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Cognitive Constraints and Economic Incentives*

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Abstract

Unique administrative data on a representative population's cognitive abilities, spending, and financials reveal that consumers at or below median cognitive abilities barely react when their incentives to spend or borrow change, even if they earn high incomes and are financially unconstrained and conditional on formal education, personal and macroeconomic expectations, and rich demographics. Matched survey-based data on this population show that non-responsive consumers fail to grasp how the incentives to consume, save, and borrow change over time. Cognitive constraints limit the effectiveness of policies targeting household consumption and debt and might lead to regressive redistribution from low- to high-cognitive-ability consumers.

JEL classification: D12, D91, E21, E52, G41, G51.

Keywords: Behavioral Economics, Limited Cognition, Consumption, Borrowing, Heterogeneous Agents, Redistribution, Inequality.

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I Introduction

This paper uses matched registry- and survey-based data for a representative population to test in the field whether cognitive constraints limit consumers' understanding of economic incentives and how incentives vary over time, thus leading to suboptimal choices at the individual level and limited policy transmission at the aggregate level. This test is motivated by the fact that cognitive abilities (which we label "IQ" for simplicity) shape agents' capacity to acquire and process economic information and to derive optimal choices and plans (Shue and Luttmer, 2009; Grinblatt et al., 2011; Agarwal and Mazumder, 2013; Zinman, 2015; Brown et al., 2017; Stango and Zinman, 2022; Enke and Graeber, 2021; Ramey, 2021; Ilut and Valchev, 2022; D'Acunto et al., 2021).[1]

We find that financially unconstrained and high-income consumers at or below the population's median IQ barely pull forward durable purchases when government subsidies incentivize them to do so. We also detect limited reactions by the same unconstrained consumers around policy-rate changes, which modify the incentives to take up new loans and repay existing debt. Our survey data provide direct evidence of a demand-side channel, whereby only high-IQ consumers display a basic understanding of what drives their economic incentives to consume, save, and borrow. Cognitive constraints thus limit the effectiveness of policies that target households (Agarwal et al., 2017; Roth and Wohlfart, 2020; D'Acunto et al., 2021; Andre et al., 2019; Pfäuti et al., 2023)) above and beyond the role of more commonly studied financial frictions (Foà, Gambacorta, Guiso, and Mistrulli, 2019).[2]

Our data allow us to disentangle the role of IQ from that of formal education and other determinants of income, consumption, and wealth, including both observables and elicited personal and aggregate expectations (Agarwal et al., 2009). For a large representative sample of Finnish men, we match at the individual level—to the best of our knowledge for the first time—administrative data on cognitive abilities and detailed demographics with outstanding debt balances, interest paid on debt, durable goods ownership and purchases from registry data as well as survey-based data on economic expectations, consumption, and borrowing plans

[1] In earlier research, D'Acunto et al. (2021) find cognitive abilities relate to how agents form and update inflation expectations in surveys. In this paper, instead, we exploit novel and rich registry-based administrative data to assess the economic relevance of cognitive abilities for actual field choices and the channels through which limited cognition leads to consumers' inaction.

[2] See also Kermani (2012), Di Maggio et al. (2017), Kaplan et al. (2018), and others.

(Fagereng, Guiso, Malacrino, and Pistaferri, 2020).[3] Observing survey-based individual plans as well as the ex-post field choices of the same agents allows us to disentangle directly supply- and demand-side drivers of individuals' choices.

We first consider consumers' incentives to move spending intertemporally by focusing on a standard measure of fiscal policy—a car scrappage scheme whereby the government provides a subsidy to consumers who trade in an old car and replace it with a newer model (Mian and Sufi (2012); Green et al. (2020)). Being aware of the program, understanding its functioning, searching for alternative options, collecting several pieces of information from various sources, comparing prices, and complying with many bureaucratic steps required to apply and obtain the subsidy might vary systematically across consumers (Grubb (2015)). And, indeed, conditional on owning an eligible old car, consumers above the median of the IQ distribution are twice as likely to participate in the program relative to others in both the raw data (see Panel A of Figure 1 below) and after controlling for income, education, assets, financial liquidity, a broad set of demographics, as well as personal and aggregate expectations that might influence agents' willingness to substitute durable purchases intertemporally.[4]

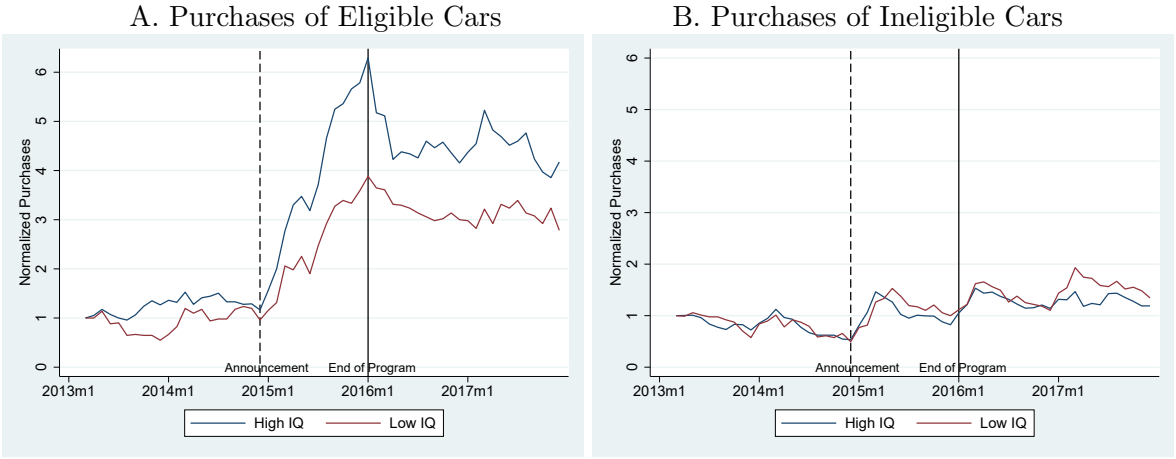
To interpret the baseline results, we first show that they hold among financially unconstrained and high-income consumers who owned an eligible old car and hence could have participated in the program if they wanted. As a falsification test, we show that purchases of non-car vehicles and cars that did not qualify for the program did not differ by IQ during the policy period (see Panel B of Figure 1), which dismisses a role for potentially unobserved time-varying shocks that affected high- and low-IQ consumers differently, including those that might have motivated the program's implementation (e.g., see Kermani (2012); Ramey and Zubairy (2016)).

Our baseline results dismiss a relevant role for several supply-side forces, such as exposure to different car dealers or differential access to bank credit by IQ. To investigate the scope for a demand-side channel, we exploit survey-based data on plans and hypothetical assessments of whether it is a good time for the average Finnish consumer to purchase cars, which were elicited both before and after the program's announcement. We find that, after the announcement, plans and assessments barely changed for agents with median and lower IQ, perhaps because

[3] As we discuss below, the sample only includes men because the individual-level administrative data on cognitive abilities come from the records of mandatory military service, which was only compulsory for men during our sample period.

[4] The results obtain also within residential areas that are served by the same car dealers, who are likely to provide the same information about the scheme to all the consumers with whom they interact.

Figure 1: **Car Purchases by Clunker Owners Around Government Program, by IQ**



Panel A plots the number of cars eligible for the cash-for-clunker scheme purchased over time (normalized by the number of purchases in the first observed month—March 2013) by Finnish men with standardized IQ scores between 6 and 9 (High IQ) and between 1 and 5 (Low IQ). The sample only includes Finnish men who owned a clunker at the announcement of the program (end of December 2014). Panel B plots the number of non-eligible cars purchased by men in the same conditions. The vertical lines represent the announcement (December 2014) and end of the program (December 2015). We use the universe of car registrations in Finland to calculate these statistics and define clunkers based on the program criteria on age and emissions. To address seasonality in car sales, we plot a trailing three-months moving average. The sample period is from January 2013 to December 2017.

they were unaware of the policy and/or did not understand its functioning. By contrast, high-IQ consumers changed their assessments in line with the policy intervention and hence displayed awareness and understanding of how the policy affected a representative consumer's economic incentives.

In the second part of the paper, we study consumers' reactions when their incentives to borrow change (Fagereng et al., 2021). Households have a higher incentive to borrow to finance their durable consumption, ceteris paribus, when policy rates decline and vice versa (e.g., see Di Maggio et al. (2017)). Our sample period includes (endogenous) changes in policy rates in both directions. We find that men above the median by IQ are substantially more likely to adjust their outstanding debt balances to changes in interest rates relative to others. High-IQ men are also more likely to take out new loans when policy rates drop and to pay down existing loans when interest rates increase, and all these results are conditional on the rich demographics and direct measures of liquidity, wealth, and income we observe.

Either supply- or demand-side channels could drive individuals' heterogeneous reactions to the same change in policy rates. On the supply side, financial intermediaries might pass through rate changes differently to agents with different IQ levels. We find that the pass-through of policy rates is virtually identical across the IQ distribution in our setting. Household leverage ratios

by IQ are also rather flat,[5] which dismisses that low-IQ men have no scope to react because they cannot/do not borrow.

Turning to the demand side, we consider agents' views about borrowing from our survey data. High-IQ men are more likely to state that it is a good time to borrow for a representative consumer when policy rates fall and the opposite when rates rise. By contrast, lower-IQ men's assessment of the viability of borrowing barely varies around policy-rate changes, irrespective of their direction. Heterogeneous preferences by IQ could in principle motivate a demand channel above and beyond agents' understanding of incentives. For instance, Dohmen et al. (2010) and Falk et al. (2018) show that agents with lower cognitive abilities are less risk tolerant and more impatient (but see also Guiso and Paiella (2008)). Preference heterogeneity is an unlikely explanation for our findings for a set of reasons. On the one hand, the higher impatience of below-median-IQ consumers predicts a higher propensity to take out loans, all else equal, which is the opposite of what we find. On the other hand, we find similar results for policy-rate increases and decreases, whereas risk preferences should matter more for the take up of new debt relative to the repayment of existing debt unless it is paired with strong precautionary-savings motives. And, we find the same patterns in actual choices as well as survey-based assessments that ask respondents to think in terms of a representative consumer rather than based on own preferences and beliefs.

Because individuals at and below median IQ earn about 49% of aggregate household income in our sample, their limited reaction to policies is likely to have sizable aggregate implications. This group's muted response can be an important human friction to explain the limited effectiveness of interventions implemented under the assumption that most financially-unconstrained households would react.

We conclude the paper by assessing qualitatively the implications of our empirical results for theories of intertemporal consumption optimization and especially recent models that feature agents with limited cognition and information frictions, such as sticky and noisy information, bounded rationality, and consumption commitments.

Our results suggest a potentially unintended redistributive role of economic policies from consumers with lower IQ to consumers with higher IQ (Agarwal et al. (2017); Andersen et al. (2020)). These potential redistributive effects call for the design of simple policies and more targeted communication to reach all agents in the economy and clarify how policy-makers think

[5]We define household leverage ratios as outstanding household debt over income.

their actions should affect consumers' incentives and choices (e.g., see Ramey (2021), D'Acunto, Hoang, and Weber (2021), Bachmann, Born, Goldfayn-Frank, Kocharkov, Luetticke, and Weber (Bachmann et al.), D'Acunto, Hoang, Paloviita, and Weber (2020); D'Acunto, Fuster, and Weber (2021)). Robo-advising and AI-based tools that reach consumers on their personal devices in real time might be a viable direction to make these efforts effective (D'Acunto and Rossi (2021, 2023)).

II Data and Summary Statistics

In this section, we describe the data sources that allow us to assess the relationship between cognitive abilities and the reaction to macroeconomic policies at the consumer level.

