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Equilibrium asset prices and the wealth distribution with inattentive consumers

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Abstract

This paper studies the effects of heterogeneity in planning propensity on wealth inequality and asset prices. I consider an economy populated by "attentive" and "inattentive" agents. Attentive agents plan their consumption period by period, while inattentive agents plan every other period. Infrequent planning increases uncertainty concerning future income or future asset returns. In general equilibrium, inattentive consumers trade at unfavorable prices. If the only source of uncertainty is future income, inattentive consumers will still accumulate more wealth. In contrast, in a version of the model driven by uncertain asset returns, infrequent planning produces the opposite result: inattentive investors accumulate less wealth, in line with empirical evidence. Moreover, asset prices are much more volatile than in a representative agent model with full attention, because changes in asset prices must induce attentive consumers to voluntarily bear the burden of adjusting to aggregate shocks.

Keywords: Inattentiveness, Infrequent Planning, Heterogeneous Agents
JEL codes: E21, D52, D80, D91

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1 Introduction

Traditional saving models assume that people formulate their consumption plans period by period, gathering and processing all information they need about the state of the economy without facing any "planning" cost. However, survey evidence suggests that such costs do exist and that they lead to infrequent planning or even a complete lack of planning. Furthermore, empirical work on planning[1] finds that not everybody's behavior departs from the assumptions of the standard permanent income/life cycle model: people differ in their propensity to plan.[2]

In this paper, I try to address both these findings. I focus on heterogeneity in planning and explore the links between propensity to plan, wealth inequality and asset prices in general equilibrium. I assume that agents are heterogenous only in their propensity to plan: attentive agents plan their consumption period by period, while inattentive ones plan every other period. Then, I study the implications of this assumption in general equilibrium. I show that differences in the propensity to plan generate wealth heterogeneity and volatile asset prices. Moreover, I find that infrequent planners are less likely to invest in stocks.

In a canonical consumption/saving model, wealth heterogeneity can be explained by differences in preferences structures. Differences in discount factors or risk aversion, for example, might do the job, as well as, bequest motives. However, the empirical work in Lusardi (2003) and Ameriks et al. (2003), among others, suggests a link between differences in wealth accumulation and propensity to plan. According to this evidence, infrequent planning has an impact on wealth accumulation, thereby causing considerable wealth heterogeneity among households with similar economic and demographic characteristics. More precisely, infrequent planning leads to lower saving and wealth accumulation. But this finding is at odds with the existing literature on infrequent planning: in a partial equilibrium model with fixed interest rates, Reis (2006) shows that consumers who plan infrequently face more uncertainty[3] and save more for precautionary reasons.

[1] Both Lusardi and Mitchell (2007) and Venti (2006) review recent empirical evidence on planning and saving behavior

[2] Heterogeneity in planning behavior might arise if planning depends on other people's experience, as individuals learn how to plan from their siblings or their parents, or if planning is related to financial litteracy.

[3] Infrequent planners face more uncertainty since their consumption is predetermined.

In my general equilibrium model, the inattentive group suffers from an adverse correlation between asset prices and savings. This adverse "term-of-trade effect" could lead to lower wealth. By setting a plan for consumption, an inattentive consumer will let her savings automatically adjust to the aggregate shock. In general, she will accumulate more assets when asset prices are high and reduce her asset holding when prices are low.

Since the main channel through which infrequent planning affects the wealth distribution is an increase in uncertainty, it becomes crucial to distinguish between income and return uncertainty. It is well known that even in a standard consumption model with full attention these two sources of risk can affect savings in opposite directions. Therefore, I develop two models with inattention to distinguish between these two different channels. First, I study the effects of inattentiveness in a model where the only source of uncertainty is future income. Then, I analyze the impact of infrequent planning in a model with uncertain asset returns and no income uncertainty.

I show that when the only source of uncertainty is future income, inattentive consumers still accumulate more wealth, despite trading at unfavorable prices. In contrast, when asset returns are uncertain, inattentive agents become poorer in the long-run. In this last case, infrequent planners optimally choose to invest less in the stock market.

Finally, I study the consequences of inattentiveness in a general equilibrium portfolio choice model that combines both sources of uncertainty. To shed light on the mechanisms behind investment decisions, I analyze a stylized two-period model, where inattentive investors infrequently review their portfolios. In this set-up, infrequent planning induces inattentive agents to invest more in bonds and less in equities. Thus, inattentiveness can account for the finding in Lusardi (2003), namely that infrequent planners are less likely to hold stocks.

Turning to asset price implications, irrespective of the source of uncertainty, inattention generates more volatile asset returns than a representative agent model with full attention. This is because in general equilibrium asset prices must induce attentive consumers to voluntarily bear the burden of adjusting to aggregate shocks, since inattentive agents are unable to do so at non-planning periods. The inability of a standard consumption-based asset pricing model to reproduce the observed high volatility in asset returns is a well-known puzzle in the literature.[4] This paper contributes to this debate by suggesting a link between inattentiveness and asset price volatility.

Recently, one branch of literature has explored the sources of deviations from full information. Sims (2003) and Moscarini (2004) use Shannon's information theory to develop a theory of costly information acquisition (Rational Inattention). Reis (2006) studies a partial equilibrium consumption/saving model where the introduction of a cost of processing and acquiring information microfounds infrequent planning (Inattentiveness). Both Gabaix and Laibson (2002) and Abel et al. (2007) compute the optimal degree of inattention to the stock market. The latter find that even small observational costs can imply a substantial degree of inattention.

A different branch of literature has focused on the implication of near-rationality and infrequent planning without specifying the rationale behind it (e.g., Caballero (1995), Lynch (1996)). The present paper is most closely connected to this branch since I abstract from planning costs and just postulate that a fraction of the population plans infrequently. However, my paper goes further by considering a general equilibrium model with endogenous asset prices.

Mankiw and Reis (2006) analyze a general-equilibrium model where agents are inattentive when setting prices, wages, and consumption. However, it is assumed that agents can sign an insurance contract ensuring that they all have the same wealth at the beginning of each period. In contrast, my paper explicitly takes into account the consequences of infrequent planning on wealth heterogeneity.

The recent work of McKay (2008) is close to the spirit of my paper. McKay (2008) develops a framework where agents devote different levels of effort when making their financial decisions. His model predicts a low degree of stock market participation among households who put minimal effort into managing their portfolio.

Finally, the paper builds on the literature about incomplete markets with heterogenous agents and aggregate fluctuations (e.g. Den Haan (1996), Krusell and Smith (1997, 1998)), but departs from it by making propensity to plan the only source of heterogeneity.

The rest of the paper is organized as follows. Section 2 presents a model with inatten-

[4] See e.g. LeRoy and Porter (1981), Shiller (1981) or Heaton and Lucas (1996)

tiveness and income uncertainty. Section 3 analyzes a model where inattentive investors deal with return uncertainty. Section 4 studies the portfolio decisions of inattentive investors in general equilibrium. Section 5 presents the conclusions.

2 Inattentive Consumers

This section analyzes the impact of inattentiveness on the wealth distribution and asset prices in a model with bond trading and income risk. In this framework, it is possible to show that inattentiveness affects wealth inequality through two different channels working in opposite directions. It increases the wealth accumulation of the inattentive group via precautionary savings motives and decreases it via negative "price effects".

Predetermining their consumption, inattentive consumers must deal with greater uncertainty. As is standard in consumption theory, this implies an increase in wealth accumulation for precautionary reasons. On the other hand, in general equilibrium, bond prices must clear the market. At non-planning dates, a positive (negative) income shock pushes up (down) the demand for savings of both groups. However, inattentive consumers have a higher marginal propensity to save, since their savings respond one-to-one to the income shock (since consumption is predetermined). It follows that market-clearing prices must be pro-cyclical and that inattentive consumers trade at unfavorable prices. Interestingly, through this last channel, inattention makes bond prices more volatile than they would be in a model with full attention.

2.1 The model

Consider an incomplete markets economy with infinite horizon and aggregate uncertainty as in Den Haan (2001), but modified to introduce heterogeneity among consumers only in the frequency of their consumption plans.[5] More precisely, attentive consumers (A) behave as in a standard model, choosing consumption and saving plans at the same point in time. Inattentive consumers (I) plan consumption every other period and let savings absorb in-

[5] Den Haan (2001) compares an economy with two types to one with a contiuunuum of different types of agents. Here, I refer to the first framework.

come shocks.[6] To focus on the effects of inattentiveness as the only source of heterogeneity, I abstract from idiosyncratic shocks. By looking at two groups of agents only, we can characterize the cross-sectional distribution of wealth by the average bond holdings of one of the two groups.

