

Longer vs. shorter denominations of unemployment and inflation rates: an experimental survey

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Abstract

Some researchers have provided evidence that contradicts the intuitive expectation that people perceive lower values expressed in a longer denomination (e.g., two dollars and eighty-five cents) as larger than higher values expressed in a shorter denomination (e.g., three dollars). Using an experimental survey administered to 637 students, we examine this bias in the context of messages related to unemployment and inflation. Our results differ from previous research in that we found no evidence of this bias. Specifically, participants did not perceive the number of unemployed and the inflation rate as higher and more serious simply because they are presented in larger denominations. Our findings suggest that communication about these dimensions that relies on the potential of numerosity heuristics should be used cautiously.

Keywords: experimental survey, inflation, numerical cognition, numerosity, unemployment

JEL Classification Codes: C99, C91, E31, J60

1. Introduction

Several studies have shown that people tend to overestimate values when they are expressed in larger numbers (e.g., 365 days, 2,000 cents) compared to equivalent but shorter numbers (e.g., 1 year, \$20) (Pelham et al., 1994; Pandelaere et al., 2011; Raghubir et al., 2017; Shrivastava et al., 2017; West et al., 2020). This “numerosity effect” also applies to longer denominations with more syllables (e.g., one thousand nine hundred eighty-four), which may be perceived as larger than their shorter equivalents (e.g., nineteen eighty-four), even though the objective value (1984) is the same (Coulter et al., 2012; Raghubir et al., 2017).

Interestingly, some scholars (Coulter et al., 2012; Shrivastava et al., 2017) have found an

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even more counterintuitive result: people tend to perceive *smaller* values expressed in longer denominations as larger than *larger* values expressed in shorter denominations. For instance, people may perceive a price of three hundred seventy-eight dollars and seventy-five cents (\$378,75) as higher than three hundred eighty dollars (\$380). In this article, we investigate this specific aspect of the numerosity bias in the context of messages about unemployment and inflation rates.

At first glance, the potential for longer versus shorter denominations to influence public perceptions could be a useful tool for communicating about sensitive issues. However, instead of assuming that this aspect of the numerosity bias applies universally and recommending its use in various contexts, we argue that it is important to test this effect before applying it to a specific domain, such as messaging about macroeconomic issues (Sunstein, 2014).

To this effect, we conducted an experimental survey using a between-subjects design with a large sample of individuals. Based on the previous research, we hypothesize that the way unemployment and inflation rates are presented (i.e., using longer versus shorter denominations) will influence individuals' perceptions of these rates. Thus, we test the following hypotheses:

H1. A lower level of unemployment expressed in a longer denomination (4,750,000 unemployed persons) is perceived as larger and more serious than a relatively higher level of unemployment expressed in a shorter denomination (5,000,000 unemployed persons).

H2. A lower inflation rate expressed in a longer denomination (2.85 %) is perceived as larger and more serious than a relatively higher inflation rate expressed in a shorter denomination (3 %).

2. Methods: experimental design

637 individuals participated voluntarily and without financial compensation in this study. The sample consists of students from a major French business school and a German university (39% female, $M_{age}=19.6$ years old). Participation in the study did not affect the students' academic evaluation. The majority of participants (98%) completed the survey via a QR code on their mobile phone. More precisely, the experiment was conducted at the beginning of a course session, during which time was set aside for students to complete the survey. Students were not allowed to discuss the survey during this period. The estimated time to complete the survey was approximately 10 minutes.

We employed a between-subjects design with two treatments, to which participants were assigned randomly. In treatment T1, participants were presented with two scenarios in a random order, one about unemployment and the other about inflation, both using shorter denominations to express higher levels of unemployment and inflation rates. In treatment T2, participants were presented with the same scenarios in a random order, but using longer denominations to express lower levels of unemployment and inflation rates. The scenarios presented to participants were as follows (with changes in treatment T2 italicized):

Scenario 1: A country with a total population of seventy million (70,000,000) of inhabitants has five million (5,000,000) [*four million seven hundred fifty thousand (4,750,000) in T2*] people looking for work.

