LCERPA

Laurier Centre for Economic Research & Policy Analysis

LCERPA Working paper No. 2019-1

May 2019

The downside of being upbeat: The effects of consumer optimism on real economic activity

Edda Claus, Wilfrid Laurier University
and Viet Hoang Nguyen, University of Melbourne

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Edda Claus
Wilfrid Laurier University

Viet Hoang Nguyen
University of Melbourne

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Abstract: Using a quarterly consumer survey, we propose two novel measures of consumer optimism, *ex ante* optimism and *ex post* optimism. We demonstrate that excessive optimism about future family finances impacts the real economy. The excessive optimism (*ex ante* optimism) compels consumers to save less and borrow more, putting upward pressure on consumption growth. When family finances improve persistently less than expected (*ex post* optimism), consumers cut back on credit and save more which puts downward pressure on consumption growth. This saving and borrowing channel of the optimism bias is robust to age and income.

Keywords: Cognitive Bias, Saving, Borrowing, Consumption, Expectations Survey Data.

JEL classification: E71; D12; D14; D84.

*Corresponding author: Edda Claus, Department of Economics, Wilfrid Laurier University, 75 University Avenue West, Waterloo ON, N2L 3C5, Canada, eclaus@eddaclaus.com; Viet H. Nguyen, MIAESR, The University of Melbourne, Level 5, FBE Building, 111 Barry Street, Carlton VIC 3010, Australia, vietn@unimelb.edu.au. We thank Bradley Ruffle, Brian McCaig, Stefano DellaVigna, Azim Essaji, Christine Neill, Hashmat Khan, participants at the 51th Annual Conference of the CEA, 2 - 4 June 2017 at St Francis Xavier University, Antigonish, Canada, and participants at the 2018 China Meeting of the Econometric Society, 15 - 17 July 2018 at Fudan University, Shanhai, China for helpful comments and suggestions.

"*Beliefs exhibit epistemic irrationality to the extent that they are badly supported by the evidence available to the agent, or are maintained despite counter-evidence which is available to the agent.*"

Jefferson et al. (2017, p.3)

1 Motivation

Using a quarterly consumer survey, we propose two novel measures of consumer optimism that capture two characteristics of a cognitive bias. Including the bias measures in two vector autoregression models with exogenous factors (VARX) reveals real macroeconomic implications of the optimism bias through its impact on consumer saving and borrowing decisions, a new result. *Ex ante*, excessive optimism about future family finances compels consumers to increase consumption by borrowing more and saving less. *Ex post*, when actual family finances improve less than expected, consumption growth falls as consumers cut back on borrowing and save more. Exploring further the saving and borrowing channel of the optimism bias reveals that optimism translates into higher borrowing for lower income households, and into lower savings for higher income households and results are persistent over a person's lifetime.

Homo economicus objectively processes all available relevant information to forecast the future. There is no room for systematic biases in expectations because errors are costly.[1] Psychologists maintain that human behavior is more complex and that expectations reflect cognitive evaluations and emotional responses. To illustrate, Figures 1 and 2 give consumer responses from the Consumer Attitudes, Sentiments and Expectations (CASiE) survey, the Australian version of the Michigan Survey of Consumers.[2] Expected family finances (*ExpFamFin*) relates to expected family finances for next year and Expected Economic Conditions (*ExpEcon*) relates to expected economic conditions for the next year. A detailed description of the data is in Section 2 below. The graphs show the proportion of respondents nominating better family finances for next year (*ExpFamFin*) minus the proportion of respondents nominating worse family finances for next year. Expected economic conditions (*ExpEcon*) are calculated analogously. Adding 100 to the calculations means that 100 is the break even point where expected improvements equal expected deteriorations. Above (below) 100, improvements are greater (less) than deteriorations. To compare expectations with outcomes, Figure 2 plots current family finances compared to 1 year ago (*CurFamFin*) and expected family finances lagged one year ($ExpFamFin_{t-4}$).[3]

[1] Information rigidities (Sims, 2003; Reis, 2006) lead to transient but not persistent biases.

[2] Claus and Nguyen (2018, 2019) demonstrate that CASiE maps closely into the Michigan Survey.

[3] The responses to $ExpFamFin_{t-4}$ and to $CurFamFin_t$ are from different consumers. It is sensible to compare the two indexes because CASiE is a representative survey. It is this representativeness of the

Insert Figures 1 and 2 here

Economists have difficulties explaining the plotted data. Four points arise from the two figures. (1) Consumers are generally more optimistic about future family finances than about future economic conditions, ($ExpFamFin_t > ExpEcon_t$); (2) Consumers generally expect family finances to improve over the next year ($ExpFamFin_t > 100$); (3) Consumers generally state that current family finances have deteriorated compared to 1 year ago ($CurFamFin_t < 100$); and (4) There is a persistent gap between expected family finances and their actual outcomes ($ExpFamFin_{t-4} > CurFamFin_t$). The two figures seem to suggest that consumers have a persistent optimistic outlook on their finances and demonstrate little evidence of realizing that their expectations are overly optimistic. This cannot be easily explained by an economist. A psychologist points to a person's cognitive bias of optimism, an innate predisposition to be positive about expected personal outcomes.

The purpose of this paper is straightforward. We test empirically whether the optimism bias that Figures 1 and 2 seem to imply has real economic implications. We propose two optimism bias measures to capture the two aspects of a cognitive bias: a belief that is badly supported by evidence (*ex ante* optimism) and a belief that is maintained despite counter-evidence (*ex post* optimism); see the Jefferson et al. (2017) quote above. We demonstrate that both aspects of the cognitive bias impact real economic activity.

Our empirical results strongly support the theoretical predictions of Brunnermeier and Parker (2005) who developed a model of 'optimal expectations' that gives rise to consumers who have an overconfident outlook on wealth that systematically distorts consumer saving and consumption decisions away from the rational expectations outcomes. Appendix A gives a brief exposition of the Brunnermeier and Parker (2005) model to demonstrate the theoretical foundations of our empirical findings.

A substantial body of literature exists on the role of expectations, animal spirits and sunspots in business cycles where empirical studies have relied on consumer sentiment data to investigate if changes in consumer expectations reflect tangible economic factors or some intangible psychological factors. Applications so far have focused on absolute consumer expectations, *i.e.*, expectations on macroeconomic or household specific variables or an aggregation of both. Results have been mixed; see, for example Barsky and Sims (2012) for evidence that innovations in expectations mainly reflect economic news, Chauvet and Guo (2003) for evidence that they are driven by psychological factors and Beaudry and Portier (2014) for a detailed overview of the literature. Our findings suggest that relative expectations of household outcomes compared to macroeconomic outcomes

survey that allows the creation of a time series from consumer responses although van Oest and Franses (2008) caution on the interpretation of results.

are more appropriate and that persistent errors in expectations impact real economic activity, areas yet to be explored in the business cycle literature.

The remainder of the paper is organized as follows. Section 2 presents the survey questions and outlines the construction of the two optimism bias measures. Section 3 examines the macroeconomic implications of consumer optimism by applying two VARX to the bias measures. Section 4 explores the saving and borrowing channel of the optimism bias further by mapping the optimism measures to consumer borrowing and saving decisions from the CASiE survey and again applying a VARX. Section 5 formally tests for the presence and persistence of the two bias measures. Section 6 offers some concluding remarks. Detailed results from our robustness exercises are provided in an Online Appendix.

2 Optimism bias

The CASiE survey is a compelling choice of dataset to develop measures of consumer optimism. Most importantly, CASiE time series map into macroeconomic variables. This means the proposed bias measures can be directly included in a macroeconomic VARX to investigate the macroeconomic implications of optimism not just the implications for individual households; see Hyytinen and Putkuri (2018). In addition, CASiE also canvasses consumer saving and borrowing behavior to corroborate the savings and borrowing channel of the optimism bias discussed in Section 4 below.

2.1 Consumer survey data

The CASiE survey started in March 1973 and has been a monthly telephone survey since 1990 with a sample size of 1200 households. The sample is stratified by age, gender and state so that it is representative of the Australian population. Responses are cross-classified by age, gender, state, capital city, education, occupation, household income, work status, voting intention and home ownership. As in the Michigan Survey of Consumers, responses are expressed as indexes, detailed below. Unlike the Michigan Survey, no households are reinterviewed so that the survey is a pure repeated cross-section. While the CASiE survey is monthly, the saving and borrowing questions are quarterly, starting in September 1994 and ending in December 2015. Our empirical analysis, hence, only uses the quarterly surveys that contain both consumer expectations and saving decisions.

We use the answers to three core CASiE questions, on current family finances, on expected family finances and on expected economic conditions. The questions are:

Q1. Current Financial Situation (*CurFamFin*)

First about how people are getting along financially these days? Would you say you and your family are better-off financially or worse-off than you were at this time last year?

1. Better-off
2. Same
3. Worse-off
4. Uncertain/Don't Know/It depends

Q2. Future Financial Situation (*ExpFamFin*)

Looking ahead to this time next year. Do you expect you and your family to be better-off financially, or worse-off, or about the same as now?

1. Better-off
2. Same
3. Worse-off
4. Uncertain/Don't Know/It depends

and

Q3. Future Economic Conditions (*ExpEcon*)

Thinking of economic conditions in Australia as a whole. During the next 12 months, do you expect we'll have good times financially, or bad times, or what?

1. Good times
2. Good with qualifications
3. Some good, some bad
4. Bad with qualifications
5. Bad times
6. Uncertain/Dont Know/It depends

The family finance indexes are calculated as the weighted proportion of respondents selecting '1.' 'Better-off' minus the share of respondents selecting '3.' 'Worse-off' plus 100. For expected economic conditions, the share of respondents selecting '4.' 'Bad with qualifications' and '5.' 'Bad times' is subtracted from the share of respondents selecting '1.' 'Good times' and '2.' 'Good with qualifications' plus 100. Adding 100 to the calculation means that 100 is the break-even point where the share of respondents selecting better-off equals the share of respondent selecting worse-off. Each index is bounded between 0, all respondents selected worse-off, and 200, all selected better-off. Descriptive statistics are in Table 1.

Insert Table 1 here

2.2 Measuring the optimism bias, *ex ante* and *ex post*

A person's innate predisposition to be optimistic about the future is a well established concept in psychology; see Shepperd et al. (2015), Jefferson et al. (2017) and Moskowitz (2013). People exhibit a general disposition toward a positive outlook and are even more positive when the outlook is about the self compared to others. The former is often referred to as 'absolute optimism', the incorrect actuarial risk assessment, and 'relative optimism' one's incorrect risk assessment compared to others, *ceteris paribus*. This cognitive state leads to unrealistically positive beliefs and predictions. We specify these expectations as beliefs and predictions about the future rather than desires and hopes about the self and the future. Beliefs and predictions are central concepts in economics; they are key whenever a decision today affects an outcome tomorrow. It is not clear if and how absolute and relative optimism are related (Jefferson et al., 2017) and whether the biases are fixed (McKay and Dennett, 2009) and evolutionarily stable (Johnson and Fowler, 2011) or whether they reflect lifetime experiences (Peterson, 2000 and Dweck, 2009).