The attentive group has mass α and total population size is normalized to one. Each household is endowed with income y, which follows an $AR(1)$ process, and can smooth its consumption by trading a risk-free one-period bond b, in zero net-supply, at price q. To rule out equilibria which admit unbounded borrowing or Ponzi schemes, it is assumed that agents can go short in bonds only up to an exogenous limit, $\underline{b}$.[7][8] All agents are price takers in the bond market. The set of relevant state variables (z) will differ between planning (P) and non-planning (NP) dates. At non-planning dates, consumption (c) of the inattentive group is predetermined and it affects utility so that it will enter the policy functions as a state variable.

Attentive consumers plan period by period, solving the following problem:

$$V^{P,A}(z_{P,t}) = Max_{c_t^A, b_t^A} \left\{ U\left(c_t^A\right) + \beta E V^{NP,A}\left(z_{NP,t+1}\right) \right\}$$
$$st: \; c_t^A + q_t b_{t+1}^A = y_t + b_t^A,$$
$$b_{t+1}^A \geq \underline{b}$$

where $V^{P,A}$ is the value function in planning periods, $V^{NP,A}$ is the value function in non-planning periods and utility is CRRA $\left(U\left(c\right) = \frac{c^{1-\mu}}{1-\mu}\right)$.

[6]Infrequent planning modifies the standard consumption/saving model also in another important respect: choosing consumption or saving is no longer equivalent. Turning to the problem of an inattentive saver, i.e. an individual who chooses her *savings* every other period, differences in planning times *do not* lead to wealth heterogeneity in general equilibrium with only aggregate shocks. In this set up, it is possible to show that both kinds of agents find it optimal to live hand-to-mouth and consume their income period by period. This result follows trivially from the assumptions that there are only aggregate shocks, that savings are in zero net supply and that agents are homogeneous ex ante.

[7]In the calibration, I choose a level for the debt limit large enough so that the constraint is hardly ever binding.

[8]In the numerical implementation of the model, instead of dealing with inequality constraints, I modified the utility function introducing a penalty function to discourage agents to borrow beyond the limit. Following Judd et al. (2000b), I used the following penalty function:

$$K \min \left\{ \left(b_{t+1}^I - \underline{b}\right), 0 \right\}^{\kappa}, \text{ for } \kappa = 4.$$

A standard Euler equation applies:

$$q_t \left(c_t^A\right)^{-\mu} \geq \beta E_t \left[c_{t+1}^A\right]^{-\mu}. \tag{1}$$

Suppose now that inattentive consumers plan every other period. Then in t they plan consumption today and tomorrow while they remain inattentive during period $t+1$. The problem of an inattentive consumer in planning periods will therefore be:[9]

$$V^{P,I}(z_{P,t}) = \underset{c_t^I, c_{t+1}^I}{Max} \left\{U\left(c_t^I\right) + \beta E V^{NP,I}\left(z_{NP,t+1}\right)\right\}, \tag{2}$$
$$st: c_t^I + q_t b_{t+1}^I = y_t + b_t^I,$$
$$b_{t+1}^I \geq \underline{b},\ b_{t+2}^I \geq \underline{b}.$$

While, in a non-planning period, it is:

$$V^{NP,I}\left(z_{NP,t+1}\right) = U\left(c_{t+1}^I\right) + \beta E V^{P,I}\left(z_{P,t+2}\right), \tag{3}$$
$$c_{t+1}^I + q_{t+1} b_{t+2}^I = y_{t+1} + b_{t+1}^I.$$

We can rewrite the problems in (2) and (3) in a more compact form,[10]

$$V^{P,I}(z_t^P) = \underset{c_t^I, c_{t+1}^I}{Max} \left\{U\left(c_t^I\right) + \beta U\left(c_{t+1}^I\right) + \beta^2 E V^{P,I}\left(z_{P,t+2}\right)\right\}, \tag{4}$$
$$st: c_t^I + q_t b_{t+1}^I = y_t + b_t^I,$$
$$c_{t+1}^I + q_{t+1} b_{t+2}^I = y_{t+1} + b_{t+1}^I,$$
$$b_{t+1}^I \geq \underline{b},\ b_{t+2}^I \geq \underline{b}.$$

From (4), it is possible to derive the following set of first-order conditions that holds in

[9] To make sure that the constraint on b_{t+2} is satisfied, in the numerical solution I imposed that it should be satisfied in the worst possible case.

[10] c_{t+1}^I is predetermined one period in advance, which implies that $E_t U\left(c_{t+1}^I\right) = U\left(c_{t+1}^I\right)$.

equilibrium:

$$q_t^P \left(c_t^{I,P}\right)^{-\mu} \geq \beta^2 E_t \left[\frac{1}{q_{t+1}^{NP}} \left(c_{t+2}^{I,P}\right)^{-\mu}\right], \tag{5}$$

$$q_t^P \left(c_t^{I,P}\right)^{-\mu} \geq \beta \left(c_{t+1}^{I,NP}\right)^{-\mu}. \tag{6}$$

As in Reis (2006), the solution implies that the consumption of inattentive consumers follows a deterministic path between t and $t+1$, (eq. (6)), but a stochastic Euler equation between t and $t+2$ (eq. (5)), i.e., between the planning dates.

Finally, the model is closed with the usual market clearing conditions:

$$\alpha b_t^A + (1-\alpha)\, b_t^I = 0,$$

$$\alpha c_t^A + (1-\alpha)\, c_t^I = y_t, \forall t.$$

2.2 Numerical Solution

In the numerical implementation of the model, the income process is approximated by a three-state Markov chain, as in Christiano (1990). To calibrate this process, I use the series "total compensation per employees" from the NIPA for the years 1952-2009 and estimate the following law of motion:[11]

$$\log y_t = \rho_y \log y_{t-1} + \varepsilon_{yt}. \tag{7}$$

The discount factor is calibrated at 0.98 to match an average return of 2%. The degree of risk aversion is equal to 1.5 and the dimension of the attentive group, α, is equal to $\frac{1}{2}$.[12] One period in the model corresponds to one year in the data. The first column in table 1 summarizes the parameters in the baseline case.[13]

[11] The series was detrended using a linear trend and divided by the total U.S. population and the CPI in each year to obtain real per capita income.

[12] Lusardi (2003) finds that one third of repondents in her sample has not made any financial plan about retirement. Ameriks and Zeldes (2004) report that the majoirty of repondents in their samples made few or no changes over time to their portfolio allocations. Here, I take a conservative stand an assume that one half of the population is inattentive.

[13] To study the robustness of my results, I simulate the inattentiveness model under different parameter configurations. In particular, I evaluate the impact of changes in risk aversion, the discount factor and the

The solution to the model is a consumption rule for inattentive consumers at planning dates and two pricing rules, at planning and non-planning dates, as a function of the states, which satisfy the system of Euler equations given by (1), (5) and (6).[14] The model is solved numerically using collocation methods by approximating the policy functions with linear splines.

Inattentiveness introduces an additional computational challenge. In non-planning periods $(t+1)$, the price function depends on two continuous state variables, bond holdings of inattentive consumers $\left(b_{t+1}^{I}\right)$ and their predetermined consumption $\left(c_{t+1}^{I}\right)$, as well as the discrete variable y_{t+1}. To simplify the problem and make the solution algorithm more efficient, I note that, in equilibrium, c_{t+1}^{I} is a function of last period's bond holdings b_t^I and income shock y_t and that b_{t+1}^{I} is also determined by y_t and b_t^I. Therefore, y_t, b_t^I and y_{t+1} constitute a sufficient state $\left(z_{t+1}^{NP}\right)$ for the price function q_{t+1} at non-planning dates along the equilibrium path. In contrast, at a planning date (t), the state space z_t^P is described by y_t and b_t^I.

