Saving and Portfolio Allocation Before and After Job Loss*†

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Abstract

Using administrative panel data from Norway, we investigate the development of household labor income, financial wealth and asset holdings over a nine-year period surrounding job loss. Consistent with a simple theoretical model, the data show precautionary saving and a shift toward safer assets in the years leading up to unemployment, and depletion of savings after job displacement. This suggests that at least some households can foresee and prepare for upcoming unemployment, which indicates that private savings can to some extent serve as a substitute for publicly provided unemployment insurance.

Keywords: unemployment, precautionary saving, consumption smoothing, household portfolios, portfolio allocation, optimal unemployment insurance

JEL Codes: D12, E21, E24, G11, J65

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1 Introduction

The financial crisis and the resulting recession have significantly increased the number of unemployed in most OECD economies, with an associated increase in governments' spending on unemployment insurance (UI) benefits. The US spending on out-of-work income maintenance amounted in 2009 to 1% of GDP, a marked increase from 0.24 % in 2005, according to OECD data. The OECD average also amounted to 1% in 2009 (Adema et al. (2011)). With strained public finances and concerns about moral hazard – under which UI can prolong unemployment by "subsidizing" it – the question is whether insurance mechanisms other than UI can smooth consumption for those hit by unemployment.

One mechanism by which a household can smooth consumption during unemployment is through depletion of private savings. Since households hit by unemployment are typically liquidity constrained, private savings need to be accumulated before job loss to enable consumption smoothing. Anticipation of unemployment can then induce more savings, and if sufficiently many households are affected, result in a demand deficiency that may enforce an economic downturn. Moreover, as the perceived likelihood of unemployment increases, the household will want to store the savings in safer and more liquid assets (like cash or deposits). Such portfolio rebalancing can affect the economy further by exacerbating detrimental interdependencies between labor and financial markets: As households threatened by unemployment reduce their holdings of stocks and instead increase holdings of safer assets, a deteriorating labor market can enforce a downturn in financial markets. Empirical documentation of the timing and magnitude of households' responses to upcoming unemployment is therefore important, not only to provide public financial support to workers hit by unemployment, but also in understanding the development of the broader economy.

In this paper we investigate how workers in wealthy welfare states, such as Norway, are able to smooth consumption by foreseeing an upcoming unemployment spell and react to it by increasing and reallocating their savings. In particular, we estimate the development of households' labor income, financial wealth and asset holdings through the period from four years before to four years after job displacement.

In the optimal UI literature, coined by Baily (1978) and further developed by e.g. Chetty (2006), the main substitute for publicly provided UI is private savings.[1] In the extreme case, unprepared "hand-to-mouth consumers" would have to reduce their consumption in line with the unemployment-induced reduction in their income, strengthening the case for UI. By contrast, households with sufficient savings might not need UI at all to maintain consumption levels.[2] Indeed, Browning and Crossley (2001) show that households in Canada, particularly those with insufficient prior wealth, have to cut their consumption during unemployment spells when UI benefits are cut. Bloemen and Stancanelli (2005) present similar findings for food consumption in the UK.[3] Finally, results in Card et al. (2007) and Basten et al. (2012) provide further indication of liquidity constraints among unemployed in Austria and Norway, respectively.

Despite the theoretical recognition of private wealth as insurance against unemployment, there is limited evidence on the extent to which households are able to accumulate wealth before and decumulate it after job loss, chiefly because of the limited availability of adequate data. A notable exception is Gruber

[1]Relatedly, Crossley and Low (2011) show how the optimal UI replacement rate depends on, among other things, the cost of self-insurance.

[2]Note that the availability of alternative insurance mechanisms captures only the benefit side of the optimal UI framework. To determine whether the current level of UI is optimal, one also needs to know its moral hazard cost, as shown in Chetty (2008). This paper focuses on the benefits of UI; see Roed and Zhang (2003) for a paper addressing the costs for Norway.

[3]This is all the more striking in the light of arguments and findings in Browning and Crossley (2009), whereby households can first, with smaller effects on utility, cut spending on durables, and only thereafter need to cut food expenditures.