Psychological biases are unobservable and psychologists maintain that they affect consumer expectations and behaviour which should impact real economic outcomes. We propose two measures of the psychological bias of optimism using consumer survey data.

Let Δy_{t+q} denote changes in general economic conditions in q quarters and Δy^*_{t+q} consumers' subjective expectation of Δy_{t+q}, conditional on information available at time t, or:

$$\Delta y^*_{t+q} = E_t(\Delta y_{t+q}|\Omega_t) = f\left(\Delta \mathbf{x}_t, u_t\right), \tag{1}$$

where Ω_t denotes the information set available to consumers at time t, $\Delta \mathbf{x}_t$ is a vector of economic information publicly and/or privately available to consumers at time t and $u_t \sim (0, \sigma_u)$ captures idiosyncratic errors in forecasting economic conditions.

Similarly, let Δg_{t+q} denote changes in the actual household financial conditions in q quarters and Δg^*_{t+q} consumers' subjective expectation of Δg_{t+q} conditional on information available at time t. Assuming these subjective expectations depend on the consumers' subjective expectations of general economic conditions, then Δg^*_{t+q} can be expressed as:

$$\Delta g^*_{t+q} = E_t(\Delta g_{t+q}|\Omega_t) = f\left(\Delta \mathbf{x}_t, u_t, z_t\right), \tag{2}$$

where z_t captures consumers' errors in forecasting household financial conditions. Consumer-specific circumstances (fixed effects) are unchanged or change slowly over time. As Δy^*_{t+q} and Δg^*_{t+q} are expected changes, the impact of consumer fixed effects is negligible.[4]

[4]This is analogous to applying a first-difference transformation in a panel regression to discount within-group fixed effects.

Ex ante optimism bias measure

From equations (1) and (2), z_t, consumer errors in forecasting household financial conditions in excess of errors in forecasting general economic conditions, can be measured as:

$$z_t = \Delta g^*_{t+q} - \Delta y^*_{t+q}, \tag{3}$$

If consumers are rational, $z_t \sim (0, \sigma_z)$. However, if $E(z_t) \neq 0$, i.e. Δg^*_{t+q} is persistently and systematically different from Δy^*_{t+q}, a consumers' psychological bias does persist and affects their subjective expectations of household financial conditions. In such case, z_t can be expressed as:

$$z_t = \epsilon_t + v_t, \tag{4}$$

where $\epsilon_t \sim (\theta, \sigma_\epsilon)$ captures the consumers' psychological bias while $v_t \sim (0, \sigma_v)$ is the consumers' idiosyncratic errors in forecasting household financial conditions.

As ϵ_t is unobservable, we will use z_t as a proxy for ϵ_t. If $E(z_t) > 0$, consumers, at the aggregate level, expect improvements in family finances in excess of improvements in the economy and would suggest that consumers, at the aggregate, believe they can outperform the economy. We term z_t *ex ante* optimism, defined as the incorrect risk assessment relating to the outlook about the self in excess of the incorrect actuarial risk assessment relating to the general outlook.

Using $ExpFamFin_t$ as a proxy for Δg^*_{t+q} and $ExpEcon_t$ as a proxy for Δy^*_{t+q}. We propose to measure the *ex ante* consumer optimism bias using expectations data as follows:

$$\hat{z}_t = AnteOptim_t = ExpFamFin_t - ExpEcon_t, \tag{5}$$

Practically, expectations on family finances $ExpFamFin_t$ encompass expectations about the economy $ExpEcon_t$ and household specific forecasts. For example, if consumers expect robust economic growth this will put upward pressure on their household specific expectations on family finances. In fact, over much of the sample period, world commodity prices rose sharply, putting upward pressure on incomes in Australia, a large commodity exporter. In times of continuously rising commodity prices, it is reasonable for Australian households to expect rising incomes that should put upward pressure on family finances. Here, we want to remove these expected business cycle influences on the expectations on family finances. The proposed measure is a lower bound of the overall optimism bias as it mainly reflects relative optimism.

Ex post optimism bias measure

Economic theory posits that, although consumers may be wrong on occasions, mistakes

should be stochastic. Psychologists maintain that errors are likely deterministic. People selectively process and evaluate information with favorable implications for the self and avoid information with negative implications for the self; see Moskowitz (2013). The bias reflects the need to maintain and enhance self-esteem; see Forsyth (2008) and García et al. (2016). And if benefits of biases in mental and physical health (Alloy and Abramson, 1979, and Taylor and Brown, 1988, 1994) increase performance and productivity (Dawson et al., 2002 and Compte and Postlewaite, 2004) the marginal benefits of biases offset their marginal costs allowing a stable equilibrium with biases.

To explore if optimism is maintained despite available evidence, we compare expectations of family finances to actual outcomes. As discussed above, the responses to $ExpFamFin_{t-4}$ and to $FamFin_t$ are from different consumers. It is nonetheless sensible to compare the two indexes because CASiE is a representative survey. It is this representativeness of the survey that allows the creation of a time series from consumer responses from different households although van Oest and Franses (2008) caution on the interpretation of results.

Formally, let $\Delta\hat{g}_t$ denote consumers' reported changes in their household financial conditions compared to q quarters ago. Hence, the consumers' realised errors in forecasting household financial conditions can be expressed as:

$$e_t = \Delta g_t^* - \Delta\hat{g}_t, \tag{6}$$

where $\Delta g_t^* = E_{t-q}(\Delta g_t|\Omega_{t-q})$. If consumers are rational then $e_t \sim (0, \sigma_e)$. However, if $E(e_t) \neq 0$, *i.e.*, consumers' forecast changes in their household financial conditions, Δg_t^*, that are persistently and systematically different from their realisations, $\Delta\hat{g}_t$, then the psychological bias does persist and systematically influences consumers' subjective expectations of household financial conditions. From equation (2), e_t can be further decomposed as:

$$e_t = \hat{z}_t + \hat{u}_t = \hat{\epsilon}_t + \hat{v}_t + \hat{u}_t, \tag{7}$$

where $\hat{\epsilon}_t$, $\hat{v}_t$, and $\hat{u}_t$ are realised quantities. Consumers' realised forecast errors comprise of idiosyncratic errors relating to forecasting general economic conditions and household financial conditions as well as the effects of the optimism bias. We propose to measure the *ex post* optimism bias e_t using consumer survey data as:

$$\hat{e}_t = PostOptim_t = ExpFamFin_{t-4} - CurFamFin_t, \tag{8}$$

where we use $CurFamFin_t$ as a proxy for $\Delta\hat{g}_t$. Figure (3) plots the time series of our two bias measures and Table (1) provides their descriptive statistics.

Insert Figures 3 and 1 here

3 Effects of optimism on the macroeconomy

To investigate whether consumer optimism affects real economic activity we apply a VARX to our proposed optimism bias measures together with key aggregate variables that represent real economic activity in the household sector. These exogenous variables control for common factors that may drive the bias measures as well as aggregate economic variables. VAR models are popular in macroeconomics. They are parsimonious data-driven multivariate time-series models that fit macroeconomic data relatively well and are used to approximate underlying theoretical relationships; see Stock and Watson (2001).

3.1 Empirical framework

The interactions between the consumer optimism bias and real economic activity can be approximated by the following VARX(p, q) model:

$$\mathbf{y}_t = \boldsymbol{\alpha} + \sum_{i=1}^{p} \boldsymbol{\phi}_i \mathbf{y}_{t-i} + \sum_{j=0}^{q} \boldsymbol{\theta}_j \mathbf{x}_{t-j} + \boldsymbol{\epsilon}_t, \tag{9}$$

where $\boldsymbol{\alpha}$ is a vector of constants; $\mathbf{y}_t = (\mathbf{a}_t', Optimism_t)$ is a vector of endogenous variables containing the consumer optimism bias measure, $Optimism_t$, and a vector of aggregate economic variables representative of real activity in the household sector, $\mathbf{a}_t$. $\mathbf{x}_t$ is a vector of exogenous variables to control for common factors affecting variables in $\mathbf{y}_t$. $\boldsymbol{\epsilon}_t$ is a vector of error terms. The VARX(p, q) model in equation (9) allows for possible information rigidities in expectations formations through the lags on both endogenous and exogenous variables; see Claus and Nguyen (2018, 2019).

To investigate the impacts of consumers' *ex ante* optimism and *ex post* optimism on real activity, we estimate two VARX models, one for each measure, $Optimism_t = \{AnteOptim_t, PostOptim_t\}$. To proxy for real activity in the household sector, we use year-end growth in real household consumption ($Consump_t$), the household saving ratio ($SavRatio_t$) and year-ended growth in personal credit ($PersCredit_t$). Hence, $\mathbf{a}_t = [Consump_t, SavRatio_t, PersCredit_t]'$. Year-ended growth rates are used to be consistent with the forecast/assessment horizon in the consumer expectations data (12 months ago and next 12 months).

The selected economic variables in $\mathbf{a}_t$, directly or indirectly, capture the major sources of fluctuations in the domestic economy. Given that Australia is a small open economy, we

use foreign variables to control for common factors that may affect the endogenous variables in $\mathbf{y}_t$. Specifically, we use US industrial production ($USIndP_t$, year-ended growth) to proxy for foreign economic activity, the US fed funds rate ($FedFunds_t$) to proxy for foreign financial conditions and monetary policy, and the US S&P 500 index ($SP500_t$, year-ended growth) to proxy for foreign financial market conditions. Hence, $\mathbf{x}_t = [USIndP_t, FedFunds_t, SP500_t]'$.

The error terms in $\boldsymbol{\epsilon}_t$ for each equation in the VARX system in (9) give the surprise changes for each variable; see Stock and Watson (2001). Impulse response analysis traces the effects of a surprise change in one variable on the other variables in the system over time. To identify a surprise change in consumer optimism, we use the Cholesky decomposition and place the optimism measure last among the endogenous variables. Using this identification strategy, we are agnostic about other domestic sources of influences (*i.e.* domestic shocks) on real activity and only focus on the influence of consumer optimism.

In our empirical analysis, the two VARX models are estimated with 1 lag for the endogenous and 1 lag for the exogenous variables with the lag lengths based on the Schwarz information criterion (SIC). For robustness checks, we re-estimate the VARX models with a longer lag length (2 lags for all variables). We implement different specifications where $\mathbf{x}_t$ is proxied by latent factors constructed from a batch of major domestic and foreign economic variables, and where $\mathbf{x}_t$ is also treated as endogenous variables. In all alternative specifications, the bias measures are also ordered last, as such movements in $\mathbf{y}_t$ that are not explained by surprise changes to fundamentals are attributable to surprise changes to the bias measures. The results are qualitatively similar to our baseline results and are in the Online Appendix.

3.2 Estimation results

Figures 5 and 6 explore the effects of the optimism bias on the real economy. The figures give the responses of endogenous variables to a one standard deviation shock to the error term of the bias measure equation. We will use the short hand of 'the response to a shock in optimism'. Figure 5 gives the impulse response analysis of a shock to the *ex ante* optimism measure on household consumption growth, the household saving ratio and personal credit growth and Figure 6 gives the impulse responses to shocks to the *ex post* optimism measure. As the control variables in $\mathbf{x}_t$ representing foreign economic conditions are assumed exogenous in the VAR systems, there are no responses from them.[5]

[5]Adding control variables to the endogenous part of the VAR systems, *i.e.* allowing for dynamic interactions between control variables and consumer expectations, does not affect the overall conclusions but only their statistical significance. This likely means that the endogeneity assumption for control variables does not hold. All VARX robustness checks are in the Online Appendix.

