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Long term stability of time preferences and the role of the macroeconomic situation

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Abstract

We look at the stability of survey based subjective time preferences over time using data from a Dutch panel survey with a long time horizon and find that the ranking of individual time preferences is stable. Simple observation of the aggregated measured time preferences reveals instability in aggregated preferences. In order to shed light on this instability we look at the relationship between the individual socio-economic situation and time preferences and the macroeconomic situation and time preferences. While we find no clear relationship between socio-economic situation and time preferences, we find that for the sample as a whole patience is positively correlated with economic growth, but negatively correlated with income inequality. When studying how the estimations differ across income groups we observe that there is a considerable asymmetry in how different income groups react to changes in the macroeconomic situation.

Keywords: Time preferences, stability of preferences, income inequality, economic growth, determinants of preferences.

JEL Codes: D01, D63, J31.

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1 Introduction

Variations in time preferences across individuals have been argued to explain some of the observed heterogeneity in economic (and non-economic) outcomes such as household income, savings and consumption as well as education and health (Tanaka et al., 2010; Borghans and Golsteyn, 2006; Meier and Sprenger, 2010; Golsteyn et al., 2014). As in the economic literature in general, when the role of preferences in individual outcomes is studied, preferences are assumed to be stable over time and the focus is on variation in preferences across individuals. With the emergence of behavioral economics, variations in individual preferences over time have gained attention. Experimental methods have been used to investigate the stability of individual preferences, and hence whether the assumption of stable preferences is reasonable.

The existing literature on the stability of time preferences has to a great extent focused on stability in the relative sense of the concept. Despite the evidence on dynamic inconsistency (present bias) when intertemporal preferences at different points in time are measured at a single point in time, time preferences, when elicited at different points in time seem to be relatively stable. Individuals keep their level of time preferences relative to others through time. Kirby et al. (2002); Kirby (2009); Wölbert and Riedl (2013) all study the correlation coefficient of two laboratory based measures of time preferences at different points in time[1] and Meier and Sprenger (2015) find that aggregated choice profiles in a field study conducted over two years are stable.

Common to the aforementioned papers is that time preferences are measured at two points in time and over a relatively short time-horizon. Although the results are informative, studying time preferences at more than two points in time and over a longer time period allows for a deeper understanding of the stability of time preferences. To this date, there is a lack of long-horizon studies of the stability of time preferences.[2] The first

[1] Wölbert and Riedl (2013) find that discount rates measured at two dates with a time interval of between 5 and 10 weeks had a correlation coefficient of around 0.6. Kirby et al. (2002) find a correlation coefficient in the range 0.004-0.46 in a sample of Bolivian Amerindians where the intervals between discount rate measures range from 3 to 12 months while Kirby (2009), when studying American students over periods ranging from 1 to 12 months, obtains correlation coefficients in the range 0.63-0.77.

[2] Krupka and Stephens (2013) is the only paper we know of that looks at time preferences in a setup with multiple points of measurement. The authors look at measured discount rate over a period of two years and find that the evolution of time preferences goes hand in hand with the market interest

contribution of this paper is to fill this gap and study the stability of time preferences over a longer period of time and with many points of measurement.

The data on time preferences we use in this paper comes from the CentERdata DNB household survey, an annual survey sent out to a panel representative of the Dutch population. We look at answers to a series of questions on subjective time preferences for the period 1998-2012. We exploit the long time horizon by looking at the pairwise correlation of subjective time preferences for pairs of years with an increasing time-span between them. Were the correlation coefficient to decrease dramatically as the time span increases, this would suggest that time preferences are affected by idiosyncratic recent events that change the relative position of individuals in the distribution, that is, time preferences are not stable in the relative sense. If, however, the correlation coefficients are stable to an increased time-span, the message would be that relative time preferences are not affected by events that occur during the time-horizon of the data, leaving either early formation or innate preferences as possible determinants of individuals' position in the distribution of time preferences and the observed instability as noise. Our results show that the correlation coefficient does not decrease as the time span increases, suggesting that time preferences are indeed stable in the relative sense.

We then look at whether a set of socio-economic variables is related to the stability of time preferences measured as the absolute value of the first difference of our time preference measure. We find no clear evidence that socio-economic background correlates with stability of time preferences. Meier and Sprenger (2015) obtain a similar result for data on time preferences measured at two points in time. Hence, our results confirm the lack of relationship between key socioeconomic variables and stability of time preferences, even when the time horizon is extended from two to ten years and the number of measurement points is increased.

Leaving relative stability behind us, we turn the focus to absolute stability of time preferences, that is, stability of the level of individual preferences. We observe a considerable fluctuation in the average answers to the time preference questions (see figures 1, 2 and 3). If time preferences are stable in the relative sense, any such aggregated instability must be due to common shocks that have an effect on individuals such that

rate, indicating that measured time preferences might capture individual interest rate rather than time preferences.

their position in the distribution of time preferences is not changed.[3] There is evidence in the literature that preferences are shifted by life experience (common to others in the society or not).[4] However, it could also be that preferences are shaped by the current situation of the individual or even the current shape of the society the individual lives in. Although the evidence for this is not as extensive as for the long term effects of life events, there are some indications that preferences are to some extent shaped "as we go". Harrison et al. (2005) find that the perception that the economy is going better/worse than the previous year correlates with their incentivized discount rates such that perceiving that the economy is doing better comes with a decrease in the discount rate. Cohn et al. (2015) confirm the importance of the economic situation in an experiment where financial professionals are primed with a boom scenario or a bust scenario. Those primed with the burst scenario showed to be more risk averse and fearful than those primed with the boom scenario. Moreover, given the experimental setting, the authors can control for the impact of expectations and draw the conclusion that the priming indeed affects risk behavior through risk preferences.

Despite the effort of Cohn et al. (2015), there is clearly a lack of studies on the subject of how the current situation of the individual relates to her preferences. The second contribution of this paper is to fill this gap by studying the relationship between the current shape of society and individual time preferences.

The literature on socially determined preferences serves as a theoretical motivation for our study on the topic. According to this literature, individual preferences depend on the social context the individual finds herself in. The basic idea is that preferences are dependent on the framing of situations (Fehr and Hoff, 2011). Applying this idea to societies, Bowles (1998) discusses how economic institutions are reflected in individual preferences as they change the dynamics of social connections, i.e. who meets who and under which

[3]The effect could be uniform across all individuals, resulting in a shift of the distribution of time preferences as a whole. It could also be asymmetric in strength as long as the result of the asymmetric effect is a "stretched", but un-shuffled distribution of time preferences.

[4]Malmendier and Nagel (2011) find that individuals that have experienced low stock market returns or low bond returns are less prone to risk taking than others when investing. Whether or not this is due to altered risk attitudes or simply different perception of the financial market is left as an open question. Other papers have shown that experiencing a natural disaster renders individuals more risk averse (Cameron and Shah, 2015; Bucciol et al., 2013). Common to all the aforementioned papers is to look at the long term effect of an extreme experience by studying preferences many years after the event.

circumstances, hence affecting the way culture or norms disseminate through society and affect preferences. Motivated by Bowles, we look at the relationship between social change and preferences by first looking at the link between individual socio-economic situation and time preferences, where socio-economic shifts are seen as symptoms of social change. Secondly, we look at the relationship between three macroeconomic variables (economic growth, income inequality and inflation in house prices) and time preferences. While we observe no clear link between an individual's socio-economic situation and time preferences, we are able to establish a relationship between the macroeconomic situation at the regional level and individual time preferences using regional data on the macroeconomic variables. We also look at how the results differ between income groups. Our results suggest that changes in individual time preferences are related to changes in the macroeconomic situation and that different income groups are affected differently.

The remaining of the paper proceeds as follows. Section 2 of the paper presents the data used. Section 3 analysis the relative stability of time preferences and looks at the possible relationship between socio-economic groups and stability of preferences. In section 4 we look at absolute stability of time preferences by looking at the relationship between individual socio-economic status and time preferences on the one hand, and the relationship between the macroeconomic situation and individual time preferences on the other hand. Section 5 concludes.

2 Data

2.1 Survey data on time preferences

The CentERdata DNB household survey has been collecting longitudinal data on the economic and psychological aspects of financial behavior since 1993. The variables of interest for this paper are a series of 12 questions that focus on subjective time preferences. The questions have been a part of the survey questionnaire since 1996 with the year 2008 as an exception.[5] Due to constraints in our macroeconomic data, we will focus on the time interval 1998-2012 in our study. The respondents answer on a scale from 1 to 7 where 1 corresponds to "extremely characteristic" of the respondent and 7 corresponds to "extremely uncharacteristic" of the respondent. In this paper, we focus on the following

[5]After 2008 respondents only answer the subjective time preference questions every second year.

three questions:

(QA) With everything I do, I am only concerned about the immediate consequences (say a period of a couple of days or weeks). (toek4 in the DNB household survey)

(QB) I think it is more important to work on things that have important consequences in the future, than to work on things that have immediate but less important consequences. (toek8 in the DNB household survey)

(QC) I often work on things that will only pay off in a couple of years. (toek2 in the DNB household survey)

Question A (QA) focuses solely on the immediate consequences of the respondent's own acts while question B (QB) puts those in perspective with relatively more important future consequences. Question C (QC) focuses on the future rather than the present or "immediate future", but does so in a way that focuses on "doing" rather than on attitudes toward intertemporal decisions.

The fact that the survey questions on time preferences are of a non-monetary nature is unusual in the literature. Borghans and Golsteyn (2006) show that despite the non-monetary nature of the time preference questions, they are strongly correlated to hypothetically elicited discount rates. Along with the 2004 wave of the survey, Borghans and Golsteyn added a questionnaire that had the goal of measuring the individual discount rate. In their paper on the link between time discounting and the body mass index, the authors regress the obtained hypothetical discount rate with possible proxies of it, amongst those the series of subjective time preference questions we study here. They find that there is a strongly significant relationship between all but one time preference question and the hypothetically elicited discount rate, confirming a tight relationship with traditional time preference measures in a static setup. In turn, these traditional measures have been shown to correlate with lifetime outcomes that are generally seen to be governed by individual time preferences, such as consumption choice, education, income and health (Borghans and Golsteyn, 2006; Meier and Sprenger, 2010; Golsteyn et al., 2014; Bradford et al., 2014).