(2001) who uses the US Survey of Income and Program Participation (SIPP) to analyze prior holdings and wealth depletion during unemployment. He observes household wealth at two points in time, enabling him to take out household fixed effects in estimating wealth depletion during unemployment.[4] In addition to investigating wealth depletion during unemployment, we investigate the extent of additional saving and of portfolio reallocation in the years leading up to the unemployment spell. This has previously been addressed in the literature on precautionary saving, which recognizes that household saving may be motivated not only by the "life-cycle" purpose of smoothing consumption and preparing for retirement, but also by a desire for "precautionary" or "buffer-stock" saving at shorter horizons, to prepare for events such as unemployment (Deaton (1991) and Carroll (1997)).[5] Furthermore, some studies investigate the extent to which households' investment in risky assets is negatively affected by labor income risk (see e.g. Guiso et al. (1996) using survey data on Italian households (SHIW), or Betermier et al. (2012) for a study of the portfolios of Swedish job and industry switchers). Krueger and Perri (2009) employs the Italian SHIW, in addition to the PSID to investigate household responses to income shocks. They find that households adjust their consumption modestly in response to income changes.

The major challenge for such empirical studies is that job loss risk can be endogenous. Households that have chosen riskier jobs may in fact be less risk-averse than others and hence engage in less precautionary saving or be less cautious about holding risky assets at all times, biasing downward any estimates of the effect of unemployment risk on saving or portfolio rebalancing.

[4]Having only two points in time has the disadvantage that the depletion will be underestimated to the extent that some of it takes place before the first or after the second point of observation. While two observations per household do allow to control for household fixed effects in the *level* of wealth, they do not suffice to control for household trends in wealth over time. In this paper we are able to address these shortcomings through the use of a 13-year annual panel on households' income, wealth and asset holdings - for households experiencing and not experiencing an unemployment spell.

[5]For a summary of the different models of precautionary saving, see also Carroll (2001)

The precautionary saving literature in particular has tried to address such endogeneity concerns by instrumenting unemployment risk with variables thought to influence this risk but not to otherwise affect saving (for examples, see Carroll et al. (2003), Fuchs-Schündeln and Schündeln (2005) or Barceló and Villanueva (2010)). In addition to the possible endogeneity of job loss risk, there is the problem that households' behavior will necessarily depend not on actual unemployment probabilities (which econometricians can predict with some measurement error and can then instrument), but rather on households' subjective expectations thereof. That is, households can prepare for upcoming unemployment only to the extent to which they are actually aware of it. In this paper we focus on cases of actual unemployment and test the hypothesis of no behavioral response against the joint hypothesis that households can to some extent foresee their job loss and are motivated and able to respond to it.[6]

This paper thus contributes to the literature in three ways. First, we investigate to what extent households prepare for an unemployment spell with additional saving in the years preceding the spell. Second, we examine to what extent they reallocate their savings toward safer and more liquid assets in the same period. Finally, we explore whether they draw on prior savings during the unemployment spell. To do so, we employ a panel of annual administrative data from Norway in which we observe labor income, financial wealth and the holdings in different asset classes for each household for 13 consecutive calendar years, 1995-2007.[7] Based on these administrative data, we construct a sample comprising households where the man experiences his first unemployment

[6]Stephens Jr (2004), using the US Health and Retirement Study, finds households to have some sense of upcoming job losses and income drops. Guvenen and Smith (2010) use observed economic choices by households (consumption-savings decisions) to assess what households know about their own income process..

[7]To strike a balance between tracing households for as many "relative years" around job loss (where the year of job loss is year 0) as possible, while also having enough observations for each relative year, using all households that experienced a job loss in 1999-2003 we estimate the coefficients of being in relative year -4 through +4.

spell in one of the years 1999-2003, and complement this with a placebo sample of comparable households that do not experience an unemployment spell in this period (similar to the approach in e.g. Jacobson et al. (1993), Davis and von Wachter (2011) or von Wachter et al. (2011)). The panel structure of our data allows us to control for any unobserved household characteristics that are time-invariant, as well as for any calendar-year fixed-effects that are household-invariant, such as the effects of being in different phases of the business cycle.

The remainder of this paper is structured as follows. Section 2 presents a simple theoretical model with predictions about how upcoming, current or recent unemployment should affect saving and portfolio choices. Section 3 explains our empirical strategy, Section 4 the data, and Section 5 presents the main results. Section 6 concludes.