A. Cognitive Abilities

We access individual-level information on IQ for the quasi-universe of Finnish men through the Finnish Defence Forces, FDF (see Grinblatt et al. (2011, 2016) for earlier papers that have used these Finnish IQ data). Finland has general conscription for men—all men between the ages of 18 and 60 are liable for military or non-military service.[6] Within the first weeks of military service, Finnish men participate in a series of tests, including cognitive-ability tests, whose results the FDF uses to select candidates for officer training. Ranking high in these tests provides access to high-quality training and to elite social networks, which is an incentive to perform as well as possible. We have test results for all participants from January 1, 1982 until September 30, 2015.

The cognitive-ability section consists of 120 questions that assess three areas—mathematical, verbal, and visuospatial cognitive skills. The questions assess respondents' ability to use information and inputs provided externally and logic to solve problems across each of the three areas. This assessment fits into the scope of our empirical exercise, which aims to isolate a proxy for agents' ability to use information about economic variables and policies they might obtain from the media and other sources as well as logic to make predictions and optimize their economic choices even if they do not have formal education in economics.

To construct an individual-level measure, for each section of the test, the FDF creates

[6]The share of men who do non-military service is only about 3% of all men who start military service. Please see https://puolustusvoimat.fi/en/conscription for these and additional details.

a score based on the number of correct answers. The FDF then aggregates the scores into a composite measure of cognitive abilities, which, for simplicity, we label "IQ." In a last step, to ensure comparability of the IQ measure across cohorts and avoid the so-called "Flynn effect"—the trend of increasing fluid and crystallized intelligence test scores detected over the last few decades across several populations around the world—the FDF standardizes IQ within cohorts. Specifically, it standardizes IQ to follow a stanine distribution within each cohort. Stanine (STAndard NINE) is a method of scaling test scores on a 9-point standard scale with a mean of 5 and a standard deviation of 2. The respondents with the lowest 4% of test scores are at least 1.75 standard deviations from the mean and are assigned a standardized IQ of 1 and the 4% with the highest test scores are assigned a standardized IQ of 9. The final measure of IQ we use thus obtains values from 1 to 9 and the middle values are attributed to a larger portion of the population than the extreme values.

As earlier research shows (e.g., Grinblatt et al. (2011)), in Finland IQ is unlikely to proxy for differences in cultural or environmental factors that individuals can manipulate, because the country is ethnically and culturally homogeneous. Moreover, because longer education is likely to impact cognitive abilities (e.g., see Ritchie and Tucker-Drob (2018) for a recent meta-analysis), settings in which education is costly and hence parental wealth affects offsprings' education levels would confound the role of these demographics and IQ. In Finland, all levels of education, including college education, are virtually free to access and students receive government subsidies to defray the costs of living during college. Paired with the rich set of individual-level demographic information from registry-based administrative data we can observe in this setting, and hence which we can keep constant in all our multivariate analyses, Finland thus constitutes a desirable laboratory to isolate the role of cognitive abilities in economic decision-making from other demographic characteristics.

Although the number of years of formal education might increase cognitive abilities, substantial variation in IQ exists even among individuals who have the *same* levels of education. This feature should not appear surprising: within a national cohort of students who obtain a college degree in the same year from any institution—all of whom are registered as having college education—the distributions of grades and abilities vary substantially and so much so that these characteristics even vary among students who take the same exact class in the same institution and same semester, as any college instructor experiences regularly. Moreover, IQ captures abilities that in some cases might be higher for agents who have lower levels of formal

education, for instance because they dropped out college to start their own business.

Regarding the correlation between IQ and income in the Finnish setting, D'Acunto et al. (2021) show it is positive but not high (15%), which suggests that access to high-paying jobs is not restricted to the top of the distribution by IQ. In all our analyses, we keep formal levels of education and individual income levels constant to ensure that our individual-level IQ measure captures variation in cognitive abilities above and beyond the effects of exposure to formal education and other unobserved innate characteristics that might predict agents' earnings over time.

B. Income, Debt, and Wealth

For the quasi-universe of Finnish men for whom we have data on cognitive abilities, we have also obtained access to administrative registry data on income, asset holdings, debt levels, and interest paid on outstanding debt at the end of each calendar year. These data are collected for tax purposes by the Finnish national statistical agency (Statistics Finland) from underlying sources across various agencies, which include, the Finnish Tax Administration (Vero), the National Institute for Health and Welfare (THL), the Social Insurance Institution of Finland (Kela) as well as other administrative registers maintained by Statistics Finland.

These administrative data contain information on individuals' labor and business incomes, received and paid income transfers, as well as overall household liabilities, which are split by types: mortgage debt, education-related debt, and total debt. For each category of debt, we observe the total amount outstanding at the end of the year as well as the total amount of interest paid throughout the year.

C. Durables: Ownership and Purchases

In terms of data on durable spending, we focus on vehicle ownership and purchases to assess the effects of the Finnish car scrappage scheme. We access administrative data on car purchases at the monthly level and the stock of cars owned by Finnish residents at the end of each fiscal year from the Vehicle Traffic Register managed by the Transport and Communications Agency (Traficom).

The vehicle data contain individual-level ownership registries covering car purchases and the stock of all outstanding cars in Finland as well as car characteristics, such as the date of

first registration, the vehicle category, and the level of CO2 emission. These data allow us to identify eligible new cars purchased and clunkers at the individual level and hence to assess which consumers could have participated in the scrappage program if they wanted. We also observe whether car purchasers received the scrappage bonus, that is, whether they took part in the program conditional on purchasing an eligible car.

D. Borrowing and Spending Plans & Economic Expectations

Our fourth source of data provides information on borrowing and consumption plans as well as a large set of personal and macroeconomic expectations from the micro data underlying the Consumer Climate Survey of Statistics Finland. Statistics Finland conducts the survey on behalf of the Directorate General for Economic and Financial Affairs of the European Commission (EC) as part of the EC's harmonized consumer survey program. We obtained access to the micro data underlying the survey for the period starting in January 2001 and ending in March 2015.

Every month, Statistics Finland asks a representative repeated cross section of approximately 1,500 Finns questions about general and personal economic conditions, macroeconomic expectations, plans to save and borrow, and their willingness to purchase different types of consumption goods.[7]

We use the answers to the following question to capture agents' assessment of the state-contingent incentives to spend on durable goods like cars for the average Finnish household (note that the questions are asked in Finnish. We report unofficial English translations for simplicity):

Question 1 *Given the current economic situation in Finland, do you think that now is the right time for people to purchase a car?*

Agents can choose between the following answers: "It is neither the right nor wrong time," "No, it is not the right time," or "Yes, it is the right time." We use similar questions to track the assessment of the incentives to purchase non-car vehicles and other durable goods.

The following question instead allows us to capture individuals' views about the state-contingent incentives to borrow:

[7]The samples are drawn from the total population of 4.4 million individuals and 2.6 million households residing in Finland. The survey is run through phone interviews. In advance of the phone interview, Statistics Finland notifies all target individuals with a letter that contains information about the contents and logistics of the survey.

Question 2 *Given the current general economic situation in Finland, do you think that ...*

Here, the possible answers inculde: "It is a very bad time to borrow," "It is a somewhat bad time to borrow," "It is a somewhat good time to borrow," or "It is a very good time to borrow."

In addition, we use questions regarding expectations about the personal and aggregate economic outlook as well as a rich set of socio-demographics from the Statistics Finland survey, which include gender, age, marital status, household size, income, employment status, number of children, region of residence, and education levels.

E. Descriptive Statistics

We provide descriptive statistics for the registry and survey data in Table 1. The median annual income is EUR 21,000 and the median respondent is 30 years old. 61% of respondents are single, 6% are unemployed, 78% have children, 34% have a college degree, about a third live in urban areas and in particular 28% live in Helsinki—the capital region. On average, 51% of respondents think it is a good time to buy durables, 20% think it is a bad time, and the other respondents think it is neither a good nor a bad time.

We then describe the characteristics of the sample of car purchasers during the Finnish car scrappage program (*ROPA*) period, for all car purchasers as well as separately based on whether the purchase was through the program. Table 2 shows that the share of individuals with IQ above 5 is similar across both samples, as is the average age and the share of urban and single men. We do not find large differences in education or number of children either. Men who purchased cars but did not participate in the ROPA scheme have higher average income and more outstanding debt than others. This difference might arise if, for instance, high-income individuals were more likely to purchase larger cars that have CO2 emissions above the limit to qualify for the ROPA program.

The last set of registry-based variables we describe relate to personal financial situations, which we use to capture the possibility that individuals face financial constraints. Table A.1 reports the average household leverage ratio by IQ bins in Panel A and the share of aggregate income by IQ bins in Panel B. Panel A of Table A.1 shows little variation in household leverage ratios by IQ. Low-IQ men display a ratio of 82%, which is slightly higher than the ratio for all other bins up to a normalized IQ of 7. High-IQ me have slightly higher leverage ratios (0.93). In Panel B, we see the share of income that accrues to the individual bins. Later in our empirical

analysis, we will often split the sample into low and high IQ, with the latter defined as having a normalized IQ of 6 or higher. Note this implies low-IQ men make up 49.2% of total income and are therefore a large share of aggregate income in the economy.

III IQ and Incentives to Spend

We start our analysis by studying consumers' reaction to changing incentives to intertemporally substitute their durable spending. We consider a traditional form of fiscal policy that changes such incentives—a government subsidy that is provided, for a limited and pre-announced period, to consumers who trade in an old car (*clunker*) and purchase a new car. Governments typically impose conditions on the characteristics of car models that can be traded in and of those that can be purchased to receive the subsidy.

Although the effects of such program on economic incentives might seem obvious, awareness of the program, understanding of its functioning, and the ability to navigate through the bureaucratic steps required to claim the bonus might vary systematically by cognitive abilities. For instance, in order to obtain the subsidy, Finns who were informed about the program through the media, car dealers, or other sources, needed to verify that the car was registered under the name of the person who asked for the subsidy; organize the scrapping procedure through a facility registered with the government; fill and issue a "Certificate of Destruction" form (we provide a sample form in the Online Appendix) to multiple governmental agencies; and, obtain a statement issued by the party in charge of scrapping the vehicle, among other steps.

Our program of interest, called ROPA, was announced by the Finnish agency Traficom in December 2014 and ran until December 2015. ROPA was the first car scrappage scheme ever implemented in Finland. The program consisted of a EUR 1,500 subsidy for cars older than ten years registered in Finland at the time of the purchase with carbon dioxide (CO2) emissions above 120 grams per kilometer that were traded in for the purchase of a new car with CO2 emissions below the same threshold.[8] The program was discussed on Finnish traditional and social media channels.

Because of these eligibility criteria, not all new cars that were purchased during the ROPA

[8]Traficom estimated that about 60% of the new car sales during the program period would have not happened absent the program. These figures and estimates are self-reported by the Traficom agency, which designed and oversaw the program. We do not have access to independent data to assess these figures.

period qualified for the program: only consumers who owned an eligible clunker could participate and our data, which cover the car ownership and transactions register for the universe of the Finnish population, allow us to observe who owned an eligible clunker at the time of the program. In Figure 2, we plot the raw-data distribution of car ownership and clunker ownership as of December 2014. Two stylized facts emerge. First, car ownership is rather homogeneous across the distribution of IQ (Panel A): the ratio of men in each of the 9 IQ categories who owned a car at the onset of the program varied between 75% and 80% and we detect no obvious patterns across the IQ distribution. We then compute the average fraction of men in each IQ group who at the onset of the program owned a car that qualified as a clunker under ROPA (Panel B). Here, we detect a clear monotonic pattern by IQ: men in lower IQ groups were systematically *more* likely to own a qualifying clunker than higher-IQ men. Lower-IQ men were more likely to own old and/or higher-emission cars because of taste, financial ability to purchase new cars, or other reasons, which underscores the importance of observing and controlling for detailed information on individuals' income, debt, debt capacity, and other demographics in our multivariate analysis. It also compels us to propose an analysis of the take-up of the program among consumers who purchased eligible cars, and hence whose taste for low emission cars is the same based on revealed preferences. Otherwise, one might worry that perhaps low-IQ men have no taste for low-emission cars and for this reason do not take part in the program.