The choice of questions A, B and C is based on a factor analysis of the data. By first excluding questions that ask about time preferences in combination with optimism about the future, as well as one question that was found not to be significantly related

to a discount rate measure of time preferences in Borghans and Golsteyn (2006) and then grouping the remaining questions and retaining those questions that explain the largest share of the common variation of each group, we are left with the three questions presented above. A more detailed description of the factor analysis conducted for choosing the questions is included in the appendix of the paper. As can be seen, while question A is increasing in impatience, questions B and C are increasing in patience. We do therefore invert the answers to question A so that all three measures of time preferences are increasing in patience. Table 1 summarizes the answers to all three questions for the whole sample as well as for subgroups determined by age, income and education and figures 1,2 and 3 illustrate how the average answer to each question evolves over time for the whole country. From the figures we can see that the average answers to questions A, B and C fluctuate considerably between years. As will be illustrated in section 4, we will study the relationship between time preferences and the macroeconomic situation using province level data. In the appendix we therefore present graphs that illustrate the evolution of the average answer to each of the three questions for each of the 12 Dutch provinces separately.

The sample consists of 5803 individual respondents that on average participate in the survey three times. Attrition is dealt with in the survey design by replacing drop-outs with new participants that are as close a match as possible on a range of socio-economic dimensions, including place of residence, age, household composition, degree of urbanization, net household wealth and monthly household income.

Table 1: Summary statistics for the whole sample and for subgroups of age, income and education.

	QA		QB		QC	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Whole sample	4.27	1.56	4.14	1.36	3.51	1.56
Age $<$ 25 years	4.30	1.57	4.24	1.25	3.79	1.63
Age between 25 and 50 years	4.27	1.50	4.10	1.26	3.44	1.49
Age between 51 and 75 years	4.28	1.61	4.19	1.42	3.59	1.62
Age $>$ 75 years	4.27	1.71	4.00	1.75	3.32	1.74
Income group 1	4.15	1.51	3.98	1.36	3.31	1.55
Income group 2	4.13	1.65	4.16	1.45	3.48	1.69
Income group 3	4.12	1.61	4.09	1.42	3.43	1.68
Income group 4	4.23	1.56	4.09	1.38	3.42	1.57
Income group 5	4.27	1.55	4.17	1.33	3.54	1.53
Income group 6	4.48	1.54	4.20	1.33	3.66	1.54
No university degree	4.23	1.55	4.10	1.36	3.47	1.56
University degree	4.62	1.59	4.42	1.29	3.80	1.54

Notes: The income groups are defined as follows, in euros from 2002, in Dfl. from 1996 to 2001: Income group 1: Less than 10,000 euros/year (Less than 20,000 Dfl), income group 2: Between 10,000 and 14,000 euros/year (20,000-28,000 Dfl.), income group 3: Between 14,000 and 22,000 euros/year (28,000-43,000 Dfl.), income group 4: Between 22,000 and 40,000 euros/year (43,000-80,000 Dfl.), income group 5: Between 40,000 and 75,000 euros/year (80,000-150,000 Dfl.) Income group 6: More than 75,000 euros/year (More than 150,000 Dfl.).

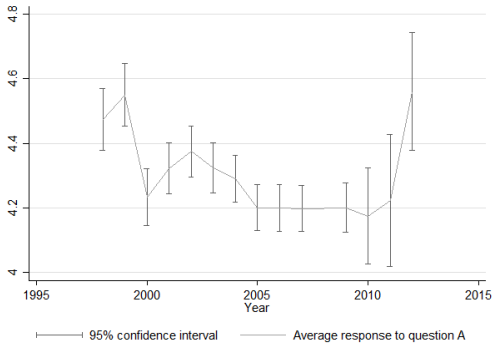

Figure 1: Average answer to question A for the whole sample with 95% confidence intervals (inverted scale)

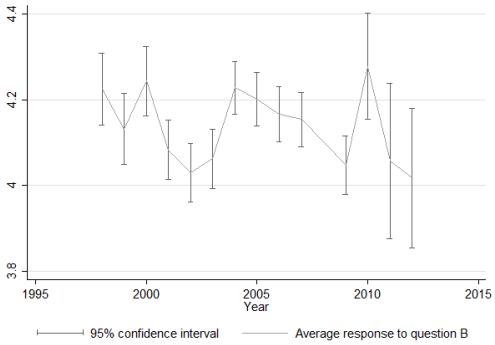

Figure 2: Average answer to question B for the whole sample with 95% confidence intervals

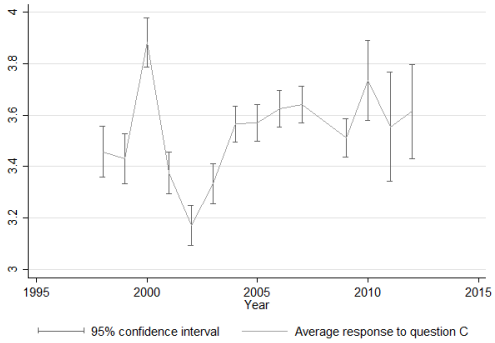

Figure 3: Average answer to question C for the whole sample with 95% confidence intervals

A problem when studying the evolution of preferences over time is the possibility that the preference measure also captures changes in incentives as time passes. For example, in the presence of inflation or altered interest rates, a monetary measure of time preferences, such as the discount rate, will react to changes in the time-value of money while time preferences (which the discount rates are meant to measure) might be stable (see e.g. Krupka and Stephens (2013)). The non-monetary measure of time preferences allows us to reduce the problem of changes in incentives and the time-value of money over time. One negative aspect of a non-monetary measure of time preferences is the fuzziness that results from the possibly large spread in how the respondents interpret the questions and the scale. However, since we are interested in the evolution of individual time preferences over time,

the problem of fuzziness in interpretation is quite unproblematic if individuals have a stable interpretation of the questions and the scale over time. Overall, we believe that the benefits of our non-monetary measure of time preferences outweigh the disadvantages. In addition we include the following control question that captures believes about the riskiness and/or uncertainty of the economic situation:[6]

> Do you think it makes sense to save money, considering the current general economic situation?
>
> 1. Yes, certainly
> 2. Yes, perhaps
> 3. Probably not
> 4. Certainly not
> 5. Don't know

The background information collected in the DNB household survey is extensive. Information on household income, net household wealth, education, age, household composition, employment and the degree of urbanization of the respondents' residence are used as individual control variables. Table 2 summarizes the background characteristics of the respondents in the aforementioned dimensions. In addition, information on the province of residence is provided and used in order to match respondents to the economic situation in their home-province when we, in section 4 of the paper, study the relationship between macroeconomic variables and time preferences.

2.2 The economic situation at the province level

To obtain increased variation across individual respondents, we use data on the economic situation in each of the 12 Dutch provinces for the period 1998-2012 which we then match to the individual respondent.

[6]Instead of dismissing the "don't know" answers, we interpret them as having a neutral perception of future risk or uncertainty. Hence, we transform the scale as follows when performing econometric analysis in section 4: Do you think it makes sense to save money, considering the current general economic situation? (1) Yes, certainly. (2) Yes, perhaps. (3) Don't know. (4) Probably not. (5) Certainly not.

Table 2: Summary statistics of the individual background variables

Variable	**Mean**	**Std. Dev.**
Age	50.49	14.51
University degree (=1)	0.11	0.32
Unemployed (=1)	0.01	0.08
Number of adults in household	1.80	0.44
Number of children in household	0.75	1.09
Household income group	4.46	1.23
Net household wealth, until 2002 (Dutch guilders)	460,934	590,235
Net household wealth, from 2003 (Euros)	221,497	8,183,404
Degree of urbanization	2.98	1.32

Notes: The Household income group variable is a categorical variable where each respondent classifies the total income of the household during past 12 months into one of six available categories ranging from less than 10,000 euros to 75,000 euros or more (corresponding amounts in Dfl. for the years before 2002). The degree of urbanization variable is also a categorical variable defined from 1 to 5 and is decreasing in degree of urbanization. Net household wealth is constructed from self-reported information on assets and liabilities from the DNB household survey. In the regressions that follow, net household wealth is reduced to a five level categorical variable by quintiles.

Motivated by the literature on socially determined preferences, we choose to include macroeconomic variables that we find likely to affect society in one way or another, assuming that macroeconomic events and development affect the individuals' preferences indirectly via society.

The variables we use are economic growth, income inequality (measured by the Gini coefficient and by the income share of the highest 10%) and inflation in house prices, all unique for each province.[7] Figures 9, 10, 11 and 12 in the appendix illustrate the dynamics of economic growth, income inequality measured by the Gini coefficient and by the income share of the highest 10% as well as inflation in house prices for each of the 12 Dutch provinces.

3 Relative stability of time preferences

We look at long-term stability of time preferences by studying whether the correlation across time for questions A, B and C is stable if the time interval increases. A correlation coefficient that is stable to an increasing time-gap indicates that time preferences are stable in the relative sense, that is the ranking of preferences is stable over time, and that the observed instability can be dismissed as noise. The intertemporal correlation of questions A, B and C is presented in tables 3, 4 and 5.

The level of correlation turns out to be in the interval 0.14-0.51. Moreover, it seems that the correlation coefficient is stable when the time span increases. This suggests that although time preferences as measured by questions A, B and C are far from being perfectly stable over time (i.e. the correlation coefficient is substantially below 1), the absence of an obvious downward trend in the correlation coefficients when the time span increases suggests that the imperfect correlation over time is mostly due to noise and that people's relative subjective time preferences are more or less stable over time. This confirms that the results in Wölbert and Riedl (2013), Kirby et al. (2002) and Meier and Sprenger (2015), that time preferences measured at two points in time are stable in the relative sense, also holds when the time horizon is extended.