2 Theoretical Framework

We illustrate the role of saving and portfolio allocation in response to impending, current and recent unemployment by means of a simple two-period model in which households earn labor and capital income and receive utility from consumption. In the first period they must decide how much to save for next-period consumption, as well as how to invest these savings. The model is a special case of Leland (1968) and yields no new results on its own. It is, however a convenient tool to structure our empirical investigation around its predictions.

2.1 Wealth Depletion during Unemployment

We start by considering a household that is currently experiencing unemployment and faces uncertainty about next period's labor income. The household receives unemployment benefits y_l[8] and additionally can draw on savings w. Income y in the following period 1 is uncertain: with probability p_1 the household remains unemployed from period 0 through period 1 and thus income remains at the UI level y_l, and with probability $(1 - p_1)$ the household returns to employment and earns $y_h > y_l$.[9]

The household derives utility from consumption (c) only, and the utility function $u(c)$ is assumed to be strictly increasing and concave in c. Let β denote the discount factor between the two periods, R the risk-free return on savings and s the saving rate. Then the household solves the following maximization problem:

$$\underset{s}{Max} \qquad u(c_0) + \beta E[u(c_1)], \tag{1}$$

subject to:

$$0 \leq s \leq 1 \tag{2}$$

$$c_0 = (w + y_l)(1 - s) \tag{3}$$

$$c_1 = y_1 + (w + y_l)sR \tag{4}$$

This maximization problem yields a simple Euler equation for savings, which tells us that – given an expectation p_1 for the probability of continued unemployment next period – the household will choose its rate of (dis-) saving such that its expectation of the marginal utility of consumption across both periods is equalized:

[8] For the majority of households in Norway, this corresponds to 62.4% of the earnings in the previous year.

[9] To focus on the main links between unemployment and saving behavior, we make two simplifying assumptions. First, we take the risk of job loss as exogenous. Second, we assume that being unemployed is synonymous with receiving lower income, but does not affect utility through any other channel. In Section 3 we discuss the potential endogeneity of unemployment.

$$\frac{\delta EU}{\delta s} : u'(c_0) = R\beta \left[(1-p_1)u'(c_1^E) + p_1 u'(c_1^U)\right], \tag{5}$$

where c_1^E and c_1^U denote consumption in period 1 in the case where the household is employed (E) and unemployed (U), respectively. As we show in the online Appendix, differentiating this equation with respect to p_1 tells us that there will be less saving, or equivalently more depletion, the more likely the household expects to be back in a regular job next period.

Proposition 1 $\frac{\delta s}{\delta p_1} > 0$. *A reduction in the expected probability* p_1 *of remaining unemployed in the next period will induce the household to deplete its current savings* s.

2.2 Extra Saving before Unemployment

Given this motivation for spending additional resources during unemployment, we consider what a household would do upon realizing an increased risk of unemployment. The central intuition behind this consideration can be illustrated using the same kind of parsimonious two-period model with time set back one period. Now we consider behavior in the pre-unemployment *period -1*, in which income is at the higher level $y_{-1} = y_h$, given that the household expects, with probability p_0, to become unemployed and hence be earning only UI benefits $y_l < y_h$ in the following period 0. In this situation the same relationship of $\frac{\delta s_{-1}}{\delta p_0} > 0$ holds and can now be interpreted as precautionary saving:

Proposition 2 $\frac{\delta s_{-1}}{\delta p_0} > 0$. *An increase in the expected probability* p_0 *of becoming unemployed in the next period will induce the household to increase its savings* s_{-1} *in the pre-unemployment period.*

2.3 Portfolio Reallocation before Unemployment

When making its financial choices in response to unemployment risk, the household may also want to optimize the risk structure of its savings, given that asset classes other than the risk-free one are available. To illustrate the mechanism that might be at play here, we add to our illustrative model a second, risky asset yielding the uncertain return of R^r. With probability $(1 - q)$ this risky asset yields a high return, $R^r = R_h$; and with probability q a low return, $R^r = R_l$. To motivate risk-averse households to invest any fraction of their financial wealth in the risky asset, its expected return needs to exceed that of the safe asset: $E(R^r) > R^s$. As before, the household chooses its optimal saving rate from period -1 to 0, s_{-1}, to depend positively on the perceived probability of being unemployed next period, p_0. In addition to the previous case, the household now chooses which fraction α of its savings it wishes to invest in the risky asset. The optimization problem now involves the two choice variables α and s_{-1} (see the online Appendix).