The raw data (Panel B of Figure 2) also show that the share of lower-IQ men who had a scope to participate in the program was higher than the corresponding share of high-IQ men. By contrast, the raw data on participation document the opposite pattern: when we limit the sample to men who purchased a car during the ROPA period in Panel C, only about 10% of men in the lower-IQ bins purchased an eligible car and asked for the subsidy, whereas more than 40% of those with the highest IQ levels did. Even in this case, keeping constant income levels, the likelihood of binding financial constraints, debt capacity, and other demographics in our multivariate analysis will be crucial to dismiss that this raw-data result is driven by the fact that low-IQ men cannot purchase cars during the program even if they wanted.

Before moving to the multivariate analysis, another raw-data fact is worth highlighting: the right graph in Figure 1 in the Introduction shows that no differences in purchases of cars ineligible for the ROPA program arose during the ROPA period by IQ. This fact excludes that differential economic shocks by IQ might explain the differential purchasing propensity for

eligible cars.[9]

A. Eligible Consumers' Reactions by IQ

Although relevant for motivational purposes, the raw-data evidence in Figure 1 might be explained by characteristics that correlate with cognitive abilities and predict a differential uptake of the program. For instance, low-IQ men might have a distaste for low-emission cars and for this reason do not purchase them despite the economic incentive provided by the subsidy. Or, characteristics that vary systematically with IQ, such as income and the binding of financial constraints, might explain these patterns. In the rest of this section, we propose a set of multivariate cross-sectional and panel-level analyses, falsification tests, and direct survey-based evidence on consumers' understanding of economic incentives to corroborate our interpretation that cognitive abilities help explain the raw differential reactions to changes in economic incentives.

Our first multivariate analysis is purely cross-sectional and focuses on the subsample of Finnish men who purchased an eligible car during the ROPA period. The aim of this test is to exclude that potential systematic differences in the demand for eligible cars across levels of IQ drive any results. For instance, if low-IQ men were more likely to not believe in climate change or were against environmentally-friendly policies, they might be less willing to purchase an eligible car irrespective of the ROPA program. The following analysis dismisses this type of concern, because the sample of men who purchased an eligible car excludes those who dislike environmentally-friendly cars enough to not participate in the program.

We estimate the following linear specification:

$$ROPA_i = \alpha + \beta High\ IQ_i \times Clunker_i + \zeta High\ IQ_i + \gamma Clunker_i + X_i'\delta + \eta_s + \epsilon_i, \quad (1)$$

where $ROPA_i$ is a dummy that equals 1 if eligible-car purchaser i participated in the ROPA program, that is, traded in a clunker and received the subsidy, and zero if he purchased an eligible car without participating in the scheme; $Clunker_i$ is a dummy that equals 1 if individual i owned an eligible clunker in December 2014—just before the announcement of the ROPA scheme; $High\ IQ$ is a dummy that equals 1 for men who have a standardized value of IQ between 6

[9]As an aside, this evidence also shows that the ROPA program did not crowd out non-eligible car sales.

and 9, and zero otherwise. Pre-announcement demographic controls as of December 2014 (X_i) include age, age^2, marital status, the logarithm of annual income, employment status, number of children, urban versus rural residence, a college-degree dummy, and a dummy that equals 1 if the respondent lives in the capital region, Helsinki; η_s is a full set of district fixed effects. Districts are the finest administrative partitions in the EU classification (NUTS 3) and constitute 19 areas in Finland. They are the equivalent of US counties. For consistency with the subsequent analyses that include a time component, we cluster standard errors at the individual level, which in this cross-sectional specification is equivalent to estimating Huber-White standard errors.[10]

Columns (1) to (3) of Table 3 report the coefficient estimates. The raw data (column (1)) reveal that about 25% of those who purchased an eligible car during the ROPA period owned a clunker as of December 2014, but this share is 5.5 percentage-point (pp) higher, that is, more than 20% higher, for men with above-median IQ. This difference is sizable also because the unconditional likelihood of purchasing an eligible car using the ROPA scheme equals 23.68%. Note also that men at the top of the IQ distribution were slightly more likely (2.8 pp) to purchase an eligible car using the ROPA scheme even if they did not own an eligible clunker as of December 2014. This sample includes, for instance, individuals who acquired a car that qualified as a clunker after December 2014 and traded it in for an eligible new car by December 2015, which unfortunately we do not observe directly because we only have end-of-year snapshots of the car ownership data. When we add demographic controls (column (2)) and restrict the variation within districts (column (3)), the sizes and statistical significance of the coefficient estimates barely change.

A.1 IQ or Financial Constraints?

Consumers can participate in the ROPA program only if they have sufficient financial resources or debt capacity to finance the remainder of the cost of the new car. Financially-constrained consumers might be unable to purchase a car even if they understand how the program affects their incentives, which could explain our results if low-IQ men were more likely to be financially constrained than others.

We dismiss that differential exposure to financial constraints explains our results in three

[10]Table A.2 in the Online Appendix shows that statistical inference is similar when we cluster standard errors at the municipality level to allow for correlation in the residuals at the local level. In fact, standard error estimates are less conservative when clustering at the municipality level relative to the specification in the main text.

ways. In this subsection, we repeat our baseline analysis within subsamples of Finnish men who are likely unconstrained; later, we propose falsification tests that consider the purchase of non-eligible cars during the ROPA scheme period, for which financial constraints would matter, too. We then study survey-based assessments of whether it is a good time for representative consumers to purchase a car before and during the ROPA period, irrespective of personally binding financial constraints and shocks respondents might face when answering.

We start with the subsample analysis based on financial constraints. Panel A of Table 4 focuses on the subsample of Finnish men who are unlikely to be constrained. We propose two proxies for binding financial constraints. First, we split the sample based on debt-to-income ratios at the end of 2019. The rationale for this proxy is that men who have a high debt-to-income ratio might find it harder to finance the purchase of a new car, even after factoring in the subsidy, whereas those who have a low debt-to-income ratio could obtain a car loan more easily. In principle, men with low debt-to-income ratios might be completely shut off lending markets and for this reason have no debt outstanding even if this possibility is inconsistent with our summary statistics. In columns (1) to (3) of Panel A, we estimate equation (1) only for men whose debt-to-income ratio is below the median of the overall population.[11] We estimate coefficients that are similar in terms of size and statistical significance to those in the baseline analysis of Table 3.

We then consider splits by income levels. Intuitively, higher-income consumers might be less likely to face financial constraints, although this proxy misclassifies high-income households who have large amounts of debt outstanding and lower-income households without debt. Another caveat is that, by construction, car purchasers are more represented among higher-income consumers than lower income ones. By splitting the sample above and below the median by income in the population, the subsample of below-median consumers who purchase a car will be smaller than its above-median counterpart. Keeping these caveats in mind, columns (4) to (6) of Panel A show that the difference in the likelihood that high-IQ and low-IQ men participate to the ROPA program is large and statistically significant in the subsample of unconstrained high- and low-IQ men.

After having dismissed that the differential participation in the government program is due to systematic differences in financial constraints across the IQ distribution, we turn to

[11] Because the split is based on median of the overall population, the two subsamples do not have the same size.

considering the remaining subsample of financially-constrained men—those below the median of debt-to-income and of income levels. The subsidy is relatively more valuable for constrained men of any IQ levels relative to their unconstrained counterparts, because absent the subsidy, they might be unable to purchase a car. Consistent with this conjecture, Panel B of Table 4 reveals that (i) constrained low-IQ men are more likely to participate in the program relative to unconstrained low-IQ men, as captured by the higher estimate for the *Clunker* dummy in all columns of Panel B relative to those of Panel A; and, (ii) this higher participation by constrained low-IQ men reduces the difference in participation relative to high-IQ men—so much so that the coefficient on the interaction with IQ is small and statistically insignificant. Because the subsamples of car purchasers who are financially constrained is small, the lack of statistical significance for the estimate on the interaction term might be due to a lack of statistical power, which is a relevant caveat in interpreting these results. At the same time, these results seem consistent with the possibility that once the relative benefit of the subsidy is high, as it is for financially-constrained agents, even cognitively-constrained agents, who find it costlier to participate in the program, are more willing to pay the participation costs.

B. Intertemporal Substitution Around Change in Incentives

The second multivariate analysis we propose assesses the role of cognitive constraints in intertemporal substitution of durable spending using within-individual variation in incentives.

Note that we do not have a clear prediction about the level of spending on eligible cars *after* the end of the program. On the one hand, car purchases might drop after the program, because agents who would have bought a car after the program period anticipated their purchase. By contrast, if the program was successful, the income of some agents in the economy, such as workers in the car sector, would have increased during the program period. These individuals might have been unable to purchase a car during the program, but might do so after the program due to this positive income effect even if the subsidy is not available anymore.[12] More relevant anecdotally is the fact that the program increases awareness of the properties of low-emission cars, which are targeted by the program, and hence might increase the overall relative demand for such cars even after the end of the program. These arguments are consistent with the evidence we observe in Figure 1 in the Introduction, in which the levels of purchases of low-emission cars

[12]Note that this is the mechanism through which cash-for-clunkers subsidy programs are theorized to jump start the economy from a slump.

dropped after the end of the program but stayed higher than before the program was announced for both high- and low-IQ consumers.

We construct an individual-month panel that includes all consumers in our sample rather than only those who purchased eligible cars. The sample period is from July 2014 to January 2016. We estimate OLS specifications of the following form:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_s + \eta_i + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where $Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car in month t; $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero before the ROPA program was announced (i.e., July 2014 to January 2015); η_t is a full set of year-month fixed effects; η_s is a full set of district fixed effects; η_i is a full set of individual fixed effects. We cluster standard errors at the individual level.

Table 5 reports the results. The unconditional likelihood that any individual in the population purchases an eligible car in any given month is low (0.32% outside the ROPA period), which is not surprising because most households purchase a new car only once every few years.

Several coefficients are of interest to our analysis. First, across the IQ distribution, those who own a clunker are less likely to purchase a new eligible car outside the ROPA period. If anything, high-IQ men are less likely to purchase eligible cars outside the ROPA period if they already own a clunker, as we can see by comparing the estimated coefficients attached to the variables $Clunker$ and $High\ IQ \times Clunker$. High-IQ men who own clunkers are thus not more likely to purchase eligible cars than other men in normal times, ceteris paribus, which reduces the concern that low-IQ men might have a systematically lower taste for low-emission cars.

Moreover, Table 5 shows that high-IQ individuals are more likely to participate in the ROPA program if they own a clunker—a result that aligns with the cross-sectional evidence in the previous section. In column (1), for instance, agents at or below median IQ who owned a clunker before ROPA are about 50% more likely to purchase an eligible car during the ROPA period relative to other times ($Clunker \times ROPA$), but the size of this effect more than doubles for high-IQ men (sum of $High\ IQ \times Clunker \times ROPA$ and $Clunker \times ROPA$). The difference in

the reactions by the two groups are similar once we absorb individual-level observables: High-IQ men who own a clunker are almost twice as likely to purchase eligible cars during the ROPA period than other clunker owners (columns (2)-(3)).

Column (4) only exploits within-individual variation over time by adding a full set of individual fixed effects, which we can do in this sample that includes several monthly observations for the same individual over time. This specification dismisses a potential role for time-invariant unobserved determinants of the timing of eligible-car purchases. And, again, we find that high-IQ men are more likely than others to purchase eligible cars during the ROPA period if they own a clunker relative to when the program is inactive.

Even in this analysis, one might worry about financial constraints binding differently across the IQ distribution. We therefore assess the results separately for individuals who are likely to be financially constrained and others. In the Online Appendix, we find that men who are below the median of the population in terms of debt-to-income ratios (Table A.3) and those above the median based on income (Table A.4) drive the intertemporal substitution results. Men who are likely to be financially constrained display no differential likelihood of substituting purchases intertemporally by IQ (see Tables A.5 and A.6 of the Online Appendix).