[7] While the Gini coefficients for the period 2000-2012 were obtained from CBS Netherlands, for the years 1998 and 1999 they were approximated using data on income deciles in the Dutch provinces, also provided by CBS Netherlands. Also, data on the income share of the highest 10% is not available for the years 1998-1999, hence only the period 2000-2012 is included.

Table 3: Cross-correlation of responses to question A.

Variables	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1998	1.00									
1999	0.41	1.00								
	(781)									
2000	0.30	0.24	1.00							
	(422)	(533)								
2001	0.22	0.29	0.31	1.00						
	((486)	(598)	(851)							
2002	0.23	0.23	0.22	0.33	1.00					
	(411)	(508)	(711)	(1,347)						
2003	0.29	0.19	0.30	0.31	0.28	1.00				
	(378)	(461)	(608)	(1,129)	(1,324)					
2004	0.28	0.27	0.21	0.23	0.24	0.29	1.00			
	(379)	(464)	(614)	(1,086)	(1,260)	(1,477)				
2005	0.24	0.25	0.22	0.33	0.26	0.31	0.29	1.00		
	(365)	(448)	(555)	(967)	(1,087)	(1,262)	(1,513)			
2006	0.21	0.24	0.31	0.32	0.24	0.25	0.280.27	1.0		
	(339)	(417)	(516)	(888)	(1,007)	(1,137)	(1,368)	(1,611)		
2007	0.14	0.25	0.25	0.31	0.22	0.25	0.29	0.29	0.31	1.00
	(330)	(412)	(504)	(869)	(985)	(1,103)	(1,311)	(1,533)	(1,600)	

Note: Number of observations in parenthesis

Table 4: Cross-correlation of responses to question B.

Variables	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1998	1.00									
1999	0.41	1.00								
	(739)									
2000	0.38	0.39	1.00							
	(381)	(473)								
2001	0.43	0.35	0.37	1.00						
	(466)	(572)	(800)							
2002	0.40	0.41	0.31	0.37	1.00					
	(385)	(476)	(643)	(1,284)						
2003	0.39	0.37	0.39	0.42	0.38	1.00				
	(354)	(424)	(546)	(1,068)	(1,230)					
2004	0.36	0.35	0.33	0.31	0.30	0.37	1.00			
	(368)	(444)	(568	(1,078)	(1,212)	(1,417)				
2005	0.40	0.37	0.31	0.33	0.31	0.34	0.29	1.00		
	(356)	(427)	(521)	(962)	(1,053)	(1,208)	(1,513)			
2006	0.35	0.40	0.27	0.28	0.30	0.34	0.36	0.29	1.00	
	(328)	(397)	(486)	(882)	(969)	(1,087)	(1,367)	(1,609)		
2007	0.36	0.33	0.32	0.33	0.25	0.31	0.33	0.28	0.38	1.00
	(322)	(394)	(475)	(865)	(954)	(1,059)	(1,311)	(1,533)	(1,598)	

Note: Number of observations in parenthesis

Table 5: Cross-correlation of responses to question C.

Variables	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1998	1.00									
1999	0.50	1.00								
	(791)									
2000	0.45	0.44	1.00							
	(425)	(527)								
2001	0.44	0.50	0.44	1.00						
	(487)	(597)	(863)							
2002	0.44	0.51	0.40	0.50	1.00					
	(417)	(516)	(720)	(1,364)						
2003	0.47	0.46	0.47	0.52	0.50	1.00				
	(380)	(460)	(611)	(1,137)	(1,344)					
2004	0.41	0.44	0.41	0.47	0.46	0.48	1.00			
	(385)	(462)	(612)	(1,089)	(1,275)	(1,484)				
2005	0.43	0.43	0.43	0.45	0.43	0.48	0.50	1.00		
	(370)	(444)	(556)	(970)	(1,102)	(1,269)	(1,513)			
2006	0.40	0.42	0.45	0.47	0.46	0.46	0.49	0.51	1.00	
	(345)	(412)	(514)	(891)	(1,018)	(1,143)	(1,368)	(1,611)		
2007	0.33	0.37	0.43	0.42	0.43	0.45	0.44	0.49	0.48	1.00
	(337)	(412)	(504)	(871)	(999)	(1,110)	(1,311)	(1,533)	(1,600)	

Note: Number of observations in parenthesis

Even if we observe a stable correlation coefficient in tables 3 to 5, it remains an open question whether some socio-economic groups have less stable subjective time preferences than others. We study this possibility by investigating the link between the stability of time preferences and the rich set of socio-economic variables presented in the previous section. Using an approach similar to the one used in Meier and Sprenger (2015), our measure of stability of time preferences is the absolute value of the first difference of time preferences measured by questions A, B and C. Regressing this absolute value on lagged socio-economic variables, ignoring the longitudinal dimension of the data but clustering the standard errors at the individual level and including year dummies, allows us to identify characteristics that correlate with the stability of time preferences. Since the absolute value of the first difference of questions A, B and C only takes on integer values between 0 and 6, we estimate the model using ordered logit. The following latent model lies behind the ordered logit estimation presented in table 6.

$$\begin{aligned} |STP_t - STP_{t-1}|^* &= \beta_1 HHI_{t-1} + \beta_2 HHW_{t-1} + \beta_3 Uni_{t-1} \\ &+ \beta_4 Age_{t-1} + \beta_5 Age^2_{t-1} + \beta_6 Kids_{t-1} + \beta_7 Adults_{t-1} \\ &+ \beta_8 Urb_{t-1} + \beta_9 Unemp_{t-1} + \boldsymbol{\gamma} BiannualYearDummies + \varepsilon \end{aligned} \quad (1)$$

where $|STP_t - STP_{t-1}|^*$ is the latent version of $|STP_t - STP_{t-1}|$ that captures the absolut value of the first difference of time preferences measured by question A, B or C. HHI is a categorical variable for household income, HHW is a categorical variable for net household wealth, Uni is a dummy variable for having a university degree, $Kids$ is the number of children living in the household, $Adults$ is the number of adults living in the household, Urb is the degree of urbanization (decreasing in urbanization) and $Unemp$ is a dummy variable for being unemployed. The results of the regressions are presented as odds ratios in table 6 and show that there is little difference between people with different socio-economic situation when it comes to the stability of time preferences.

Although the intertemporal stability of the correlation coefficient supports relative stability of time preferences it is silent about the stability of time preferences in the absolute sense. In the next section we turn to the absolute stability of time preferences and look at whether individual socio-economic changes or macroeconomic shifts can explain intertemporal variation in time preferences.

4 Absolute stability of subjective time preferences

If time preferences are stable in the relative sense, as is suggested in the previous section, the fluctuation of aggregated time preferences observed in figures 1 to 3 must be caused by a common factor, a social change, affecting time preferences of everyone. It is hard, if not impossible to quantify a social change. To overcome this problem the first part of this section focuses on the individual socio-economic situation as a symptom of a social change and looks at the relationship to time preferences. In the second part of this section we look at the relationship between the macroeconomic situation and time preferences. Assuming that changes in the macroeconomic situation can give rise to social changes, we are looking at a relationship between a possible cause of a social change and time preferences.

4.1 The role of individual socio-economic status

In this section we look at whether the same setup of socio-economic variables as used in table 6 can explain changes in subjective time preferences at the individual level and hence reveal a link between an underlying social change and time preferences. To answer

Table 6: Absolute value of the first difference of QA, QB and QC regressed on socio-economic variables with one year lag (ordered logit estimation). Results presented as odds ratios.

	$\lvert QA_t - QA_{t-1}\rvert$	$\lvert QB_t - QB_{t-1}\rvert$	$\lvert QC_t - QC_{t-1}\rvert$
Household income$_{t-1}$	0.990	1.013	1.007
	(0.018)	(0.019)	(0.019)
Risk perception$_{t-1}$	1.020	1.029	0.999
	(0.027)	(0.027)	(0.026)
Net household wealth$_{t-1}$	0.973*	0.982	1.005
	(0.015)	(0.015)	(0.015)
University Degree$_{t-1}$ (=1)	1.010	1.011	0.961
	(0.064)	(0.065)	(0.061)
No. of adults in household$_{t-1}$	1.055	0.978	0.948
	(0.052)	(0.049)	(0.047)
No. of children in household$_{t-1}$	1.008	0.985	0.996
	(0.021)	(0.020)	(0.021)
Age$_{t-1}$	1.002	1.006	1.017*
	(0.010)	(0.010)	(0.010)
Age$^2{}_{t-1}$	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)
Degree of ruralization$_{t-1}$	0.989	1.014	1.002
	(0.015)	(0.015)	(0.015)
Unemployed$_{t-1}$	1.083	0.759	1.129
	(0.264)	(0.183)	(0.281)
Year = 2000	0.644***	1.211	1.302**
	(0.076)	(0.144)	(0.158)
Year = 2001	0.870	0.946	0.537***
	(0.090)	(0.100)	(0.058)
Year = 2002	1.071	1.015	0.784**
	(0.100)	(0.096)	(0.075)
Year = 2003	0.838*	1.173*	1.157
	(0.077)	(0.110)	(0.110)
Year = 2004	0.870	1.385***	1.423***
	(0.078)	(0.127)	(0.132)
Year = 2005	0.833**	1.114	0.997
	(0.074)	(0.101)	(0.091)
Year = 2006	0.902	1.101	1.070
	(0.079)	(0.098)	(0.096)
Year = 2007	0.853*	1.047	1.003
	(0.075)	(0.094)	(0.091)
No. obs.	8,725	8,725	8,725
Pseudo R^2	0.001	0.001	0.005

Odds ratios; Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The Household income group variable is a categorical variable where each respondent classifies the total income of the household during the past 12 months into one of six available categories ranging from less than 10,000 euros to 75,000 euros or more (corresponding amounts in Dfl. for the years before 2002 have been converted to euros). The degree of urbanization variable is also a categorical variable defined from 1 to 5 and is decreasing in degree of urbanization. Net household wealth is constructed from self-reported information on assets and liabilities from the DNB household survey that is transformed into a categorical variable by quintiles. Risk perception is a 4-scale variable where 1 corresponds to certainly agreeing that it makes sense to save money considering the current general economic situation and 5 corresponds to certainly not agreeing to the same statement.

this we need an estimation method that is able to handle both the ordinal nature of the data and the panel dimension of it. Following Bucciol and Miniaci (2012) and supported by Riedl and Geishecker (2014), we choose to use the Blow-up-and-cluster (from now on referred to as bucologit) approach developed in Baetschmann et al. (2015). A description of the approach can be found in the appendix.