Scenario 2: A country has an annual increase in prices (inflation) of three percent (3 %) [*two point eighty-five percent (2.85 %) in T2*] from one year to the next.

After reading each scenario, participants rated the level and seriousness of unemployment and inflation on a 5-point Likert scale (1: very low / not serious at all; 5: very high / very serious). Participants also indicated whether they were concerned about unemployment and inflation in their country, and whether they thought that their government was doing enough to address these issues. Participants completed a deliberative processing scale adapted from Effron and Raj (2020) on a scale from 1 = “Strongly disagree” to 5 = “Strongly agree.” The four items were “It took me time to deliberate,” “I thought very hard,” “I made a quick decision,” and “I did not think too hard”. This variable was expected to moderate the effect of longer versus shorter denominations. Participants also reported their sociodemographic characteristics.

3. Results

Before reporting individuals’ responses with regards to our main variables, we present in Table 1 the results of a balance test showing that there were no significant differences in the characteristics of participants between treatments T1 and T2. Given that the groups are similar, our results are not driven by differences between the two groups.

Table 1. Balance Test

Variables	Treatment 1 (Shorter denomination)	Treatment 2 (Longer denomination)	Difference
Age	19.562 (1.146)	19.683 (1.647)	0.121 (0.112)
Education	2.369 (1.001)	2.310 (0.960)	-0.059 (0.078)
Income	1.236 (0.648)	1.235 (0.708)	-0.001 (0.054)
Male	0.563 (0.497)	0.574 (0.495)	0.011 (0.039)
French	0.937 (0.243)	0.915 (0.279)	-0.022 (0.021)
German	0.022 (0.147)	0.022 (0.147)	-0.000 (0.012)
Siblings	1.786 (1.019)	1.737 (0.955)	-0.049 (0.078)
Position Siblings	1.887 (0.943)	1.818 (0.900)	-0.069 (0.073)
Observations	318	319	637

Source: own elaboration

Note: Standard errors in parentheses.

3.1. Univariate results

As shown in Table 2, there is no statistically significant difference in individuals’ perceptions of unemployment across treatments. However, for inflation, participants who were presented with longer numbers perceived the level of inflation as less problematic. Overall, our results do not support the hypothesis of a numerosity bias that argues that individuals’ perceptions depend on the denominations used (H1 and H2). In the inflation scenario, participants perceived longer numbers as less serious. Interestingly, the lack of significance also suggests that participants did not perceive a difference in unemployment, even when presented with different denominations (5,000,000 vs. 4,750,000). This is a surprising and interesting finding.

Table 2. Mean responses for the level and seriousness of unemployment and inflation (by treatment)

	Treatment 1 (Shorter denomination) (N=299)	Treatment 2 (Longer denomination) (N=338)	t-test (p value)
<i>Unemployment</i>			
Perceived Seriousness	3.35	3.39	0.598
Perceived Level	3.34	3.31	0.733
<i>Inflation</i>	(N=318)	(N=319)	
Perceived Seriousness	3.49	3.31	0.020
Perceived Level	3.40	3.28	0.099