Insert Figures 5 and 6 here

The symmetry in the two sets of results is remarkable; the two sets of graphs seem like reflections of one another. A positive shock to *ex ante* optimism puts upward pressure on household consumption growth and personal credit growth and puts downward pressure on the household savings ratio. A positive shock to *ex post* optimism has the opposite effect. Consumption growth and personal credit growth decline and the household savings ratio rises. Overall, statistical significance is more pronounced is response to an innovation in *ex ante* optimism as the *ex ante* optimism measure is a cleaner measure of the optimism bias. Specifically, equation (7) demonstrates that the *ex post* optimism measure also contains the consumers' idiosyncratic errors in forecasting general economic conditions (likely resulting from surprise changes in economic conditions).

The response of consumption growth to a positive innovation to *ex ante* optimism is surprisingly large. Consumption growth rises by about 0.1 percentage points in each of the first three quarters after the shock before slowly decaying back to zero. Over the first year following the shock, consumption growth is about 0.15 percentage points higher. Given household consumption is nearly 60% of GDP, an *ex ante* optimism shock adds about 0.1 percentage point to annual GDP growth. The responses of saving and credit growth are also surprisingly large. The savings ratio declines with the trough at about a -0.3 percentage point decline in the fourth quarter after the shock and slowly converging back to zero. The response of personal credit growth builds over the first three quarters and peaks at about a 0.6 percentage points rise before slowly converging back to zero.

The response of consumption growth, credit growth and the saving ratio to a positive innovation to *ex post* optimism is almost the exact opposite to an innovation in *ex ante* optimism. Consumption growth declines over the first three quarters to a trough of about -0.11 percentage points before slowly converging back to zero. The savings ratio rises and peaks at about a rise of 0.3 percentage points in the fourth quarter after the *ex post* optimism shock while personal credit growth declines to trough at about -0.6 percentage points. Both converge slowly back to zero thereafter.

4 The saving and borrowing channel of optimism

Figures 5 and 6 are compelling in demonstrating the impact of a cognitive bias on real economic activity but may not be entirely convincing, due to the lack of a mapping from surveyed consumer expectations (and hence, bias measures) to real economic activity. This warrants further investigation of the saving and borrowing channel of consumer

optimism. The CASiE survey includes a quarterly saving and borrowing module that we utilize. We present aggregate results and also disaggregate consumers by age and income.

Saving decisions are typically explored along life-cycle dimensions where households save to smooth consumption over their lifetime and business-cycle dimensions that impact precautionary savings, and that impact credit availability and interest rates. Two other examples of researchers formally exploring the effects of cognitive biases on savings is Loewenstein et al. (2005) whose theoretical model shows the effects of people's projection bias (the general bias in predicting one's future tastes) on their consumption and savings decisions and Choi et al. (2011) who demonstrate empirically sub-optimal retirement investment of employees at seven U.S. companies. Disaggregating savings by age should capture life-cycle effects while disaggregating savings responses by income should capture income effects and varying degrees of financial literacy (Lusardi and Mitchell, 2007).

4.1 Consumer survey data, savings and borrowing decisions

We link consumer responses to questions *CurFamFin*, *ExpFamFin* and *ExpEcon* to their reported household saving behavior. We use responses to the following question:

Q4. Household Savings
Which one of the following statements best describes the present situation of your household?

1. We are running into debt
2. We are having to draw on our savings
3. We are managing to make ends meet on our income
4. We are saving a little
5. We are saving a lot
6. None/Don't know

The data are the proportion of respondents nominating answers '1.' to '5.' Table 2 gives the descriptive statistics at the aggregate level and responses disaggregated by age and income. Households are divided into four age groups, aged 18 to 24 years, 25 to 44 years, 45 to 64 years and 65 years and over. For income, consumers are divided into six income groups (all incomes are in Australian dollars per year): households earning less than $20,000; households earning between $20,000 and $40,000; households earning between $40,0000 and $60,000; households earning between $60,000 and $80,000; households earning between $80,000 and $100,000; and households earning over $100,000. The shares (sums of each row) may not add to 100 percent as some respondents nominate answer 6. None/Don't know.

Insert Table 2 here

CASiE is a representative survey of the Australian population. Table 2 shows that, at the aggregate, the majority of Australian consumers either save a little (*SavLittle*) about 39% or make ends meet (*MakeEnds*) about 38%. About 9% of consumers save a lot (*SavLots*) or draw on savings (*DrawOnSav*) and about 5% are running into debt (*RunInDebt*).

Against the permanent income hypothesis, late career consumers, those aged 45 to 64, stand out. At this age, workers are at their peak earning and are getting close to retirement. So, this age group should be saving and their propensity to save should be higher than those aged 25 to 44. Results in Table 2 do not align with these theoretical propositions. Late career consumers save less and dissave more than consumers earlier in their careers. About 36% and 8% of late career consumers state they are saving a little or a lot compared to 42% and 10% for earlier career consumers. A higher proportion of late career workers is also making ends meet and drawing on savings, about 39% and 10%, compared to early career consumers, about 34% and 7%. Perhaps worryingly, a non-negligible share of the over 65 year olds, about 1.7%, are running into debt.

The bottom part of Table 2 gives the descriptive statistics by income. Two points stand out in the table. The first is that the proportion of consumers running into debt changes relatively little as household income rises. The share of consumers running into debt falls from just under 6% for those earning between $20,000 and $40,000 to about 3% for those earning more than $100,000. *A priori*, one might have expected a larger decline in borrowing as income rises. This leads to the second noteworthy point, higher income households seem less financially secure than perhaps initially expected. A surprisingly large share of consumers earning $80,000 to $100,000 are making ends meet, about 28%. This share falls to about 21% of consumers earning over $100,000, suggesting that about a quarter of the highest income brackets are not saving, but are just making ends meet. A surprisingly large share of these high income groups is also dissaving. About 6% of those earning $80,000 to $100,000 and about 5% of those earning over $100,000 are drawing on savings. These shares add to the about 3% of consumer running into debt. Australian households are highly indebted; household debt as a share of disposable income was 173% in the fourth quarter 2015 with the lion's share representing housing debt, about 127%.[6] Table 2 suggests that high income households have few financial assets to fall back on which leaves them excessively exposed to small rises in interest rates and small declines in house price, a concern for policy makers.

[6]Reserve Bank of Australia, Table E2 Household Finances - Selected Ratios, `http://www.rba.gov.au/statistics/tables/`; accessed 28 February 2019.

4.2 Empirical framework

To investigate the effects of the optimism bias on consumer saving and borrowing decisions, we estimate the following VARX(p, q) model:

$$\mathbf{y}_t = \boldsymbol{\alpha} + \sum_{i=1}^{p} \boldsymbol{\phi}_i \mathbf{y}_{t-i} + \sum_{j=0}^{q} \boldsymbol{\theta}_j \mathbf{x}_{t-j} + \boldsymbol{\epsilon}_t, \tag{10}$$

where $\boldsymbol{\alpha}$ is a vector of constants; $\mathbf{y}_t = (Optimism_t, \mathbf{s}_t')$ is a vector of endogenous variables capturing consumer optimism and saving and borrowing decisions. Specifically, $\mathbf{s}_t =$($RunInDebt_t$, $DrawOnSav_t$, $MakeEnds_t$, $SavLots_t$, $SavLittle_t$)$'$ is a vector of current saving and borrowing decisions where *DrawOnSav* denotes the proportion of consumers who 'draw on savings', *RunInDebt* 'run into debt', *MakeEnds* 'make ends meet', *SavLots* 'saving a lot', and *SavLittle* 'saving a little'.

Consumer expectations (captured in $Optimism_t$) and their reported saving and borrowing decisions (captured in $\mathbf{s}_t$) are derived from the same survey and reflect consumers' endogenous expectations-formation and decision-making processes. Therefore, $\mathbf{y}_t$ is treated as endogenous in the model above. For consistency, we only use the *ex ante* optimism bias measure, (*i.e.*, $Optimism_t = AnteOptim_t$). $AnteOptim_t$ and $\mathbf{s}_t$ are extracted from the consumer survey at time t on the same random panel of consumers. $ExpFamFin_{t-4}$ in the $PostOptim_t$ optimism measure is extracted from the consumer survey at time $t-4$ on a different random panel of consumers which may not map consistently into $\mathbf{s}_t$.

The vector of exogenous factors $\mathbf{x}_t$ is to control for general economic conditions at time t that impact both consumer expectations and saving behaviour. Consumer expectations formations and subsequent saving decisions at time t are likely conditional on observed economic information at time t. Therefore, $\mathbf{x}_t$ is treated as exogenous so that $\mathbf{x}_t$ and its lags are allowed to affect $\mathbf{y}_t$, but not the other way around. Robustness checks, presented in the Online Appendix, demonstrate that treating $\mathbf{x}_t$ as endogenous (which allows for dynamic interactions between consumer expectations, saving behaviour and general economic information), does not change the results qualitatively or quantitatively. As before, lags on $\mathbf{x}_t$ allow for possible information rigidities in consumer expectations formations.

To minimize the loss of degrees of freedom, we construct latent principal components (PCs) from a batch of major economic series representative of both domestic and foreign economic conditions. This allows estimating a parsimonious model while controlling for major domestic and foreign factors affecting consumer expectations and saving behaviour. Specifically, we construct the PCs from 14 major domestic and international economic data series that are publicly available. They are: the unemployment rate, the

target cash rate (Australia's monetary policy rate), the Sydney Stock Exchange share price index (ASX/S&P200), the consumer price index (CPI), real gross domestic product (GDP), total credit, total monthly hours worked, retail trade, dwelling approvals, the AUD/USD exchange rate, the Reserve Bank of Australia commodity price index, US industrial production, the US S&P500 index, and the US fed funds rate. All series are released on a monthly basis, except for quarterly Australian CPI and GDP. Prior to the construction of the PCs, the monthly series are converted into quarterly frequency using the last observation of each quarter to match with the quarterly CASiE surveys. Following the PC analysis, the first five PCs account for more than 65% of variations in the 14 economic series. However, we only use the first and the second PCs as exogenous factors in our model, $\mathbf{x}_t = (pc1_t, pc2_t)'$. Adding additional PCs as exogenous factors does not change the results qualitatively or quantitatively. Panel B in Table 3 provides the descriptive statistics for the 14 chosen economic data series and the constructed PCs, and Figure 4 plots them.