For a given level of savings, the risk averse households will want to reduce the level of consumption in the next period as a response to an increase in the expected probability of unemployment in the next period. As this concave utility function is steeper at lower levels of consumption, any absolute variation in consumption at low levels will result in larger fluctuations in utility compared with the case when consumption is higher.[10] Hence, a utility-maximizing household will shift from risky assets to safe assets to reduce this dispersion :

Proposition 3 $\frac{\delta \alpha}{\delta p_0} < 0$. *An increase in the probability p_0 of being unemployed next period will induce the household to reduce the share of savings α that is invested in risky assets.*

[10] The proposition holds if we assume no correlation between returns to human capital and risky assets. Fagereng et al. (2012) find little or no correlation between asset returns and labor income risk for a sample of Norwegian households during the period 1995-2007.

3 Empirical Strategy

Cross-sectional regressions of portfolio changes on employment changes using observational data will typically fail to identify the relationship of interest because households that experience unemployment will differ from those not experiencing unemployment. At the same time, there is the risk of confounding general changes in asset markets with developments because of job loss, since the majority of job losses occur during economic downturns.

Our panel, in which we observe households annually for 13 years, 1995-2007, enables us to trace our outcomes of interest for many years. At the same time we can control for both household fixed effects and calendar-year fixed effects. Specifically, our empirical strategy is illustrated by the following model estimated on a panel of households experiencing unemployment:

$$Y_{i,t} = \alpha_i + \beta(RY_{i,t}) + \gamma_t + \varepsilon_{it}, \tag{6}$$

where $Y_{i,t}$ denotes different outcome variables (e.g. saving; see Section 4) for household i in calendar year t, α_i is a vector of household fixed effects, γ_t is a vector of calendar-year dummies, $RY_{i,t}$ is a vector of dummies for nine relative years around the year of job loss (the relative year zero is the year of job loss) and ε is an error term with mean zero. Because we use job losses from different calendar years, we are able to separately identify the calendar-year and the relative-year fixed effects. For each outcome variable of interest, we can thus estimate this equation and thereby obtain the respective variable's time path (given by the betas) for relative years before, during and after the year of job loss (see e.g. Jacobson et al. (1993), Davis and von Wachter (2011) or von Wachter et al. (2011)).

This empirical strategy identifies the effect of an anticipated[11] unemployment event on saving or portfolio rebalancing - or of an actual unemployment event on subsequent depletion of savings - if the timing of the event is uncorrelated with unobserved determinants of the outcome variable. Although unobservable differences in households that are time-invariant or aggregate calendar-year variation - both potential sources of bias in previous studies - are not a threat to our identification strategy, several legitimate concerns remain. It is possible, for example, that there exist unobserved "third factors" (confounders) that cause both changes in saving behavior and in the employment situation. Individuals going through some kind of personal crisis might become less disciplined in their saving and investment behavior and might for the same underlying reasons lose their job soon after. If so, effect estimates of the upcoming unemployment would be biased downward. By contrast, households that recently managed to put an above-average amount of money on the side might not fear unemployment (given that some individuals have some leeway on when or whether they are laid off), biasing the effect estimate upward. Indeed, we may even imagine that a worker could be saving *because* he is planning to make himself become unemployed, in which case it is not the anticipation of (involuntary) unemployment that causes saving, but the saving that causes the unemployment.

We attempt to shed some light on the empirical relevance of such endogeneity issues by repeating our analyses for a subsample of households whose job loss occurs in association with a major plant downsizing event. In the Results section (5) we confirm that using the subsample of job losers who are separated from their jobs as part of a mass layoff does not significantly change the response patterns of the households. However, the number of households involved in

[11]Some workers will be aware of the upcoming unemployment spell with certainty, others may only fear it with low probability. At the end of the current section, we elaborate on how this affects the interpretation of our results.

mass layoff is small, which limits the precision and reliability of this analysis.