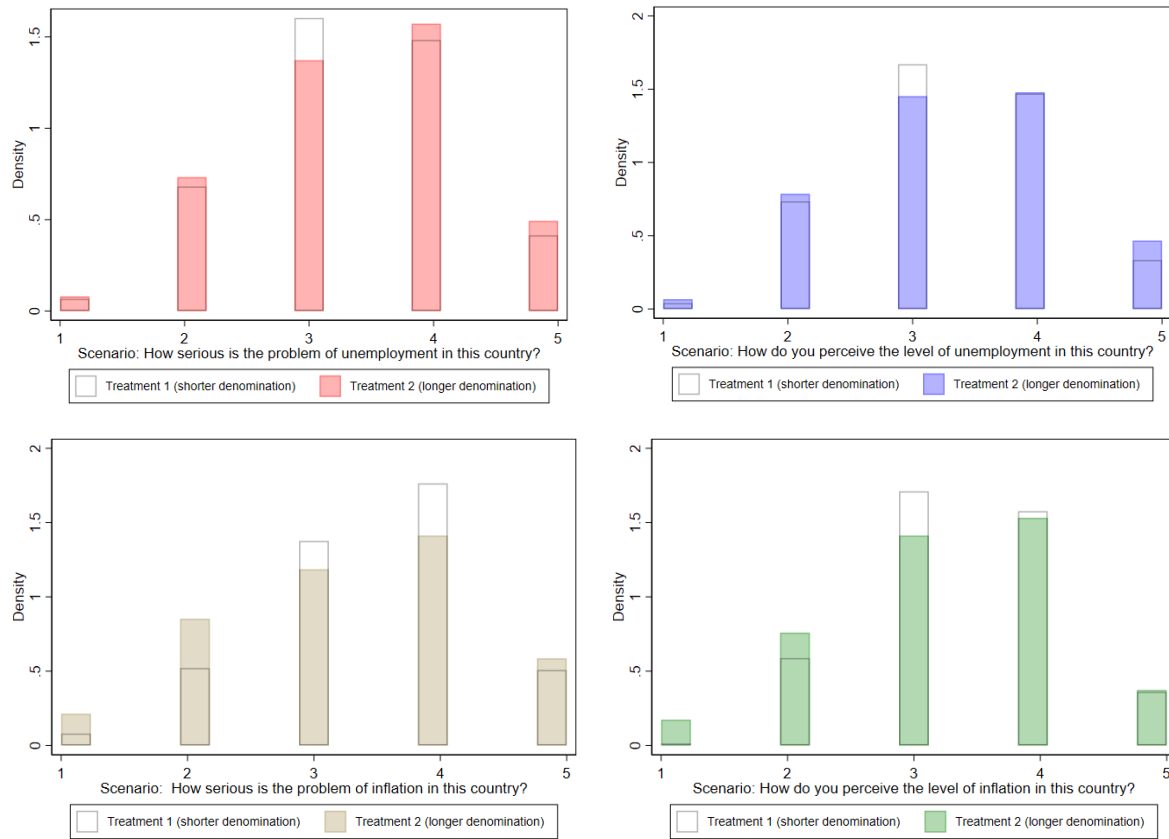
Source: own elaboration

In addition to analyzing mean responses, we also examined the distribution of responses by treatment. On one hand, a graphical representation (Figure 1) shows the following features: first, regarding the seriousness of unemployment (top-left), a relatively higher number of participants in Treatment 1 chose a medium score of 3, while more participants in Treatment 2 chose higher scores of 4 or 5. This suggests that participants in Treatment 2 perceived the problem as more serious. Second, regarding the level of unemployment (top-right), an even larger proportion of Treatment 2 participants chose the highest value of 5, compared to the Treatment 1. This reinforces the observation that participants in Treatment 2 were more concerned about the problem. Third, for the seriousness of inflation (bottom-left), we see that Treatment 1 participants were more likely to choose the middle value of 3, but also more likely to choose 4, indicating a higher range of concern. In contrast, participants in Treatment 2 were more likely to choose lower values. Interestingly, a small number of participants in Treatment 2 chose the highest possible value. Fourth, for the level of inflation (bottom-right), we observe the same previous trend, reinforcing the conclusion that participants in Treatment 2 were less inclined to choose higher values, reflecting less concern about inflation when inflation rates were presented as an absolute lower number.

On the other hand, we conducted a Kolmogorov-Smirnov test (Table 3), which evaluates whether the distributions of two independent samples are identical. The null hypothesis for this two-sample test is that the distribution functions of the two groups (T1 and T2) are equal. In this case, for most variables, the null hypothesis cannot be rejected, indicating no significant differences in the distribution of responses between the treatment 1 and treatment 2 groups. However, for inflation, the test revealed a statistically significant difference in the distribution of responses regarding the perceived seriousness of inflation, which is consistent with our overall findings.