By using the decision rules resulting from the above computations, I then simulate the economy to study the long-run times series properties of my model and evaluate the welfare costs associated with inattentiveness. The next subsections describe these results, which are summarized in table 2.[15]

2.3 Inattentiveness and income risk in general equilibrium

The first two columns of table 2 report the simulation results for the model described in the previous subsection.[16]

To highlight the effects of inattentiveness, table 2 compares the results of my model to an economy without inattention, i.e. populated by a continuum of representative agents. I

persistence or volatility of the shock processes. The second column in table 1 reports the parameter values I used. The main results of the paper, in terms of wealth accumulation and asset prices volatility, remain unaltered using a different parameters configuration.

[14] The consumption rule for the attentive group can then be recovered by the market clearing conditions.

[15] I created 5 parallel chains simulating the economy for 1,500,000 periods and disregarding the first 500,000 observations. The long time horizon was chosen to eliminate the effects of initial conditions. The results in table 2 reports the average across these chains.

[16] Although I cannot theoretically prove the existence of a stationary stochastic distribution, my numerical simulations indicate that the distribution is not degenerate. In the simulations agents are seldom close to the constraint. Moreover, whenever the constraint is hit, the economy quickly moves away from it.

refer to this last case as RA in the table. Absent idiosyncratic shocks, in such an economy, everybody lives hand-to-mouth consuming their income period by period. The second column in the table, I, reports the results for the model with inattention.

Table 2 shows that when the income is the only source of uncertainty, inattentive consumers save more $\left(mean\left(b^I\right) > 0\right)$. The results thus resemble the partial equilibrium analysis in Reis (2006), even though in general equilibrium inattentive consumers trade at unfavorable prices.

To shed further light on the results, figures 1 and 2 illustrate the saving behavior of an inattentive consumer by graphing her bond accumulation as a function of initial bond holdings in planning (t) and non-planning periods ($t+1$).[17]

First, analyze figure 1. Consider a planning date when there is no cross-sectional dispersion in wealth so that both agents hold zero assets: $b_t^I = 0$ in the figure. Even if both groups receive the same income shock, inattentive consumers face more uncertainty since they predetermine future consumption. This induces them to save more in planning periods for every realization of the shock for precautionary reasons $\left(b_{t+1}^I - b_t^I > 0, \forall y \text{ if } b_t^I = 0\right)$. For increased wealth dispersion, inattentive investors' behavior partially resembles the model without inattention: they increase their bond holdings pro-cyclically towards the lower end of wealth and vice versa.

Next, consider figure 2. At a non-planning date, one must distinguish between high and low realization of the income shock. For a good realization of the income shock (right panel), both agents would like to save in anticipation of future declines of income. However, the marginal propensity to save of the inattentive group is higher than that of the attentive group since they fixed their consumption one period in advance. Hence, their savings increase to satisfy the budget constraint and bond prices rise to keep the market in equilibrium. The opposite is true for a bad realization of the income shock (left panel). In that case, inattentive agents save less than attentive ones and bond prices decrease to clear the market.

A similar argument holds towards the lower end of wealth. In non-planning periods, the inattentive group accumulates bonds when income and bond prices are high and decreases its bond holdings when income and bond prices are low.

[17] For illustration purposes, these figures are plotted over a smaller grid for b_t^I .

Above a certain threshold for initial bond holdings, an inattentive consumer is so rich that the prudence motive for wealth accumulation fades out. At the same time, prudence motives are strong for an attentive agent because $b^A = -b^I$. This implies that the attentive group is now willing to pay a high price in order to save in good periods and decrease savings in bad periods.

Bond prices must induce attentive agents to voluntarily bear the entire adjustment burden since the inattentive ones are unable to react to income shocks. This last channel creates a link between inattention and asset price volatility. Translating this result into returns,[18] table 2 shows that the presence of inattentive consumers makes the risk-free return four times more volatile than in a model with full attention. Thus, in terms of asset price volatility, inattentiveness improves on the representative agent model even though the predicted standard deviation of the bond return is still half of what is observed in the data. In contrast, a standard two-agent model with idiosyncratic shocks would imply an unreasonably high standard deviation.[19]

Thus, inattention magnifies bond price volatility and positively correlates inattentive consumer saving behavior with bond prices, while the opposite is true for attentive consumers.

Being inattentive obviously alters the ability of consumption smoothing. The first column in table 2 reports some sample moments from the simulated series. According to the numerical results, consumption of the inattentive group is 10% less volatile than consumption of the attentive group. By accumulating more wealth, an inattentive consumer improves her ability to smooth consumption fluctuations. This implies that, despite being fully rational and planning period by period, the attentive group bears part of the cost of living in an environment where half the population plans infrequently. Specifically, attentive consumers' consumption is more volatile as compared to what they would experience in a world with full attention. However, since their consumption profile is optimally chosen, they are also fully compensated for this utility cost by trading at more favorable prices. The net externality on the attentive consumers' welfare turns out to be positive. This will be further clarified in the next subsection, where I explicitly compute the welfare costs for both groups due to the

[18] Bond returns R_t are defined as $\frac{1}{q_t}$ in table 2.
[19] See, Heaton and Lucas (1996) .

presence of inattentiveness.

Summarizing the results, with inattention and income risk, wealth accumulation is influenced by two mechanisms working in opposite directions: precautionary saving and price effects. Table 2 shows that the saving effect prevails and the inattentive group accumulates on average more wealth than the attentive one. Moreover, inattentiveness increases asset price volatility.

2.4 The costs of inattentiveness

To evaluate the welfare consequences of inattentiveness, I assume that agents start out with zero bond holdings and derive the level of expected lifetime utility by simulating 1,000 parallel series of 1,000 periods for the two groups of agents ($V^j, for\ J = A, I$).

For the sake of comparison, I also derive the expected lifetime utility that would arise in a model without inattentiveness, where the representative agent consumes her income period by period $\left(V^{RA}\right)$.

Table 2 reports losses in terms of utility and translated into consumption units, namely the certainty equivalent level of consumption necessary to attain the same level of expected lifetime utility:

$$V^J = \frac{1}{1-\beta}\frac{\left(C^J\right)^{1-\mu}}{1-\mu} \text{ for } J = A, I, RA.$$

According to the results in table 2, the welfare costs of inattentiveness are very small. The differences between the certainty equivalent consumption level of an attentive and an inattentive agent is about 0.02%.

The magnitude of these costs should not be very surprising. As a matter of fact, the results of this subsection can be seen as confirming previous findings that welfare gains from eliminating aggregate fluctuations are small (Lucas (1987)) and that losses due to small deviations from rationality are trivial (e.g. Cochrane (1989), Pischke (1995)). Idiosyncratic shocks, more uncertainty or longer periods of inattentiveness would probably magnify these costs.

3 Inattentive investors

The results from the previous section show that even in general equilibrium, higher uncertainty about future income induces inattentive consumers to accumulate more wealth in the long run. Thus, the empirical link between the propensity to plan and wealth accumulation mentioned in the introduction still appears to be a puzzle. However, if the source of uncertainty is asset returns rather than income, infrequent planning could lead to the opposite result in line with the empirical evidence. In this case more uncertainty may push the inattentive group to invest less in the risky asset and accumulate less wealth in general equilibrium. In this section, I present a simple model with return uncertainty to elucidate the mechanisms behind investment decisions in a general equilibrium model with inattentiveness.

3.1 The model

Consider an incomplete markets economy with infinite horizon and aggregate uncertainty, where the only source of uncertainty is asset returns. More precisely, each household is endowed with a non-stochastic income stream $\bar{y}$. Moreover, agents can trade a share of stock s, with price p, that provides a flow of stochastic dividends, d. Stocks are in positive fixed supply, normalized to one.

As in the previous section, the economy is populated by attentive and inattentive agents. The attentive group has mass α and total population size is normalized to one. To rule out equilibria which admit unbounded borrowing or Ponzi schemes, a short-sales constraint, $s \geq 0$, is imposed.[20] As explained in the previous section, the set of relevant state variables (z) will differ between planning (P) and non-planning (NP) dates.

Attentive investors plan period by period, solving the following problem:

$$V^{P,A}\left(z_{P,t}\right) = Max_{c_t^A, s_{t+1}^A} U\left(c_t^A\right) + \beta E V^{NP}\left(z_{NP,t+1}\right),$$
$$st : c_t^A + p_t s_{t+1}^A = \left(d_t + p_t\right) s_t^A + \bar{y},$$
$$s_{t+1}^A \geq 0$$

[20]In the calibration, the constraint is hardly ever binding. As in the income-risk model, I used a penalty function to impose that the constraint on s_{t+2} is satisfied in the worse possible state.

where $V^{P,A}$ is the value function in planning periods, $V^{NP,A}$ is the value function in non-planning periods and utility is CRRA.

