2013 with a specific locus of control orientation do not have neither higher nor lower probabilities to come back to 2014 experiment. In other words, when comparing the "comebackers" with those who participated only in 2013, we can see that there is no difference in locus of control between them. I will explain in detail each piece of evidence.

The distribution of locus of control punctuations among the "comebackers" is statistically equal to the distribution among the "non-comebackers" (Kolmogorov-Smirnov test p-value = 0.963). As seen in Figure 1, "comebackers" as much as the rest

of participants (in 2013) have their highest percentage of the simple in 7 locus of control value, while have very low percentages in the tails. Means – 7.378 for "comebackers" and 7.357 for the rest – are also statistically equal (see Table 4). Moreover, if we compare unmatched observations from both groups (Wilcoxon rank-sum – Mann-Whitney – test) we do not find statistically significant differences in locus of control (p-value = 0.853).

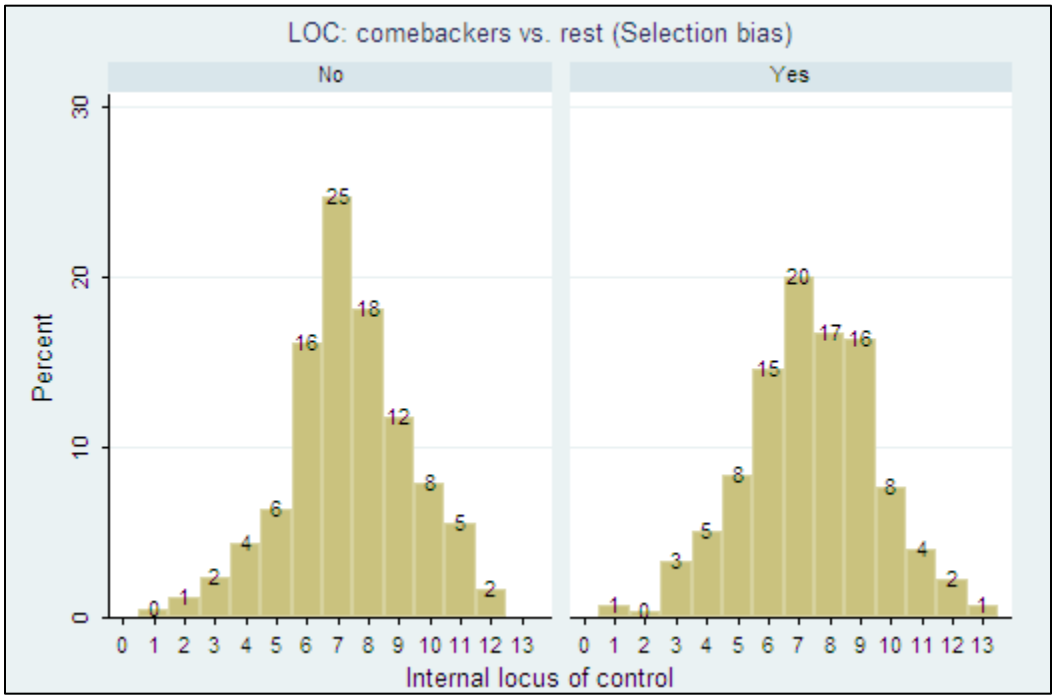

Fig. 1 Distribution of internal locus of control punctuations of 2013 experiment participants. Differences between those who do not attend 2014 experiment and the ones who participate in both years. Kolmogorov-Smirnov test for equality of distribution functions: p-value = 0.963.

Table 4 Summary statistics of internal locus of control (2013).

	LOC: comebackers vs. rest (Selection bias)				
Come back	Mean	Std.Deviation	Frequency	Min.	Max.
No	7.357	2.032	255	1	12
Yes	7.378	2.155	275	1	13
Total	7.368	2.095	530	1	13

Two-sample t test with equal variances: p-value = 0.907

This finding is corroborated by running the regressions presented above:

$$\text{Prob(comeback)}_{i,14} = \text{LOC}_{i,13}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\delta} + \varepsilon_i \qquad (1)$$

$$\text{LOC}_{i,13} = D_{i,14}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\delta} + \varepsilon_i \qquad (2)$$

The results obtained in regressions (1) and (2) (see Tables 5 and 6) have the same meaning: neither the locus of control orientation has an impact on the probability of coming back to the second experiment nor the fact that an individual has come back in 2014 affect his previous locus of control tendencies, since both coefficients are not significant.

Hence, individuals do not resolve to come back or not to come back depending on their locus of control orientation, meaning that there is no self-selection that could have biased the results of the experiment, at least due to locus of control –other individuals' characteristics could have caused selection bias, but they are beyond this study's aim –.

Table 5 Regression results of probability of coming back 2014 experiment.

VARIABLES	Pr(comeback)
Internal LOC	0.004
	(0.011)
Age	-0.002
	(0.005)
Female	0.028
	(0.045)
Years of education	-0.002
	(0.008)
Economic status	0.044
	(0.038)
Observations	527
R^2	0.003
χ^2	2.321
p	0.803

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 Regression results of internal locus of control punctuation.

VARIABLES	Internal LOC
Come back	0.068
	(0.182)
Age	0.013
	(0.022)
Female	-0.302
	(0.185)
Years of education	-0.034
	(0.034)
Economic status	-0.296**
	(0.147)
Constant	8.737***
	(0.851)
Observations	527
R^2	0.014
F	1.493
p	0.190

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2. Stability of Locus of Control

So far we have seen that there is no selection bias that could invalid the results. Next step in my analysis is to check whether locus of control is fixed over the analysis period, and whether it is exogenous or shocks occurring during this period influence it. These two sub-steps allow us to contrast the possibility of using our measure of locus of control to predict individuals' revealed preferences in economic experiments.

From now on, I will focus on the sample of subjects who have participated in both years, since it does not make sense to observe the evolution of individuals participating only in one year.