C. Falsification Test

The ROPA program allows us to design a natural falsification test: We can assess if individuals across the IQ distribution were also differentially likely to purchase non-eligible new cars during the ROPA period, which would suggest a role for unobserved shocks that affected men across the IQ distribution differently, whether related or unrelated to the motivations that drove the government's decision to implement the ROPA program.

The right panel of Figure 1 in the Introduction performs this falsification test in the raw data. In Table A.7 of the Online Appendix, we implement the test in a multivariate setting. We estimate the same specifications as in Table 5, but replace the outcome variable with a dummy that equals 1 if the individual purchased a non-eligible car. We find no differential likelihood of purchasing new non-eligible cars during the ROPA period across the IQ distribution, which corroborates the results in Figure 1 and our interpretation of the results on IQ for eligible cars during the program period.

D. Demand Channel: Evidence from Purchasing Plans

A demand-side channel, i.e., that high-IQ men are more aware of the program and/or understand better its functioning and the bureaucratic steps needed to obtain the subsidy, appears a plausible remaining explanation for our results, but the observational data do not allow a direct test of this channel. We thus move on to analyze our survey-based data in which respondents are asked directly about a representative Finnish household's incentives to purchase cars and other vehicles.

In each month, we observe, for a representative cross section of Finns, whether they think it is a good or bad time "for people" to purchase cars (see question text in section II.*D.*). The question is framed explicitly to capture respondents' assessments based on the economic incentives of a representative Finnish household rather than based on their own personal economic and financial outlook.

We compare this assessment about the timing of purchasing cars after the program was announced relative to before and across the IQ distribution by estimating the following specification:

$$\begin{aligned} \textit{Good Time to Purchase Car}_{i,t} =& \alpha + \beta \textit{High IQ}_{i,t} \times \textit{ROPA}_t \\ &+ \zeta \textit{High IQ}_{i,t} + \gamma \textit{ROPA}_t + X'_{i.t}\delta + \eta_t + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where $\textit{Good Time to Purchase Car}_{i,t}$ is a dummy that equals 1 if respondent i in month t says it is a very good or good time to purchase a car, and zero otherwise; $\textit{ROPA}_t$ is a dummy that equals 1 in the months after the program was announced, and zero before the announcement; η_t is a full set of month fixed effects; and all other variables are defined as above, including the controls. If our hypothesis is true, we should observe that after the announcement of the ROPA program high-IQ men are more likely to state it is a good time to purchase cars relative to other men.[13]

This setting also allows natural falsification tests, because the survey asks respondents not only about the timing of purchasing cars but also about the timing of purchasing non-car vehicles as well as other durable goods, such as electronic items and furniture. None of these alternative durables were subsidized under any program. We can therefore dismiss directly

[13]We only have access to the survey data until March 2015. Results are virtually identical when we restrict the pre-announcement period to the one or two years before the announcement.

that high-IQ men's assessment of whether it is a good timing to purchase cars is driven by systematic differences in beliefs about current and future macroeconomic conditions across the IQ distribution.

Table 6 reports the results for estimating equation (3). Columns (1)-(4) consider respondents' assessment of purchasing a car over the 6 months and the 12 months subsequent to the survey month. High-IQ men are about 4 to 5 percentage points more likely than low-IQ men to think it is a good time to purchase cars after the announcement of the ROPA program relative to before. This effect amounts to between 22% and 27% of the average assessment of whether it is a good time to purchase cars in the sample (18%). And, the estimated effect is similar if we absorb the set of demographic characteristics and other economic expectations we observe.

In Table 6, we also report the results for the survey falsification tests. In columns (5)-(6), we consider the same respondents' assessment about purchasing non-car vehicles. Consistent with our interpretation of the baseline result, we fail to detect any differences in the stated beliefs about purchasing non-car vehicles after the ROPA program was announced relative to before by IQ. The estimated coefficients are not only statistically but also economically insignificant. Similarly, in columns (7)-(8), we do not detect any differential assessment for the purchase of other durable goods.

Overall, the results in Table 6 provide direct evidence that high-IQ men understand how policies affect the economic incentives to purchase durable goods over time better than low-IQ men.

IV IQ and Incentives to Borrow

We move on to assess the role of cognitive constraints in agents' reaction to changing incentives to borrow. The management of short-term interest rates is a common policy measure that changes borrowing incentives: central banks often lower nominal rates to stimulate consumption by increasing households' incentive to take out loans and vice versa. The conjecture we bring to the data is that agents at and below the median by IQ might be less aware of policy-rate changes and/or less likely to understand the implications of these changes for their own borrowing incentives.

Our data include two substantial decreases and increases in short-term nominal interest

rates in Finland, as shown in Figure 3, which depicts the ECB beginning-of-quarter deposit facility rate over time.[14] On May 31, 2001, the ECB lowered the deposit facility rate from 3.75% to 3.50% (right y-axis) and continued lowering the rate until it reached a trough of 1.00% on June 30, 2003. Recessionary pressure in France and Germany, the largest economies in the Euro area, mainly drove these cuts. In times of lower interest rates, financing conditions become more favorable and individuals have an incentive to borrow more, ceteris paribus. In our setting, we can control directly for individual expectations regarding future income and employment status, which absorbs the effects of potentially concurrent recessionary pressures that motivated the ECB to cut rates on households' willingness to borrow. The ECB kept the deposit facility rate stable from June 30, 2003, until June 30, 2005, when it started to increase rates steadily until the end of 2006.

To assess agents' reactions to such changes across the IQ distribution, we first focus on survey-based assessments about the optimal time to borrow, for which respondents have to answer in terms of what an average Finnish household should do rather than based on their own personal financial outlook or binding financial constraints. We then move on to analyze the actual changes in household debt over the same periods.

A. Demand Channel: Assessing Borrowing Incentives by IQ

Starting with the raw data, Panel A and Panel B of Figure 3 compare the average sensitivity of beliefs about the optimal timing to take out loans (*propensity* to take out loans) over time for high-IQ men and others (solid blue lines) against the ECB policy rate (dashed red lines). For this propensity, respondents can pick a number between 1 and 4, with 4 meaning they think it is a very good time to borrow and 1 means they think it is a really bad time to borrow. The propensity to take out loans is the average of individual numerical responses. A value closer to 4 means that, on average, respondents are more likely to think that it is a good time to borrow for households in general.

During the period 2001-2003, while the ECB gradually reduced short-term rates, high-IQ men increased their propensity to take out loans, with a peak at 3.1 exactly when the deposit facility rate reached its lowest point for the 6-year period we consider. During the same period,

[14]Other short-term policy rates such as the rate on the main refinancing operations move in parallel to the deposit facility rate. We do not extend the analysis beyond the start of the Global Financial Crisis and the Great Recession, because policy rates dropped dramatically and stayed unchanged and close to zero throughout the rest of our sample period.

low-IQ men's propensity to borrow also increased but more moderately. Ultimately, the increase in high-IQ men's propensity to borrow (0.6) in the raw data was 100% higher than the increase of low-IQ men's propensity to borrow over the same period (0.3).

We detect this higher sensitivity of high-IQ men's borrowing propensity also when policy rates moved in the opposite direction: High-IQ men reduce their propensity to borrow from 3.1 at the end of June 2005 to 2.6 in the third quarter of 2006. By contrast, low-IQ men do not change their propensity to borrow over the same period, despite the concurrent and steady increase in interest rates.

Although interesting, the raw-data variation might confound relevant unobservables that vary systematically by IQ. For instance, low-IQ men might be more affected by the positive economic shock that led the ECB to increase policy rates throughout 2006 and for this reason might have had a higher propensity to borrow over that period.[15]

To assess the relevance of these endogeneity concerns, we perform the analysis in a multivariate setting by estimating specifications of the following type:[16]

$$Good\ Time\ Borrow_{i,t} = \alpha + \beta High\ IQ_{i,t} \times \Delta Rate_t + \zeta High\ IQ_{i,t} + \gamma \Delta Rate_{i,t} + X'_{i,t}\delta + \eta_t + \epsilon_{i,t}, \quad (4)$$

where $Good\ Time\ Borrow_{i,t}$ is a dummy variable that equals 1 if respondent i in month t said it was a good or very good time to take out a loan, and zero otherwise; $High\ IQ_{i,t}$ is a dummy that equals 1 when the standardized IQ score of individual i is 6 or above; $\Delta Rate_{i,t}$ is the annual change in the marginal facility lending rate set by the ECB in the twelve months before respondent i was interviewed; and X is the same vector of individual characteristics we used in the car-purchase analysis.

Note that we use the annual rate change before the survey date because we do not observe survey respondents more than once and hence we cannot study the effect of changes in rates on contemporaneous changes in the propensity to take out loans using individual fixed effects.

Table 7 reports the results for estimating equation (4) for the period from January 2001

[15] This alternative explanation also requires that low-IQ men do not follow the survey instructions and answer the question based on their own personal outlook rather than based on what an average Finnish household should do.

[16] We report estimates of a linear probability model (OLS), but marginal effects from using non-linear probit and logit models, available upon request, are economically and statistically very similar.

to March 2015. We consider the full time period we have available rather than the limited time period in the motivational evidence of Figure 3, but our estimated effects are larger if we end the sample before the start of the 2008-2009 Financial Crisis. In column (1), we find that high-IQ men are 5.3% more likely to state it is a good or very good time to take out loans relative to other men unconditionally. Note also that low-IQ men, on average, think that times of rate increases are times in which it is a better time to take out loans, likely indicating the endogenous nature of these monetary policy tightenings in good times. At the same time, though, high-IQ men are 2.6% less likely to state it is a good time to borrow for a one-percentage-point increase in policy rates, relative to low-IQ men. Results are similar if we control for demographic characteristics in column (2), if we add year-month fixed effects to control for aggregate shocks in column (3), and if we also absorb individual level expectations regarding the aggregate Finnish economy and personal economic outlooks in column (4).

Overall, high-IQ men appear to recognize more than low-IQ men that higher interest rates reduce the convenience of borrowing above and beyond business-cycle considerations.

B. Borrowing Choices Around Interest-rate Changes by IQ

Despite different survey answers, both high- and low-IQ men might adjust their *actual* borrowing choices in similar ways around changes in interest rates. For instance, financial advisers, family members or peers might contact (prospective) borrowers and suggest that they adjust their debt balances based on the dynamics of interest rates. Even agents that did not understand or were unaware of rate changes might thus adjust their actual debt choices around such changes.

To assess this possibility, we consider actual debt choices based on registry data. For any debtholder in Finland, we observe the amount of total debt outstanding at the end of the calendar year. Contrary to the survey data, the registry data is a panel—we observe end-of-year debt outstanding for the same individual over time. This feature allows us to estimate the relationship between IQ and the sensitivity to interest rates while absorbing time-invariant characteristics across individuals, which we cannot do in the survey sample.

Building on the panel nature of the registry sample, we estimate the following pooled OLS

specification:

$$\begin{aligned} Debt\ Adjustment_{i,t} = \alpha + \beta High\ IQ_i \times Rate_t + \zeta High\ IQ_i \\ + \gamma Rate_t + X'_{i,t}\delta + \eta_t + \eta_i + \epsilon_{i,t}, \end{aligned} \tag{5}$$

where $Debt\ Outcome_{i,t}$ is, based on the specification, either the percent change in the debt balance of individual i between year t and year $t-1$, a dummy that equals 1 if the individual took out a new loan in year t, or a dummy that equals 1 if the individual paid back in full at least one existing loan in year t; $Rate_t$ is the average level of the marginal lending facility rate set by the ECB in year t; η_i is a full set of individual fixed effects; and all other variables are defined as before.

Our administrative data allow us to observe these debt outcomes for the same individual at the end of each year and hence we can estimate the relationship between changes in interest rates and contemporaneous changes in debt outcomes by adding individual fixed effects to our empirical specification.