3.2. Regression analysis

To determine whether other factors influenced our results, we conducted regression analyses to examining the effect of denominations on the perceived level and seriousness of unemployment and inflation. We controlled for individuals' concern about the level of unemployment (or inflation) in their country, their perception of government action, the use of a deliberation process, sociodemographic characteristics, and possible interactions between these variables (Table 4 and 5). The deliberation variable was calculated as a score based on the four items used, with Cronbach's alpha being 0.77 for the unemployment case and 0.72 for the inflation case.

Figure 1. Distribution of answers for the “Perception of seriousness of unemployment”, “Perception of unemployment as a problem”, “Perception of seriousness of inflation”, and “Perception of inflation as a problem”

Source: own elaboration

Table 3. Kolmogorov-Smirnov test of differences between treatments

Variable	Smaller group	D	p-value	Exact p-value
Perception of seriousness of unemployment	T1 (shorter denomination)	0.0394	0.611	
	T2 (longer denomination)	-0.0151	0.93	
	Combined K-S:	0.0394	0.966	0.953
Perception of unemployment as a problem	T1 (shorter denomination)	0.0332	0.705	
	T2 (longer denomination)	-0.0182	0.899	
	Combined K-S:	0.0332	0.995	0.991
Perception of seriousness of inflation	T1 (shorter denomination)	0.0184	0.897	
	T2 (longer denomination)	-0.1093	0.022**	
	Combined K-S:	0.1093	0.045**	0.038**
Perception of inflation as a problem	T1 (shorter denomination)	0.0029	0.997	
	T2 (longer denomination)	-0.0779	0.145	
	Combined K-S:	0.0779	0.288	0.262

Source: own elaboration

* indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Our regression results confirm the findings already presented in Table 2: there is no evidence of a bias between longer versus shorter denominations. Our findings, therefore, challenge the empirical evidence from other studies that have reported a numerosity bias (e.g., Coulter et al., 2012). Furthermore, our results show that individuals perceive inflation as significantly less important when presented with longer denominations. Nevertheless, we caution against dismissing the numerosity bias entirely based on our survey. First, one reason for the non-existence of a numerosity bias may be that the domains analyzed in our study are bads, whereas previous studies have focused on prices and discounts. In addition, participants may naturally round to the next highest number for unemployment, whereas they are more aware of smaller differences for inflation rates. Another explanation could be that people suffer from a left digit bias (see, e.g., List et al., 2023). It may be an interesting approach to explicitly test the effects of rounding and left digit bias in another study, as these two effects go in opposite directions. Second, another finding of our study is that individuals' perceptions do not fully align with the predictions of the rational model, as they exhibit a form of magnitude insensitivity. Third, we also found that individuals' concerns about the level of inflation significantly impact their perception of inflation as a problem. Interestingly, our results show that male respondents are significantly less worried about inflation, which is in line with recent research (Corduas, 2022). Fourth, our study shows that the effect of the deliberation process on individuals' perceptions depends on the issue: participants who engaged more in deliberation reported lower levels of perceived severity of unemployment, but higher levels of perceived severity of inflation.

3.3. *Heterogeneous treatment effect analysis*

While participants were randomly assigned to either Treatment 1 or Treatment 2 and there is, hence, no specific reason for any differences between the groups (see Table 1), we analyzed whether there are heterogeneous treatment effects. To do so, we first examined interaction terms between the treatments (T1 or T2) and various explanatory variables. However, these interactions did not lead to significant differences in the results. In other words, the results do not seem to depend on the subgroups or other participants' characteristics.