In this case, a standard Euler equation applies:

$$\left(c_t^A\right)^{-\mu} \geq \beta E_t \left[\frac{(d_{t+1} + p_{t+1})}{p_t} \left(c_{t+1}^A\right)^{-\mu} \right]. \tag{8}$$

Inattentive consumers plan their consumption only every other period, solving the following problem:

$$\begin{gathered} V^{P,I}\left(z_{P,t}\right) = Max_{c_t^I, c_{t+1}^I} U\left(c_t^I\right) + \beta U\left(c_{t+1}^I\right) + \beta^2 E_t V^{P,I}\left(z_{P,t+2}\right), \\ st : c_t^I + p_t s_{t+1}^I = \left(d_t + p_t\right) s_t^I + \bar{y}, \\ c_{t+1}^I + p_{t+1} s_{t+2}^I = \left(d_{t+1} + p_{t+1}\right) s_{t+1}^I + \bar{y}, \\ s_{t+1}^I \geq 0, s_{t+2}^I \geq 0. \end{gathered} \tag{9}$$

From (9), it is possible to derive the following set of Euler equations that holds in equilibrium:

$$\left(c_t^I\right)^{-\mu} \geq \beta^2 E_t \left[\frac{(d_{t+1} + p_{t+1})}{p_t} \frac{(d_{t+2} + p_{t+2})}{p_{t+1}} \left(c_{t+2}^I\right)^{-\mu} \right], \tag{10}$$

$$\left(c_{t+1}^I\right)^{-\mu} \geq \beta E_t \left[\frac{(d_{t+2} + p_{t+2})}{p_{t+1}} \left(c_{t+2}^I\right)^{-\mu} \right]. \tag{11}$$

Market clearing requires:

$$(1-\alpha) s_t^I + \alpha s_t^A = 1, \tag{12}$$

$$(1-\alpha) c_t^I + \alpha c_t^A = d_t + \bar{y}, \forall t. \tag{13}$$

3.2 Numerical Solution

The exogenous state of the economy is described by a Markov chain that captures the dynamic of the dividend shock. To calibrate this process, I use dividends data from the

NIPA for the years 1952-2009 and estimate the following law of motion[21]:

$$\log d_t = \rho \log d_{t-1} + \varepsilon_t. \tag{14}$$

In the numerical implementation of the model, eq. (14) is approximated by a three-state Markov chain. To also capture other sources of wealth stemming from tradable assets, I follow Heaton and Lucas (1996). Therefore, I target a steady state ratio of non-labor income over total income $\left(\frac{d}{d+\bar{y}}\right)$ of approximately 15% when calibrating $\bar{y}$, the non-stochastic income endowment. The time period in the model corresponds to a year and the discount factor is calibrated at 0.925 to target an average stock return of approximately 8%. The other parameters follow the calibration for the model with only income risk, as described in the previous section. The first column in table 1 summarizes the parameters used in this case.

The solution to the model consists of two consumption rules for inattentive consumers and two pricing rules, at planning and non-planning dates, as a function of the states, which satisfy the system of Euler equations given by eq.(8), eq.(10) and eq.(11) and the market clearing condition, eq. (13).

As concerns the state space of the economy with return risk, a similar argument applies as in the income-risk model described in the previous section. Therefore, in the numerical implementation it is assumed that the space state at a non-planning date $(t+1)$ contains only d_t, s_t^I and d_{t+1}. In contrast, at a planning date (t) it is composed only by d_t and s_t^I.

Having solved the model, I then proceed as in the previous section and simulate the economy to study the long-run times series properties of my model and evaluate the welfare costs associated with inattentiveness. The next subsections describe these results, which are summarized in table 2.

3.3 Inattentiveness and investment risk in general equilibrium

As shown in table 2, when the only source of uncertainty is return risk, inattentive investors choose to invest less in the risky asset and accumulate less wealth $\left(mean\left(s^I\right) < 1\right)$.[22]

[21] The dividends series was detrended using a linear trend and divided by the total U.S. population and the CPI in each year to obtain real per capita dividends.

[22] Recall that $s^A = 2 - s^I$.

What makes this model fundamentally different from the model described in the previous section is that now the amount of risk born by each agent is endogenously determined and increasing in their stock positions. In this case, facing more uncertainty, inattentive investors optimally choose to invest less in the risky asset. As a result, in the long run they will consume less, accumulate less wealth but experience a less volatile consumption path.

To understand the properties of this economy, it is useful to recall first what would happen in the absence of inattention in such an environment.

Without inattention or idiosyncratic shocks, the only difference between the two agents is their initial stock holdings. If they are both endowed with the same amount of wealth ($s = 1$), the model is recast into the representative agent framework of Lucas (1978). Trivially, it follows that in equilibrium the total stock positions of all agents is equal to the aggregate number of shares and the share price is an expected discounted sum of future dividends. In this environment, identical agents do not trade, hence saving in equilibrium is equal to zero ($s_{t+1} = s_t = 1$).

Conversely, if agents are heterogenous with respect to initial stock holding, i.e. one half of the population is richer than the other, this heterogeneity will create incentives to trade. By construction, the richer half of the population is more exposed to risk. To smooth their consumption, rich agents save procyclically and the stock price moves accordingly to clear the market.[23]

Now, lets introduce inattentiveness and assume that half of the population can adjust their consumption plans only sporadically. It is also useful with return risk to distinguish between planning and non-planning dates. Figures 3 and 4 are useful to understand the results. They describe the saving behavior of an inattentive consumer at planning and non-planning periods as a function of her initial stock holding.

Consider a planning date when there is no cross-sectional dispersion in wealth so that both agents hold one share each : $s_t^I = 1$ in figure 3. Even though both agents receive the same aggregate dividend shock, inattentive investors face more uncertainty since they predetermine future consumption. In contrast to the economy with income uncer-

[23]In the long-run, even this economy with intital wealth dispersion will converge to a representative agent economy.

tainty, this induces them to save *less* in planning periods for every realization of the shock $\left(s^I_{t+1} - s^I_t < 0, \forall d \text{ if } s^I_t = 1\right)$.

This result, counterintuitive at first, is better understood recalling that even without inattention, an increase in return risk can lead to a decrease in savings. With return uncertainty, two counterbalancing forces are at work. On one hand more uncertainty increases savings for precautionary reasons. On the other hand, it decreases demand for the risky asset by risk-averse investors.[24] Infrequently planning their consumption profile, inattentive investors perceive the stock as more volatile and will choose to invest less in this asset.

For increased wealth dispersion, inattentive investors' behavior partially resembles the model without inattention: they invest in stocks pro-cyclically towards the higher end of wealth and vice versa. As in the income-risk model, asset prices are procyclical.

Overall, the difference between this economy and the economy with full attention is not quantitatively large at planning periods.[25] It is useful to turn to non-planning periods to understand the full picture. Figure 4 describes an inattentive investor's saving behavior in non-planning periods and plots her stock accumulation $(s^I_{t+2} - s^I_{t+1})$ as a function of initial stock holdings $\left(s^I_t\right)$.

At non-planning dates, with low wealth dispersion, inattentive investors' stock holdings accommodate dividend movements to satisfy the budget constraint and prices move accordingly to clear the market. Thus, also in this case, infrequent planners save procyclically and trade at unfavorable prices. They will buy more stocks when prices are high and sell when prices are low. The term-of-trade effect described in the previous section is also in force in this case.

Precautionary saving, investment risk and price effects are mechanisms that affect wealth accumulation in two different directions. Simulation results show that the last two effects prevail and that inattentive investors accumulate less wealth than attentive ones in the long-run. By accumulating less wealth, on average they consume less but they also smooth their consumption better.

[24] Reis (2009) makes this point clear in a representative agent model where the only source of income is investment in a risky asset. Gollier and Kimball (1996) show that with CRRA utility, the opportunity to invest in a risky asset increases savings only if risk aversion is lower than one.

[25] Without inattentiveness, figure 3 would look similar but the three plotted curves would cross at zero for $s = 1$.