More generally, concerns may remain as to whether our calendar year fixed effects do really manage to absorb all macroeconomic developments, such as inflation or asset market performance and whether factors like age and life cycle are confounding our results. To investigate this, we repeat our analyses with an interaction of a placebo sample of households subjected to exactly the same criteria as our main sample but who do not experience unemployment. Instead, they are randomly assigned some "relative year 0". This enables us to include a polynomial in age as an additional explanatory variable in the interacted regression.

Furthermore, it is worth highlighting again that we can expect households to prepare for unemployment only if they can see it coming, which in turn we do not observe. Stephens Jr (2004), using the US Health and Retirement Study, finds that households have some sense of upcoming job losses and income drops, but the strength of such expectations depends on the specifics of each national labor market. Thus our tests for behavioral responses to upcoming unemployment spells are essentially testing the joint hypothesis that households can *sense* the job loss and that they possess the financial ability to *respond* to the upcoming event by saving more.

4 Data

We use administrative data from Norwegian tax registers that cover every Norwegian resident throughout the period 1995-2007. These data are well suited for our purposes. They enable straightforward merging of information on employment status and labor income with information on household financial wealth (through a unique personal identifier available in all registries in Norway). Observing households in a panel format for a total of 13 years allows us to distinguish household and calendar year fixed effects from what happens in the different years around job loss. Finally, register data are in many respects considered more reliable than survey data, an aspect that has previously been found to be of particular importance for data on income and financial wealth, as well as for data on unemployment spells, both of which are frequently recalled imperfectly or misreported.[12]

Households are identified as couples who are married or who live together with common children (data to identify unmarried but cohabiting couples without children are not available). We focus on cases of male unemployment, as this will have a more significant impact on the household's financial situation. A household is defined as unemployed in a year if the man receives unemployment benefits. Throughout the analysis, income is defined as the man's labor-related income.[13]

We follow Gruber (2001) in focusing on financial wealth, thus excluding real estate. Chetty and Szeidl (2007) argue that real estate will very rarely be liquidated during unemployment due to the high transaction costs. This is likely even more relevant in Norway than in the US due to special transaction taxes.[14] Household financial wealth and the holdings of different types of assets are used at the household level, i.e. we use the sum of the husband's and the wife's assets. This makes sense conceptually as we would expect most of our households to live on a shared budget. Furthermore, financial variables are more reliable at

[12]For an example of the effects of misreporting in household surveys, see Meyer et al. (2009). For more information on the Norwegian administrative data see Røed and Raaum (2003), and on the wealth data in particular see e.g. Fagereng et al. (2012).

[13]This includes wage income as well as work-related transfers, such as unemployment benefits, sickness benefits and parental leave benefits.

[14]Real estate values are not reliably observed in our data set. However, we do have reliable information on whether households are home-owners. An analysis of this variable reveals that indeed very few households switch their home-owner status around their unemployment spell.

the household level: while the two spouses do report their wealth separately to the tax authorities, they are jointly taxed and they do not have any incentive to ensure that the one who reports holding the wealth is the one who does in fact own it. The category of safe assets includes mostly bank deposits, as well as bonds (less prevalent), whereas risky assets are defined to include direct and indirect (mutual fund) holdings of stocks. To ensure that our analyses of the impact of unemployment on labor income and wealth are not just driven by outliers in the far right tail of the distribution, we top-code both variables at the 99th percentile for each year. Furthermore, we use 2004 as the omitted calendar year category, and convert NOK values into US dollars at 2004 exchange rates (USD 1 =NOK 6.7).

Using the above data sources, our main sample is defined as follows. To exclude households still in full-time education or with access to early-retirement schemes, we require the man to be from 30 to 58 (inclusive) years old in the year of job loss. We also require that in the year before the job loss the man had sufficient income to be eligible for the publicly provided and universally utilized unemployment benefits.[15] Households with business income, whose unemployment benefits are calculated under different rules, are also excluded. Moreover, we require that households have not experienced any unemployment in the four years leading up to the unemployment spell. To ensure that our comparison of income and wealth across the different relative years is not biased by differences in the sample composition, we require our panel to be fully balanced both across the nine relative years and across the 13 calendar years. We also follow Chetty (2008) in excluding workers who return to the same plant after their unemploy-