Column (1) of Table 8 reveals that high-IQ agents' debt balances grow faster than those of others, i.e. the percent change in debt balance is, on average, higher over our sample period. At the same time, this relationship is muted for high-IQ men in times of higher interest rates, when increasing debt becomes costlier. High-IQ men are therefore more sensitive to changing their debt balances based on the level of interest rates, i.e. they increase their debt more when rates are low and reduce debt growth more when rates are high relative to low-IQ men. Columns (2)-(3) of Table 8 repeat the analysis when absorbing the effect of common business-cycle shocks (year fixed effects) and time-invariant systematic differences across individuals (individual fixed effects). The baseline result is driven by within-individual variation in the reaction to changing economic incentives rather than systematic (time-invariant) characteristics across agents.

In addition to debt balances, which capture the intensive margin of households' debt adjustment, we consider an extensive margin by constructing two dummy variables for whether agents took out a new loan or paid back in full any existing loans. We report the linear probability model estimates using these dummies as the outcome variables in columns (4)-(9) of Table 8. Even at the extensive margin, high-IQ men react more than others to changes in policy rates. They are about 22% less likely to take out a new loan for a 100-basis point increase in the marginal lending rate (0.008/0.035, column (4)). At the same time, high-IQ men are 26% more

likely to pay down at least one existing loan in full relative to low-IQ men (0.009/0.034, column (7)). The size of the estimates is stable if we restrict the variation within years and within individuals.

C. Supply Side? Interest-Rate Pass-Through by IQ

High-IQ agents' debt choices could be more sensitive to policy-rate changes if banks passed through such changes more to them than to low-IQ agents (supply-side channel). For instance, we know that interest rates on credit-card debt vary substantially across US consumers due to differential shopping intensity for credit-cards (Stango and Zinman (2016)). We can assess this possibility because we observe the annual interest paid and principal of our agents' outstanding debt. We can thus compute individual-level average interest rates by dividing the yearly interest paid by each agent in the registry data by the average of their beginning- and end-of-year debt balances.

Figure 4 plots the average annual interest rates paid across different forms of debt, i.e. mortgages (Panel A), student loans (Panel B) and total outstanding debt (Panel C). Across all types of debt, average interest rates in the raw data are quite similar across the IQ distribution. The rates are almost identical for student loans. For mortgages and total debt, we find a slightly lower average rate for high-IQ men but no differential changes in debt pricing around policy-rate changes, which dismisses the scope for a supply-side channel to explain differential debt choices around policy-rate changes.

V Implications for Theory

We complete our inquiry by discussing the implications of our empirical evidence for the microfoundation of intertemporal consumption models.

A. Sticky and Noisy Information Models

Researchers have built upon two leading approaches that incorporate rigidities in information acquisition and processing into intertemporal consumption models. The first approach is based on the slow diffusion of information through the economy due to the costs of gathering information and reoptimizing choices (*sticky information models*, Mankiw and Reis (2002))

whereas the second on decision-makers' limited attention (*noisy information models*, Sims (2003)).[17]

Earlier empirical evidence supports the implications and predictions of models incorporating information rigidities. For instance, Coibion and Gorodnichenko (2012, 2015) provide empirical evidence in support of the role of information rigidities using data from professional forecasters and Link, Peichl, Roth, and Wohlfart (2023) provide evidence on the differential heterogeneity of information frictions among experts, firms, and households. Also, Carroll (2003) develops an epidimological model of expectations formation in which households gather their information about the macroeconomy from news media but do not pay attention to macro news constantly. He tests the model empirically on the Michigan Survey of Consumers and shows that agents update information about inflation and unemployment about once a year.

The results in our paper have relevant implications for the microfoundation of these models with information rigidities. Our finding that agents below the top of the distribution by IQ seem either unaware of fiscal or monetary policy announcements or unable to map this information into optimal decision-making suggests that cognitive abilities might be a microfoundation for the costs of gathering information and reoptimizing choices in sticky-information models. Similarly, cognitive abilities can microfound the heterogeneity in the capacity to pay attention to all available information by consumers and firms in noisy information models. So far, these models do not allow for heterogeneity across agents but our findings suggest an important role for such heterogeneity and motivate theoretical advances in this direction. Specifically, our results inform advances on the development of heterogeneous information rigidity models in which agent heterogeneity can be microfounded through differences in cognitive constraints.

B. Models with Bounded Rationality

Another strand of theoretical models has emerged recently in response to the "forward guidance puzzle"—the fact that promises about future interest rates during a liquidity trap appear to have only a small impact on agents' expectations, which goes against the predictions of the standard New Keynesian model (e.g., see Giannoni et al. (2015)).

To explain this puzzle, Woodford (2019) questions that agents can form fully state-contingent intertemporal plans ad infinitum. He assumes that agents do not choose the optimal

[17]Mackowiak and Wiederholt (2009) build on the noisy information model and allow agents to decide to which information they pay attention subject to a cognitive constraint.

plan based on backward induction but rather start from the current situation and plan forward for a finite number of steps. Gabaix (2020), instead, models an agent that displays partial myopia towards distant and atypical events resulting in *cognitive discounting*. Farhi and Werning (2019) introduce bounded rationality in the form of level-k thinking and market incompleteness with occasionally binding financial constraints, whereas Angeletos and Lian (2018) relax the assumption that agents have common knowledge about future policies and fundamentals as well as about others' reaction to such policies.

Our empirical results have fewer implications for this class of models for at least two reasons. First, we study agents' reactions to policy-rate changes outside of a liquidity trap, which does not map into the setting these models aim to explain. Second, we provide evidence of heterogeneity in the reaction to a simple subsidy program for the purchase of durable goods, which does not require agents to solve a problem with infinite planning horizons.

Our empirical setting speaks more closely to the model by Laibson, Maxted, and Moll (2020), who introduce present bias and naivete (Laibson (1997)) in a model with liquid and illiquid assets. The authors show that present bias increases the aggregate demand effects of fiscal stimulus payments. In their model, interest rate cuts can increase the cash-out refinancing of mortgages if the agent does not procrastinate in her refinancing choices. Our results inform the microfoundation of heterogeneity in procrastination across agents, although the relationship between cognitive constraints and procrastination should have a different sign than that between cognitive constraints and present bias, because we find that high-IQ agents are more likely to react to policy changes and, conditional on reacting, they react more.

C. Models with Consumption Commitments

Another set of models that predict a muted effect of fiscal policies on agents' choices is based on consumption commitments and previously-optimized consumption plans (e.g., see Grossman and Laroque (1990) and Chetty and Szeidl (2007)): The cognitive costs of making and adjusting consumption plans over several future periods with different incentives across potential policy states of the world might be larger for low- than for high-IQ agents. Our results call for extensions of consumption-commitments models from representative- to heterogeneous-agent models, in which agents differ based on the cognitive costs they face to update and reoptimize their consumption plans.

Ultimately, we see our empirical results as a motivation for the advancement of

heterogeneous-agent models that feature a role for the costs of gathering and processing economic information and/or reoptimizing consumption plans and procrastination in explaining consumers' consumption, saving, and borrowing choices. Our results point to heterogeneous cognitive constraints as a relevant source of heterogeneity in the extent of such costs across consumers.

Pfäuti et al. (2023) is one way in this direction. The authors introduce permanent differences in agents' cognitive skills and beliefs about them in a heterogeneous agent New Keynesian model, which successfully matches the empirical distribution of marginal propensities to consume. They show that providing liquidity to agents with cognitive constraints is less effective in moving them away from their borrowing constraint.

VI Conclusion

Agents facing stronger cognitive constraints react less than others when their incentives to consume, save, and borrow change. This differential propensity survives after absorbing a rich set of determinants of economic decision-making such as income, formal education, economic expectations, financial constraints, and other demographics. We find in survey-based data that high-IQ consumers form beliefs and plans that are consistent with how policies shape incentives over time, whereas other consumers barely do so. By contrast, we do not detect direct evidence in support of a supply-side channel, such as a differential pricing of debt for consumers at and below the median by IQ by financial institutions.

Our results suggest an overlooked and unintended redistributive effect of policies that target households' incentives to consume, save, and borrow, whereby unreactive low-IQ consumers do not take advantage of policy incentives as much as high-IQ consumers. Future empirical and theoretical research should delve into these redistributive effects in terms of isolating, describing, and quantifying them.

Future research should also study how these unintended consequences of traditional fiscal and monetary policies could be countered. For instance, targeted and simplified communication by policymakers could be a fruitful avenue (see Ramey (2021), D'Acunto et al. (2021, 2020); Coibion et al. (2021)). To this aim, the use of robo-advice and FinTech tools for consumption, saving, and borrowing choices, which are salient and can reach consumers at low cost and in real time through personal devices (D'Acunto and Rossi (2021, 2023)), might enhance the

transmission of policy communication and hence facilitate the optimal reaction of all agents, including those who face stronger cognitive constraints.

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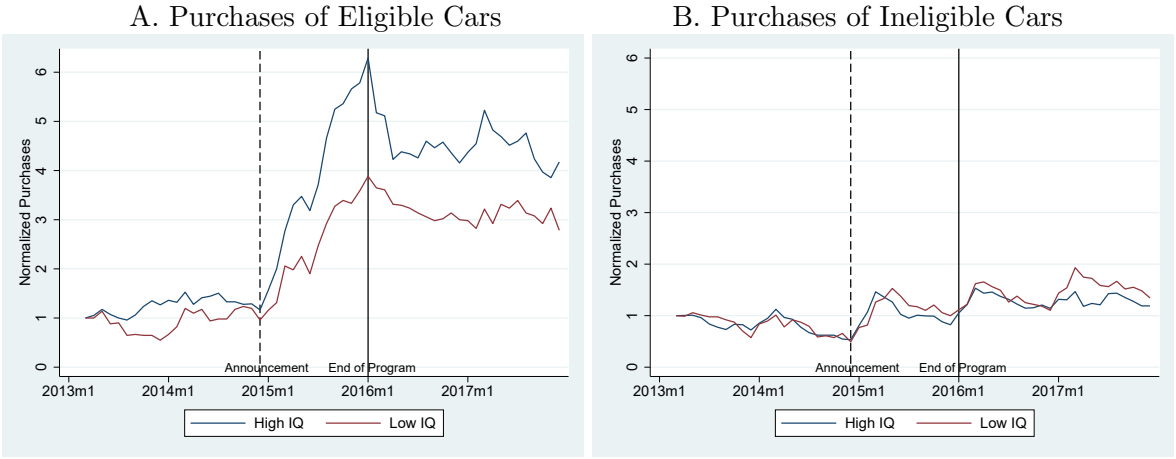
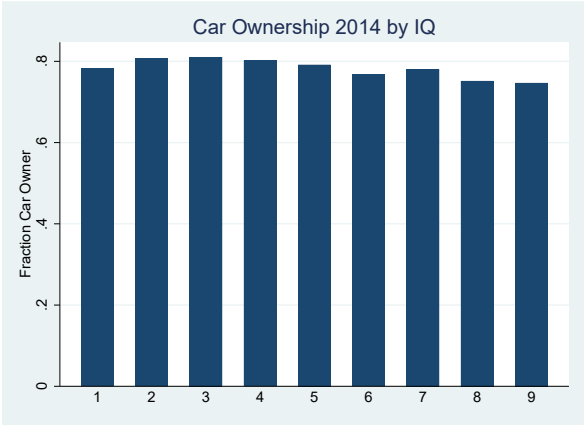
Figure 1: **Car Purchases by Clunker Owners Around Government Program, by IQ**



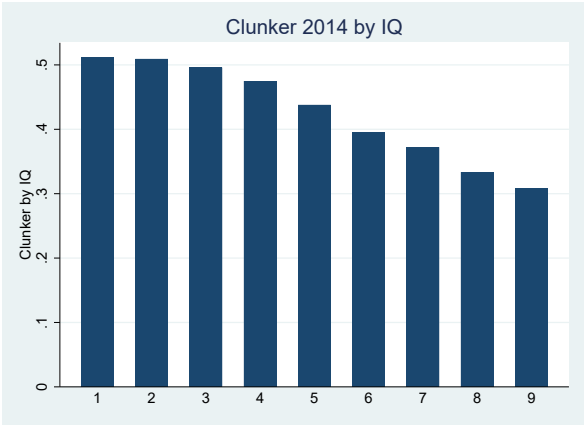
Panel A plots the number of cars eligible for the cash-for-clunker scheme purchased over time (normalized by the number of purchases in the first observed month—March 2013) by Finnish men with standardized IQ scores between 6 and 9 (High IQ) and between 1 and 5 (Low IQ). The sample only includes Finnish men who owned a clunker at the announcement of the program (end of December 2014). Panel B plots the number of non-eligible cars purchased by men in the same conditions. The vertical lines represent the announcement (December 2014) and end of the program (December 2015). We use the universe of car registrations in Finland to calculate these statistics and define clunkers based on the program criteria on age and emissions. To address seasonality in car sales, we plot a trailing three-months moving average. The sample period is from January 2013 to December 2017.