As in the income risk case, with inattention asset prices become more volatile and less autocorrelated. More specifically, inattention increases returns volatility by 30%.[26] Again, this increase implies an improvement with respect to a representative agent model, even though asset returns are still much more volatile in the data (16%).[27]

3.4 The costs of inattentiveness

To also evaluate the welfare consequences of inattentiveness in a model with return risk, I proceed as described in the previous section and assume that agents start out holding one share each. I also derive the expected lifetime utility that would arise in a model without inattentiveness, where the representative agent lives hand-to-mouth, period by period. Table 2 shows the results.

As in the income risk model, inattentive investors are worse off compared to both attentive investors and the representative agents. On the other hand, as opposed to the income risk case, attentive investors now experience a much more volatile consumption path and a lower level of welfare than in the representative agent case. Nevertheless, it is worth noting that with return risk the cost of inattentiveness is one order of magnitude lower than in the model with income risk, thus suggesting that even minor planning costs will rationalize infrequent planning.

4 A portfolio problem with inattention

The previous two sections show that, in a model with inattention, income and return risk have opposite effects on wealth accumulation while both increase asset prices volatility. It comes therefore natural to wonder how the presence of both kinds of risk would modify this conclusion.

A growing literature looks at the implication of planning costs on optimal portfolio decisions. Both Lynch (1996) and Gabaix and Laibson (2002) study the effects of infrequent

[26] Asset Returns, R'_{t+1}, are defined as $\frac{p_{t+1}+d_{t+1}}{p_t}$ in table 2. The table shows that the predicted standard deviation of stock returns increases from 0.017 to 0.022.

[27] To generate this figure, I used the long term stock, bond, interest rates and consumption data available from Robert Shiller's webpage. Heaton and Lucas (1996) report a similar number.

planning on investment decisions. More recently, Abel et al. (2009) evaluate the impact of both transaction and information costs on the optimal degree of inattention to the stock market. What all these papers have in common is that they consider partial equilibrium frameworks. Little can therefore be said on wealth dispersion or asset prices volatility in such environments. In this section, I tackle this issue in general equilibrium, combining the two models of the previous sections.

Portfolio problems in incomplete market settings have been intensively studied. Judd et al. (2000a) and Judd et al. (2002) review some of the computational problems attached to these set-ups. Inattention makes things harder since it increases both the dimension of the state space and the number of equations to be solved. For the sake of tractability, I limit my analysis to a two-period model that can be easily solved numerically and clearly illustrates the main mechanisms between inattention and portfolio choices.

4.1 The model

Consider the following model of portfolio decisions. There are two assets: b is a risk-free bond with price q, while s is a risky asset with dividend d and price, net of dividend, p. In each period, the dividend can only take two values: d_H or d_L, with $d_H > d_L$, each with probability $\frac{1}{2}$. The risk-free bond is in zero net supply, while the share is in unitary net supply. Besides investment income, agents in the model also receive a stochastic labor income that can take two values, $y_H > y_L$, each with probability $\frac{1}{2}$.

There are two groups of agents. Attentive investors choose their portfolio once the shocks of period 1 are realized. The inattentive ones choose consumption and the risky asset s before the shocks are realized. Utility is CRRA.

Agents are homogenous ex ante ($b_0^J = 0$, $s_0^J = 1$ for $J = A, I$) and both groups are of equal size, $\alpha = \frac{1}{2}$. The maximization problem faced by an attentive investor is therefore:

$$\begin{array}{ll} Max_{c_1^A, s_1^A} & U\left(c_1^A\right) + \beta E_1 U\left(c_2^A\right), \\ st: & c_1^A + q_1 b_1^A + p_1 s_1^A = b_0^A + \left(p_1 + d_1\right) s_0^A + y_1, \\ & c_2^A + q_2 b_2^A + p_2 s_2^A = b_1^A + \left(p_2 + d_2\right) s_1^A + y_2. \end{array} \tag{15}$$

The problem in (15) yields the following first-order conditions:

$$q_1 U'\left(c_1^A\right) = \beta E_1 U'\left(c_2^A\right),$$
$$p_1 U'\left(c_1^A\right) = \beta E_1 \left(d_2 + p_2\right) U'\left(c_2^A\right).$$

The maximization problem for an inattentive investor is:

$$\begin{array}{ll} Max_{c_1^I, s_1^I} & U\left(c_1^I\right) + \beta E_0 U\left(c_2^I\right), \\ st: & c_1^I + q_1 b_1^I + p_1 s_1^I = b_0^I + \left(p_1 + d_1\right) s_0^I + y_1, \\ & c_2^I + q_2 b_2^I + p_2 s_2^I = b_1^I + \left(p_2 + d_2\right) s_1^I + y_2, \end{array}$$

leading to the following optimality conditions:

$$U'\left(c_1^I\right) E_0 q_1 = \beta E_0 U'\left(c_2^I\right),$$
$$\beta E_0 \left(d_2 + p_2\right) U'\left(c_2^I\right) = \beta E_0 \frac{p_1}{q_1} U'\left(c_2^I\right)$$

The model is closed with the usual market clearing conditions:

$$\begin{aligned} \alpha b_t^A + (1-\alpha) b_t^I &= 0, \\ \alpha s_t^A + (1-\alpha) s_t^I &= 1, \ t = 1, 2. \end{aligned}$$

4.2 Results

Table 3 summarizes the numerical solutions for different values of risk aversion, μ. In the numerical implementation of the model, the discount factor, β, is calibrated at 0.98, as in the model in section 2. For simplicity, it is assumed that dividend and labor income are perfectly correlated. The standard deviation of both shocks and the dividend income share follow the calibration of the previous two sections. To highlight the effects of inattention, table 3 also reports the results for the representative agent model (RA).

The model in this section differs from the previous two in two respects: agents can now invest in more than one asset and there are two sources of risk. To separate the effects of these two channels, I first study a model with one asset but no income risk. I then reintroduce income volatility and evaluate the effect of this channel.

First, consider the model described above but where the only source of uncertainty is asset returns, $y_H = y_L = 0$. I refer to this model as "Return Risk" in table 3. Facing higher uncertainty in asset returns, the inattentive group saves more in bonds and less in equities compared to the attentive group. Moreover, inattention increases both the level and the volatility of both the risky (r') and the risk-free $\left(r^f\right)$ return. These conclusions hold irrespective of the degree of risk aversion.

Interestingly, inattentiveness increases the risk premium because attentive agents now demand a higher premium for bearing the macroeconomic risk. However, as in a standard representative agent model, risk aversion plays a central role in determining the size of this effect. When risk aversion is high, the increase in the risk premium induced by inattentiveness is large enough to impoverish inattentive investors, given their portfolio composition. This implies that only for a high degree of risk aversion, $\mu > 10$, will attentive investors accumulate the most wealth.[28] Nevertheless, even in this last case the difference between the risk premium in the model with inattentiveness and the one generated in a representative agent setting is only 0.4%. Moreover, this increase comes at the expense of implausibly high returns, showing again a connection between the risk premium and the risk-free rate puzzles.[29]

Now, introduce income risk. I refer to this model as "Return and Labor Income Risk" in table 3. As before, regardless of the degree of risk aversion, inattention induces inattentive agents to sell equities and buy bonds and it increases asset prices volatility. However, now the effects of inattention on risk premium are even more muted (leading to differences of less than 0.01% in the three cases). It follows that, even for a high degree of risk aversion, inattentive agents accumulate more wealth. This last result is better understood recalling the findings in Polkovnichenko (2004). In that paper, it is shown that the implications of limited stock market participation for the equity premium are marginal if shareholders are endowed not only with capital income, but also with labor income.

To summarize the results, in a portfolio choice model with both income and return risk, inattentive investors invest less in the stock market while accumulating more bonds. Even

[28] Wealth is defined as $(E(w_2) = E(s_1 d_2 + b_1))$, since in equilibrium $p_2 = 0$.
[29] See Weil (1992).

with two sources of risk, asset prices are more volatile. Thus, inattentiveness can explain the link between infrequent planning and limited stock market participation, but cannot account for the lower saving rate of infrequent planners observed in the data.

5 Conclusions

This paper explores the links between the propensity to plan, wealth inequality and asset prices in general equilibrium. In a simple endowment economy where agents receive equal income or dividend streams, differences in the propensity to plan generate wealth heterogeneity and volatile asset prices. Attentive agents plan their consumption pattern period by period, while inattentive ones plan every other period. In a partial equilibrium model with fixed interest rates, Reis (2006) shows that inattentive consumers face more uncertainty and save more for precautionary reasons. Here, I show that in general equilibrium, inattentive consumers will trade at unfavorable prices. This negative term of trade effect might potentially lead to lower wealth. However, even in general equilibrium, inattentive consumers accumulate claims on attentive ones if the only source of risk is income. In contrast, they accumulate less wealth when they can trade only in a risky asset.