Insert Table 3 and Figure 4 here

In our empirical analysis, we estimate the VARX(1,1) model in equation (10).[7] To identify a surprise change (shock or innovation) to the consumer optimism bias, we argue that a shock to the consumer cognitive bias affects consumer saving decisions contemporaneously, but shocks to saving decisions do not affect consumer biases contemporaneously.[8] So, we order $AnteOptim_t$ first in our model and use the Cholesky decomposition (recursive ordering) to identify a shock to the consumer optimism bias as the first orthogonal shock in the system. An innovation in *ex ante* optimism feeds immediately into saving and borrowing decisions at time t and in the following periods, ($RunInDebt_{t+h}$, $DrawOnSav_{t+h}$, $MakeEnds_{t+h}$, $SavLots_{t+h}$, $SavLittle_{t+h}$) for $h = 0, 1, 2, ...$, until its effects have died out. The effects of surprise changes in saving and borrowing decisions at time t, however, only feed into optimism from time $t+1$ onwards reflecting the recursive ordering to identify a surprise change in confidence. [9]

4.3 Estimation results

Figures 7 to 9 graph the impulse responses of $s_t^i \in \mathbf{s}_t = (RunInDebt_t, DrawOnSav_t, MakeEnds_t, SavLots_t, SavLittle_t)'$ to a one standard deviation shock to the error term of

[7] VARX(1,1) is selected based on the Schwarz Information Criterion.

[8] We have verified that the bias measure is not driven by inflation or inflation expectations. Regressing the optimsm bias measure on inflation and inflation expectations gives insignificant coefficients.

[9] For impulse response analysis in a VAR system, see Lütkepohl (1991).

equation $AnteOptim_t$. Again, we will use the short hand of 'the response to a shock in $AnteOptim_t$'. All impulse responses converge back to zero after around 8 to 10 quarters.

The impulse response functions are responses in financial flows. For example, in response to a positive shock in optimism, fewer consumers save but this drop in the proportion of savers is temporary, because all impulse response functions converge back to zero. However, although there is no net response on the proportion of savers, the stock of savings is lower with the positive confidence shock than without the shock. If fewer people save even just temporarily, fewer assets are accumulated. So, although there are no long term flow responses, there are long term effects on the stock of assets. Similarly, a temporary increase in the proportion of consumers running into debt leads to a permanent increase in the stock of debt.

Again, the CASiE survey is representative of the Australian population so survey responses can be translated into its number of Australian consumers. The discussion below gives the percentage point (p.p.) changes in the proportion of consumers and the actual number of consumers this represents.

4.3.1 Aggregate results

Figure 7 gives the saving and borrowing responses to shocks in the *ex ante* optimism bias measure ($AnteOptim_t$). The figure suggests that a shock in the *ex ante* optimism bias measure mainly affects saving. Consumers immediately draw on savings, $DrawOnSav_t$ rises almost 0.5 p.p. (about 90,000 people), while the proportion of consumers who save falls. The proportion of consumers saving a little falls immediately, $SavLittle_t$ declines 0.4 p.p. (about 72,000 people), and the decline in the proportion of consumers saving a lot $SavLots_t$ troughs at -0.4 p.p. (about -72,000 people) in the second quarter.

Insert Figure 7 here

4.3.2 Results by age and income

Figures 8 and 9 present the impulse response functions when households are disaggregated by age and by income. All impulse responses are stable and converge back to zero after around 10 quarters.

Figure 8 gives the impulse responses of shocks to the *ex ante* optimism bias measure disaggregated by age. The results suggest that the optimism bias impacts saving decisions, particularly for later career consumers (aged 45 to 64) and older consumers (aged 65 and

over). Later career consumers save a lot less ($SavLots_t$) with the proportion of this age group saving a lot less declining 0.4 p.p. and remaining statistically significantly negative for five quarters. This age group of consumers seems to move from saving a lot to making ends meet, $MakeEnds_t$ rising about 0.7 p.p. and also remaining statistically significantly positive for five quarters. These results may be cause for concern. This age group is close to retirement and should be building up savings rapidly rather than simply making ends meet. In response to an *ex ante* optimism shock, older consumers save less, $SavLots_t$ declining about 0.4 p.p. in the first two quarters.

Insert Figure 8 here

Figure 9 gives the impulse response analysis when consumers are disaggregated by income. Low income earners seem to react the least to changes in optimism. For this income group, impulse responses converge back to zero quickly. For lower income earners (with income \$20,000 to \$40,000) and around median income earners (with income \$40,000 to \$60,000), shocks to *ex ante* optimism lead to a rise in borrowing, $RunInDebt_t$ up about 0.4 p.p. and about 0.8 p.p., and a decline in saving a little, $SavLittle_t$ down about 1 p.p. and about 1.2 p.p. At the higher income end, those earning \$80,000 to \$100,000, the shocks lead to a decline in consumers saving a lot, $SavLots_t$ down about 1.5 p.p. For high income earners, those with income above \$100,000 *ex ante* optimism shocks lead to a draw-down in savings, $DrawOnSav_t$ rises about 0.9 p.p., an increase in debt, $RunInDebt_t$ rising about 0.3 p.p, and a decline in saving, $SavLots_t$ falling about 1.0 p.p. It is interesting that the responses of high income earners also include running into debt and bodes well with the fact that household debt in Australia is held by the rich.

Consumers with income of \$60,000 to \$80,000 increase debt holdings with $RunInDebt_t$ rising about 0.6 p.p. while consumers in the next higher income group \$80,000 to \$100,000 seem to move from making ends meet to saving a little, $MakeEnds_t$ down about 1.5 p.p. and $SavLittle_t$ up about 1.9 p.p. The reaction of the higher income group is rather interesting. Recall that $AnteOptim_t$ is the difference between $ExpFamFin_t$ the positive outlook on family finances and $ExpEcon_t$ the positive outlook on the economy in general so that $AnteOptim_t$ can be thought of as the illusionary income growth. Maybe the illusionary income growth of the \$80,000 to \$100,000 income group leads to this group‘s adjusting retirement plans. Higher expected income growth might make people move their retirement age closer which could compel them to save more (and consume less) to reach the retirement income goal earlier.

Insert Figure 9 here

5 Optimism bias, testing presence and persistence

Cognitive biases may not be constant over a person's lifetime. Some psychologists suggest that young and old people are more optimistic than middle age people; see Moutsiana et al. (2013), pointing to a perhaps relatively larger optimism bias for those age groups. It is also possible that people become increasingly aware of their cognitive biases over their lifetime which may decrease their incidences. Biases may also be correlated with the level of education and experience where, intuitively, the bias could smaller for more educated and more experienced consumers; see Groeger and Brown (1989) and D'Acunto et al. (2019).

To explore empirically the presence and persistence of optimism, we extend the model proposed by Bovi (2009) and regresses the two bias measures on a constant, an error term and an AR(1) regressor. Statistical significance of the constant lends empirical support for the presence of the biases (Bovi, 2009). A significantly positive constant points to stable consumer optimism over the sample period and points to the presence of a cognitive bias. Significance of the coefficient on the AR(1) regressor indicates persistence. A statistically significant positive AR(1) coefficient points to a positive relationship between the bias measure this period and the bias measure last period.

Descriptive statistics for the measures, aggregate and disaggregate by age and income, are in Table 1 and Table 4 presents the empirical results of applying an AR(1) with a constant term to each of the two bias measures.[10]

Insert Table 4 here

At the aggregate level, both constants and both AR(1) coefficients are statistically significantly positive supporting the presence and persistence of a cognitive bias. Consumers are overoptimistic about their family finances and consistently overpredict the financial situation of their households. Disaggregating consumers by age and income leads to similarly strong empirical results. All constants are statistically significant and positive with the exception of consumers over 65 years who display a negative optimism bias and consumers aged 45-64 and consumers with income of less than $40,000 where the constant is positive but not statistically significantly different from zero.

The descriptive statistics in Table 1 show the unconditional means while the constants in Table 4 show the conditional means. Both means align and give some interesting insights

[10]The minimum lag length that leads to rejection of auto-correlation in the residuals is '1' according to the Durbin-Watson (DW) autocorrelation statistic. Adding further lags leads to statistically insignificant parameter estimates on the higher order autoregressors with little impact on the AR(1) coefficient.

about the biases by age and income. The size of the *ex ante* optimism bias measure declines with age but rises with income. The size of the *ex post* optimism bias measure declines with age and income. The higher income earners tend to be overoptimistic in their ability but realize more readily that their expectations were wrong. Higher income earners are likely more educated which may increase their bias recovery while education is associated with larger overoptimism; see Groeger and Brown (1989). Older consumers tend to be least optimistic with larger bias recovery, pointing to some lifetime learning.

All autoregressive coefficients are positive and statistically significant except for the coefficients on *ex post* optimism of consumers aged 18 to 24 years and those earning more than $100,000. The bias measures all display relatively high persistence with coefficients of between 0.3 and 0.6, indicating that the effects of a bias shock take 6 months to 1 year to disappear.

6 Concluding remarks

The purpose of this paper was to explore whether cognitive biases can affect real economic activity. We develop two measures of the cognitive bias of optimism and demonstrate that the bias impacts the real economy through its impact on consumption, saving and borrowing decisions. Human decisions are at the core of economics but it is not easy to model, theoretically or empirically, complex agents making complex decisions. Here, we explore the human side of consumers. We demonstrate that cognitive evaluations impact real decisions and hint at the complexity of decision making. Although biases are present and persistent when consumers are disaggregated by age and income, the impacts of biases on saving and borrowing decisions vary. Our results strongly suggest that adding psychological dimensions to our models can greatly improve our understanding of the economy.

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Tables and Figures

Table 1: Descriptive Statistics for Indices from Key Consumer Survey Questions

	Proportion		$CurrFamFin_t$		$ExpFamFin_t$		$ExpEcon_t$		$AnteOptim_t$		$PostOptim_t$	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Aggregate			90.47	8.47	109.73	8.61	98.55	15.98	11.18	13.26	19.81	10.86
Aged 18-24	12.97	2.37	116.35	16.41	136.49	12.30	109.16	19.74	27.34	22.17	20.91	22.30
Aged 25-44	40.90	2.43	96.60	8.70	119.49	8.98	99.14	16.53	20.35	14.68	23.66	11.27
Aged 45-64	29.27	3.23	79.12	9.30	98.10	9.02	93.95	17.92	4.15	13.72	18.94	13.05
Aged 65+	16.86	1.40	74.58	9.70	85.13	9.03	96.99	17.42	-11.86	13.28	10.40	13.48
Under $20k	12.22	3.90	65.98	8.56	93.21	10.52	89.44	15.63	3.78	14.01	27.79	12.37
$20k-$40k	16.43	3.89	78.02	11.50	101.84	14.15	94.92	16.52	6.93	17.05	25.33	13.70
$40k-$60k	14.77	1.98	88.49	15.41	110.85	12.84	99.91	17.28	10.94	14.50	23.52	18.14
$60k-$80k	10.66	1.95	99.17	16.88	116.46	12.39	102.22	20.47	14.24	17.32	18.33	15.86
$80k-$100k	7.53	2.36	105.95	16.71	116.85	14.97	102.62	22.97	14.23	21.27	12.34	18.16
Over $100k	18.03	10.84	117.18	17.22	124.09	14.63	108.27	20.07	15.82	17.88	8.02	15.81

NOTE: $CurrFamFin_t$ relates to consumers' assessment of family financial conditions in the last 12 months, $ExpFamFin_t$ relates to consumers' expected family financial conditions in the next 12 months; $ExpEcon_t$ relates to consumers' expected economic conditions in the next 12 months; $AnteOptim_t = ExpFamFin_t - ExpEcon_t$ and $PostOptim_t = ExpFamFin_{t-4} - CurrFamFin_t$.