Figure 2: **Clunker Ownership and Program Participation by IQ**

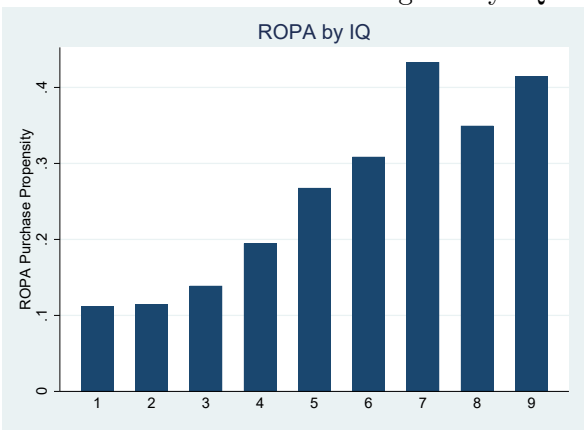
A. Ownership of Any Cars at Program Announcement by IQ



B. Ownership of Clunker at Program Announcement by IQ



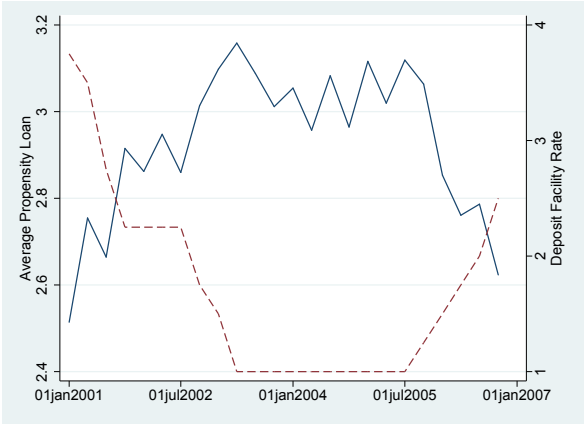
C. Car Purchases under Program by IQ



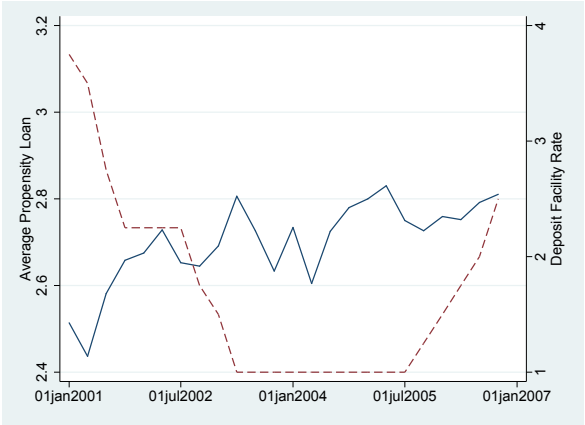
Panel A plots the share of consumers who owned any cars at the time of the ROPA program announcement (December 2014) across IQ levels. Panel B plots the share of consumers who owned a clunker (old car eligible to be traded in based on the ROPA program requirements) at the time of the program announcement (December 2014) by IQ. Panel C plots the share of car purchases through the ROPA program over all car purchases during the ROPA program period by IQ. We use administrative data on the universe of car registrations in Finland and on all participants to the ROPA program from several Finnish agencies. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9 and follows a stanine distribution.

Figure 3: **ECB Deposit Facility Rate and Propensity to Borrow by IQ**

A. Propensity to Borrow and Policy Rates: High IQ



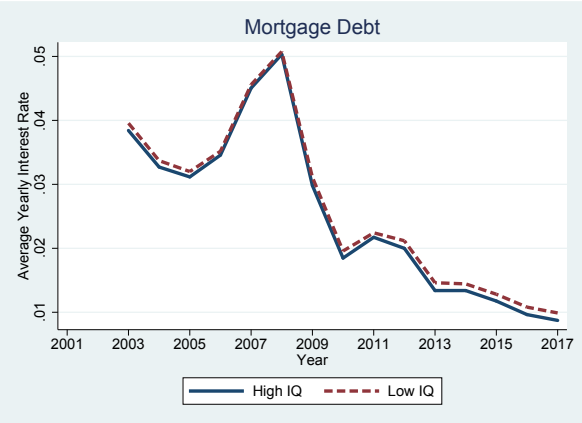
B. Propensity to Borrow and Policy Rates: Low IQ



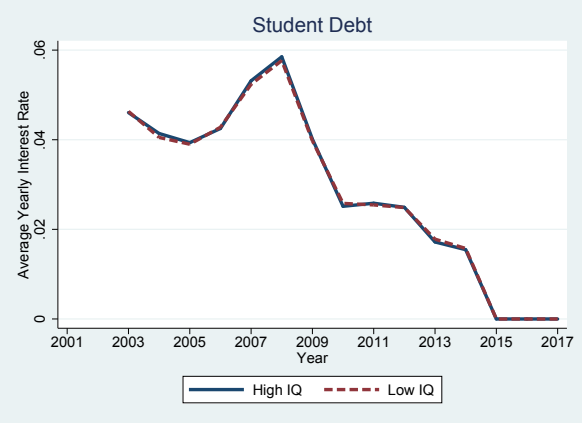
Panel A and Panel B of this figure plot the cross-sectional mean of whether individuals think it is a good time to take out a loan in Finland (solid blue line) for high-IQ and low-IQ men against the beginning-of-quarter ECB Deposit Facility Rate from quarter 1 2001 to quarter 4 of 2006 (red dashed line). Individuals can answer that now is a "very good time for people to borrow" (4), a "pretty good time for people to borrow" (3), a "pretty bad time for people to borrow" (2), or a "really bad time for people to borrow" (1) to the question, "If you think about the general economic situation in Finland, then do you think that at this time it is ..." High-IQ men are all men for whom normalized IQ is larger than 5. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure the propensity to take out a loan. The sample period is January 2001 to December 2006.

Figure 4: **Interest Rates Paid by High-IQ and Low-IQ Borrowers**

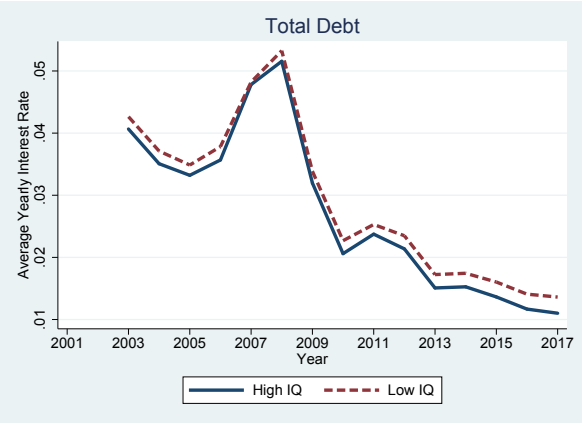
A. Average Yearly Interest Rate on Outstanding Mortgages



B. Average Yearly Interest Rate on Student Loans



C. Average Yearly Interest Rate on Overall Debt Outstanding



This Figure plots the average yearly interest rate on overall outstanding debt across three types of debt, separately for high-IQ borrowers (solid blue line) and low-IQ borrowers (dashed red line). Panel A considers mortgage debt, Panel B considers student loans, and Panel C considers the overall amount of debt outstanding, irrespective of type. High-IQ men are all men for whom normalized IQ is larger than 5. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. The interest and debt balance data are from Statistics Finland, which is available from December 2002 to December 2017.

Table 1: **Descriptive Statistics: Survey Sample**

This table reports descriptive statistics for the variables we use in the paper. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. High IQ equals 1 if normalized IQ is larger than 5. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. The sample period is January 2001 to March 2015.

Statistic	Inflation Perception	Inflation Expectation	Total Debt	High IQ	Age	Income
Nobs	27,544	27,566	27,828	27,856	27,856	27,856
Mean	3.00	2.47	38,510	0.50	31	22,516
Std	4.63	3.76	53,734	0.50	7	14,247
p1	-5.00	-5.00	0	0	19	900
p10	0.00	0.00	0	0	21	6,800
p25	0.00	0.00	0	0	25	13,100
p50	2.00	2.00	14,400	0	30	21,000
p75	5.00	3.50	62,200	1	36	28,850
p90	7.00	5.00	102,200	1	40	38,200
p99	20.00	15.00	242,400	1	46	74,200
Single	no	38.75%	Urban		no	64.59%
	yes	61.25%			yes	35.41%
Unemployed	no	94.11%	Helsinki		no	72.28%
	yes	5.89%			yes	27.72%
Kids	no	22.43%	College		no	66.06%
	yes	77.57%			yes	33.94%
Durables	Good time	50.84%	Loan		Good time	70.71%
	Neutral	28.69%			Bad time	29.29%
	Bad time	20.47%				

Table 2: **Descriptive Statistics: ROPA Program Sample**

This table reports descriptive statistics for the variables in the analysis of the cash-for-clunkers program (ROPA). Clunker is a dummy variable that takes the value of 1 of individual i owned a clunker (=old car eligible to be traded in under the ROPA program) in December 2014 before the announcement of the program. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. High IQ_i equals 1 if normalized IQ is larger than 5. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2015 to January 2016.

	Car Purchaser	$ROPA_i$=1	$ROPA_i$=0	Δ
High IQ	0.76	0.80	0.76	0.05***
Clunker	0.26	0.55	0.22	0.34***
Eligible Car	0.53	1.00	0.46	0.54***
Age	43.40	42.02	43.60	-1.59***
Income	57,509	51,565	58,378	-6,813***
Debt	92,118	83,596	93,384	-9,787***
Single	0.73	0.70	0.74	-0.04**
Unemployed	0.03	0.03	0.03	0.00
Kids	0.73	0.73	0.73	0.00
Urban	0.90	0.89	0.90	-0.01
Helsinki	0.40	0.37	0.40	-0.03*
College	0.40	0.39	0.41	-0.01
Observations	11,934	1,522	10,412	11,934

Table 3: **IQ and Car Purchases During Government Program**

This table reports the coefficient estimates from the following OLS regression:

$$ROPA_i = \alpha + \beta High\ IQ_i \times Clunker_i + \zeta High\ IQ_i + \gamma Clunker_i + X_i'\delta + \eta_s + \epsilon_i,$$

where $ROPA_i$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car through the ROPA scheme, and zero if he purchased an eligible car outside the ROPA scheme when the scheme was available. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. $Clunker_i$ is a dummy variable that takes the value of 1 if individual i owned a clunker in December 2014, i.e. just before the announcement of the ROPA scheme. Demographic controls measured as of December 2014 (X_i) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural residence, college dummy, and a dummy that equals 1 if the respondent lives in the capital region, Helsinki; η_s is a full set of district fixed effects. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2015 to January 2016.