Stability over time

As explained below, locus of control seems not to be stable from one year to another. Even though distributions do not show relevant differences (see Figure 2), a T-test reports statistically significant differences between means (see Table 7), and a Wilcoxon signed-rank test supports this outcome (p=0.009).

For distribution functions of locus of control along this 2-year period, we do not find statistically significant differences between both years although p-value shows that both distributions are not much far away from being statistically different (see Figure 2). The average locus of control is 7.38 in 2013 and 6.99 in 2014, meaning that, on average, individuals become more external in 2014; p-value shows that the difference between both means is significant (see Table 7). A Wilcoxon signed-rank test confirms that locus of control in 2013 is systematically higher than locus of control in 2014 (p = 0.009).

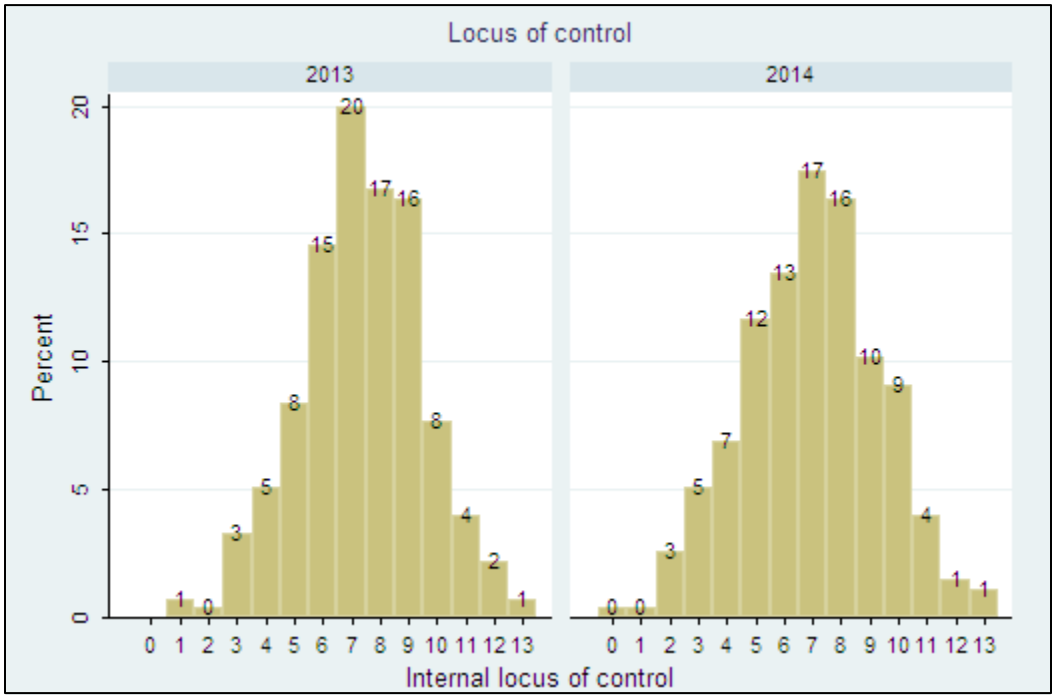

Fig. 2 Distribution of internal locus of control punctuations of "comebackers". Difference between both years. Kolmogorov-Smirnov test for equality of distribution functions: p = 0.178.

Table 7 Summary statistics of internal locus of control by year

	Internal Locus of Control				
Year	Mean	Std.Deviation	Frequency	Min.	Max.
2013	7.378	2.155	275	1	13
2014	6.985	2.406	275	0	13
Total	7.182	2.290	550	0	13

Two-sample t test with equal variances: Pr(|T| > |t|) = 0.044 Pr(T > t) = 0.022

If we detail the changes over time, differences between men and women are pointed out. Table 8 reports all the absolute changes suffered in locus of control from 2013 to 2014, that is, the subtraction of 2013 values from 2014 values of locus of control. If the change is negative the individual becomes more external, and if the change is positive the individual becomes more internal. More than a half of the participants (53.5%) either reveal no shift at all or vary their locus of control in only 1 point; this proportion is in essence similar between men (53.2%) and women (53.7%). However, the biggest negative variations – more external locus of control – are concentrated among males, while females are who show the largest positive differences – more internal locus of control –. Table 9 summarizes these results: we observe that most of women become more external (median = -1), and that the variations although negative are quite small on average.

Table 8 Absolute changes in LOC by gender

Change	Male	Female	Total
-10	1	0	1
-7	1	0	1
-6	4	0	4
-5	2	3	5
-4	2	8	10
-3	7	15	22
-2	14	22	36
-1	17	30	47
0	27	29	56
1	21	23	44
2	15	8	23
3	7	7	14
4	3	6	9
5	0	3	3
Total	121	154	275

Table 9 Summary statistics of changes in LOC by gender

Gender	Median	Mean	Std.deviation
Male	0	-0.339	2.396
Female	-1	-0.435	2.163
Total	0	-0.393	2.265

In view of these results, now I will replicate the same analysis by gender. As illustrated in Figure 3, punctuations are similarly distributed among women in both years; a Kolmogorov-Smirnov test for equality of distribution functions yields a p-value of 0.260. Nevertheless, it does not mean that women do not modify their locus of control tendencies. This can be seen in Table 10: women present an average locus of control of 7.26 in 2013 but in 2014 this mean diminishes to 6.82; using a T-test we have that women, on average, were more internal in 2013 than they are in 2014, with a 95% confidence level. A

Wilcoxon signed-rank test supports this result, telling us that if we look at each woman individually, we can see they become systematically more external in 2014 (p = 0.006). Hence, females' results coincide with the results observed among the whole sample.