The latent equation underlying the bucologit estimations presented in table 7 is the following

$$\begin{aligned} STP^*_{t,i} &= \beta_1 HHI_{t,i} + \beta_2 HHW_{t,i} + \beta_3 Uni_{t,i} + \beta_4 HighInc_{t,i} \\ &+\beta_5 LowInc_{t,i} + \beta_6 Age_{t,i} + \beta_7 Age^2_{t,i} + \beta_8 Kids_{t,i} + \beta_9 Adults_{t,i} \\ &+\beta_{10} Urb_{t,i} + \beta_{11} Unemp_{t,i} + \boldsymbol{\gamma} BiannualYearDummies + \alpha_i + u_{t,i}, \end{aligned} \tag{2}$$

where the socio-economic variables are the same as in equation (1), α_i is the intercept and $u_{t,i}$ is the error term. Note that the varying number of individuals and observations across questions is due to the fact that the number of individuals with no variation in the explanatory variable which are excluded from the estimation is not the same for the three questions. Also note that we include biannual year dummies instead of plain year dummies. This is to avoid problems with multicollinearity when estimating using the bucologit procedure.

We present our results as odds ratios. Due to the linear nature of the ordered logit model, the interpretation of our estimation will be the ratio of the odds of reporting maximum patience in a baseline scenario (e.g. where the number of adults in a household is one) and the odds of reporting maximum patience in another scenario (e.g. where the number of adults in a household is one unit greater, i.e. two), or, equivalently, the ratio of the odds of not reporting minimum patience in the first scenario and the odds of not reporting minimum patience in the latter scenario.

The results indicate a weak relationship between the individual socio-economic situation and subjective time preferences. Net household wealth is positively correlated with patience across all measures of subjective time preferences, although the effect is statistically significant for question B only. Age is negatively correlated with patience across all three measures of subjective time preferences although only significant for question A. There is also a strong and significant positive relationship between getting unemployed and patience as measured by question B. Moreover, the opinion that saving makes sense given the economic situation (the variable labeled "Risk perception" in table 7) is posi-

Table 7: Questions A, B and C regressed on socio-economic variables and year dummies using the bucologit procedure for a fixed effect ordered logit estimation

	QA	QB	QC
Household income	1.016	0.992	0.971
	(0.024)	(0.024)	(0.022)
Risk perception	0.945*	0.937*	0.936*
	(0.032)	(0.034)	(0.033)
Net household wealth	1.020	1.062**	1.017
	(0.024)	(0.027)	(0.025)
University Degree (=1)	1.052	0.972	1.208
	(0.237)	(0.190)	(0.285)
No. of adults in household	1.010	0.856	0.937
	(0.109)	(0.100)	(0.100)
No. of children in household	0.895*	1.016	0.983
	(0.053)	(0.061)	(0.060)
Age	0.896**	0.936	0.925
	(0.042)	(0.045)	(0.051)
Age^2	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)
Degree of ruralization	1.006	0.955	1.013
	(0.086)	(0.081)	(0.091)
Unemployed (=1)	0.827	1.986**	1.387
	(0.225)	(0.623)	(0.445)
Years 2000-2001	0.758**	1.084	1.146
	(0.085)	(0.118)	(0.157)
Years 2002-2003	0.964	1.008	0.709
	(0.152)	(0.160)	(0.150)
Years 2004-2005	0.951	1.553**	1.460
	(0.201)	(0.343)	(0.441)
Years 2006-2007	1.010	1.584	1.738
	(0.278)	(0.453)	(0.687)
Years 2009-2010	1.176	1.468	1.416
	(0.419)	(0.550)	(0.738)
Years 2011-2012	1.981	1.333	3.317*
	(1.229)	(0.777)	(2.415)
Ind. FE	Yes	Yes	Yes
Number of individuals	2,771	2,667	2,718
Number of observations	13,749	13,402	13,614
Pseudo R^2	0.009	0.008	0.017

Odds ratios; Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The Household income group variable is a categorical variable where each respondent classifies the total income of the household during the past 12 months into one of six available categories ranging from less than 10,000 euros to 75,000 euros or more (corresponding amounts in Dfl. for the years before 2002 have been converted to Euros). The degree of urbanization variable is also a categorical variable defined from 1 to 5 and is decreasing in degree of urbanization. Net household wealth is constructed from self-reported information on assets and liabilities from the DNB household survey that is transformed into a categorical variable by quintiles. Risk perception is defined from 1 to 4, where 1 corresponds to "yes, I certainly think it makes sense to save money given the economic situation" and 4 corresponds to "no, I certainly do not think it makes sense to save money given the economic situation".

tively correlated with patience across all measures of subjective time preferences.

4.2 The role of the macroeconomic situation

We now add our three macroeconomic variables, income inequality measured by the Gini coefficient, economic growth and inflation in house prices, all measured at the province level, to the set of explanatory variables in tables 6 and 7. The socio-economic variables from before are included for control purposes, but all focus is on the three macroeconomic variables. As before, we estimate an ordered logit with individual fixed effects using the bucologit model, but now we cluster the standard errors at the province level, not at the individual level, to take possible cross-correlation within provinces into account. We therefore use bootstrapped standard errors (with 400 bootstrap replications), taking the province-structure as well as the panel structure of the data into account when bootstrapping. Since there are only 12 Dutch provinces, there is a risk that clustering the standard errors at the province level could result in too small standard errors due to a few-clusters bias. In the appendix we test whether estimating using the wild-cluster bootstrap procedure as well as the pairs-cluster bootstrap procedure, that both have been shown to be robust to the problem of few clusters, does affect the standard errors. The results show only a small difference in standard errors between the small-cluster robust methods and regular cluster-robust regressions, suggesting that the small number of provinces is not a significant source of error in our estimations.[8]

The following latent model is underlying in the bucologit estimation presented in table 8.

$$\begin{aligned} STP^{*}_{i,t} &= \beta_1 Growth_{p,t} + \beta_2 Gini_{p,t} + \beta_3 HPI_{p,t} + \boldsymbol{\gamma} YearDummies + \\ &\quad \boldsymbol{\delta} Ind.ControlVar_{i,t} + \alpha_i + u_{t,p}, \end{aligned} \tag{3}$$

where $STP^{*}_{i,t}$ stands for subjective time preferences of individual i at time t, $HPI_{p,t}$ is inflation in house prices in province p at time t, $Ind.ControlVar_{i,t}$ stands for the individual control variables listed in table 7, α_i is the intercept and $u_{t,p}$ is the error term, clustered at the province level (p).

[8]Note also that in order to be able to cluster our standard errors at the province level, for respondents that have moved between provinces, all observation after the move (or after the first move if the respondent moves several times) have been dropped.

We also estimate a modified version of the model with interactions between income level dummies and the macroeconomic variables to detect whether there is a difference in the response to the macroeconomic changes across income groups,

$$\begin{aligned} STP^{*}_{i,t} &= \beta_1 Growth_{p,t} + \beta_2 Gini_{p,t} + \beta_3 HPI_{p,t} + \beta_4 HI_{i,t} + \beta_5 LI_{i,t} + \\ &\quad \delta_1(HI_{i,t} \times MacroVar_{p,t}) + \delta_2(LI_{i,t} \times MacroVar_{p,t}) + \\ &\quad \boldsymbol{\gamma} YearDummies + \gamma Ind.ControlVar_{i,t} + \alpha_i + u_{t,p}, \end{aligned} \tag{4}$$

where $HI_{i,t}$ is a dummy that takes on the value 1 if the respondent reports household income during the previous year that is in the top decile and zero otherwise, and $LI_{i,t}$ is a dummy that takes on the value 1 if the respondent reports household income during the previous year that is in the bottom decile and zero otherwise. Due to the categorical nature of the household income variable, the high- and low income dummies should be seen as approximate. Respondents that belong to the same income category as the 10th and the 90th decile will belong to the low and the high income groups, respectively. Hence, the percentage of respondents in the two groups varies from year to year.

We begin by estimating equation 3 including economic growth, the Gini coefficient and inflation in house prices one at a time as well as including them all simultaneously, with questions A, B and C as our measures of subjective time preferences. Table 8 shows that economic growth is positively related to patience for all three questions, and significantly so for questions B and C. Interpreting the magnitude of the observed relationship requires an interpretation of the odds ratio. For growth, an odds ratio of 1.027 for question B indicates that when economic growth increases with one percentage point, there are 2.7% more individuals that report maximum patience (or do not report minimum patience).

The relationship between income inequality and the Gini coefficient is negative and even larger than the effect observed for economic growth, although not significantly so for questions A and B (p-value of 0.25 for question A and 0.14 for question B). The odds ratio of 0.966 for question A indicates that when the Gini coefficient increases with one unit, $1 - 0.966 = 0.034 = 3.4\%$ fewer individuals will report maximum patience (or not report minimum patience). Finally, inflation in house prices is positively related to patience measured by question C.