In my model, asset returns are much more volatile than in a representative agent model with full attention. This is due to the fact that, in general equilibrium, prices must induce attentive agents to voluntarily bear the whole burden of adjusting to aggregate income shocks. Thus, my simple model suggests a natural link between infrequent planning and the high volatility of stock returns observed in the data.

According to my findings, inattentiveness can replicate the empirical evidence in Lusardi (2003) and explain the limited stock market participation of infrequent planners. However, it cannot account for the observed positive relationship between propensity to plan and savings rate. [30]

Inattentiveness captures only one of the channels through which propensity to plan influences wealth accumulation: infrequent planning increases uncertainty concerning future income or future asset returns. My results suggest that in order to replicate the empirical ev-

[30] See, e.g., Ameriks et al. (2003).

idence in Ameriks et al. (2003), the standard consumption/saving model should also be modified in other dimensions besides introducing heterogeneity in the propensity to plan. In the behavioral literature, undersaving is often related to self-control problems (e.g. O'Donoghue and Rabin (1999), Ameriks et al. (2004)). Ameriks et al. (2003) suggest that present bias preferences could turn infrequent planners into overspenders.

Exploring these different channels is left to future research.

References

Abel, A. B., Eberly, J. C., and Panageas, S. (2007). Optimal inattention to the stock market. *American Economic Review: Papers and Proceedings*, 97(2):244–249.

Abel, A. B., Eberly, J. C., and Panageas, S. (2009). Optimal inattention to the stock market with information costs and transaction costs. *NBER Working Paper No.15010*.

Ameriks, J., Caplin, A., and Leahy, J. (2003). Wealth accumulation and the propensity to plan. *Quarterly Journal of Economics*, 118(3):1007–1047.

Ameriks, J., Caplin, A., and Leahy, J. (2004). The absent-minded consumer. *NBER Working Paper No.10216*.

Ameriks, J. and Zeldes, S. P. (2004). How do household portfolio shares vary with age? *Mimeo*.

Caballero, R. J. (1995). Near rationality, heterogeneity, and aggregate consumption. *Journal of Money, Credit, and Banking*, 27(1):29–48.

Christiano, L. J. (1990). Solving the stochastic growth model by linear-qaudratic approximation and by value function iteration. *Journal of Business and Economic Statistics*, 8(1):23–26.

Cochrane, J. H. (1989). The sensitivity of tests of the intertemporal allocation of consumption to near-rational alternatives. *American Economic Review*, 79(3):319–337.

Den Haan, W. J. (1996). Heterogeneity, aggregate uncertainty, and the short-term interest rate. *Journal of Business and Economic Statistics*, 14(4):399–411.

Den Haan, W. J. (2001). The importance of the number of different agents in a heterogeneous asset-pricing model. *Journal of Economic Dynamics and Control*, 25(5):721–746.

Gabaix, X. and Laibson, D. (2002). The 6d bias and the equility-premium puzzle. In Bernanke, B. and Rogoff, K., editors, *NBER Macroeconomics Annual*, volume 16, pages 2341–2378. MIT Press.

Gollier, C. and Kimball, M. (1996). Toward a systematic approach to the economic effects of uncertainty: Characterizing utility functions. *Discussion Paper. University of Michigan.*

Heaton, J. and Lucas, D. J. (1996). Evaluating the effects of incomplete markets on risk sharing and asset pricing. *Journal of Political Economy*, 104(3):443–487.

Judd, K. L., Kubler, F., and Schmedder, K. (2000a). Computational methods for dynamic equilibria with heterogeneous agents. *Mimeo.*

Judd, K. L., Kubler, F., and Schmedder, K. (2000b). Computing equilibria in infinite-horizon finance economies: The case of one asset. *Journal of Economic Dynamics and Control*, 24:1047–1078.

Judd, K. L., Kubler, F., and Schmedder, K. (2002). A solution method for incomplete asset markets with heterogeneous agents. *Mimeo.*

Krusell, P. and Smith, A. A. (1997). Income and wealth heterogeneity, portfolio choice, and equilibrium asset returns. *Macroeconomic Dynamics*, 1:387–422.

Krusell, P. and Smith, A. A. (1998). Income and wealth heterogeneity in the macroeconomy. *Journal of Political Economy*, 106(5):867–896.

LeRoy, S. F. and Porter, R. D. (1981). The present value relation: tests based on implied variance bounds. *Econometrica*, 49(3):555–574.

Lucas, Robert, E. (1978). Asset prices in an exchange economy. *Econometrica*, 46(6):1426–1445.

Lucas, Robert, E. (1987). *Models of Business Cycles.* Basil Blackwell, New York.

Lusardi, A. (2003). Planning and savings for retirement. *Mimeo.*

Lusardi, A. and Mitchell, O. S. (2007). Financial literacy and retirement preparedness: Evidence and implications for financial education. *Business Economics*, 42(1):35–44.

Lynch, A. W. (1996). Decision frequency and synchronization across agents: Implications for aggregate consumption and equity return. *Journal of Finance*, 51(4):1470–1497.

Mankiw, N. G. and Reis, R. (2006). Pervasive stickiness. *American Economic Review Papers and Proceedings*, 96(2):164–169.

McKay, A. (2008). Household saving behavior, wealth accumulation and social security privatization. *Mimeo.*

Moscarini, G. (2004). Limited information capacity as a source of inertia. *Journal of Economic Dynamics and Control*, 28(10):2003–2035.

O'Donoghue, T. and Rabin, M. (1999). Procrastination in preparing for retirement. In Aaron, H. J., editor, *Behavioral Dimensions of Retirement Economics*, pages 125–156. Brookings Institution Press.

Pischke, J. S. (1995). Individual income, incomplete information, and aggregate consumption. *Econometrica*, 63(4):805–840.

Polkovnichenko, V. (2004). Limited stock market participation and the equity premium. *Finance Research Letters*, 1(1):24–34.

Reis, R. (2006). Inattentive consumers. *Journal of Monetary Economics*, 53(8):1761–1800.

Reis, R. (2009). The times series properties of aggregate consumption: implications for the costs of fluctuations. *Journal of European Economic Association*, 7(4):722–753.

Shiller, R. J. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? *America Economic Review*, 71(3):421–436.

Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, 50(3):665–690.

Venti, S. (2006). Choice, behavior and retirement saving. In Gordon Clark, A. M. and Orszag, M., editors, *Oxford Handbook of Pensions and Retirement Income*. Oxford University Press.

Weil, P. (1992). Equilibrium asset prices with undiversifiable labor income risk. *Journal of Economic Dynamic and Control*, 16:769–790.

A Tables and Figures

Table 1: Calibration

Variable	Description	Benchmark	Robustness
β	Discount factor	$0.98, 0.925$	0.94
μ	Risk aversion	1.5	3
α	Dimension attentive group	$\frac{1}{2}$	–
κ	Penalty factor	4	–
$\frac{d}{d+\bar{y}}$	Dividend income share	15%	–
$\sigma_{\varepsilon y}$	Std. income shock	0.01	0.005
$\sigma_{\varepsilon d}$	Std. dividend shock	0.03	0.06
ρ_y	Income autocorrelation	0.94	0.50
ρ_d	Dividend autocorrelation	0.87	0.50
nY, nD	Exogenous shocks states	3	–
nB, nS	Grid points	251	–
$\underline{b}$	Debt limit	-2	–