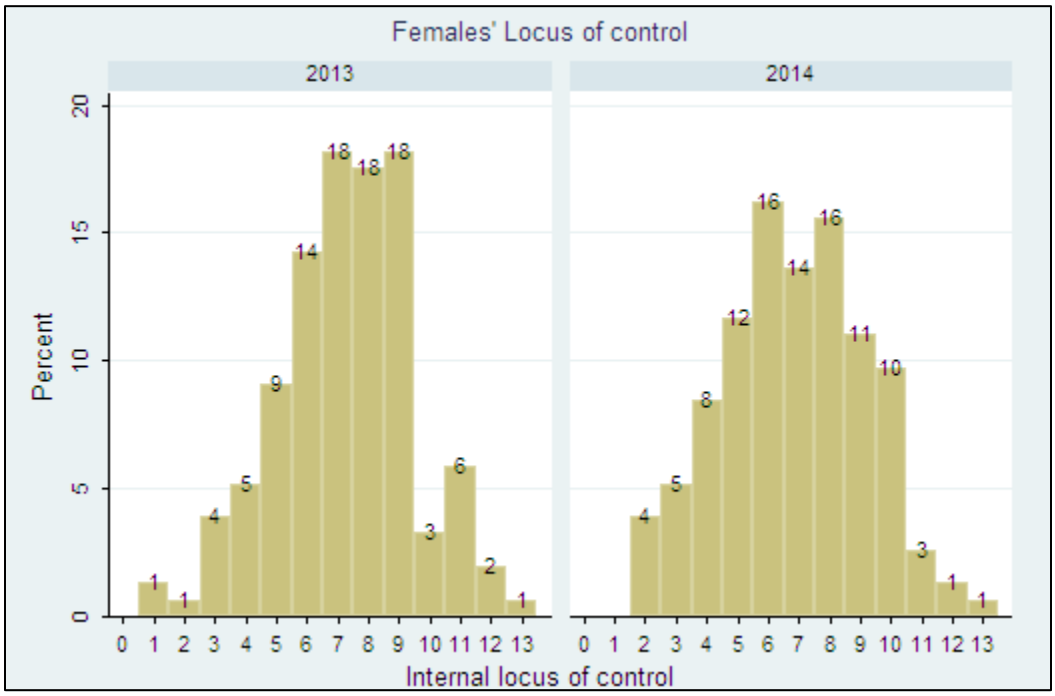

Fig. 3 Distribution of internal locus of control punctuations. Differences between both years. Only for female "comebackers". Kolmogorov-Smirnov test for equality of distribution functions: p=0.260.

Table 10 Summary statistics of internal locus of control by year. Only for female.

	Females' Internal Locus of Control				
Year	Mean	Std.Deviation	Frequency	Min.	Max.
2013	7.260	2.246	154	1	13
2014	6.825	2.377	154	2	13
Total	7.042	2.319	308	1	13

Two-sample t test with equal variances: Pr(|T| > |t|) = 0.0997 and Pr(T > t) = 0.0499

If we do the same analysis for men we observe that the distribution functions of locus of control again are statistically equal between 2013 and 2014 (see Figure 4), but also means are similar (see Table 11). Men show on average a 7.53 locus of control in 2013 and 7.19 locus of control in 2014, being the difference not significant. So men do not turn neither into more internal nor into more external. A Wilcoxon signed-rank test reinforces this idea, as matched observations are systematically equal as well (p = 0.461).

Consequently, women appear to be more unstable than men concerning locus of control, since there are significant

differences through time for women while I do not find them for men. Therefore, the instability observed at the beginning of this section seems to be caused by the variability among women.

Table 11 Summary statistics of internal locus of control by year. Only for male.

	Males' Internal Locus of Control				
Year	Mean	Std.Deviation	Frequency	Min.	Max.
2013	7.529	2.033	121	3	13
2014	7.190	2.437	121	0	13
Total	7.360	2.246	242	0	13

Two-sample t test with equal variances: Pr(|T| > |t|) = 0.241 and Pr(T > t) = 0.121

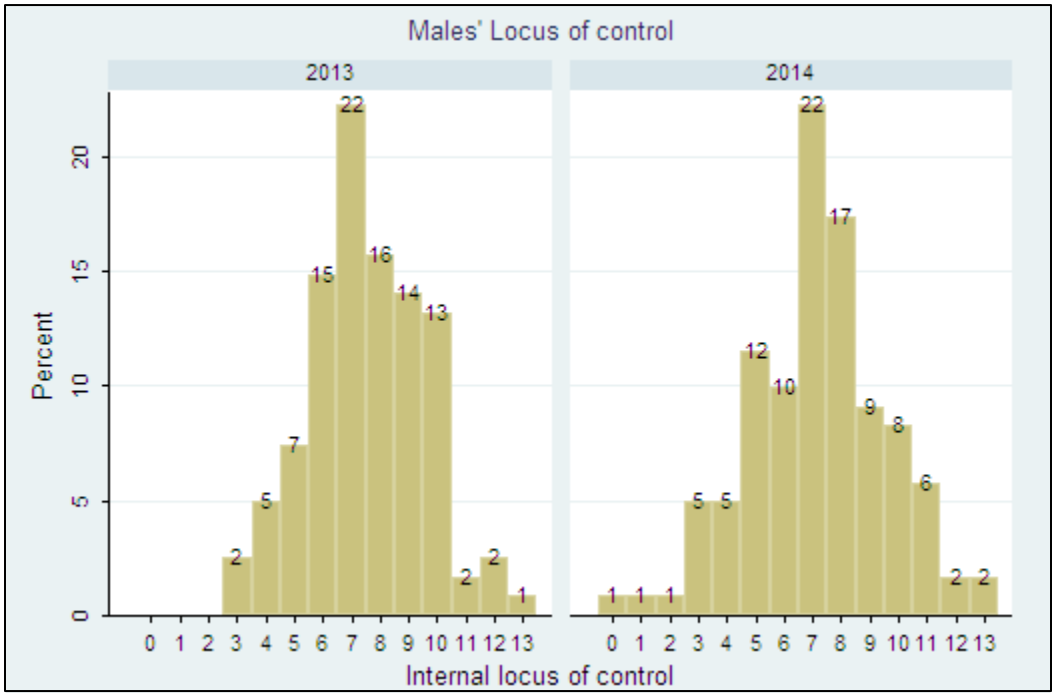

Fig. 4 Distribution of internal locus of control punctuations. Differences between both years. Only for male "comebackers". Kolmogorov-Smirnov test for equality of distribution functions: p = 0.646.