In table 9, we include interactions between the three macro-variables and dummies for high and low household income,[9] one at the time and all simultaneously. Here we detect

[9]Recall that due to the categorical nature of the household income variable, the actual percentage of

Table 8: Equation (3) estimated with the bucologit method for ordered logit with fixed effects

	QA	QA	QA	QA	QB	QB	QB	QB	QC	QC	QC	QC
Growth	1.010	1.008			1.027***	1.025**			1.033	1.045*		
	(0.014)	(0.014)			(0.010)	(0.011)			(0.026)	(0.026)		
Gini	0.966		0.969		0.972		0.979		1.018		1.033	
	(0.029)		(0.027)		(0.018)		(0.020)		(0.029)		(0.034)	
HPI	1.000			1.001	1.001			1.003	1.033***			1.038***
	(0.013)			(0.013)	(0.007)			(0.007)	(0.011)			(0.007)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. obs	13,749	13,749	13,749	13,749	13,402	13,402	13,402	13,402	13,614	13,614	13,614	13,614
No. individuals	2,771	2,771	2,771	2,771	2,667	2,667	2,667	2,667	2,718	2,718	2,718	2,718
pseudo R^2	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.019	0.018	0.017	0.019

Notes: Results presented as odds ratios. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. HPI: inflation in house prices. Bootstrapped, exponentiated standard errors, clustered at the province level in parentheses. The Gini coefficient is multiplied with 100 and hence defined on the interval $[0, 100]$. As in table 7, the year dummies are biannual. All macroeconomic variables are collected at the province level.

Table 9: Equation (4) estimated with the bucologit method for ordered logit with fixed effects

	QA	QA	QA	QA	QB	QB	QB	QB	QC	QC	QC	QC
Growth	1.011	1.010	1.010	1.014	1.030***	1.027***	1.026***	1.025**	1.025	1.033	1.034	1.027
	(0.017)	(0.014)	(0.014)	(0.019)	(0.011)	(0.010)	(0.010)	(0.011)	(0.025)	(0.026)	(0.027)	(0.025)
Gini	0.966	0.955	0.965	0.954	0.972	0.973	0.974	0.974	1.017	1.029	1.016	1.029
	(0.029)	(0.031)	(0.029)	(0.031)	(0.019)	(0.021)	(0.019)	(0.021)	(0.030)	(0.030)	(0.030)	(0.031)
HPI	1.000	1.000	0.999	0.998	1.001	1.001	1.004	1.005	1.033***	1.033***	1.029***	1.031***
	(0.013)	(0.013)	(0.014)	(0.013)	(0.007)	(0.007)	(0.007)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)
Growth x LI	0.981			0.971	0.992			1.007	1.044*			1.029
	(0.025)			(0.026)	(0.018)			(0.029)	(0.026)			(0.030)
Growth x HI	1.008			0.996	0.988			0.999	1.013			1.022
	(0.015)			(0.022)	(0.015)			(0.015)	(0.030)			(0.035)
Gini x LI		1.061		1.067		1.091		1.089		0.969		0.963
		(0.045)		(0.047)		(0.061)		(0.058)		(0.043)		(0.050)
Gini x HI		1.021		1.022		0.919*		0.919*		0.947		0.942
		(0.037)		(0.036)		(0.042)		(0.042)		(0.048)		(0.050)
HPI x LI			1.000	1.007			0.981*	0.980			1.025**	1.018
			(0.010)	(0.010)			(0.010)	(0.015)			(0.010)	(0.011)
HPI x HI			1.009	1.010			0.993	0.993			1.001	0.994
			(0.009)	(0.012)			(0.008)	(0.008)			(0.012)	(0.015)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. control var.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	13,749	13,749	13,749	13,749	13,402	13,402	13,402	13,402	13,614	13,614	13,614	13,614
No. individuals	2,771	2,771	2,771	2,771	2,667	2,667	2,667	2,667	2,718	2,718	2,718	2,718
pseudo R^2	0.009	0.009	0.009	0.009	0.008	0.009	0.008	0.009	0.020	0.020	0.020	0.020

Notes: Results presented as odds ratios. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. HPI: inflation in house prices. HI =1 if the respondent lives in a household belonging to the top income decile. LI =1 if the respondent lives in a household belonging to the bottom income decile. Given the categorical nature of the household income variable, all respondents that fall into the same income category as the top (bottom) decile also belong to the high (low) income group. As a result, the percentage of respondents belonging to the high- and low income groups varies from year to year. Bootstrapped, exponentiated standard errors, clustered at the province level in parentheses. The Gini coefficient is multiplied with 100 and hence defined on the interval $[0, 100]$. The year dummies included are biannual. All macroeconomic variables are collected at the province level.

that the relationship between economic growth and subjective time preferences as well as the relationship between inflation in house prices and subjective time preferences are roughly uniform across income groups. However, when looking at the Gini coefficient, we note that for the high-income group, patience measured by question B is more negatively related to the Gini coefficient than for the broad middle class, which is defined as individuals living in a household with income between the 10th and the 90th percentile. The coefficient 0.92 of the interaction between the Gini coefficient and the high income dummy for the QB regressions suggests that for the high-income group, the odds ratio of the Gini coefficient is 0.92 times that of the broad middle class, that is $0.92 \times 0.97 = 0.89$. Hence, the odds of reporting maximum patience (or not to report minimum patience) decreases by $1 - 0.89 = 0.11 = 11\%$ for the high-income group when the Gini coefficient increases by one unit, while the same number is 3% for the broad middle class.

The asymmetric relationship between the Gini coefficient and patience measured by question B, as well as the rather large, but insignificant, coefficient for the Gini coefficient in the QA regressions suggests that it is worth taking a second look at the relationship between income inequality and time preferences. One way to do this is to see how a different measure of income inequality relates to our three questions on time preferences. In table 10 we look at the relationship between the share of the total income that goes to households belonging to the top decile of the income distribution and time preferences measured by questions A, B and C. Since data on the share of the top 10% in total income at the province level is only available from the year 2000 and onwards, we exclude the years 1998 and 1999. Compared to the previous results presented in tables 8 and 9, we now observe a significant and even larger negative relationship between income inequality (now measured at the top of the distribution) and patience measured by question B. Also, the difference between the different income groups is more pronounced here. Looking at question B, an odds ratio of 0.86 for the interaction between inequality at the top and the high income dummy variable suggests that when the share of total income ending in the pockets of the top 10% of the income distribution increases by one percentage point, the odds that a high income person reports maximum patience (or does not report minimum patience) decreases by $1 - 0.86 \times 0.96 \approx 0.17 = 17\%$, while the same number is a $1 - 0.96 = 0.04 = 4\%$ decrease for the broad middle class and an $1.09 \times 0.96 \approx$

respondents belonging to the high and low income groups varies from year to year.

$1.05 = 5\%$ increase for the low-income group. Hence, there is an increasing relationship between income and impatience when inequality at the top increases. Similarly, looking at question A, the difference between the low-income group and the broad middle class is considerably larger than in table 9. A coefficient of 1.12 indicates that an increase in inequality at the top results in the odds of a low-income person reporting maximum patience (or not reporting minimum patience) increasing by $0.99 \times 1.12 \approx 1.11 = 11\%$, while the same number is a $1 - 0.99 = 0.01 = 1\%$ decrease for the broad middle class and an $1.057 \times 0.99 \approx 1.05 = 5\%$ increase for the high-income group. Thus, there is a u-shaped relationship between patience and income when inequality at the top increases with increased patience amongst the high- and low-income groups while patience decreases for the broad middle class.

The fact that the income share of the top 10% is used as a measure of inequality opens up the possibility of linking our results to the results on "trickle down consumption" illustrated in Bertrand and Morse (2016). Bertrand et al. find that increasing inequality at the top, measured by the income share of the top decile of the income distribution, triggers consumption and increases debt for the middle class. The channels for this effect discussed by Bertrand et al. are both supply driven consumption (i.e. increased supply of expensive goods as the rich get richer) and status driven consumption amongst the middle class. Given that consumption is at least partly determined by time preferences, such that more patience comes with less consumption (see e.g. Meier and Sprenger (2010)), the results presented in table 10 open up the possibility of a link between income inequality at the top and consumption via the channel of time preferences.

Despite no observed relationship between income inequality at the top and patience measured by question A, the asymmetry across income groups for question A indicates that the middle class gets more impatient than both the high- and the low-income groups when income inequality the top increases, suggesting that, given a positive relationship between time preferences and consumption, the middle class will increase their consumption more than the high- or low-income groups. The negative relationship between patience measured by question B and income inequality at the top for the broad middle class could however also drive the effect observed in Bertrand and Morse (2016), despite the fact that the relationship is stronger for the richest decile than for the broad middle class. Assuming that the rich are getting richer while the middle class is stagnant, the rich get more money, both in the relative and the absolute sense. Lower patience boosts consumption

Table 10: Questions A, B and C regressed on macroeconomic variables with share of total income of the top 10% as a measure of income inequality using the bucologit method for ordered logit with fixed effects.

	QA	QA	QB	QB	QC	QC
Growth	1.015	1.023	1.033**	1.030**	1.032	1.029
	(0.017)	(0.020)	(0.014)	(0.014)	(0.028)	(0.027)
Share of top 10%	1.015	0.992	0.948**	0.956*	0.974	0.994
	(0.034)	(0.035)	(0.022)	(0.026)	(0.040)	(0.046)
HPI	0.983	0.980	1.004	1.007	1.054***	1.052***
	(0.016)	(0.016)	(0.008)	(0.009)	(0.013)	(0.013)
Growth x LI		0.959		1.005		1.019
		(0.027)		(0.037)		(0.032)
Growth x HI		0.988		1.010		1.015
		(0.022)		(0.013)		(0.039)
Top10 x LI		1.122*		1.090		0.921
		(0.073)		(0.095)		(0.086)
Top10 x HI		1.057		0.863**		0.924
		(0.060)		(0.053)		(0.053)
HPI x LI		0.999		0.987		1.021*
		(0.009)		(0.018)		(0.013)
HPI x HI		1.016		0.997		0.998
		(0.014)		(0.011)		(0.019)
Biannual year effect	Yes	Yes	Yes	Yes	Yes	Yes
Individual control variables	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	12,291	12,291	12,002	12,002	12,146	12,146
No. individuals	2,509	2,509	2,421	2,421	2,454	2,454
pseudo R^2	0.006	0.007	0.008	0.009	0.022	0.023

Notes: Results presented as odds ratios. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the province level. HI = High income household, belonging to the top 10%. LI= Low income household, belonging to the bottom 10%. Given the categorical nature of the household income variable, all respondents that fall into the same income category as the top (bottom) decile also belong to the high (low) income group. As a result, the percentage of respondents belonging to the high- and low income groups varies from year to year. HPI = inflation in house prices. Share of top 10% = the share of the total income that goes to the highest income decile. All macroeconomic variables are collected at the province level.

in both classes, but more so for the rich. Given that the increase in income inequality across the two income groups outweighs the increase in impatience-driven consumption, the debt increases will be larger for the broad middle class than for the decile at the top of the income distribution, simply because there is no income increase to cover the increased consumption of the middle class.