Second, we used the matching-smoothing estimation, which follows the methodology outlined by Xi et al. (2012) and uses propensity score matching. This method allows us to compare participants with similar characteristics in Treatment 1 and Treatment 2 and examine how the treatment affected these comparable individuals (Table 6). The approach uses different types of matching estimators, i.e., nearest neighbor matching (with and without replacement), nearest neighbor matching, radius matching (with and without replacement), and kernel matching.

The results show that there is no significant treatment effect for the perception of the seriousness of unemployment and the perception of unemployment as a problem, as the T-statistics are all below 2. However, in line with our previous findings, we find a significant treatment effect for the perception of the severity of inflation using the different types of matching estimators. There is also some evidence of a treatment effect on the perception of inflation as a problem, although the effect is less pronounced. In sum, these results are consistent with the general findings presented earlier that we find a treatment effect for inflation but not for unemployment.

Table 4. Estimates of treatment effect on perceived seriousness of unemployment/inflation

Variable	reg1	reg2	reg3	reg4	reg5	reg6	reg7	reg8	reg9	reg10
	Dep. variable: Perception of seriousness of unemployment					Dep. variable: Perception of seriousness of inflation				
Concern about unemployment			0.104*** (0.039)	0.107*** (0.04)	0.105*** (0.039)					
Concern about inflation						0.130*** (0.043)	0.125*** (0.043)	0.124*** (0.043)	0.124*** (0.043)	0.124*** (0.042)
Government success in reducing inflation						-0.041 (0.046)	-0.033 (0.047)	-0.033 (0.047)	-0.029 (0.047)	
Deliberation		-0.021* (0.011)	-0.020* (0.011)	-0.019* (0.011)	-0.020* (0.011)	0.021 (0.014)	0.024* (0.014)	0.024* (0.014)	0.026* (0.014)	0.024* (0.013)
French	0.018 (0.166)	0.044 (0.165)		-0.005 (0.196)		0.159 (0.207)				
German				-0.028 (0.344)	-0.575* (0.316)	-0.672* (0.403)				
Siblings	-0.020 (0.041)	-0.018 (0.041)			0.017 (0.043)	-0.009 (0.041)	-0.007 (0.04)	-0.018 (0.045)	-0.023 (0.044)	
Position Siblings					-0.063 (0.049)			0.025 (0.051)	0.031 (0.051)	
Education	-0.012 (0.038)	-0.007 (0.039)		0.010 (0.043)	0.001 (0.042)	-0.037 (0.043)	-0.035 (0.048)	-0.035 (0.047)	-0.047 (0.048)	
Age				-0.033 (0.029)	-0.029 (0.027)	0.023 (0.031)	-0.010 (0.036)	-0.012 (0.036)	-0.017 (0.038)	
Income				0.055 (0.083)					0.078 (0.058)	
Male	-0.070 (0.075)	-0.076 (0.075)	-0.078 (0.075)	-0.068 (0.076)	-0.077 (0.075)	-0.355*** (0.079)	-0.343*** (0.08)	-0.340*** (0.08)	-0.343*** (0.08)	-0.352*** (0.079)
Higher number	0.033 (0.075)	0.065 (0.076)	0.094 (0.076)	0.239 (0.151)	0.078 (0.077)					
Lower Number						-0.220*** (0.081)	-0.216*** (0.081)	-0.214*** (0.081)	-0.213*** (0.081)	-0.214*** (0.08)
Constant	3.440*** (0.211)	3.377*** (0.213)	3.003*** (0.153)	3.545*** (0.562)	3.662*** (0.51)	2.860*** (0.616)	3.645*** (0.703)	3.642*** (0.704)	3.656*** (0.723)	3.258*** (0.17)
N	637	637	637	637	637	637	637	637	637	637
F	0.31	0.88	3.00	1.44	1.93	4.80	5.24	4.77	4.47	10.26
Adj. R ²	-0.005	-0.001	0.014	0.009	0.014	0.058	0.048	0.047	0.048	0.051
AIC	1739.2	1737.4	1725.9	1735.2	1731.7	1799.1	1803.9	1805.7	1806.1	1797.8
BIC	1765.9	1768.6	1748.2	1784.2	1780.7	1848.1	1844.1	1850.2	1855.1	1820.0

Source: own elaboration

The table shows the results of OLS regressions. The dependent variable in regressions reg1 to reg5 is the perception of the seriousness of unemployment in the proposed example and inflation in regressions reg6 to reg10. Standard errors are shown in parentheses. The asterisks correspond to the p-value. ***, ** and * correspond to parameter significance at the 1%, 5% and 10% levels respectively.