Even though we find no significant differences for men and significant ones for women along time, we do not know yet if gender differences are significant. It might be that the significant variations along time suffered by women were not statistically different from the non-significant variations experienced by men. For the purpose of testing it, instead of considering locus of control values I consider the shift occurred in locus of control from 2013 to 2014, in order to compare these changes by gender.

The pattern of gender similarities is displayed in an aggregated manner in Figure 5 and Table 12. This plot shows the distribution function of changes in locus of control both for men and women. Although differences by gender are visually noticed (see Figure 5), a Kolmogorov-Smirnov test for equality of distribution functions settles that these differences are not

significant (p = 0.334). Moreover, the average change in locus of control among males (-0.33) is statistically equal from the average change among females (-0.43). We have the same results doing a T-test (see Table 12). An additional confirmation is given by a Wilcoxon rank-sum – Mann-Whitney – test, which compares unmatched observations – each male is paired with one female for individual comparison – and reports that women and men vary their locus of control in systematically equal amounts.

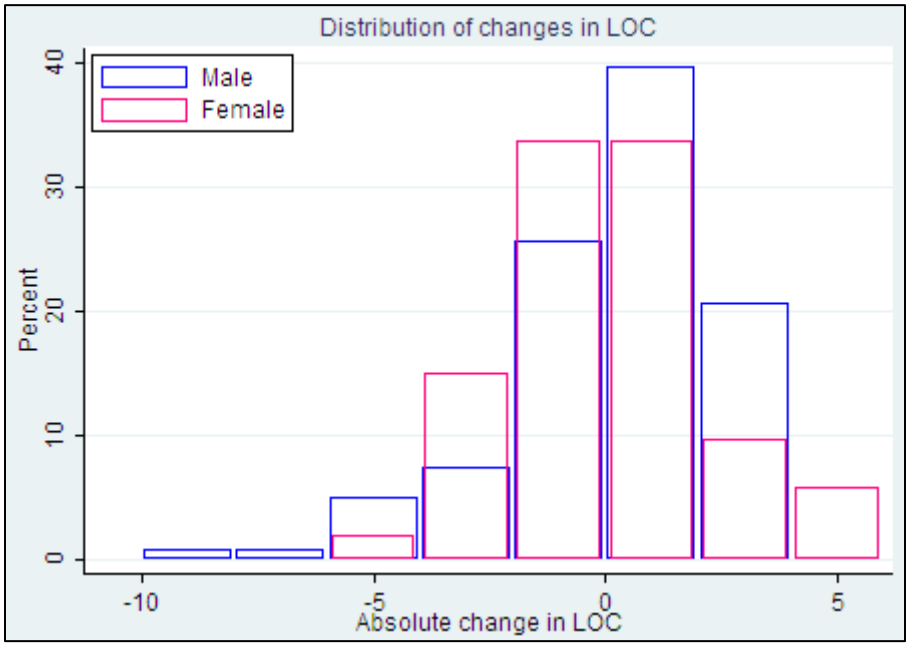

Fig. 5 Distribution of absolute changes in internal locus of control punctuations from 2013 to 2014. Difference between genders. Only for "comebackers". Kolmogorov-Smirnov test for equality of distribution functions: p = 0.334.

Table 12 Summary statistics of changes in LOC by gender

	Difference in Internal Locus of Control by gender				
Gender	Mean	Std.Deviation	Frequency	Min.	Max.
Male	-0.339	2.396	121	-10	4
Female	-0.435	2.163	154	-5	5
Total	-0.393	2.265	275	-10	5

Two-sample t test with equal variances: Pr(|T| > |t|) = 0.727 and Pr(T > t) = 0.364

Another relevant concern to be considered is related to the individuals' age, since changes in locus of control could appear along the life cycle. In order to take this possibility into account, I divide the sample in three age groups – from 18 to 24, from 25 to 30 and from 31 to 35 years old – and run the same non-parametric tests – Kolmogorov-Smirnov test for equality of distribution functions, two-sample Wilcoxon rank-sum (Mann-Whitney) test and two-sample t test with equal variances –.

When comparing changes in locus of control between the three age groups, we do not find significant differences, regardless considering the whole sample, the males' subsample or the females' subsample.

Still, an interesting insight is gained dividing the sample by gender and age at the same time and running the Wilcoxon signed-rank test for equality of matched observations (see Table 13). It compares 2013 locus of control and 2014 locus of control of the same individual within each of the six resulting groups. The p-values are displayed in table 11, from which we can say that locus of control is quite stable except among the youngest women. For all the groups locus of control is systematically equal in 2013 and in 2014, but women between 18 and 24 years become systematically more external over the analysis period.

Table 13 Wilcoxon signed-rank test: equality of matched observations by gender and age group.

Wilcoxon signed-rank test: equality of matched observations (p-values)	Age group: 18-24 years	Age group: 25-30 years	Age group: 31-35 years
Female	0.006	0.178	0.699
Male	0.575	0.687	0.730

Thus, the observed instability seems to be caused by the variability among women, but mainly by the variability among the youngest ones.

Once analyzed the first central matter of the thesis, I address the endogeneity problem.

Exogeneity: influence of shocks

Now I estimate the impact of different shocks on changes in locus of control. To assess the relevance of each shock individually, in Table 14, I display the estimates resulting from the explained above model, which I recall here:

$$\Delta LOC^{j}_{i,14/13} = S^{\boldsymbol{j}}_{i,14/13}\gamma^{j} + \boldsymbol{X}^{j}_{i,13}\boldsymbol{\beta}^{j} + \varepsilon^{j}_{i}\ , \qquad (3)$$

where *j* indexes are shocks and $\Delta LOC^{j}_{i,14/13}$ is the change in locus of control between the years 2013 and 2014, with positive changes indicating an increase in internal control tendencies. Vector $\boldsymbol{X}^{j}_{i,13}$ comprises control variables (age, gender, years of education and economic status) measured in 2013. Moreover, $S^{\boldsymbol{j}}_{i,14/13}$ is an indicator variable that takes value 1 if an individual reports experiencing shock *j* in between 2013 and 2014, and value 0 otherwise.