5 Conclusions

The results of this paper are twofold. First, we look at the stability of subjective time preferences using data with a long time-horizon. We come to the conclusion that preferences are stable in the relative sense. This extends previous results of the literature on the stability of time preferences that have been based on measures of time preferences made at only two points in time. We also fail to find a difference in the stability of time preferences between socio-economic groups. Same goes for our study of the link between socio-economic changes at the individual level and subjective time preferences. Also there we find no clear evidence of a relationship.

Secondly, our results illustrate that macroeconomic variables are correlated with people's subjective time preferences. People do in general get more patient when growth increases and when income inequality decreases. When looking at income groups separately, we observe that there is a difference between how the income groups respond to changes in income inequality. In particular, we observe that the rich get more impatient than the middle class when income inequality increases and the focus of the time preference measure is on attitude towards intertemporal decisions (question B). However, when income inequality is measured as the share of the total income that goes to the top decile and patience is measured as the respondent's focus on the immediate consequences of his own acts (question A), the middle class gets more impatient than both the richest and the poorest deciles. For both questions A and B, it is notable is that the patience of the poorest decile is less sensitive to increases in inequality, both when inequality is measured by the Gini coefficient and when it is measured by the income share of the richest 10 %.

Given that there is a positive relationship between decreased patience and consumption (as illustrated in e.g. Meier and Sprenger (2010)), our results on the relationship between income inequality at the top and time preferences could co-exist with or lie behind the results in Bertrand and Morse (2016) where the authors argue that when the income share

of the richest and consequently the consumption of the richest, increases, the consumption of the middle class also increases through supply- and status driven mechanisms.

Since the macroeconomic situation is an important, time-dependent factor that all individuals are affected by, the results open up the question of a possible dynamic effect between the macroeconomic economic situation and time preferences and the important policy implications such an effect could have. It is important to understand how sharp macroeconomic change correlates with changes in preferences since such an understanding would contribute to successfully designed policy responses. Also, and perhaps more importantly, an understanding of how long spells of macroeconomic situations correlate with preferences is crucial if the goal is to understand the overall effects of a given macroeconomic situation and, if applicable, find possible remedies to escape the situation.

Next steps in this line of research would be to attempt strengthen the evidence for the correlation we observe between time preferences and the macroeconomic situation and ultimately answer the question whether there is a causal relation running from the macroeconomic situation to time preferences. One possible path to take that could shed light on the issue is to study the question in the lab.

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6 Appendix

6.1 Survey questions on time preferences

The questions on time preferences in the DNB household survey follow below in the same format as they appear in the questionnaire. Note that question A comes fourth below, question B is number eight and question C comes second.

Please indicate on a scale from 1 to 7 to what extent you agree with the following statements, where 1 indicates it is 'extremely uncharacteristic' and 7 indicates it is 'extremely characteristic' of you.

Toek1 I think about how things can change in the future, and try to influence those things in my everyday life.

Toek2 I often work on things that will only pay off in a couple of years.

Toek3 I am only concerned about the present, because I trust that things will work themselves out in the future.

Toek4 With everything I do, I am only concerned about the immediate consequences (say a period of a couple of days or weeks).

Toek5 Whether something is convenient for me or not, to a large extent determines the decisions that I take or the actions that I undertake.

Toek6 I am willing to sacrifice my well-being in the present to achieve certain results in the future.

Toek7 I think it is important to take warnings about negative consequences of my acts seriously, even if these negative consequences would only occur in the distant future.

Toek8 I think it is more important to work on things that have important consequences in the future, than to work on things that have immediate but less important consequences.

Toek9 In general, I ignore warnings about future problems because I think these problems will be solved before they get critical.

Toek10 I think there is no need to sacrifice things now for problems that lie in the future, because it will always be possible to solve these future problems later.

Toek11 I only respond to urgent problems, trusting that problems that come up later can be solved in a later stage.

Factoring the questions using a principal component factorization (excluding question 5 that Borghans and Golsteyn (2006) found not to correlate with their time discount factor), we observe a grouping of the questions into three main clusters, as is illustrated in figure 4. Since toek3, toek9, toek10 and toek11 all implicitly elicit optimism about the future in addition to time preferences, we rule them out. For the remaining questions, we can observe in figure 4 that toek1, toek2, toek6, toek7 and toek8 form a cluster while toek4 is separate. This is in line with the interpretation that while the focus of toek4 is on the immediate future, the focus of the remaining questions lies further away in time. Focusing on toek1, toek2, toek6, toek7 and toek8, we can see in figure 5 that toek1 and toek2 form a cluster while toek6, toek7 and toek8 form another, less dense cluster. This is in line with the fact that while toek1 and toek2 discuss "doing", toek6, toek7 and toek8 discuss "opinion", and hence capture different aspects of time preferences.

Given our two final clusters in figure 5, we want to identify the question that embodies the largest share of the common variation in each cluster. To do this, we simply pick the question with the lowest uniqueness, and hence the strongest weight in the factor. Amongst toek1 and toek2, we have observed that toek2 contributes more to the factor variable than toek1 both when all the questions are included and when toek1, toek2, toek6, toek7 and toek8 are studied. For the cluster of toek6, toek7 and toek8, it is toek8 that has the lowest uniqueness and contributes the most to the common factor. Finally, since toek4 is on its own, it will also be included.

This reasoning has hence left us with toek2, toek8 and toek4. Toek2 and toek8 focus on the future to a greater extent than toek4. Toek2 does so by highlighting "I do" while toek8 highlights "I should do". Toek4, on the other hand uses same expression as toek8, but puts all focus on "immediate consequences" instead of contrasting those with future consequences as in toek8.

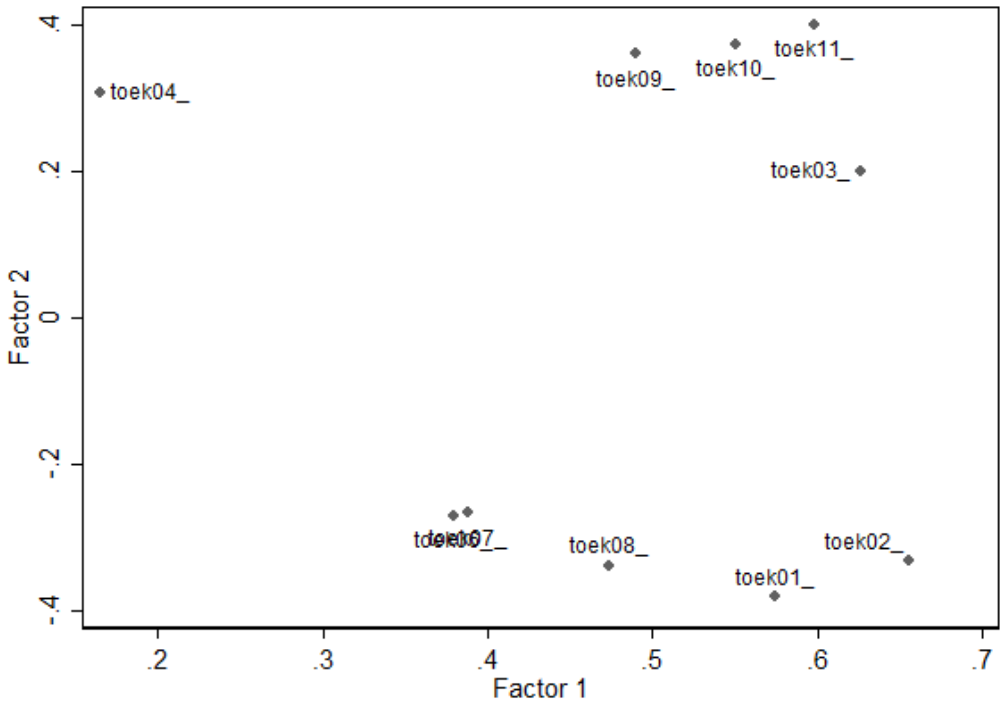

Figure 4: Factor loading plot for all questions

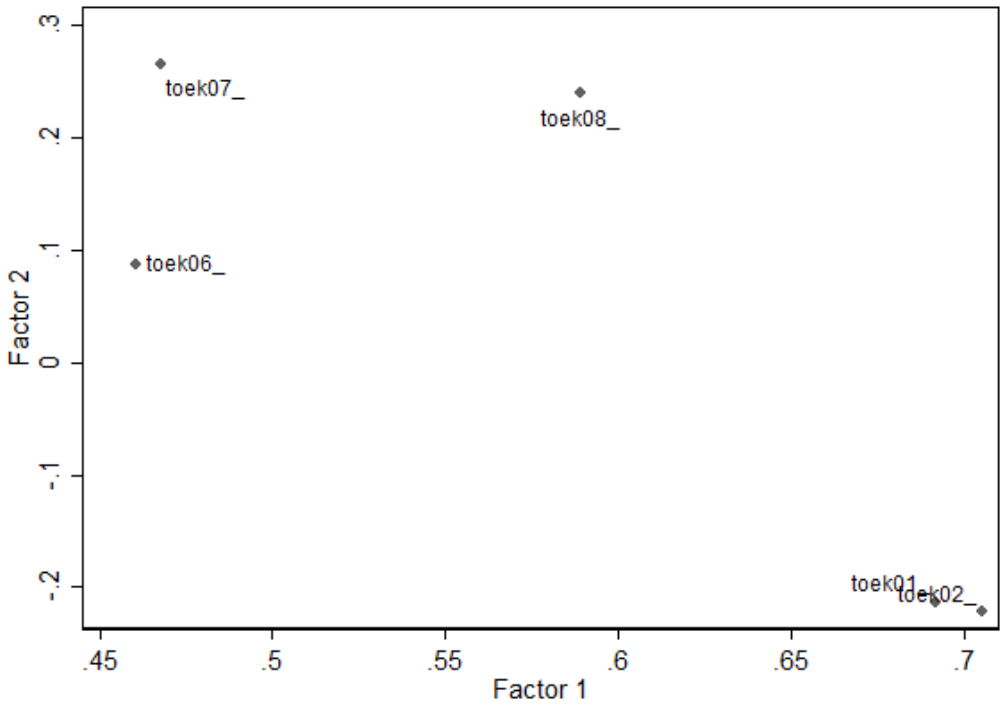

Figure 5: Factor loading plot for toek1, toek2, toek6, toek7 and toek8

6.2 Estimating an ordered logit with fixed effects

$$y_{it}^{*} = x_{it}^{'}\beta + \alpha_i + \varepsilon_{it}$$

describes a relationship between a latent variable y^* and explanatory variables $x^{'}$ when controlling for individual fixed effects, α_i. The variable y is observed and relates to y^* in such a way that