Table 2: Inattentiveness in General Equilibrium

	Inattentive Consumers			Inattentive Investors	
	RA	I		RA	I
Simulation results					
$Mean\left(b^I\right)$	0	0.288	$Mean\left(s^I\right)$	1	0.889
$Var\left(b^I\right)$	0	0.119	$std\left(s^I\right)$	0	0.09
$mean\left(R\right)$	1.020	1.020	$mean\left(R'\right)$	1.081	1.081
$std\left(R\right)$	0.003	0.012	$std\left(R'\right)$	0.017	0.022
$corr\left(\Delta b^I, q\right)$	-	0.873	$corr\left(\Delta s^I, p\right)$	-	0.314
$mean\left(c^I\right)$	1.000	1.006	$mean\left(c^I\right)$	6.678	6.568
$mean\left(c^A\right)$	1.000	0.995	$mean\left(c^A\right)$	6.678	6.790
$std\left(c^I\right)$	0.029	0.029	$std\left(c^I\right)$	0.0607	0.106
$std\left(c^A\right)$	0.029	0.032	$std\left(c^A\right)$	0.0607	0.116
Cost of Inattentiveness					
$\left(\frac{C^I-C^A}{C^A}\right)\%$	-	-0.016	$\left(\frac{C^I-C^A}{C^A}\right)\%$	-	-0.005
$\left(\frac{C^I-C^{RA}}{C^{RA}}\right)\%$	-	-0.012	$\left(\frac{C^I-C^{RA}}{C^Y}\right)\%$	-	-0.006
$\left(\frac{C^A-C^{RA}}{C^{RA}}\right)\%$	-	0.004	$\left(\frac{C^A-C^{RA}}{C^{RA}}\right)\%$	-	-0.001

Table 3: A Portfolio Problem with Inattention

Return Risk

	$\mu = 1.5$		$\mu = 3$		$\mu = 10$	
	RA	I	RA	I	RA	I
w^I	1.002	1.006	1.002	1.006	1.002	0.999
$E\left(b^I\right)$	0	0.005	0	0.007	0	0.004
s^I	1	0.999	1	0.997	1	0.994
w^A	1.002	0.998	1.002	0.998	1.002	1.004
r^f	4.17%	4.23%	4.17%	5.06%	4.17%	18.02%
$std(r^f)$	0.093	0.269	0.186	0.483	0.559	1.029
r'	4.73%	4.79%	5.29%	6.18%	7.63%	21.90%
$std\left(r'\right)$	0.113	0.278	0.198	0.492	0.583	1.068
$r' - r^f$	0.56%	0.56%	1.12%	1.12%	3.46%	3.88%

Return and Labor Income Risk

	$\mu = 1.5$		$\mu = 3$		$\mu = 10$	
	RA	I	RA	I	RA	I
w^I	1.002	1.003	1.002	1.004	1.002	1.006
$E\left(b^I\right)$	0	0.002	0	0.003	0	0.006
s^I	1	.9999	1	0.9997	1	0.999
w^A	1.002	1.000	1.002	0.999	1.002	0.997
r^f	4.17%	4.16%	4.17%	4.16%	4.17%	4.47%
$std(r^f)$	0.021	0.064	0.042	0.127	0.140	0.386
r'	4.30%	4.30%	4.42%	4.42%	5.00%	5.32%
$std\left(r'\right)$	0.066	0.089	0.076	0.142	0.154	0.395
$r' - r^f$	0.13%	0.13%	0.26%	0.26%	0.84%	0.84%

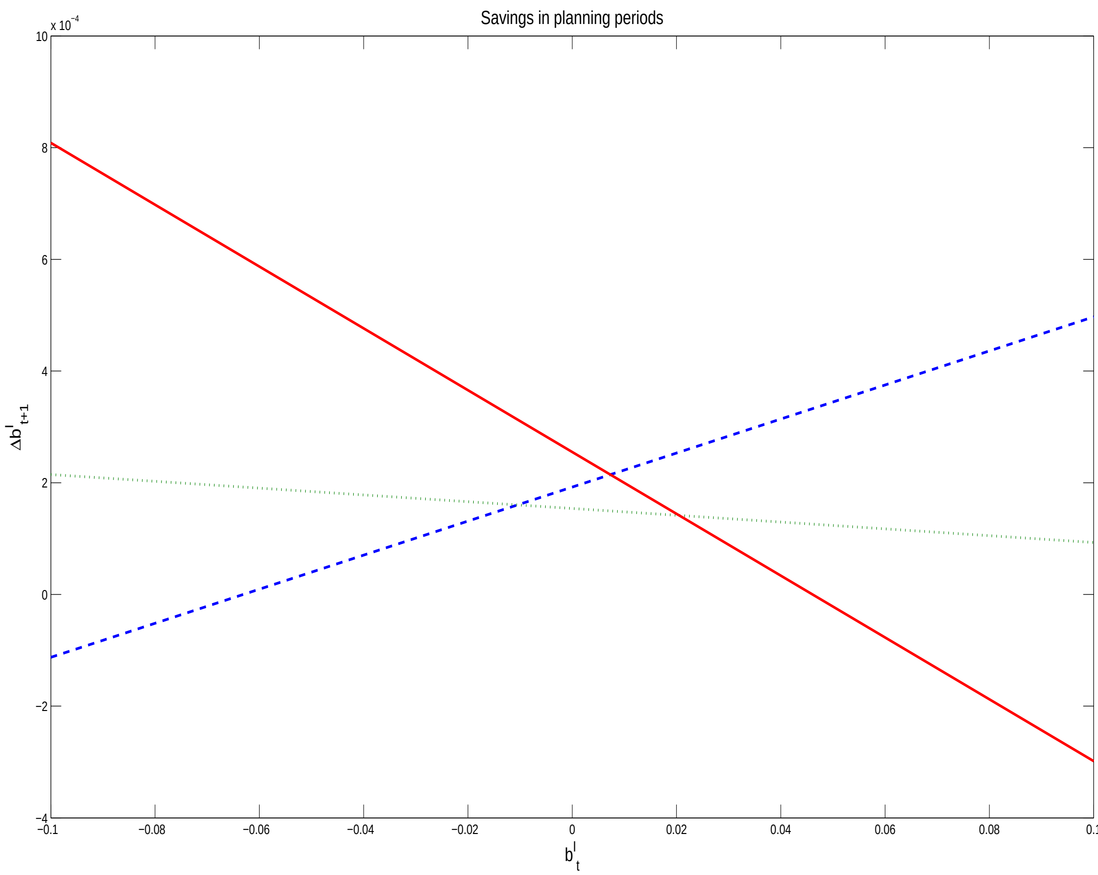

Figure 1: Inattentive consumers' saving behavior in planning periods, b(t+1)-b(t), as a function of initial bond holding, b(t), and the three realizations of the income shock: high (solid line), medium (dotted line) and low (dashed line).