The same model is used to study the effect of shocks in three different ways. Firstly, individual shocks are taking into account, so *j* takes values from 1 to 6, being the different shocks losing the job, obtaining a job, a wage decrease, a wage increase, a health worsening and a health improvement. All of them are important enough life events able to influence personality traits like locus of control. Then, $S^{\boldsymbol{j}}_{i,14/13}$ will be a continuous variable that comprises the number of positive (*j* = 1)

or negative (j = 2) shocks occurred in between 2013 and 2014. And finally, $S^{j}_{i,14/13}$ will be an indicator variable that takes value 1 if an individual reports having been unemployed for a long period – 12 months or longer –, and value 0 otherwise. I will start with the first part of this exogeneity analysis.

Table 14 displays the estimation results from the regression model. Locus of control variations appear to be correlated with changes in health. On the other hand, the only labor market shock that is significant is to lose the job. However, it is only significant at 10% significance level and it affects locus of control in an unexpected direction: when an individual loses his job, it might be expected that he becomes more external because he realizes that some important events are not under his control. So it is necessary to be cautious when interpreting this result.

According to logical expectations, health improvements affect locus of control in a positive direction, making individuals to be more internal, while health deteriorations influence in the opposite direction.

Table 14 Regression results of absolute changes in internal locus of control punctuation

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Change LOC	Change LOC	Change LOC	Change LOC	Change LOC	Change LOC
Find a job	0.368					
	(0.386)					
Age	0.011	0.017	-0.004	0.090	0.018	0.003
	(0.046)	(0.034)	(0.034)	(0.064)	(0.035)	(0.035)
Years of education	-0.037	0.018	0.031	0.106	0.021	0.031
	(0.067)	(0.046)	(0.044)	(0.066)	(0.047)	(0.045)
Female	-0.026	-0.135	-0.229	-0.246	-0.142	-0.178
	(0.350)	(0.282)	(0.270)	(0.475)	(0.284)	(0.277)
Economic status	-0.137	-0.068	-0.100	-0.003	-0.059	-0.095
	(0.258)	(0.225)	(0.225)	(0.457)	(0.231)	(0.225)
Wage/hour increase		0.032				
		(0.274)				
Health improve			0.970***			
			(0.277)			
Lose a job				0.807*		
				(0.480)		
Wage/hour decrease					-0.191	
					(0.377)	
Health worse						-0.670**
						(0.288)
Constant	0.309	-0.905	-0.888	-5.014	-0.952	-0.364
	(1.724)	(1.381)	(1.378)	(3.214)	(1.437)	(1.452)
Observations	189	273	273	84	273	273
R^2	0.008	0.003	0.048	0.085	0.004	0.024
F	0.307	0.157	3.022	1.836	0.181	1.503
p	0.908	0.978	0.0113	0.116	0.970	0.189

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 6 graphically displays the results from the same regressions presented in Table 14. Specifically, the results displayed here are estimated by OLS coefficients and 90% confidence intervals – the colored points and the vertical lines containing those points, respectively –. On the horizontal axis we have the six individual shocks. On the vertical line above them, we have the estimates. The horizontal red line represents the value 0, in order to show easily if shocks are statistically different from zero (when the vertical lines are above or below the red line) or they are not statistically significant (if the vertical lines cross the red line). When they are above the red line, the effect on changes in locus of control is positive, and when they are below it is negative. The estimated value of the impact is represented by the point in the middle of the vertical lines.

Other reason to be cautious when it comes time to interpret the impact of losing the job is depicted in Figure 6. We can observe how wide the confidence interval is – even including values extremely close to zero –, meaning that this estimate is not accurate enough and its significance is too weak.

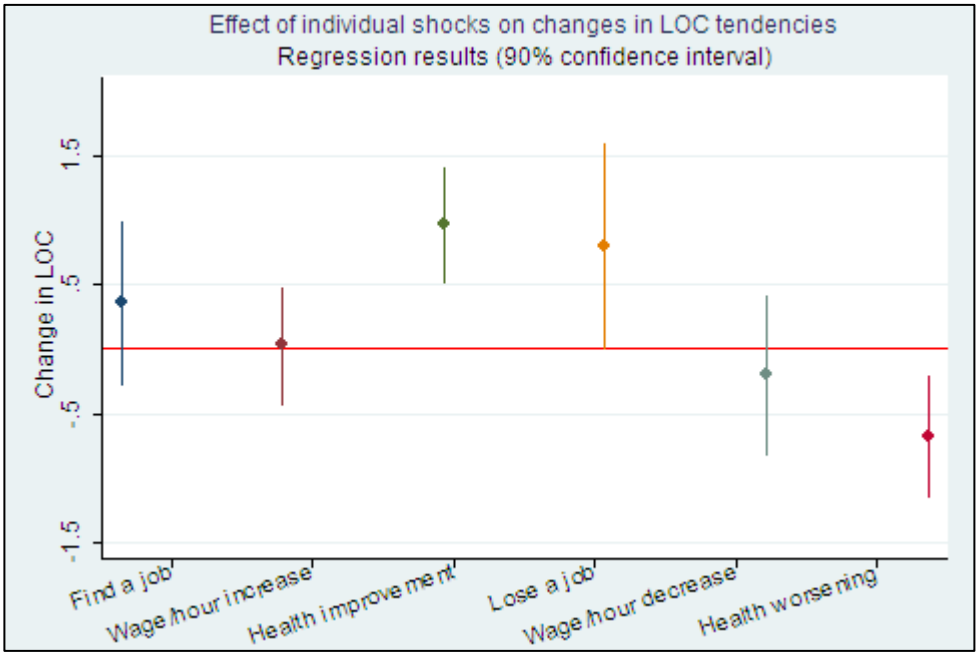

Fig. 6 Regression results of individual shocks (90% confidence interval)

As mentioned before, I will continue here with the second part of the exogeneity analysis. In the next regression (see Table 15), instead of adding each shock individually, I add one variable consisting in the number of positive shocks and another one consisting in the number of negative shocks. As observed in the regression, people tend to be more internal when the number of positive shocks increases and more external when the number of negative shocks increases. Even though individual shocks do not influence locus of control, except health shocks, when we let the shocks to be accumulated, they can affect locus of control tendencies. Still, the effects are small and only significant at 10% significance level.