Table 5. Estimates of treatment effect on perceived level of unemployment/inflation

Variable	reg1	reg2	reg3	reg4	reg5	reg6	reg7	reg8	reg9	reg10
	Dep. variable: Perception of unemployment as a problem					Dep. variable: Perception of inflation as a problem				
Concern about unemployment			0.106*** (0.038)	0.106*** (0.038)	0.103*** (0.038)					
Concern about inflation						0.159*** (0.037)	0.155*** (0.037)	0.156*** (0.037)	0.156*** (0.037)	0.157*** (0.037)
Government success in reducing inflation						-0.042 (0.039)	-0.037 (0.039)	-0.037 (0.039)	-0.034 (0.04)	
Deliberation		-0.026** (0.012)	-0.025** (0.012)	-0.025** (0.012)	-0.025** (0.012)	0.029** (0.012)	0.032*** (0.012)	0.032*** (0.012)	0.034*** (0.013)	0.031** (0.012)
French	-0.062 (0.17)	-0.030 (0.17)	-0.074 (0.201)	-0.072 (0.203)		0.174 (0.216)				
German			-0.223 (0.339)	-0.221 (0.34)		-0.446 (0.39)				
Siblings	-0.009 (0.04)	-0.006 (0.04)	-0.004 (0.039)	0.000 (0.045)		-0.024 (0.035)	-0.024 (0.034)	-0.021 (0.037)	-0.024 (0.037)	
Position Siblings				-0.008 (0.048)				-0.007 (0.045)	-0.002 (0.045)	
Education	-0.007 (0.036)	-0.001 (0.037)	-0.005 (0.037)	-0.005 (0.037)		-0.042 (0.046)	-0.041 (0.051)	-0.041 (0.051)	-0.051 (0.052)	
Age						0.044 (0.039)	0.018 (0.043)	0.018 (0.043)	0.014 (0.044)	
Income									0.061 (0.057)	
Male	0.026 (0.074)	0.019 (0.073)	0.019 (0.073)	0.018 (0.073)	0.020 (0.073)	-0.420*** (0.07)	-0.411*** (0.071)	-0.412*** (0.071)	-0.414*** (0.071)	-0.415*** (0.07)
Higher number	-0.027 (0.073)	0.012 (0.074)	0.041 (0.074)	0.041 (0.075)	0.039 (0.074)					
Lower Number						-0.162** (0.071)	-0.160** (0.071)	-0.160** (0.071)	-0.160** (0.071)	-0.154** (0.071)
Constant	3.421*** (0.212)	3.344*** (0.215)	3.016*** (0.281)	3.024*** (0.279)	2.934*** (0.149)	2.319*** (0.768)	2.987*** (0.795)	2.988*** (0.796)	2.999*** (0.814)	3.081*** (0.149)
N	637	637	637	637	637	637	637	637	637	637
F	0.1	0.8	1.6	1.5	3.1	8.4	9.9	8.8	8.1	18.8
Adj. R ²	-0.007	0.000	0.011	0.010	0.016	0.092	0.085	0.084	0.084	0.088
AIC	1710.6	1706.8	1701.9	1703.9	1694.5	1650.7	1653.4	1655.4	1656.2	1647.6
BIC	1737.3	1738.0	1742.0	1748.5	1716.8	1699.8	1693.5	1700.0	1705.2	1669.9

Source: own elaboration

The table shows the results of OLS regressions. The dependent variable in regressions reg1 to reg5 is the perception of unemployment as a problem and inflation in regressions reg6 to reg10. Standard errors are shown in parentheses. The asterisks correspond to the p-value.