Table 2: Descriptive Statistics for Consumers' Current Savings Patterns

	DrawOnSav		*RunInDebt*		*MakeEnds*		*SavLittle*		*SavLots*	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Aggregate	8.97	2.67	4.69	1.13	37.54	2.91	38.55	2.67	9.01	1.67
Aged 18-24	5.49	3.46	3.74	2.74	29.93	8.21	45.38	8.81	13.62	6.26
Aged 25-44	7.02	2.64	5.91	1.90	34.41	3.91	41.62	3.30	10.17	2.38
Aged 45-64	10.39	3.14	5.08	1.77	38.54	3.77	36.56	3.45	8.26	2.44
Aged 65+	13.61	3.88	1.73	0.93	49.41	4.57	29.51	3.83	3.92	1.67
Under $20k	15.48	5.03	7.68	3.37	52.67	5.49	21.34	5.23	1.73	1.61
$20k-$40k	12.70	5.96	5.91	2.30	45.76	4.20	31.90	6.66	3.11	1.57
$40k-$60k	8.82	5.04	4.82	2.39	38.26	6.31	40.55	8.97	6.94	3.17
$60k-$80k	7.00	4.68	4.60	3.07	31.64	6.55	46.91	8.23	9.39	4.66
$80k-$100k	5.84	4.79	3.35	2.67	28.33	7.31	48.70	8.73	13.39	6.10
Over $100k	4.52	3.07	3.06	2.15	21.27	5.33	46.56	5.85	23.89	7.53

NOTE: *DrawOnSav* denote 'drawing on saving', *RunInDebt* 'running into debt', *MakeEnds* 'making ends meet', *SavLittle* 'saving a little', *SavLots* 'saving a lot'.

Table 3: Descriptive Statistics for Economic Information

Data series	Mean	Stdev.	Max	Min	Data unit	Data source
Panel A						
Household consumption	3.624	1.427	6.704	-0.231	YE (%)	ABS
Saving ratio	3.947	3.303	10.400	-1.900	(%)	ABS
Personal credit	7.382	6.269	16.693	-7.070	YE (%)	RBA
Panel B						
Unemployment rate	-0.014	0.152	0.402	-0.405	Q (p.p.)	ABS
Target cash rate	-0.015	0.177	0.750	-1.000	Q (p.p.)	RBA
ASX/S&P 200 index	0.465	3.577	7.472	-10.417	Q (%)	ABS
GDP	0.795	0.547	3.104	-0.742	Q (%)	ABS
CPI	0.655	0.560	3.846	-0.448	Q (%)	ABS
Credit	0.771	0.397	1.814	-0.079	Q (%)	RBA
Hours worked	0.110	0.501	1.532	-1.814	Q (%)	ABS
Retail trade	0.522	1.128	8.058	-1.006	Q (%)	ABS
Dwelling approvals	-0.222	6.643	20.923	-19.938	Q (%)	ABS
AUD/USD	0.163	3.416	8.399	-8.512	Q (%)	RBA
Commodity prices	0.213	2.931	7.758	-8.254	Q (%)	RBA
US Industrial production	0.055	0.777	1.057	-4.303	Q (%)	FRED
S&P 500 index	0.620	4.088	9.672	-11.002	Q (%)	FRED
US Federal fund rate	-0.005	0.126	0.260	-0.580	Q (p.p.)	FRED
Principal component 1	0.000	1.690	3.451	-6.823	(%)	Constructed
Principal component 2	0.000	1.450	2.877	-8.354	(%)	Constructed

NOTE: 'YE (%)' denotes year-ended growth in %; 'Q (%)' denotes quarterly growth in %; 'Q (p.p.)' denotes quarterly change in percentage points. The principal components (1 and 2) are constructed based the changes in 14 major domestic and international economic data series. The summary statistics in Panel B are based on quarterly frequency with monthly data series (all except for GDP and CPI) being converted into quarterly basis, using the last observation of each quarter, to match with quarterly CASiE survey data for saving. 'ABS' denotes the Australian Bureau of Statistics, 'RBA' denotes the Reserve Bank of Australia and 'FRED' denotes the Federal Reserve at St. Louis.

Table 4: $AR(1)$ Regression Results for *Ex Ante* Optimism ($AnteOptim_t$) and *Ex Post* Optimism ($PostOptim_t$)

	$AnteOptim_t$						$PostOptim_t$					
	c		$AR(1)$		$\overline{R}^2$	DW	c		$AR(1)$		$\overline{R}^2$	DW
	Coeff	SE	Coeff	SE			Coeff	SE	Coeff	SE		
Aggregate	4.39	1.30	0.61	0.08	0.37	1.90	8.35	1.93	0.56	0.07	0.30	1.92
Aged 18-24	19.32	2.88	0.29	0.08	0.07	1.80	18.98	2.84	0.09	0.13	-0.01	2.00
Aged 25-44	11.13	2.10	0.46	0.09	0.21	2.07	10.82	2.80	0.53	0.10	0.25	1.80
Aged 45-64	1.74	1.18	0.60	0.08	0.35	1.97	10.64	1.88	0.42	0.09	0.17	2.06
Aged 65+	-4.63	1.46	0.61	0.07	0.36	1.92	4.53	1.49	0.55	0.08	0.29	2.06
Under $20k	2.27	1.42	0.49	0.09	0.22	1.94	22.43	2.45	0.19	0.08	0.02	1.95
$20k-$40k	2.07	1.30	0.68	0.08	0.45	2.07	14.22	3.18	0.42	0.10	0.16	1.97
$40k-$60k	5.82	1.50	0.46	0.10	0.20	1.91	15.35	3.50	0.33	0.10	0.10	2.00
$60k-$80k	8.91	1.76	0.38	0.10	0.13	1.99	11.18	1.96	0.38	0.09	0.14	1.93
$80k-$100k	8.03	2.20	0.46	0.10	0.21	2.15	7.16	1.89	0.39	0.08	0.14	1.99
Over $100k	7.86	2.03	0.51	0.08	0.25	2.07	7.00	1.96	0.16	0.14	0.01	1.96

NOTE: 'Coeff' denotes estimated coefficient, 'S.E.' denotes heteroskedasticity and autocorrelation-consistent standard error, $\overline{R}^2$ denotes adjusted R^2, and DW denotes Durbin-Watson statistic for auto-correlation in the residuals.

Figure 1: Consumer Survey Indices: Expected Family Finances ($ExpFamFin_t$) and Expected Economic Conditions ($ExpEcon_t$)

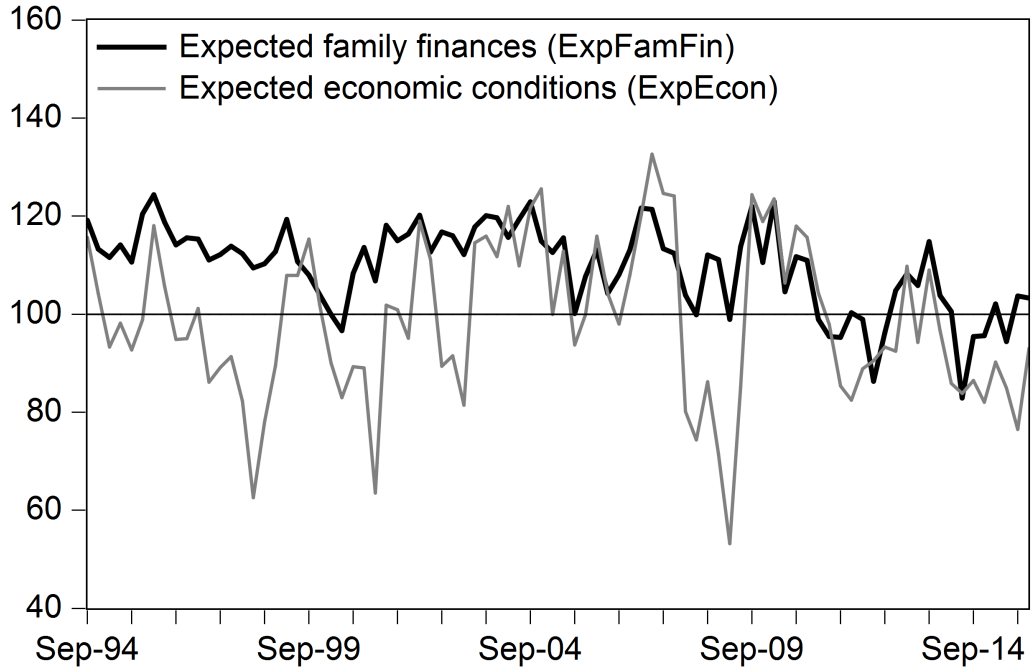


Figure 2: Consumer Survey Indices: Lagged Expected Family Finances ($ExpFamFin_{t-4}$) and Current Family Finances ($CurFamFin_t$)