$$y_{it} = k \text{ if } \tau_k < y_{it}^{*} \leq \tau_{k+1}, \quad k = 1, ..., K$$

where $\tau_k < \tau_{k+1}$ $\forall k$ and the upper and lower bounds are infinity, i.e. $\tau_1 = -\infty$ and $\tau_{K+1} = \infty$. With ε_{it} assumed to be logistically distributed, the probability of individual i to report outcome k at time t is

$$\Pr(y_{it} = k|x_{it}, \alpha_i) = \Lambda(\tau_{i(k+1)} - x_{it}^{'}\beta - \alpha_i) - \Lambda(\tau_{ik} - x_{it}^{'}\beta - \alpha_i) \tag{5}$$

Estimating (5) with maximum likelihood imposes problems. To begin with, τ_{ik} is indistinguishable from α_i, making only $\alpha_{ik} = \tau_{ik} - \alpha_i$ identified and possible to estimate consistently when $T \to \infty$. However, when T is fixed and relatively small, even α_{ik} cannot be estimated consistently due to an incidental parameter problem. This contaminates onto the estimates of β, resulting in biased $\hat{\beta}$s. To solve the problem, collapsing y_{it} into a binary variable, d_i^k that takes on the value 1 when $y_{it} \geq k$ and maximizing the following conditional likelihood estimator proposed by Chamberlain (1980) yields a consistent estimator.

$$\log\mathcal{L}^k(b) = \sum_{i=1}^{N} \log \Pr\left(d_i^k = j_i \middle| \sum_{t=1}^{T} d_{it}^k = \sum_{t=1}^{T} a_i \right) \tag{6}$$

Still, there are some drawbacks to the Chamberlain estimator. First, all time-invariant elements, such as α_i and $\tau_{i,k+1}$ as well as time-invariant βs, are not estimated. Secondly, individuals that have a constant d_{it}^k are excluded and do not contribute to (6). Das and van Soest (1999) solved this problem by estimating β at all $K-1$ possible cutoff points (and hence including all individuals with some variation in y_{it}) and then weighting the resulting β^ks efficiently, using the inverse of their variances. This estimator is consistent, but has some small sample issues that result from an unprecise estimate of the variance matrix under certain conditions. A solution is to estimate all dichotomizations jointly subject to the restriction $\beta^k = \beta$, i.e. maximize

$$\log\mathcal{L}(b) = \sum_{k=2}^{K} \log\mathcal{L}^k(b). \tag{7}$$

This is the Blow-Up-and-Cluster (bucologit) estimator proposed in Baetschmann et al. (2015). The name comes from the fact that the observations are "blown up" in the sense that they are replaced by $K-1$ copies of themselves which then each are dictomized at a different cutoff point. The estimations are then clustered using the standard White sandwich estimator to allow for correlation within the same individual.

6.3 Additional figures and tables

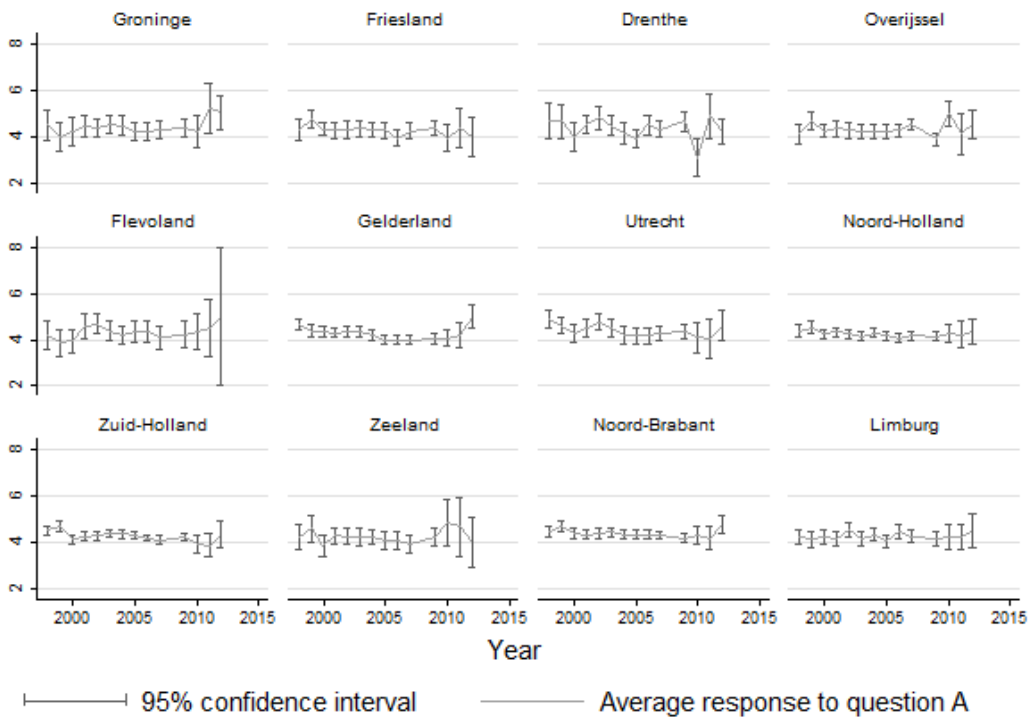

Figure 6: Average answer to question A for the 12 Dutch provinces with 95% confidence intervals

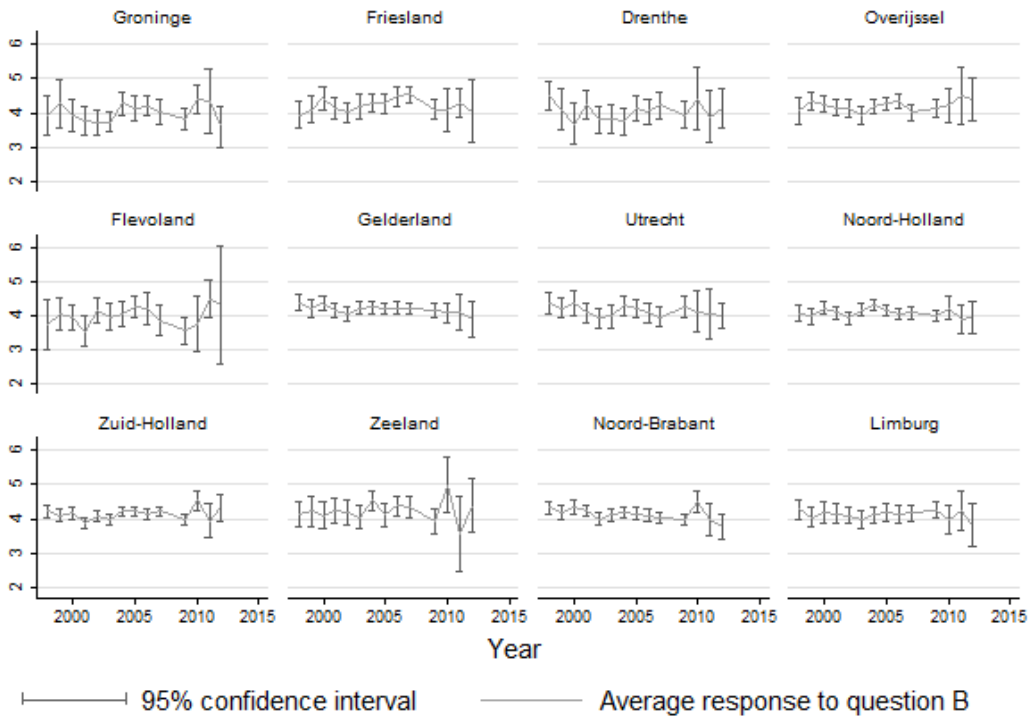

Figure 7: Average answer to question B for the 12 Dutch provinces with 95% confidence intervals