Section 4.2 will finish now with the third part of the exogeneity analysis. I also consider the importance of the persistence in negative events, specifically the effect of long unemployment on locus of control. As table 16 shows, locus of control is unaffected in the presence of unemployment periods longer than 12 months, since the coefficient of "Long-unemployed" is not significant.

Table 15 Regression results of absolute changes in LOC tendencies depending on number of shocks

VARIABLES	(1) Change LOC	(2) Change LOC
Number of (+) shocks	0.255*	
	(0.138)	
Age	0.005	0.010
	(0.036)	(0.034)
Years of education	0.013	0.037
	(0.046)	(0.048)
Female	-0.167	-0.157
	(0.277)	(0.279)
Economic status	-0.040	-0.053
	(0.233)	(0.225)
Number of (-) shocks		-0.399*
		(0.218)
Constant	-0.923	-0.581
	(1.380)	(1.381)
Observations	273	273
R^2	0.017	0.016
F	1.180	0.877
p	0.319	0.497

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16 Regression results of absolute changes in LOC tendencies depending on being long-unemployed

VARIABLES	(1) Change LOC
Long-unemployed	-0.047
	(0.636)
Age	0.023
	(0.034)
Years of education	0.017
	(0.046)
Female	-0.125
	(0.279)
Economic status	-0.150
	(0.250)
Constant	-0.753
	(1.550)
Observations	272
R^2	0.005
F	0.237
p	0.946

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As soon as stability and exogeneity have been analyzed, I examine an additional problem that could arise when working with experiments if the individuals behave in a different way due to their experience in previous experiments.

4.3. Experimental experience

As mentioned above, during the experiment, the individuals are asked to distribute the money among themselves and the other three participants in their group (they never know who they are). I will consider that a participant has had a positive experience if he finally earned more than he kept for himself in that distribution. I will consider a neutral experience when a participant earns exactly what he desired. Finally, a participant will have a negative experience when he earned less than he

wanted for himself. A descriptive analysis is done comparing these three categories of participants, and a regression of locus of control depending on the previous experience includes the shock as a continuous variable instead. They are presented and explained in detail below.

The idea is the following: if individuals had revealed different locus of control values depending on whether they had a negative or positive previous experience, spill-overs between 2013 and 2014 experiments would have appeared. Those spill-overs could bias the results.

A Wilcoxon signed-rank test for equality of matched observations establishes that individuals who had a neutral or positive experience become more external (p-values of 0.067 and 0.045 respectively). It is not the case for those who had a negative previous experience (p = 0.859). However, we will see now that those differences across groups are not significant.

Figure 7 shows the similarities between changes in locus of control distribution functions when negative and positive previous experiences have been suffered. A Kolmogorov-Smirnov test for equality of distribution functions confirms that both distributions are statistically equal (p = 0.741).

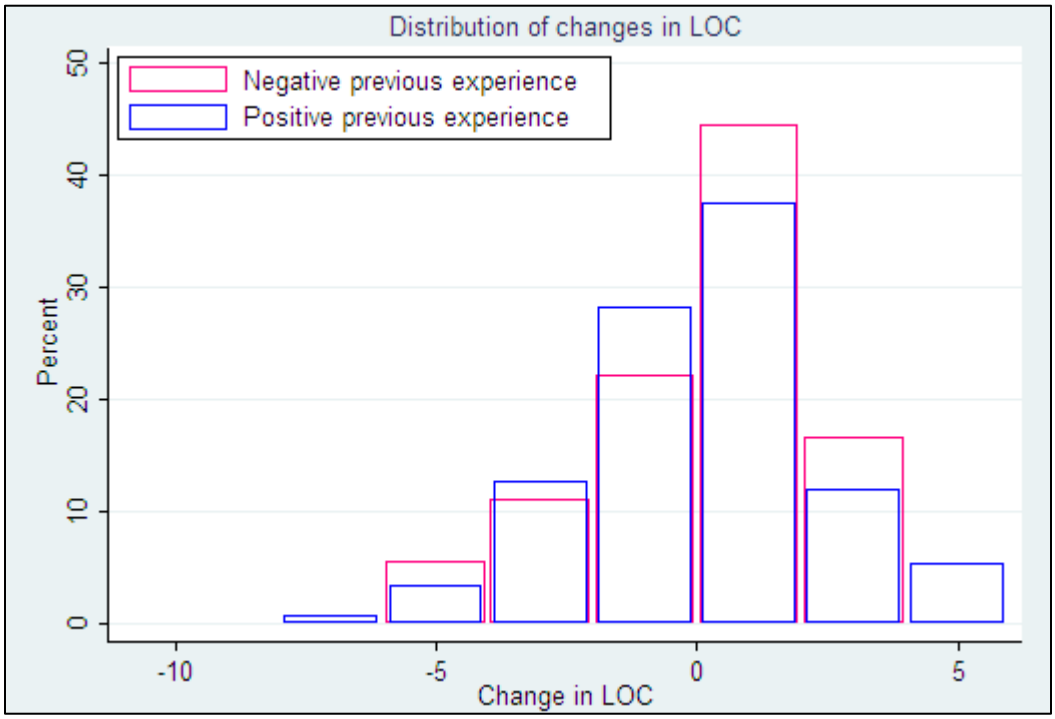

Fig. 7 Distribution of absolute changes in internal locus of control punctuations from 2013 to 2014. Difference between negative and positive previous experience. Only for "comebackers". Kolmogorov-Smirnov test for equality of distribution functions: p = 0.741.