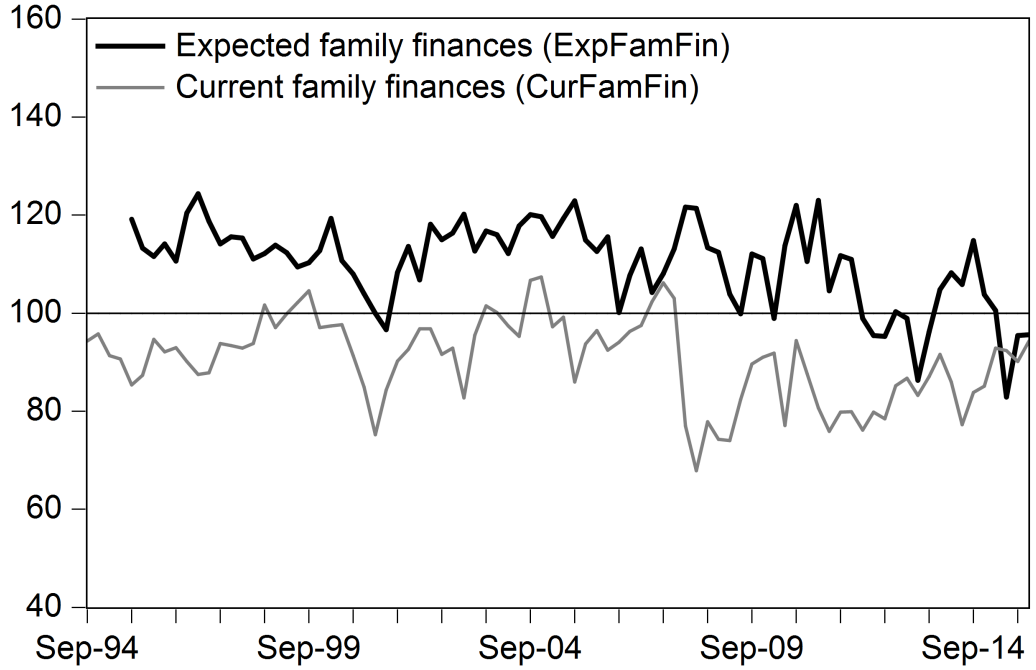


Figure 3: Two Optimism Bias Measures: *Ex Ante* Optimism and *Ex Post* Optimism

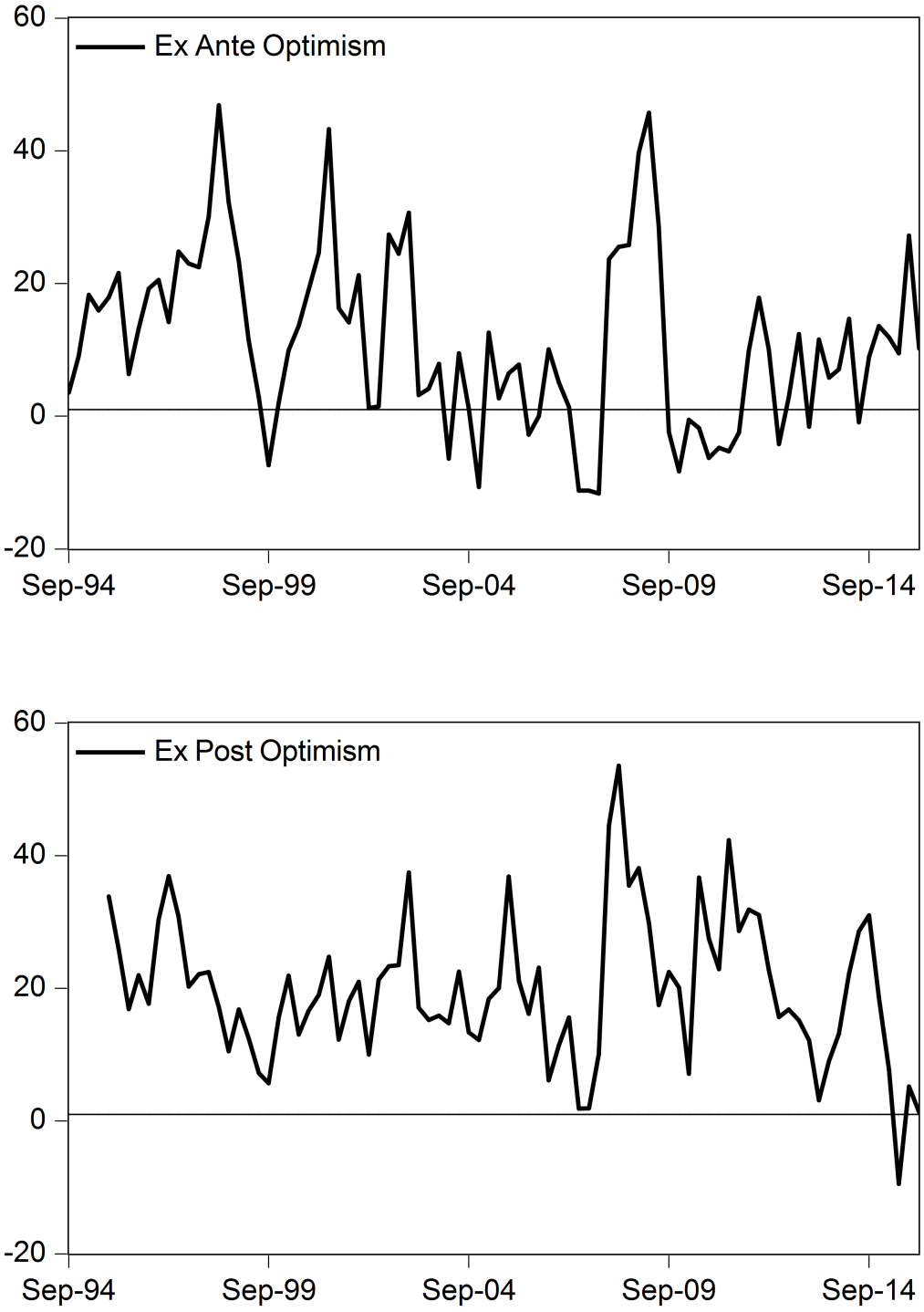
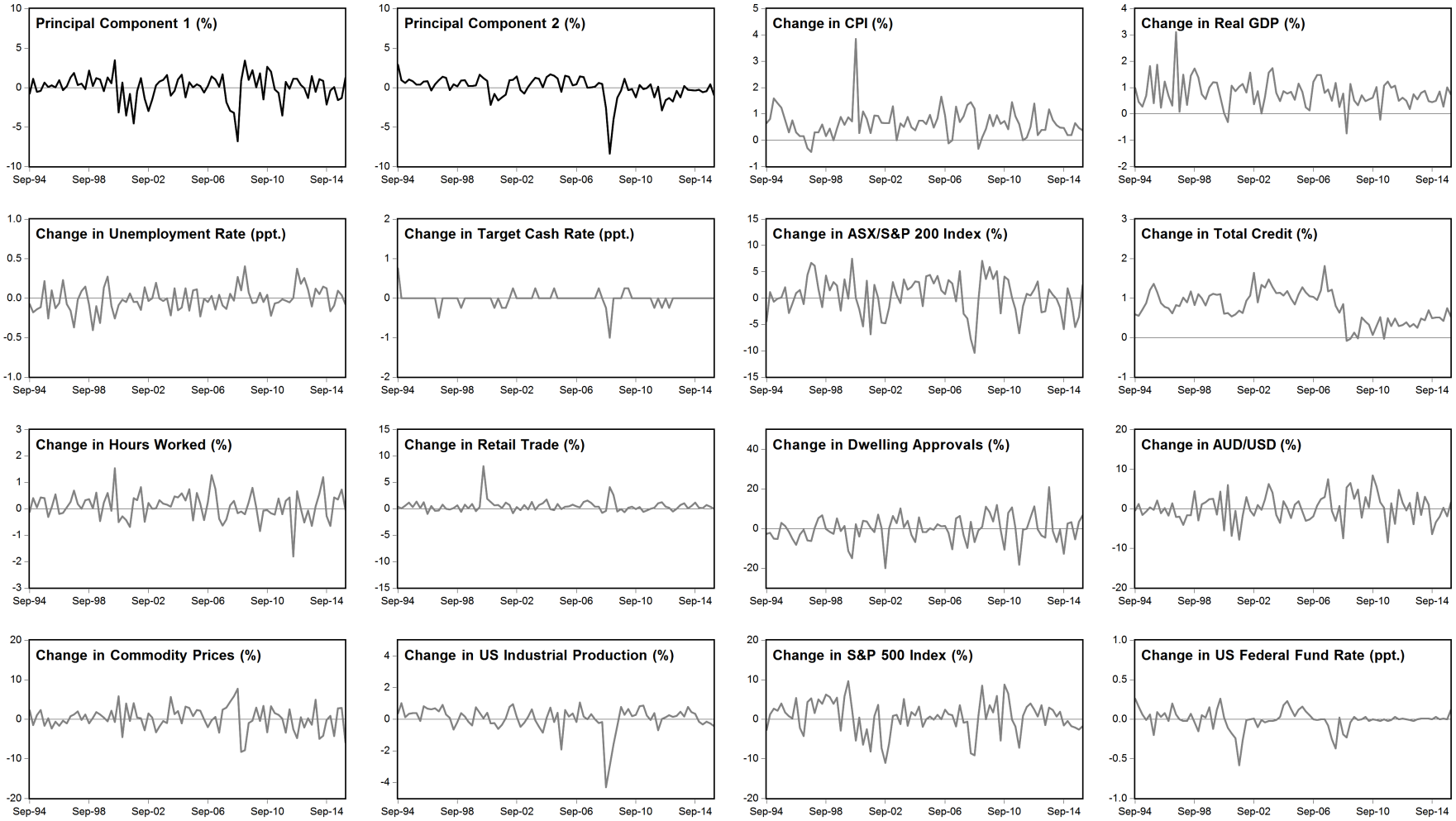
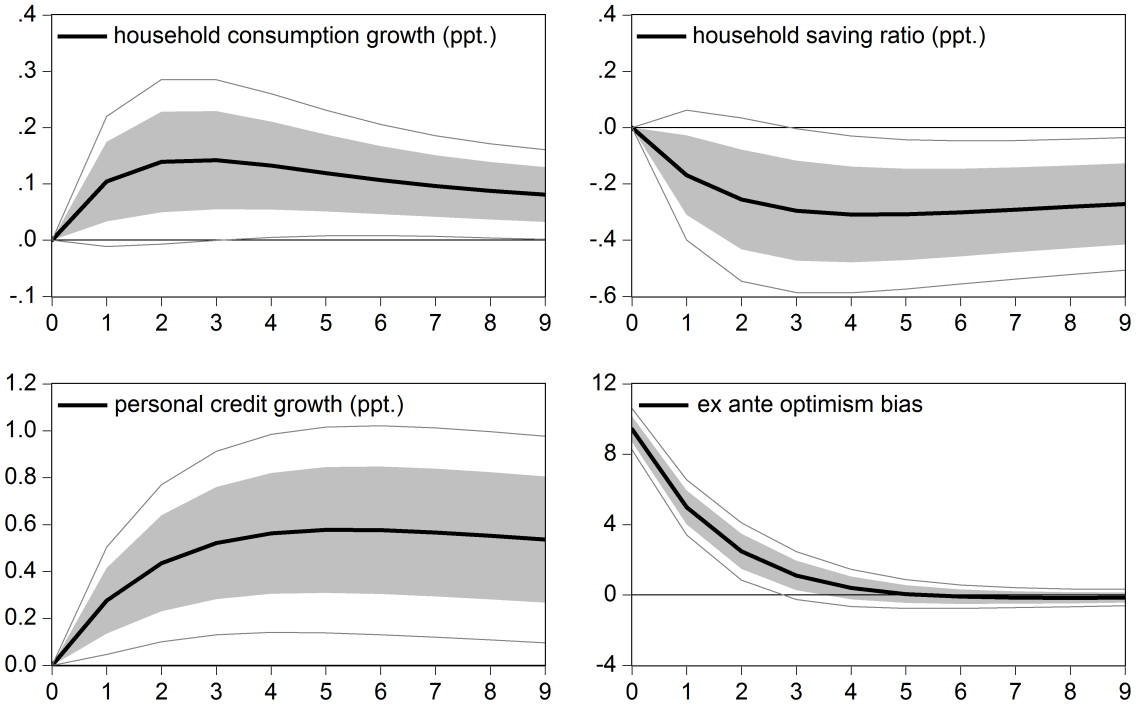