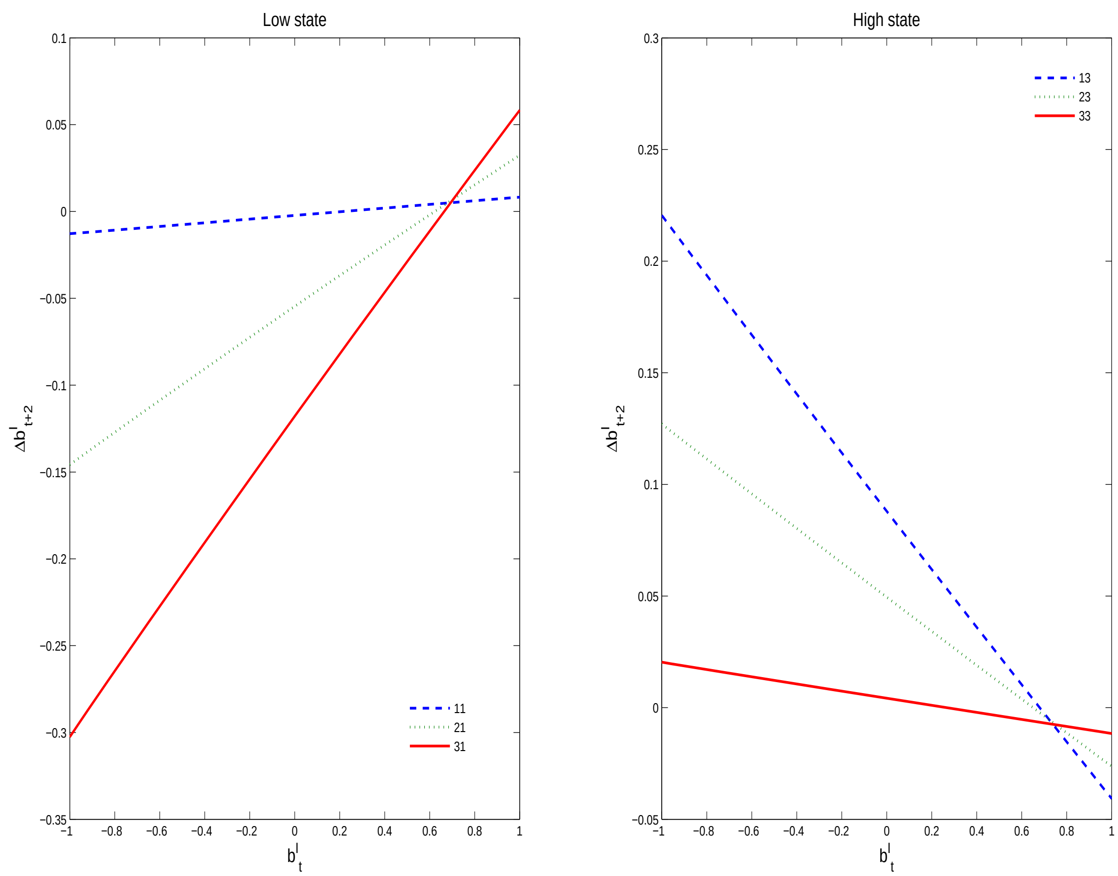

Figure 2: Inattentive consumers' savings in non-planning periods, b(t+2)-b(t+1), for two realizations of the income shock in t+1: low (left panel) and high (right panel). Each panel reports three different saving rules that depend on the initial income state in t. For example, in the left panel, 11 corresponds to y(t)=low and y(t+1)=low, 21 corresponds to y(t)=medium and y(t+1)=low and 31 corresponds to y(t)=high and y(t+1)=low.

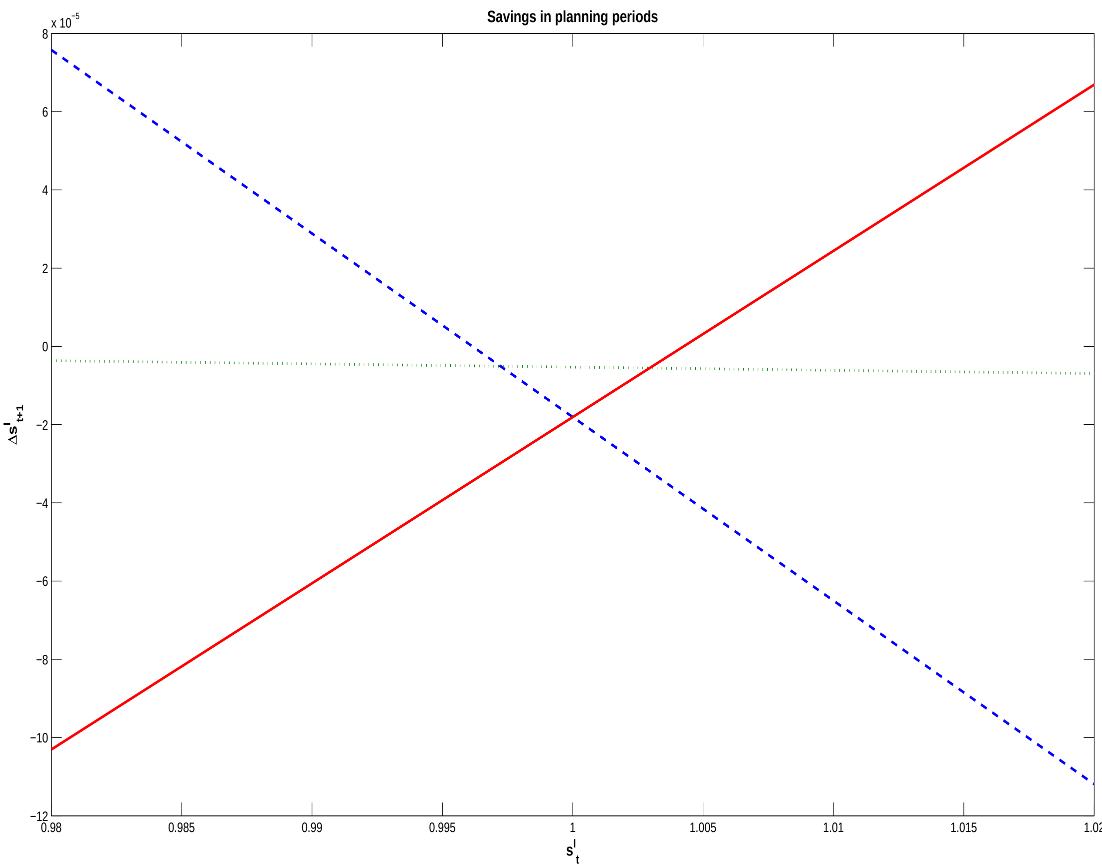

Figure 3: Inattentive investors' saving behavior in planning periods, s(t+1)-s(t), as a function of initial stock holding, s(t), and the three realizations of the dividend shock: high (solid line), medium (dotted line) and low (dashed line).

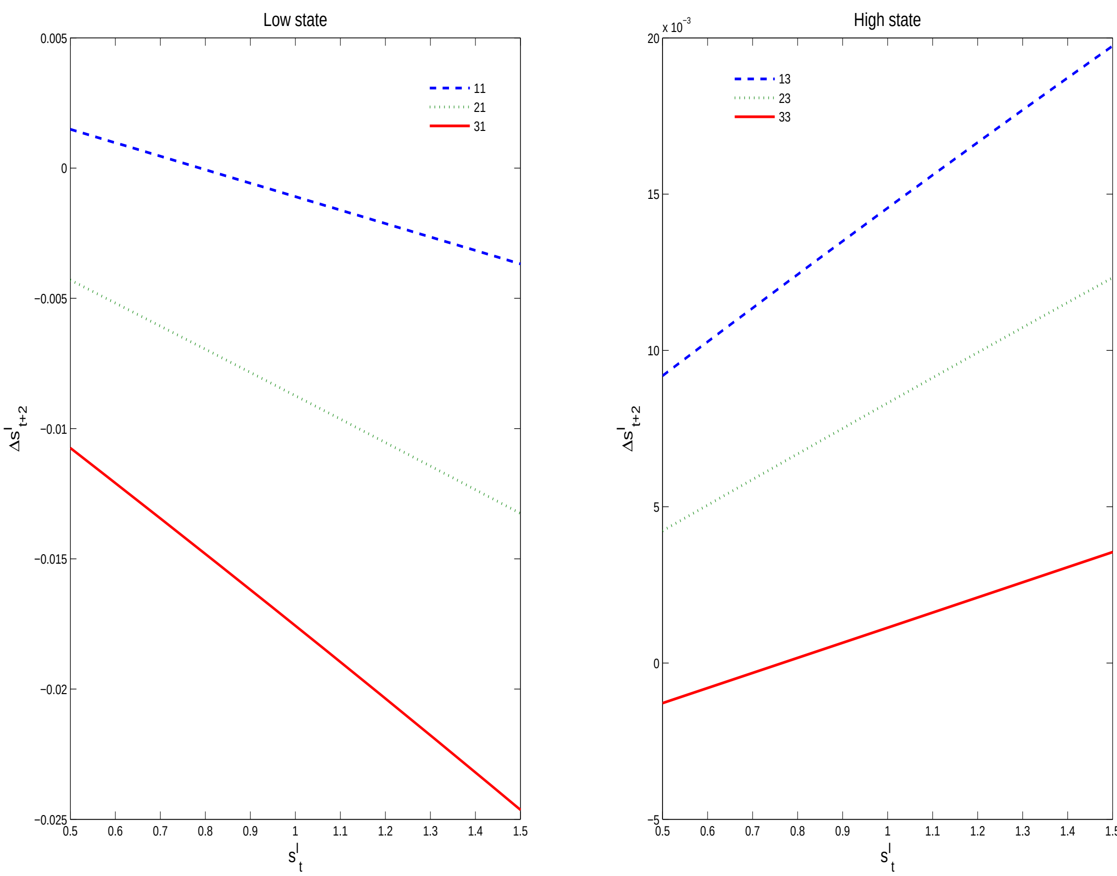

Figure 4: Inattentive investors' savings in non-planning periods, s(t+2)-s(t+1), for two realizations of the dividend shock in t+1: low (left panel) and high (right panel). Each panel reports three different saving rules that depend on the initial dividend state in t. For example, in the left panel, 11 corresponds to d(t)=low and d(t+1)=low, 21 corresponds to d(t)=medium and d(t+1)=low and 31 corresponds to d(t)=high and d(t+1)=low.

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