Neither significant difference between means is found when comparing the individuals with a positive previous experience with those with a negative one (see Table 17). Those individuals who had a negative previous experience decrease their locus

of control in 0.11 on average, those who had a neutral previous experience decrease it in 0.41 and those who had a positive previous experience diminish it in 0.42. A T-test settles that these variations are not statistically different between the three groups. A Wilcoxon rank-sum – Mann-Whitney – test for equality of unmatched observations confirms this result (p = 0.423).

Table 17 Summary statistics of internal locus of control by type of previous experience

Previous experience	Changes in LOC by shock type			
	Median	Mean	Std.dev.	Frequency
Negative	0.5	-0.111	2.026	18
Neutral	0	-0.407	2.271	108
Positive	0	-0.416	2.299	149
Total	0	-0.393	2.265	275

Two-sample t test with equal variances: p = 0.591

For running the regression analysis to estimate the impact of previous experience on changes in locus of control, I define the variable "earnings shock". It is a continuous variable, ranging from –5 to 43, which measures the difference between the expected money and the one actually earned. I include this new variable in the above mentioned model:

$$\Delta LOC_{i,14/13} = E_{i,13}\beta + \boldsymbol{X}_{i,13}\boldsymbol{\alpha} + \varepsilon_i \qquad (4)$$

Table 18 reports the regression results. I add one control in each equation and all the controls in the last one. In any case the coefficient of "earnings shock" is significant, so the regression analysis confirms what the descriptive analysis has showed before. We can conclude that the experimental experience in this study do not generate spill-overs. Locus of control seems to be unaffected by previous experiences.

Table 18 Regression results of absolute changes in LOC tendencies depending on previous experience

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Change LOC	Change LOC	Change LOC	Change LOC	Change LOC	Change LOC
Earnings shock	0.009	0.010	0.008	0.010	0.009	0.010
	(0.014)	(0.014)	(0.014)	(0.0140)	(0.0139)	(0.014)
Age		0.026				0.019
		(0.032)				(0.033)
Female			-0.074			-0.107
			(0.279)			(0.281)
Years of education				0.036		0.021
				(0.047)		(0.050)
Economic status					-0.066	-0.056
					(0.230)	(0.235)
Constant	-0.442***	-1.123	-0.398*	-1.075	-0.256	-1.091
	(0.159)	(0.850)	(0.231)	(0.858)	(0.781)	(1.386)
Observations	275	275	275	275	273	273
R^2	0.001	0.004	0.002	0.003	0.002	0.005
F	0.379	0.522	0.224	0.471	0.289	0.276
p	0.539	0.594	0.799	0.625	0.749	0.926

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Before summing up all these results and concluding, a preliminary analysis relating locus of control and behavioral preferences is presented below.

4.4. Behavioral preferences

In this last section of results, a preliminary and descriptive analysis is introduced. I do not aim to do an exhaustive analysis on locus of control and behavioral preferences, but set the starting point for next study.

During the experiment, it is explained to the participants that the money will be distributed among them according to their success in performing the tasks. When they received that distribution, they can leave it as it is, or they can change it. "Selfish" behavior is considered when an individual takes all the money from the others, "equal division" when he divides the money equally among all the participants in his group, "equal division across others" when he takes more or less money for himself and divides the rest equally among the others, and "leave" when he does not change the distribution.

To check whether locus of control could be used to predict revealed behavioral preferences, it is necessary to analyze the possible correlation between them. We can see in the following tables and figures the distribution and statistics of locus of control values related to the behaviors explained just above. The 2013 result from a Kruskal-Wallis equality-of-populations rank test shows significant differences in locus of control distribution functions depending on the experimental behavior ($p = 0.043$), leaving the door open for further analysis on the relation between locus of control and revealed preferences. The result in 2014 is not consistent with it, so more exhaustive analyses are needed.

Table 19 Summary statistics of internal locus of control by type of behavior in 2013 experiment

	LOC by behavior type (2013)				
Distribution chosen	Mean	Std.Deviation	Frequency	Min.	Max.
Selfish	7.250	2.540	32	3	12
Equal division	7.473	2.199	169	1	13
Equal division across others	6.890	2.111	118	2	12
Leave	7.755	2.235	53	1	12
Others	7.506	1.762	158	3	12
Total	7.368	2.095	530	1	13

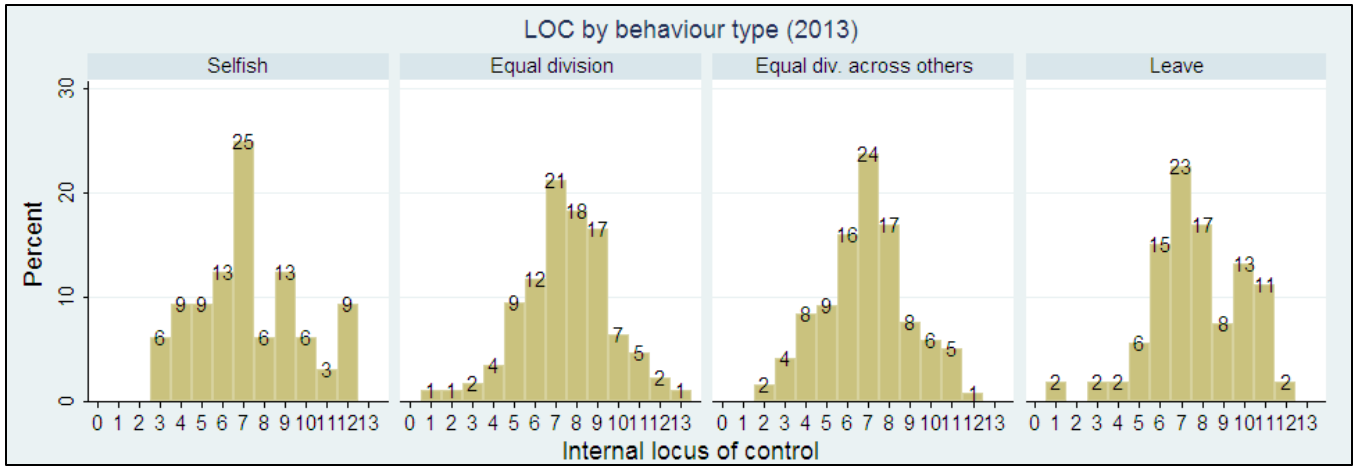

Fig. 8 Distribution of internal locus of control punctuations of "comebackers". Difference among different behaviors in 2013 experiment. Kruskal-Wallis equality-of-populations rank test: p-value = 0.043.