Figure 4: Economic Data



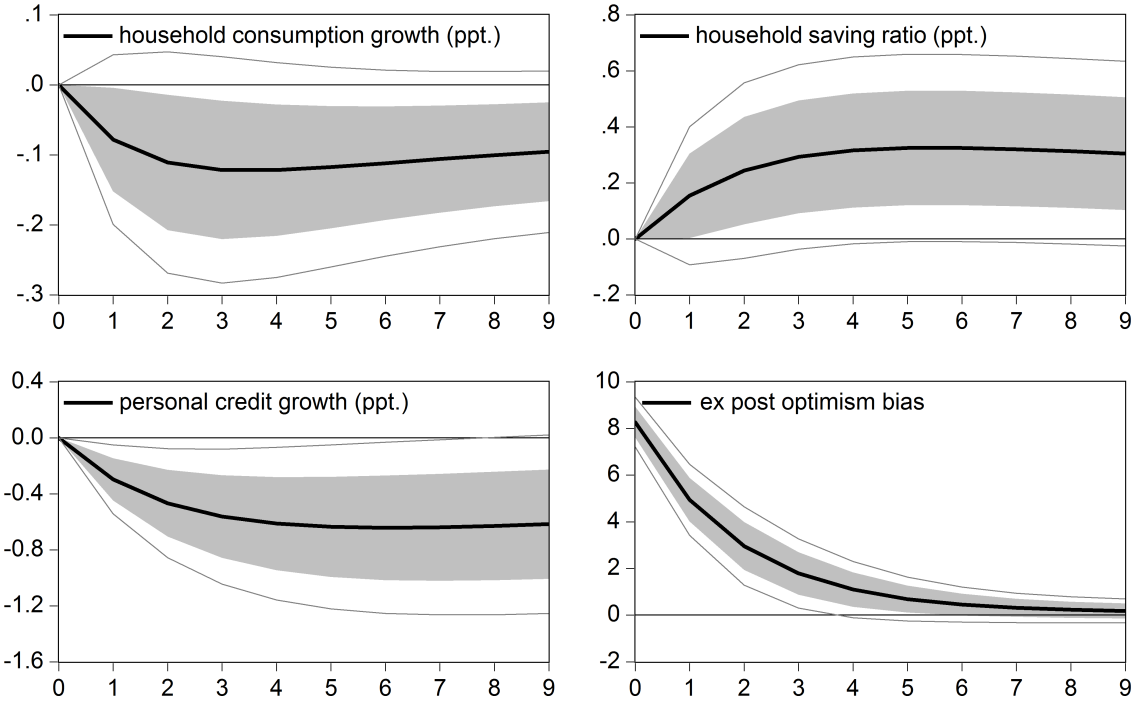
NOTE: 'ppt.' denotes percentage point. The data series plotted in black are the principal components. The data series plotted in gray are publicly available domestic and international economic data used for the principal component construction.

Figure 5: Effects of a Shock to *Ex Ante* Optimism ($AnteOptim_t$) on Real Outcomes



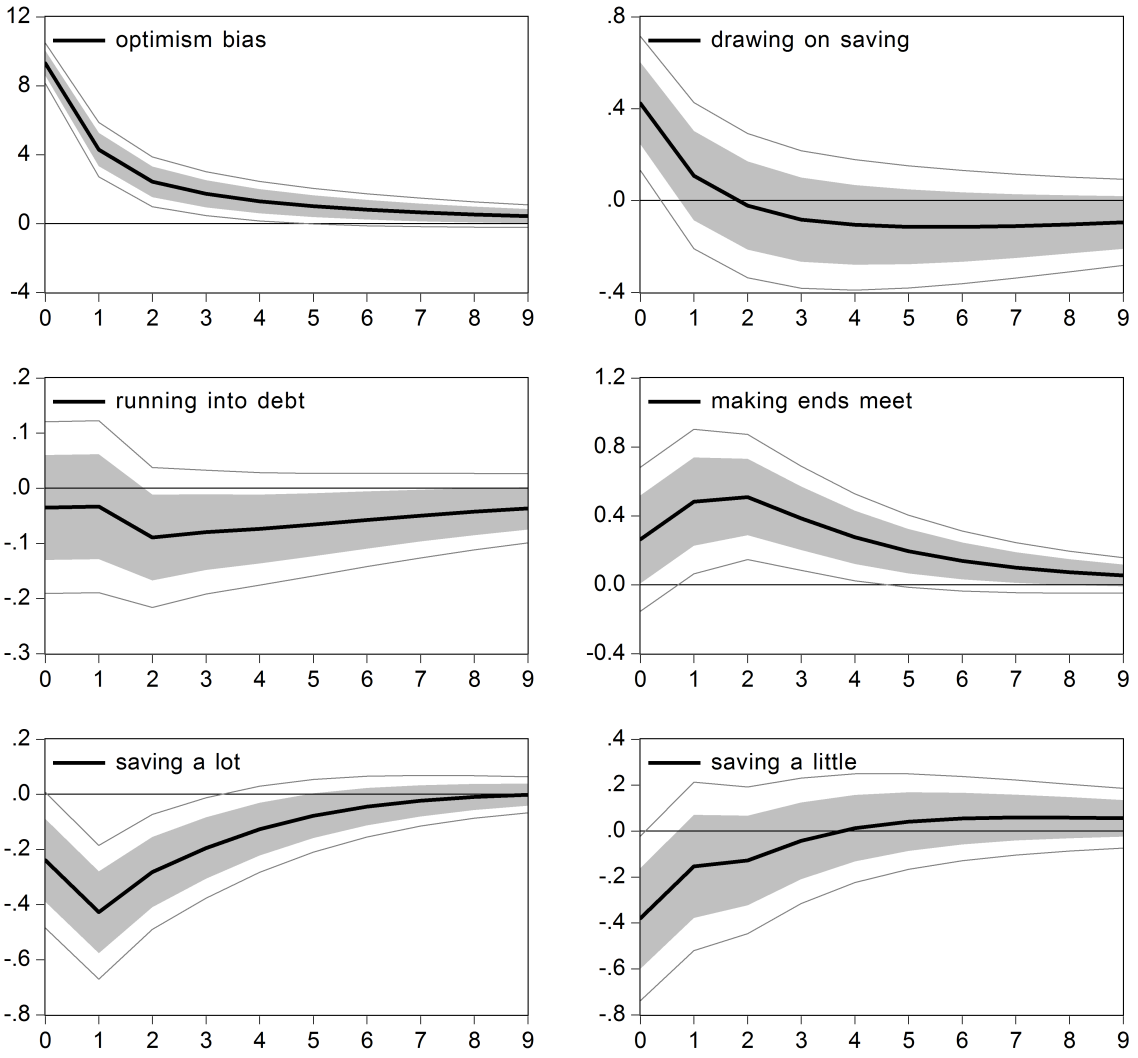
NOTE: $AnteOptim_t$ denotes *ex ante* optimism bias measure ($ExpFamFin_t - ExpEcon_t$). Shaded areas denote one standard error band; the gray lines denote 90% confidence interval.

Figure 6: Effects of a Shock to *Ex Post* Optimism ($PostOptim_t$) on Real Outcomes



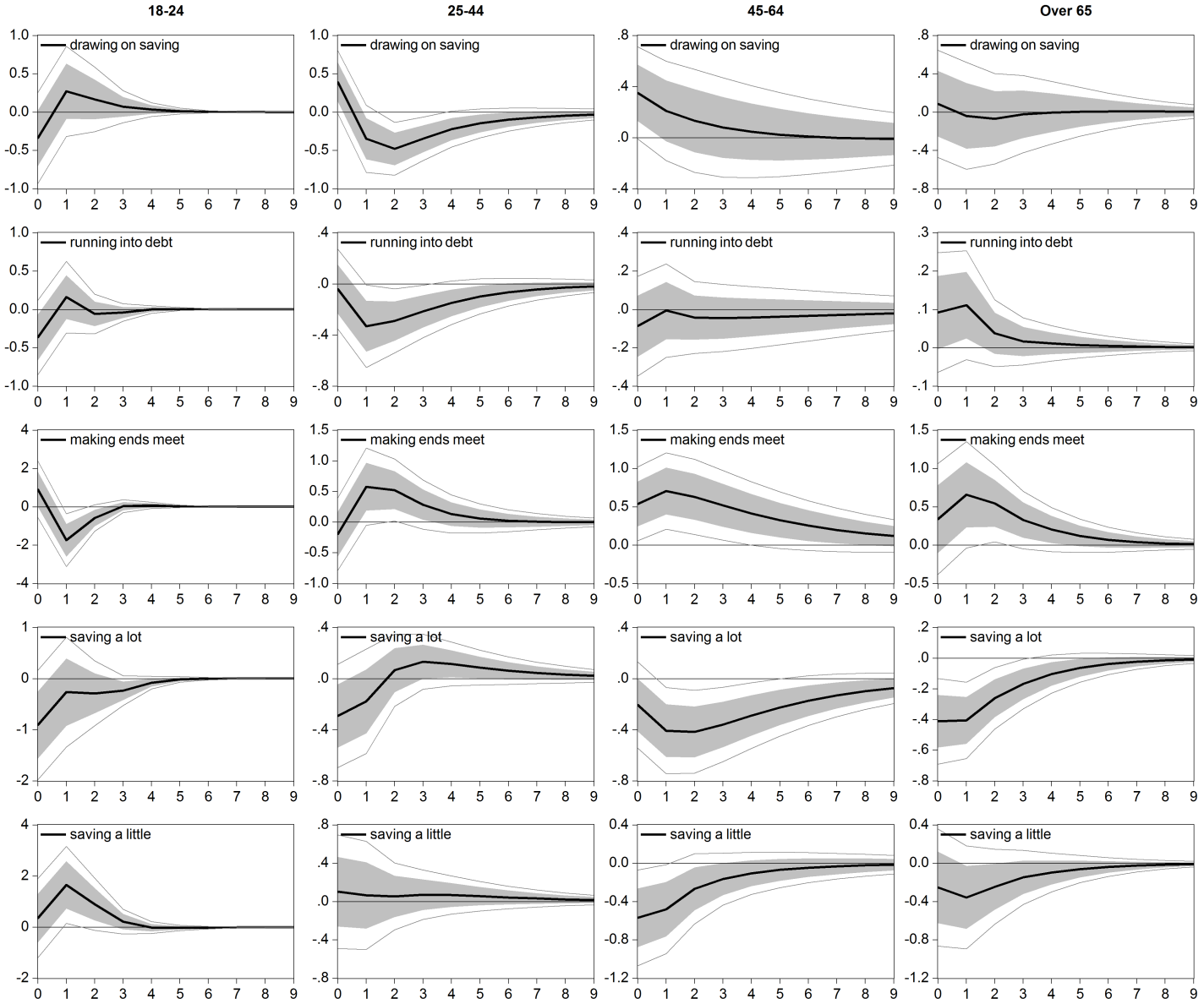
NOTE: $PostOptim_t$ denotes the *ex post* optimism bias measure ($ExpFamFin_{t-4} - CurrFamFin_t$). Shaded areas denote one standard error band; the gray lines denote 90% confidence interval.