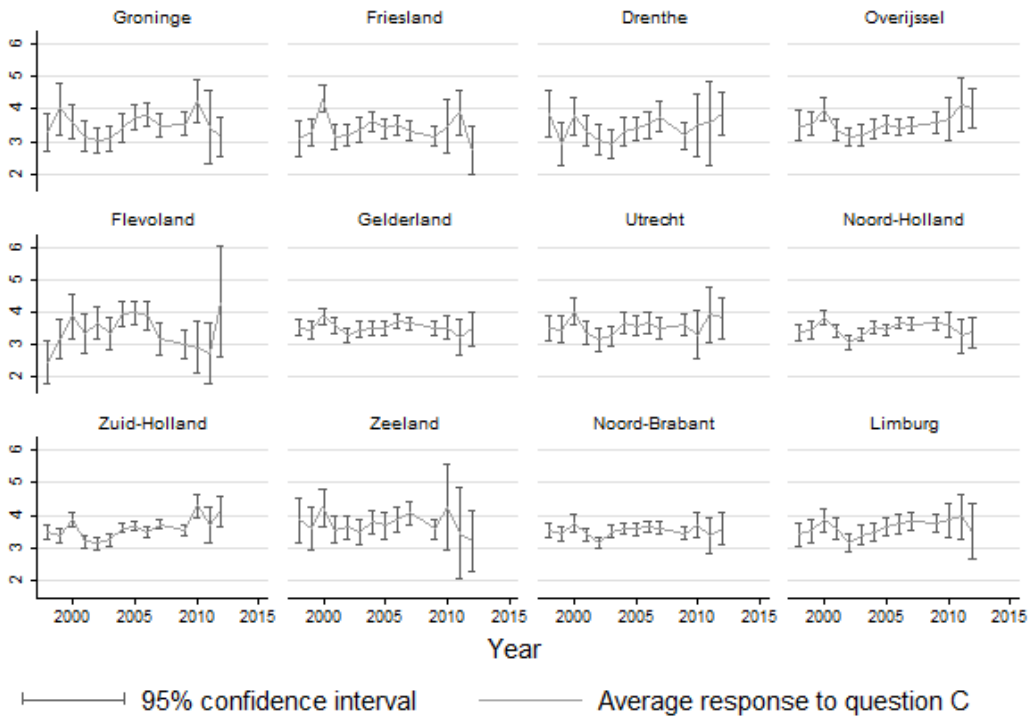

Figure 8: Average answer to question C for the 12 Dutch provinces with 95% confidence intervals

6.4 Few cluster bias

When the bootstrapped standard errors are clustered at the province level in the regressions in tables 8, 9 and 10, the relatively few number of clusters (12 provinces) can result in downward biased standard errors. A common method to correct for this bias is to use special bootstrap procedures to obtain the standard errors. Unfortunately these procedures seem to be available for linear models only. We therefore estimate model (3) for all three measures of subjective time preferences using a standard linear regression, ignoring the discrete nature of the dependent variable, with clustered standard errors and compare with the same regression with few-cluster robust bootstrapped standard errors.

Webb (2014) shows that the wild-cluster bootstrap method is especially effective in eliminating bias caused by few clusters. However, the wild cluster bootstrap is not de-

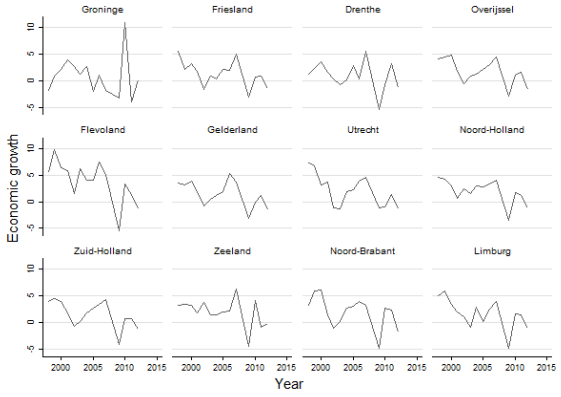

Figure 9: Economic growth at the province level for each of the 12 Dutch provinces

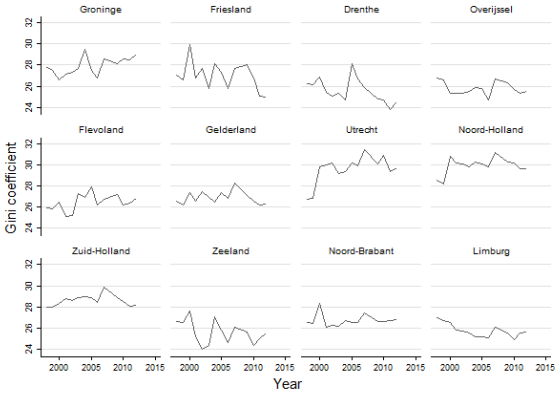

Figure 10: The Gini-coefficient for each of the 12 Dutch provinces

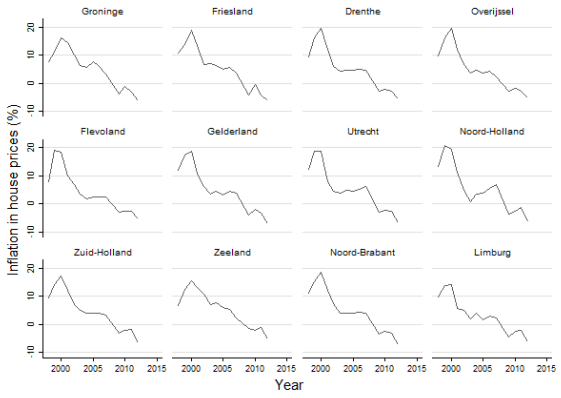

Figure 11: Inflation in house prices for each of the 12 Dutch provinces

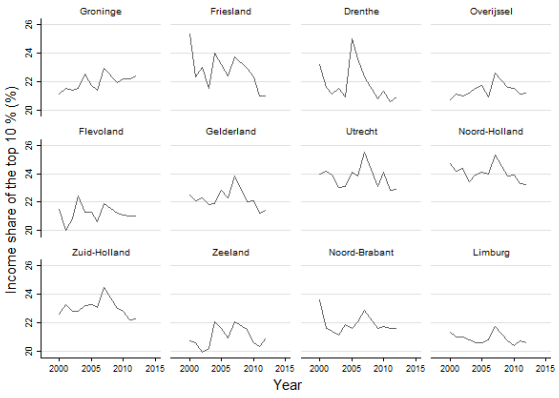

Figure 12: The income share of the richest 10% for each of the 12 Dutch provinces

signed for including fixed effect, which the pairs cluster bootstrap method allows. We therefore compare equation (3) estimated using a linear fixed effect regression with cluster robust standard errors and with the same estimation with pairs cluster bootstrapped standard errors. Given the superiority of the wild cluster bootstrap method over the pairs cluster bootstrap method, we also compare equation (3) estimated using standard OLS with cluster robust standard errors, ignoring both the discrete nature of the dependent variable and the individual fixed effect, with the same estimation with wild cluster bootstrapped standard errors.

Assuming that the bias resulting from inappropriately omitting both the discrete nature of the dependent variable and the panel structure of the data is independent of the few cluster bias, we can draw conclusions from the comparison of the two bootstrap methods with the corresponding cluster robust estimates of the standard errors.

In tables 11 to 14, the few cluster bias of (3) with the Gini coefficient as a measure of inequality and with the income share of the highest 10% as a measure of income inequality is studied using both the pairs cluster bootstrap and wild cluster bootstrap methods. From the tables, it is clear that with few exceptions there is little difference between the standard cluster robust standard errors and the pairs cluster and wild cluster bootstrapped errors, indicating that the relatively low number of provinces is not a problem in our estimations.

Table 11: Equation (3) estimated using linear fixed effect regression with standard errors clustered at the province level. Cluster robust p-values in upper parantheses. Pairs cluster bootstrapped p-values italized in lower parenthesis.

	QA	QB	QC
Gini	-0.025	-0.017	0.009
	(0.217)	(0.115)	(0.580)
	(0.27)	*(0.16)*	*(0.62)*
Growth	0.006	0.015	0.019
	(0.524)	(0.009)	(0.199)
	(0.58)	*(0.02)*	*(0.28)*
HPI	0.0005	-0.0003	0.019
	(0.954)	(0.919)	(0.002)
	(0.96)	*(0.92)*	*(0.00)*
Ind. fixed effects	Yes	Yes	Yes
No. obs.	17,192	17,192	17,192
No. individuals.	5,800	5,800	5,800

Table 12: Equation (3) estimated with Share of the richest 10% of the total income instead of the Gini coefficient as a measure of inequality using linear regression (without fixed effects) with standard errors clustered at the province level. Cluster robust p-values in upper parantheses. Pairs cluster bootstrapped p-values italized in lower parenthesis.

	QA	QB	QC
Income share of top 10%	0.005	-0.029	-0.013
	(0.837)	(0.028)	(0.597)
	(0.84)	*(0.06)*	*(0.62)*
Growth	0.009	0.018	0.019
	(0.427)	(0.020)	(0.253)
	(0.45)	*(0.07)*	*(0.36)*
HPI	-0.008	0.002	0.029
	(0.301)	(0.637)	(0.000)
	(0.42)	*(0.64)*	*(0.00)*
Ind. fixed effects	Yes	Yes	Yes
No. obs.	15,130	15,130	15,130
No. individuals.	4,997	4,997	4,997

Table 13: Equation (3) estimated using OLS. Cluster robust p-values in upper parantheses. Wild cluster bootstrapped p-values italized in lower parenthesis.

	QA	QB	QC
Gini	-0.016	-0.01	-0.002
	0.142	0.074	0.821
	(0.168)	*(0.068)*	*(0.784)*
Growth	-0.008	.0194	0.027
	0.328	0 .036	0.03
	(0.368)	*(0.042)*	*(0.044)*
HPI	0.002	0.001	0.013
	0.783	0.888	0.031
	(0.756)	*(0.756)*	*(0.004)*
Ind. fixed effects	No	No	No
No. observations	17,192	17,192	17,192

Table 14: Equation (3) with share of the richest 10% of the total income instead of the Gini coefficient as a measure of inequality using OLS. Cluster robust p-values in upper parantheses. Wild cluster bootstrapped p-values italized in lower parenthesis.

	QA	QB	QC
Income share of top 10%	-0.024	-0.007	-0.017
	(0.095)	(0.499)	(0.215)
	(0.144)	*(0.502)*	*(0.246)*
Growth	-0.009	0.021	0.033
	(0.324)	(0.036)	(0.014)
	(0.284)	*(0.046)*	*(0.012)*
HPI	-0.0007	0.007	0.022
	(0.921)	(0.266)	(0.013)
	(0.89)	*(0.302)*	*(0.004)*
Ind. fixed effects	No	No	No
No. observations	15,130	15,130	15,130