	(1)	(2)	(3)
High IQ × Clunker	5.53**	6.12**	5.91**
	(2.58)	(2.59)	(2.59)
High IQ	2.88***	4.46***	4.45***
	(1.11)	(1.18)	(1.18)
Clunker	24.65***	23.50***	23.78***
	(2.22)	(2.24)	(2.24)
Constant	12.59***	96.68***	95.70***
	(0.95)	(14.29)	(14.29)
Nobs	7,588	7,534	7,534
Controls		X	X
District FE			X
R2	0.101	0.109	0.114

Table 4: **IQ and Car Purchases During Government Program: Constrained vs. Unconstrained Agents**

This table reports the coefficient estimates from the following OLS regression:

$$ROPA_i = \alpha + \beta High\ IQ_i \times Clunker_i + \zeta High\ IQ_i + \gamma Clunker_i + X_i'\delta + \eta_s + \epsilon_i,$$

where $ROPA_i$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car through the ROPA scheme, and zero if he purchased an eligible car outside the scheme when the scheme was active. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. $Clunker_i$ is a dummy variable that takes the value of 1 if individual i owned a clunker in December 2014, i.e. just before the announcement of the ROPA scheme. Demographic controls measured as of December 2014 (X_i) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural residence, college dummy, and a dummy that equals 1 if the respondent lives in the capital region, Helsinki; η_s is a full set of district fixed effects. Panel A reports results for unconstrained men and Panel B reports results for constrained men. Columns (1) to (3) split the sample by the median debt-to-income ratio and columns (4) to (6) split the sample by the median income in the overall sample. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2015 to January 2016.

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Unconstrained					
	Below-median Debt-to-Income			Above-median Income		
High IQ × Clunker	10.52**	11.23***	10.34**	6.45***	6.64***	6.45**
	(4.27)	(4.24)	(4.24)	(2.35)	(2.32)	(2.75)
High IQ	1.47	3.62*	3.79*	3.15***	4.62***	4.56***
	(1.91)	(2.08)	(2.08)	(1.13)	(1.28)	(1.23)
Clunker	21.52***	19.72***	20.25***	23.33***	22.57***	22.81***
	(3.68)	(3.68)	(3.67)	(1.99)	(1.95)	(2.39)
Constant	12.93***	132.19***	135.30***	12.12***	85.98***	86.49***
	(1.66)	(25.07)	(25.15)	(0.94)	(20.50)	(17.97)
Nobs	2,683	2,680	2,680	6,997	6,988	6,988
Controls		X	X		X	X
District			X			X
R2	0.111	0.123	0.132	0.098	0.104	0.109
	Panel B. Constrained					
	Above-median Debt-to-Income			Below-median Income		
High IQ × Clunker	1.59	2.04	1.67	4.69	4.69	4.07
	(3.75)	(3.76)	(3.77)	(8.23)	(8.23)	(9.79)
High IQ	4.40***	5.41***	5.56***	2.82	1.03	−0.77
	(1.59)	(1.66)	(1.66)	(4.51)	(4.47)	(5.50)
Clunker	27.07***	26.27***	26.78***	29.98***	28.60***	33.26***
	(3.20)	(3.24)	(3.25)	(6.38)	(6.46)	(7.54)
Constant	11.94***	74.51***	73.70***	17.27***	118.08***	128.96***
	(1.35)	(22.22)	(22.26)	(3.62)	(40.26)	(47.04)
Nobs	3,585	3,578	3,578	551	546	478
Controls		X	X		X	X
District			X			X
R2	0.095	0.100	0.106	0.119	0.166	0.323

Table 5: **IQ and Purchase of Eligible Cars During Government Program**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_s + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where Eligible $Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car in month t. High IQ_i equals 1 if normalized IQ is larger than 5. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero otherwise (i.e., July 2014 to January 2015). We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2015 for the pre period and July 2015 to January 2016 for the ROPA period.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA_t	0.10***	0.10***	0.10***	0.10***
	(0.03)	(0.03)	(0.03)	(0.03)
High IQ × Clunker	−0.09***	−0.08***	−0.08***	
	(0.02)	(0.02)	(0.02)	
High IQ × ROPA_t	0.04	0.04	0.04	0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Clunker × ROPA_t	0.09***	0.09***	0.09***	0.09***
	(0.02)	(0.02)	(0.02)	(0.02)
High IQ	0.13***	0.04**	0.04**	
	(0.02)	(0.02)	(0.02)	
Clunker	−0.20***	−0.21***	−0.20***	
	(0.01)	(0.02)	(0.02)	
ROPA_t	0.04**	0.03	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.03)
Constant	0.25***	−0.76***	−0.73***	1.47*
	(0.01)	(0.07)	(0.07)	(0.79)
Nobs	1,573,190	1,521,209	1,521,209	1,521,209
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.002	0.002	0.507

Table 6: **Assesment of Incentives to Purchase Cars During Government Program**

This table reports the coefficient estimates from the following specification:

$$Willingness\ Purchase\ Car_{i,t} = \alpha + \beta High\ IQ_i \times Post\ Announcement + \gamma Post\ Announcement + \zeta High\ IQi + X'_{i.t}\delta + \epsilon_{i,t},$$

where $Willingness\ Purchase\ Car_{i,t}$ is a dummy variable that equals 1 if the respond answers it is a good time to purchase a car, and zero otherwise.$High\ IQ_i$ equals 1 if normalized IQ is larger than 5. Post Announcement is a dummy variable that equals 1 in the months after the announcement of the cash for clunkers program by the government agency Traficom (December 2014), and zero in the months before the announcement. We estimate this specification with a linear probability model (OLS). We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls are age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki. We cluster standard errors at the individual level. The sample period is August 2013 to March 2015.

	Want Purchase Car Within 6 months		Want Purchase Car Within 1 year		Want Purchase Non-car Vehicle		Want Purchase Other Durables	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High IQ × Post Announcement	0.05**	0.043*	0.05**	0.04*	−0.00	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	−0.02	(0.02)	(0.03)	(0.03)
High IQ	−0.04	−0.03**	−0.04***	−0.03**	0.03*	0.03*	0.05***	0.04**
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Post Announcement	−0.01	−0.01	−0.01	−0.00	0.03*	0.03*	−0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Nobs	5,634	4,906	5,625	4,899	5,654	4,920	5,657	4,922
Controls		X		X		X		X
Expectations		X		X		X		X

Table 7: **Assessment of Incentives to Borrow Around Policy-Rate Changes**

This table reports the coefficient estimates from the following specification:

$$Good\ Time\ Borrow_{i,t} = \alpha + \beta High\ IQ_i \times \Delta Rate_t + \zeta High\ IQ_i + \gamma \Delta Rate_t + X'_{i,t}\delta + \eta_t + \eta_i \epsilon_{i,t},$$

where $Good\ Time\ Borrow_{i,t}$ *is a dummy variable that equals 1 if the respond answers it is a good time for people to take out a loan, and zero otherwise.* $High\ IQ_i$ *equals 1 if normalized IQ is larger than 5.* $\Delta Rate_t$ *is the annual change in the marginal lending facility rate set by the ECB in twelve months before the survey wave. We estimate this specification with a linear probability model (OLS). We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) are age, age*^{2}*, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki.* η_t *is a full sets of year-month fixed effects. We cluster standard errors at the individual level. The sample period is January 2001 to March 2015.*

	(1)	(2)	(3)	(4)
High IQ $\times \Delta Rate$	-0.026^{**}	-0.033^{***}	-0.028^{**}	-0.025^{**}
	(0.012)	(0.012)	(0.011)	(0.011)
High IQ	0.053^{***}	0.036^{***}	0.034^{***}	0.029^{***}
	(0.005)	(0.005)	(0.005)	(0.005)
$\Delta Rate$	0.036^{***}	0.036^{***}		
	(0.008)	(0.008)		
Nobs	37,145	34,858	34,858	34,858
Controls		X	X	X
Year-Month FE			X	X
Expectations				X
R2	0.004	0.025	0.097	0.115

Table 8: **Debt Adjustment Around Policy-Rate Changes**

This table reports the coefficient estimates from the following pooled OLS regression based on a panel of individual-year observations:

$$Debt\ Adjustment_{i,t} = \alpha + \beta High\ IQ_i \times Rate_t + \zeta High\ IQ_i + \gamma Rate_t + X'_{i.t}\delta + \eta_t + \eta_i \epsilon_{i,t},$$

where Debt Adjustment$_{i,t}$ is the end-of-year total debt balance of individual i in year t in columns (1)-(3); a dummy variable that equals 1 if the individual took out a new loan in year t in columns (4)-(6); a dummy variable that equals 1 if the individual paid down at least one existing loan in year t. High IQ$_i$ equals 1 if normalized IQ is larger than 5. Rate$_t$ is the average level of the marginal lending facility rate set by the ECB in year t. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) are age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t and ηi are full sets of year and individual fixed effects. The debt outcomes information is obtained from the Finnish registry data discussed in Section II. The data set is a full balanced panel in which we observe outcomes for any debt holder in Finland at the end of each year. This structure allows restricting the variation within individual in columns (3), (6), and (9). We cluster standard errors at the individual level. The sample period is December 2000 to December 2013.

	% Change Debt Balance			New Loan			Repay Loan		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
High IQ × Rate	−0.010***	−0.010***	−0.007**	−0.008***	−0.008***	−0.007***	0.009***	0.009***	0.007***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
High IQ	0.020***	0.020***		−0.004	−0.006		0.002	0.004	
	(0.007)	(0.007)		(0.004)	(0.004)		(0.004)	(0.004)	
Rate	0.025***			0.035***			−0.034***		
	(0.002)			(0.002)			(0.002)		
Nobs	244,640	244,640	244,640	213,473	213,473	213,473	213,473	213,473	213,473
Controls	X	X	X	X	X	X	X	X	X
Year FE		X	X		X	X		X	X
Individ FE			X			X			X

Online Appendix:
Cognitive Constraints and Economic Incentives

Francesco D'Acunto, Daniel Hoang, Maritta Paloviita, and Michael Weber

Not for Publication

W

Trafi
Liikenteen turvallisuusvirasto
Trafiksäkerhetsverket
Finnish Transport Safety Agency

88

Romutustodistus
Skrotningsintyg
Certificate of destruction

W

Ajoneuvon tiedot **Fordons-uppgifter** **Vehicle particulars**	Rek.tunnus Reg.tecken Reg. number	Järj.nro Ordn.nr Serial No.	Valmistenumero Tillverkningsnummer Vehicle identification number
	Ajoneuvoluokka Fordonskategori Vehicle category		Merkki ja malli Märke och modell Make and model
	Ajoneuvon kansallisuustunnus Fordonets nationalitetsbeteckning Distinguishing national registration sign		

Ajoneuvon luovuttajan tiedot **Uppgifter om fordonets överlåtare** **Vehicle deliverer´s details**	Sukunimi Efternamn Last name	Henkilötunnus Personbeteckning Identity number
	Etunimi Förnamn First name	Kansallisuus Nationalitet Nationality
	Lähiosoite Näradress Address	
	Postinumero ja -toimipaikka Postnummer och -anstalt Postal number and post office	
	Vakuutan, että minulla on oikeus luovuttaa ajoneuvo romutettavaksi. **Jag intyger, att jag har rätt att överlåta fordonet till skrotning.** **I affirm that I have the right to hand over this vehicle to a collection facility to be destroyed.** Ajoneuvon luovuttajan allekirjoitus ja nimenselvennys Underskrift och namnförtydligande av fordonets överlåtare Signature and name clarification of the deliverer of the vehicle	