Figure 7: Effects of a Shock to the Optimism Bias ($Optimism_t$) on Consumer Saving Behavior



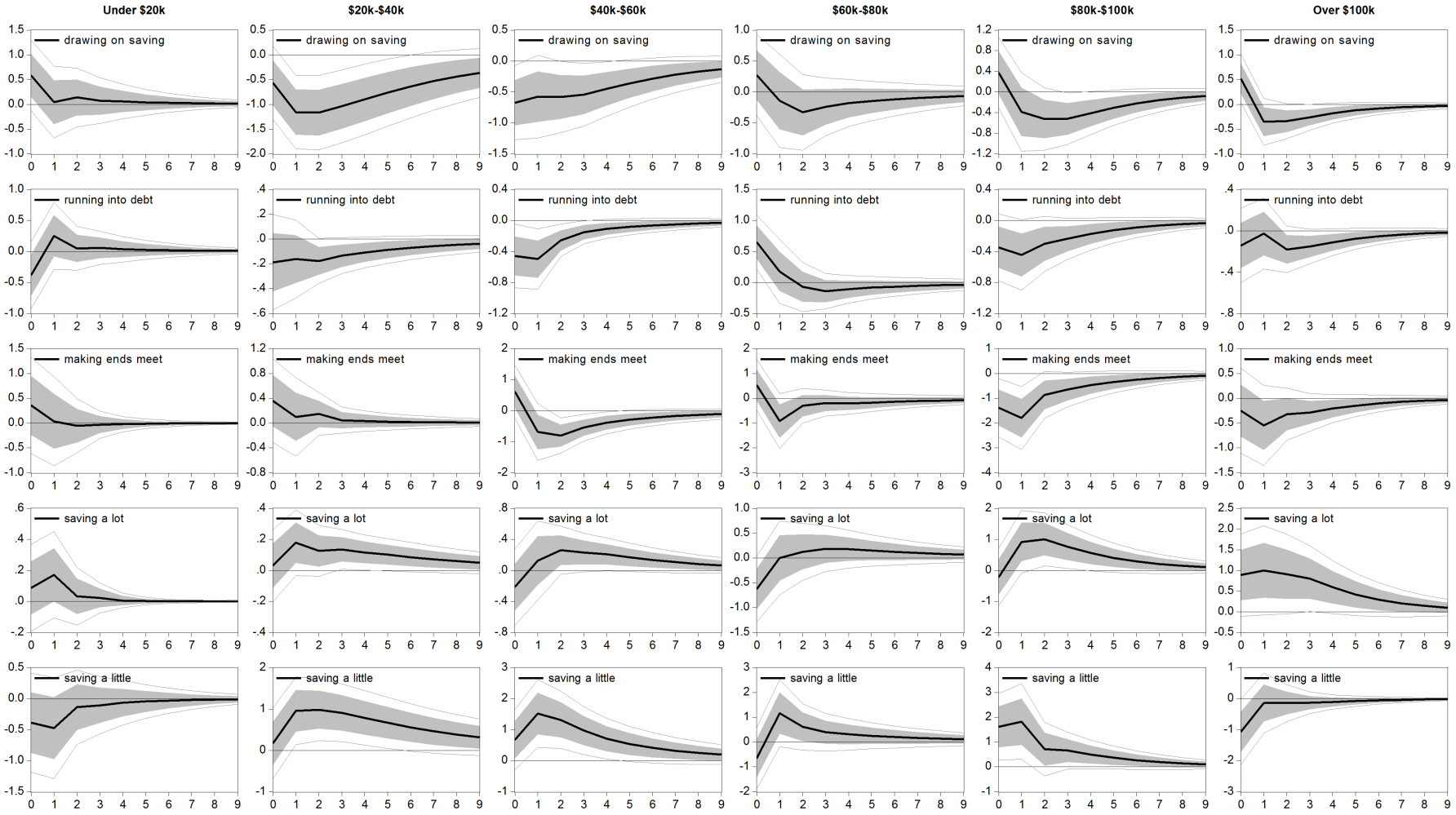
NOTE: $Optimism_t$ denotes the measure of the illusion bias ($ExpFamFin_t - CurrEcon_t$). Shaded areas denote one standard error band; the gray lines denote 90% confidence interval.

Figure 8: Effects of a Shock to the Optimism Bias ($Optimism_t$) on Consumer Saving Behavior - By Age



NOTE: $Optimism_t$ denotes the measure of the illusion bias ($ExpFamFin_t - CurrEcon_t$). Shaded areas denote one standard error band; the gray lines denote 90% confidence interval.

Figure 9: Effects of a Shock to the Optimism Bias ($Optimism_t$) on Consumer Saving Behavior - By Income



NOTE: $Optimism_t$ denotes the measure of the illusion bias ($ExpFamFin_t - CurrEcon_t$). Shaded areas denote one standard error band; the gray lines denote 90% confidence interval.

A Relating the empirical results to the theoretical optimal expectations model

Brunnermeier and Parker (2005) propose a theoretical model of optimal expectations where agents hold subjective beliefs that are persistently incorrect but optimal. The marginal benefit of optimism about the future is offset by the costs of incorrect expectations. Our empirical results strongly support the theoretical predictions that consumers are too optimistic about expected wealth which leads them to overconsume and undersave. We focus on the main results relating to consumption and savings behavior of optimal expectations model and refer to the original article for a detailed exposition of the model.

In traditional rational expectations models, agents care about future consumption and forgo some consumption today for consumption tomorrow. In optimal expectations, agents also care today about the utility they receive tomorrow from consumption tomorrow. Utility tomorrow increases agent felicity today. Formally, optimal expectations (OE) are defined as a set of subjective probabilities that maximize well-being W

$$W := E\left[\frac{1}{T}\sum_{t=1}^{T}\widehat{E}\left[U\left(c_1^*, c_2^*, \ldots c_T^*\right)|\underline{s}_t\right]\right] \tag{11}$$

where $\widehat{E}\left[U\left(\cdot\right)|\underline{s}_t\right]$ is the felicity of the agent at time t. Agents care about the utility from consumption yesterday, today and tomorrow. $U\left(\cdot\right)$ is the utility function and is increasing and strictly concave and $\widehat{E}_t$ is the subjective expectations operator associated with $\{\widehat{\pi}\}$ and given information available at t. $\pi\left(s_t|\underline{s}_{t-1}\right)$ denotes the true probability that state $s_t \in S$ is realized after state history $\underline{s}_{t-1} := (s_1, s_2, \ldots, s_{t-1}) \in \underline{S}_{t-1}$. $\widehat{\pi}\left(s_t|\underline{s}_{t-1}\right)$ and $\widehat{\pi}\left(\underline{s}_t\right)$ are the conditional and unconditional subjective probabilities. Agents know the correct mapping from actions to payoff in different states but incorrectly assess the probabilities of each state. Optimal consumption with subjective beliefs is given by $c_t^* = \widehat{E}\left[c_{t+1}^*|\underline{y}_t\right]$. Optimal expectations ($\widehat{E}^{OE}$) maximize well-being subject to the agent's optimal behavior. Applying a usual budget constraint and a quadratic utility function give the optimal expectations consumption function

$$c^{OE}\left(\underline{y}_t\right) = \frac{a}{b} - \frac{\psi_{t+\tau}}{\psi_t} + R^{\tau}\left(\frac{a}{b} - E\left[c^{OE}\left(\underline{y}_{t+\tau}\right)|\underline{y}_t\right]\right) \tag{12}$$

where R is the gross return on a risk free asset and $\beta R = 1$; $u\left(c_{t+\tau}\right) = ac_{t+\tau} - \left(\frac{b}{2}c_{t+\tau}^2\right)$ and $a, b > 0$; $\psi_t = \beta^{t-1}\left(1 + \sum_{\tau=1}^{T-t}\left(\beta^{\tau} + (\beta\delta)^{\tau}\right)\right)$; β is the conventional discount factor and $0 < \beta \leq 1$ so the agent discounts past utility flows at rate δ, $0 \leq \delta \leq \frac{1}{\beta}$. Income y_t has a cumulative distribution function $\prod\left(y_t|y_{t-1}\right)$ with support $[\underline{y}, \overline{y}]$ and $d\prod\left(y_t\right) > 0$ for all $y \in Y$ where $0 < \underline{y} < \overline{y} < \frac{a}{(bT)}$. Actual income is assumed to be independently distributed over time, *i.e.*, $\prod\left(y_t|y_{t-1}\right) = \prod\left(y_t\right)$ but agents believe income is autocorrelated so that the subjective income distribution is $\widehat{\prod}\left(y_t|y_{t-1}\right)$.

Result 1: Overconsumption and undersaving

Agents aim for a smooth consumption path, so $\widehat{E}^{OE}\left[c_{t+\tau}^{OE}|\underline{y}_t\right] = c_t^{OE}$. But subjective

expectations are higher than objective expectations, *i.e.* consumers are optimistic about future consumption so agents overconsume and undersave at every period.

$$\widehat{E}^{OE}\left[c_{t+\tau}^{OE}|\underline{y}_t\right] > E\left[c_{t+\tau}^{OE}|\underline{y}_t\right] \tag{13}$$

If consumers are optimistic about future consumption, they will save too little in the current period. These theoretical predictions are corroborated by our empirical results. Shocks to optimism clearly compel consumers to save less, dissave more and borrow more.

Result 2: Ex ante optimism bias

Optimal consumption evolves as $c_{t+1}^{OE} = \frac{1-R^{-1}}{1-R^{-(T-t)}}\left(A_{t+1} + \widehat{E}\left[H_{t+1}|\underline{y}_{t+1}\right]\right)$ where human wealth (H_t) is defined as the present value of current and future labor income, or $H_t = \sum_{\tau=0}^{T-t} R^{-\tau} y_t + \tau$. Optimism about future consumption is driven by optimism about future wealth, or

$$\widehat{E}^{OE}\left[H_{t+1}|\underline{y}_{t+1}\right] > E\left[H_{t+1}|\underline{y}_{t+1}\right] \tag{14}$$

Consumers realize in $t+1$ that their forecast at t for income at $t+1$ was too high and hence they revise down their life-time wealth estimate in $t+1$. If consumers revise down their expectations of human wealth over time, this means they persistently overestimate their income growth and when actual income persistently turns out lower than expected, consumers revise down their expectations of lifetime wealth at every period.

These theoretical prediction align with empirical results presented here; see Table 4. In the theoretical model, consumers err every period and adjust their wealth expectations down every period.

Result 3: Ex post optimism bias

Agents update their beliefs on future income according to $\widehat{\prod}(y_t|y_{t-1})$. Although they realize that their income forecasts have been wrong and hence they update their wealth estimate, agents never learn that their belief about the income distribution is wrong:

$$\widehat{\prod}(y_t|y_{t-1}) > \prod(y_t|y_{t-1}) = \prod(y_t) \tag{15}$$

and $d\prod(y_t) > 0$ gives a persistent overprediction of future income.

Agents continue to assume that income is autocorrelated while actual income is not. When agents observe only one realization at each age, they attribute lower than expected income growth to 'bad luck' rather than 'bad modeling of income'; Brunnermeier and Parker (2005) [p. 1106]. This assumption is strongly supported by the empirical evidence.

To sum up, under optimal expectations, agents are too optimistic about their future labor income, $\widehat{E}\left[y_{t+\tau}|\underline{y}_t\right]$ and hence $\widehat{E}^{OE}\left[c_{t+1}^{OE}|\underline{y}_t\right]$ is too high and $c^{OE}\left(\underline{y}_t\right)$ is too high. When realized income turns out to be lower than expected income, consumption falls and agent revise down their expected wealth and future income. So, rather than a smooth consumption profile, optimal expectations consumption decreases every period.