***, ** and * correspond to parameter significance at the 1%, 5% and 10% levels respectively.

Table 6. Heterogenous treatment effect analysis (matching-smoothing method)

Dep. Variable	Treated	Controls	Difference	S.E.	T-statistic	Method
Perception of seriousness of unemployment	3.392	3.352	0.040	0.075	0.53	unmatched
	3.392	3.329	0.063	0.109	0.58	nearest neighbor matching
	3.387	3.352	0.035	0.075	0.46	nearest neighbor matching, no replacement
	3.392	3.345	0.047	0.086	0.55	3 nearest neighbors matching
	3.392	3.352	0.040	0.074	0.53	radius matching
	3.392	3.352	0.040	0.074	0.53	radius matching, no replacement
	3.392	3.351	0.041	0.077	0.53	kernel matching
Perception of unemployment as a problem	3.351	3.311	0.040	0.073	0.55	unmatched
	3.351	3.216	0.135	0.110	1.23	nearest neighbor matching
	3.349	3.311	0.038	0.073	0.52	nearest neighbor matching, no replacement
	3.351	3.284	0.067	0.085	0.79	3 nearest neighbors matching
	3.351	3.311	0.040	0.073	0.55	radius matching
	3.351	3.311	0.040	0.073	0.55	radius matching, no replacement
	3.351	3.303	0.048	0.075	0.64	kernel matching
Perception of seriousness of inflation	3.307	3.494	-0.187	0.080	2.33	unmatched
	3.307	3.571	-0.263	0.114	2.31	nearest neighbor matching
	3.305	3.494	-0.189	0.080	2.35	nearest neighbor matching, no replacement
	3.307	3.491	-0.184	0.091	2.01	3 nearest neighbors matching
	3.307	3.494	-0.187	0.080	2.33	radius matching
	3.307	3.494	-0.187	0.080	2.33	radius matching, no replacement
	3.307	3.511	-0.203	0.082	2.48	kernel matching
Perception of inflation as a problem	3.276	3.396	-0.120	0.073	1.65	unmatched
	3.276	3.649	-0.373	0.118	3.17	nearest neighbor matching
	3.270	3.396	-0.126	0.073	1.73	nearest neighbor matching, no replacement
	3.276	3.487	-0.211	0.090	2.36	3 nearest neighbors matching
	3.276	3.396	-0.120	0.073	1.66	radius matching
	3.276	3.396	-0.120	0.073	1.66	radius matching, no replacement
	3.276	3.436	-0.160	0.075	2.15	kernel matching

Source: own elaboration

4. Concluding remarks

We tested whether the longer versus shorter denomination bias applies to unemployment and inflation, and found no evidence of such an effect on individuals' perceptions. Additionally, our results suggest that individuals are insensitive to substantial changes in the denominations used. Our findings highlight the importance of caution when recommending the use of nudges from other domains without first testing their effectiveness in the target domain, even through simple experimental studies, to ensure that they deliver the expected benefits or avoid costly

mistakes.

One limitation of our study is that our sample mainly consists of students. While young people in France are increasingly concerned about inflation and employment, future research could benefit from a different and more diverse sample. Moreover, the experimental treatments may have different impacts on various subgroups within the study population. This type of analysis can reveal important nuances in how different segments of the population perceive and react to economic policies or information. It could help policymakers tailor their approaches to address the concerns of specific groups more effectively. While we examined whether some demographic groups respond more or less strongly to the treatments, we could not, however, explore whether the treatments affect participants differently based on their pre-existing concerns about inflation or unemployment, as we did not collect this data. Collecting it at the time of survey administration could have led to unintentional priming and carryover effects. Furthermore, testing the effect of denominations on other (positive) macroeconomic variables, such as employment, GDP, tax cuts, and interest rates, could provide a robustness check of our findings.

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