Table 20 Summary statistics of internal locus of control by type of behavior in 2014 experiment

	LOC by behaviour type (2014)				
Distribution chosen	Mean	Std.Deviation	Frequency	Min.	Max.
Selfish	6.756	2.791	41	2	12
Equal division	7.122	2.552	90	0	12
Equal division across others	6.792	2.351	120	2	12
Leave	7.053	2.571	19	3	12
Others	6.965	2.471	141	0	13
Total	6.932	2.484	411	0	13

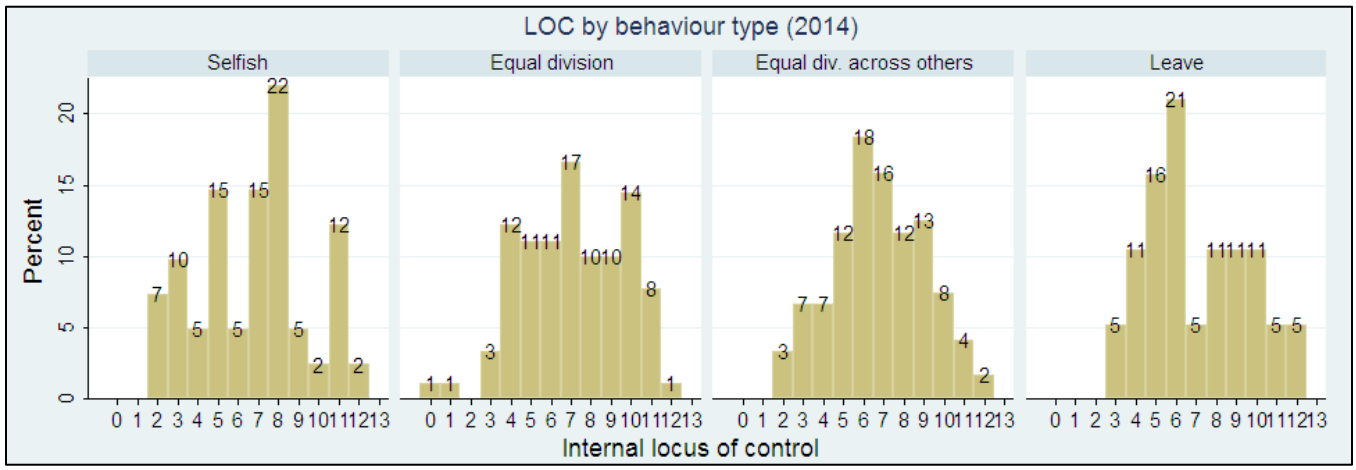

Fig. 9 Distribution of internal locus of control punctuations of "comebackers". Difference among different behaviors in 2014 experiment. Kruskal-Wallis equality-of-populations rank test: p-value = 0.773.

5. Conclusion

Although this study represents a preliminary analysis inside a large study that can be done about locus of control and social preferences, some important conclusions can be drawn. Apart from exposing these conclusions or findings, next I give an answer to the research question and I add some final touch about caveats and future research.

5.1. Findings

First of all, there is no selection bias, meaning that not only individuals with a specific internal/external tendency come back to the experiment. This claims that there is no selection bias (due to locus of control differences) in our experiment and we can continue with next steps.

Regarding the core of the thesis, locus of control is quite stable over time, although the youngest females are more unstable, but most of them make small changes. This result is consistent with what Cobb-Clark and Schurer (2013) found – locus of control changes are modest on average and concentrated among the youngest and oldest individuals –. In addition, locus of control is not deeply affected by external shocks – Cobb-Clark and Schurer claim that locus of control changes are not related to important life events –. Interestingly, the number of shocks presents some evidence of impact but this evidence is not robust; this result is also consistent with Cobb-Clark and Schurer's one. The significant individual shocks are those related to the health, which somehow is consistent with the finding of Cobb-Clark and Schurer, since they have more precise shocks that have a significant impact on locus of control when some of them are accumulated. Instead, we introduce an approximation of general physical and mental welfare that could be seen as an accumulation of different shocks. Lastly, we have seen that persistent unemployment is not significant, something consistent with Cobb-Clark and Schurer's outcome as well.

Additionally, locus of control is not affected by the experience of previous experiments. Hence, the kind of experience the individuals previously suffer, do not determine their subsequent locus of control tendencies.

Finally, locus of control orientation seems to be correlated with behavioral preferences, although a deeper analysis is needed in this regard.

5.2. Summary

To sum up, we say that it is possible to use this non-cognitive skill, locus of control, to predict individuals' revealed preferences in economic experiments, but always taking into account some considerations: although locus of control is stable, there exist exceptions and it is not completely invariant through time. Hence, it is necessary to observe individuals' non-cognitive skills and to look for the suitable estimation procedure in order to incorporate the possible changes.

5.3. Caveats

On the one hand, tests normality, heteroskedasticity, omitted variables bias, functional form, etcetera have not been run. Including them would enrich the analysis and make it more robust. On the other hand, there is a six sentences Likert-type scale included in the data from the experiment which has not been utilized. It might serve as a tool for comparison, in order to check whether we are measuring locus of control in a correct way. Furthermore, some authors have normalized the values of locus of control or converted them into a zero to one scale. This methodology has not been applied here.

5.4. Future research

Once the assumptions took in the literature have been proved to be valid, the predictive power of locus of control on labor market outcomes and revealed preferences can be examined within the experimental context. The last result I have obtained on the relation of locus of control with preferences – experiment behavior – opens new directions for further research.

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