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Vastaanotto-pisteen tiedot **Mottagnings-ställets uppgifter** **Collection facility par ticulars**	Yrityksen nimi Företagets namn Company name	Y-tunnus FO-nummer Company identification number
	Lähiosoite Näradress Address	
	Postinumero ja -toimipaikka Postnummer och -anstalt Postal number and post office	
	Olemme vastaanottaneet jätelain (1072/1993) mukaisesti romuajoneuvon romutettavaksi. **Vi har mottagit skrotfordon enligt avfallslagen (1072/1993) till skrotning.** **We have received this end-of life vehicle to treatment according to the waste act (1072/1993).** Ajoneuvon rekisterikilvet Fordonets registerskyltar Vehicle number plates ☐ on palautettu vastaanottopisteeseen. har returnerats till mottagningsstället. have been returned to collection facility. ☐ ei ole palautettu. har inte returnerats. have not been returned. Ajoneuvon rekisteröintitodistus on liitteenä. Fordonets registreringsbevis bifogas. Vehicle registration certificate enclosed. ☐ Kyllä Ja Yes Ajoneuvon lunastuspäätös on liitteenä. Fordonets inlösningsbevis bifogas. Vehicle redemption certificate enclosed. ☐ Kyllä Ja Yes Ajoneuvon siirtopäätös on liitteenä. Fordonets flyttningsbevis bifogas. Vehicle removal certificate enclosed. ☐ Kyllä Ja Yes	
	Romutustodistus annettu (pvm) **Skrotningsintyg beviljat (datum)** **Certificate of destruction issued (date)**	Luovuttajan henkilöllisyys tarkastettu (hetun 4 viim. merkkiä) Överlåtares identitet kontrollerad (personbet. 4 sista märken) Identity of the deliverer verified (id-number's last 4 characters)
	Vastaanottopisteen allekirjoitus, nimenselvennys ja leima Mottagningsställets underskrift, namnförtydligande och stämpel Signature, name clarification and stamp of collection facility	**Poiston päivittäjä** Murskaamo/Käsittelijän nimi Liitteet kpl

W

Lupaviran-omainen **Tillstånds-myndighet** **Licenced by**	Lupaviranomaisen nimi Tillståndsmyndighetens namn Name of the licensing authority	
	Lähiosoite Näradress Address	
	Postinumero ja -toimipaikka Postnummer och -anstalt Postal number and post office	

B140 - 2/2015

Romutustodistus on annettu romuajoneuvoista annetun Euroopan parlamentin ja neuvoston direktiivin (2000/53/EY) ja jätelain (1072/1993) nojalla.
Skrotningsintyget är beviljat med stöd av Europaparlamentets och rådets direktiv (2000/53/EG) och avfallslagen (1072/1993).
This certificate of destruction has been issued on the basis of the directive 2000/53/EC of the European parliament and of the council and on the basis of the amendment of the waste act (1072/1993).

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Table A.1: **Debt and Income by IQ**

This table reports the household leverage ratio by bins of IQ in Panel A and the share of income in total income in Panel B. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Income and debt data come from the registry of Statistics Finland. The sample period is January 2001 to March 2015.

IQ	1 (Lowest)	2	3	4	5	6	7	8	9 (Highest)
Panel A. Total Debt / Taxable Income by IQ									
	0.82	0.77	0.76	0.75	0.78	0.80	0.81	0.87	0.93
Panel B. Income Share by IQ									
	1.86%	4.52%	6.28%	15.38%	21.16%	17.79%	16.11%	8.83%	8.07%

Table A.2: **IQ and Car Purchases During Government Program: Statistical Inference Robustness**

This table reports the coefficient estimates from the following OLS regression:

$$ROPA_i = \alpha + \beta High\ IQ_i \times Clunker_i + \zeta High\ IQ_i + \gamma Clunker_i + X_i'\delta + \eta_s + \epsilon_i,$$

where $ROPA_i$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car through the ROPA scheme, and zero if he purchased an eligible car outside the ROPA scheme when the scheme was available. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. $Clunker_i$ is a dummy variable that takes the value of 1 if individual i owned a clunker in December 2014, i.e. just before the announcement of the ROPA scheme. Demographic controls measured as of December 2019 (X_i) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural residence, college dummy, and a dummy that equals 1 if the respondent lives in the capital region, Helsinki; η_s is a full set of district fixed effects. We cluster standard errors at the municipality level to allow for correlation of unknown form across the decisions of agents that live in the same cities. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2015 to January 2016.

	(1)	(2)	(3)
High IQ × Clunker	5.53**	6.12***	5.91***
	(2.31)	(2.25)	(2.26)
High IQ	2.88***	4.46***	4.45***
	(1.02)	(1.16)	(1.16)
Clunker	24.65***	23.50***	23.78***
	(2.00)	(1.91)	(1.93)
Constant	12.59***	96.68***	95.70***
	(0.85)	(15.17)	(14.82)
Nobs	7,588	7,534	7,534
Controls		X	X
District			X
R2	0.101	0.109	0.114

Table A.3: **Purchases of Eligible Cars by IQ: Unconstrained (Debt to Income)**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_l + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where $Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero during July 2014 to January 2015 and July 2016 to January 2017. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We only keep the sample of Finnish men below the median debt to income ratio. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2017.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA$_t$	0.15**	0.15**	0.15**	0.16**
	(0.06)	(0.06)	(0.06)	(0.07)
High IQ × Clunker	−0.10***	−0.08**	−0.08**	
	(0.04)	(0.04)	(0.04)	
High IQ × ROPA$_t$	0.00	0.00	0.00	−0.01
	(0.05)	(0.05)	(0.05)	(0.06)
Clunker × ROPA$_t$	0.11**	0.11**	0.11**	0.06
	(0.05)	(0.05)	(0.05)	(0.05)
High IQ	0.16***	0.05	0.05	
	(0.03)	(0.03)	(0.03)	
Clunker	−0.25***	−0.24***	−0.24***	
	(0.03)	(0.03)	(0.03)	
ROPA$_t$	0.07*	0.06	0.06	0.06
	(0.04)	(0.04)	(0.04)	(0.06)
Constant	0.30***	−1.06***	−1.01***	3.09*
	(0.03)	(0.15)	(0.15)	(1.69)
Nobs	533,435	529,928	529,928	529,928
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.002	0.002	0.592

Table A.4: **Purchases of Eligible Cars by IQ: Unconstrained (Income Levels)**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_l + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where $Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero during July 2014 to January 2015 and July 2016 to January 2017. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We only keep the sample of Finnish men above the median income. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2017.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA$_t$	0.17***	0.17***	0.17***	0.19***
	(0.06)	(0.06)	(0.06)	(0.06)
High IQ × Clunker	−0.08**	−0.07*	−0.07*	
	(0.04)	(0.04)	(0.04)	
High IQ × ROPA$_t$	0.03	0.03	0.03	0.01
	(0.05)	(0.05)	(0.05)	(0.05)
Clunker × ROPA$_t$	0.10**	0.10**	0.10**	0.09*
	(0.05)	(0.05)	(0.05)	(0.05)
High IQ	0.14***	0.05	0.05	
	(0.03)	(0.03)	(0.03)	
Clunker	−0.34***	−0.31***	−0.31***	
	(0.03)	(0.03)	(0.03)	
ROPA$_t$	0.08**	0.07*	0.07*	0.06
	(0.04)	(0.04)	(0.04)	(0.05)
Constant	0.42***	−1.18***	−1.14***	−1.72
	(0.03)	(0.34)	(0.34)	(2.14)
Nobs	787,979	785,031	785,031	785,031
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.001	0.002	0.533

Table A.5: **Purchases of Eligible Cars by IQ: Constrained (Debt to Income)**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_l + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where $Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero during July 2014 to January 2015 and July 2016 to January 2017. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We only keep the sample of Finnish men above the median debt to income ratio. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2017.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA$_t$	0.09	0.08	0.08	0.10
	(0.06)	(0.06)	(0.06)	(0.07)
High IQ × Clunker	−0.09**	−0.07**	−0.08**	
	(0.04)	(0.04)	(0.04)	
High IQ × ROPA$_t$	0.06	0.06	0.06	0.05
	(0.05)	(0.05)	(0.05)	(0.05)
Clunker × ROPA$_t$	0.06	0.07	0.07	0.05
	(0.05)	(0.05)	(0.05)	(0.05)
High IQ	0.12***	0.04	0.04	
	(0.03)	(0.03)	(0.03)	
Clunker	−0.24***	−0.21***	−0.20***	
	(0.03)	(0.03)	(0.03)	
ROPA$_t$	0.08**	0.07*	0.07*	0.08
	(0.04)	(0.04)	(0.04)	(0.05)
Constant	0.31***	−0.74***	−0.70***	−0.79
	(0.03)	(0.16)	(0.16)	(1.78)
Nobs	541,367	539,128	539,128	539,128
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.002	0.002	0.566

Table A.6: **Purchases of Eligible Cars by IQ: Constrained (Income Levels)**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_l + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where $Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased an eligible car. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero during July 2014 to January 2015 and July 2016 to January 2017. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We only keep the sample of Finnish men below the median income. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2017.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA$_t$	0.01	0.01	0.00	−0.03
	(0.03)	(0.03)	(0.03)	(0.03)
High IQ × Clunker	−0.01	−0.02	−0.02	
	(0.02)	(0.02)	(0.02)	
High IQ × ROPA$_t$	0.02	0.02	0.02	0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Clunker × ROPA$_t$	0.09***	0.09***	0.09***	0.10***
	(0.02)	(0.02)	(0.02)	(0.03)
High IQ	0.02	0.01	0.01	
	(0.02)	(0.02)	(0.02)	
Clunker	−0.11***	−0.12***	−0.12***	
	(0.01)	(0.02)	(0.02)	
ROPA$_t$	0.01	0.00	0.00	0.02
	(0.02)	(0.02)	(0.02)	(0.03)
Constant	0.15***	−0.37***	−0.36***	1.22*
	(0.01)	(0.06)	(0.06)	(0.72)
Nobs	749,199	736,178	736,178	736,178
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.001	0.001	0.579

Table A.7: **Falsification: Purchases of Non-Eligible Cars by IQ**

This table reports the coefficient estimates from the following OLS regression:

$$\begin{aligned} Non-Eligible\ Car_{i,t} = \alpha &+ \beta_1 High\ IQ_i \times Clunker_{i,t-1} \times ROPA_t + \beta_2 High\ IQ_i \times Clunker_{i,t-1} \\ &+ \beta_3 High\ IQ_i \times ROPA_t + \beta_4 Clunker_{i,t-1} \times ROPA_t + \zeta High\ IQ_i \\ &+ \gamma Clunker_{i,t-1} + \nu ROPA_t + X'_{i.t}\delta + \eta_t + \eta_l + \eta_i + \epsilon_{i,t}, \end{aligned}$$

where $Non-Eligible\ Car_{i,t}$ is a dummy variable that takes the value of 1 if individual i purchased a non-eligible car. $High\ IQ_i$ equals 1 if normalized IQ is larger than 5. $Clunker_{i,t-1}$ is a dummy variable that takes the value of 1 of individual i owned a clunker in December 2014 before the announcement of the ROPA scheme. $ROPA_t$ is a dummy variable that takes the value of 1 during the ROPA period (July 2015 to January 2016) and zero during July 2014 to January 2015 and July 2016 to January 2017. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9 with 9 being the highest score. Demographic controls (X) include age, age^2, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki; η_t is full sets of year-month fixed effects; η_l is full sets of location fixed effects; η_i is full sets of individual fixed effects. We cluster standard errors at the individual level. The car purchase and ownership data come from the official Finnish car registry data discussed in Section II. The sample period is July 2014 to January 2017.

	(1)	(2)	(3)	(4)
High IQ × Clunker × ROPA$_t$	−0.01	−0.02	−0.02	−0.02
	(0.03)	(0.03)	(0.03)	(0.03)
High IQ × Clunker	−0.05**	−0.04*	−0.04*	
	(0.02)	(0.02)	(0.02)	
High IQ × ROPA$_t$	0.02	0.01	0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Clunker × ROPA$_t$	0.05**	0.06**	0.06**	0.05**
	(0.02)	(0.02)	(0.02)	(0.02)
High IQ	0.10***	0.02	0.02	
	(0.02)	(0.02)	(0.02)	
Clunker	−0.23***	−0.25***	−0.25***	
	(0.02)	(0.02)	(0.02)	
ROPA$_t$	−0.01	−0.03	−0.03	−0.06**
	(0.02)	(0.02)	(0.02)	(0.03)
Constant	0.29***	−0.77***	−0.77***	−1.35*
	(0.01)	(0.07)	(0.07)	(0.73)
Nobs	1,573,190	1,521,209	1,521,209	1,521,209
Controls		X	X	X
District FE			X	X
Individ FE				X
R2	0.001	0.002	0.002	0.505

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