[15] This minimum income level necessary to be eligible is updated every year by the Norwegian Parliament in accordance with the general growth in prices and wages. The amount is low by Norwegian standards, and in practice employees with a non-minor position throughout a calendar year will meet the requirements. For 2010, for instance, the amount was about NOK 165,000, or USD 26,000. To ensure that the man's labor market attachment is not too loose, we impose a somewhat stronger restriction (equivalent to about NOK 220,000 in 2010). For more information on UI and these amounts; see www.nav.no/english.

ment spell, as these are likely to know already at the time of layoff that they will be able to return to their previous plant at a specific time. These requirements leave us with our main analytic sample including the households that were in fact unemployed at some point during 1999-2003. This sample comprises 5,513 households or 71,669 household-year observations.

Table 1 displays summary statistics for this sample of households experiencing unemployment. As we consider men in a relationship (i.e. formally married or cohabiting the mother of a common child), the mean age of the man is relatively high. Close to 35% of the household men have less than a high school education. We see that male labor income is more than twice as high as female income, in terms of both the mean and the median. We also note significant dispersions in financial wealth: whereas the mean holdings in the sample amount to more than USD 14,000, the median is about USD 4,500. We also see that the median household does not participate in risky asset markets.

5 Results

5.1 Main Results

We now turn to our findings on households' inclination to save and shift assets toward less risky ones before an upcoming unemployment spell, as well as the depletion of savings during unemployment. For our main results, we have estimated the model in Equation (6). Regression results are reported in Table 2, and Figures 1, 2 and 3 plot the predicted paths of labor income, wealth and its components over time, obtained by adding to the estimate of the constant those of the respective relative-year coefficients.

We start our discussion with the results for labor-related income, the variable that is directly affected by job loss even without any active responses. From Figure 1, we see that this income path is flat until relative year -1 (recall that the calendar-year fixed effects take out average income growth), but then the average household income drops significantly[16] from about USD 51,000 in the last year before job loss to USD 45,000 in the year of job loss.[17] Income then remains low in relative year +1 before it gradually starts increasing again, as more and more households move back into employment. By relative year +4 the difference has shrunk to about USD 1,000, which can be partly because of some households still being unemployed and partly due to lower average income in the new job.[18]

[Figure 1 about here]

Figure 2 reports the predicted time path of financial wealth.[19] We find that the average household starts out with financial wealth of about USD 34,500 in relative year -4 and increases this by more than USD 1,000 by the end of the last calendar year before job loss. This is the average across all households, presumably including both households aware of an impending job loss who respond by saving more and households not aware of the upcoming job loss who are thus unable to take any measures to save before the job loss. Despite these factors, however, we do find precautionary saving that is both statistically and

[16]We refer to a difference with a p-value of less than 0.05 as statistically significant; see notes in the figures and tables for details.

[17]The drop in relative year 0 here amounts to about 12%. Since we know that all of our households are eligible for UI benefits, which for most of them amount to 62.4% of prior income and thus imply an annualized drop of 37.6%, this tells us that the average household in this sample is unemployed for about one-third of its relative year 0.

[18]This differs from the findings made for instance by von Wachter et al. (2011), where workers displaced during the 1982 US recession are permanently worse off in terms of income. Presumably, this difference reflects the general strength of the Norwegian labor market with low unemployment rates during the period under consideration.

[19]We have checked that the same pattern prevails if we exclude the 5% richest households or the households that participate in the stock and bond markets from the sample. Those participating in the stock and bond markets, by contrast, respond more strongly in terms of rebalancing their portfolio structure, as we discuss below.

economically significant, suggesting that the average household is aware of the upcoming job loss and does prepare for it.[20]

Moreover, the subsequent wealth depletion of on average about USD 3,000 between relative years -1 and 2 also in line with theoretical predictions. This depletion of savings does not seem very large, but it issubstantial relative to the income shortfall of more than USD 6,000 in years 0 and 1. Since by the time of job loss the average household would have enough resources for greater wealth depletion, this may suggest that the average household can do remaining adjustment along other margins, such as spousal labor supply (a slight increase in spousal labor income/supply is indeed found in complementary analyses not reported here), temporarily lower spending on durables (as in Browning and Crossley (2009)) or substituting some home production for market consumption.

[Figure 2 about here]

To pursue the predictions for portfolio rebalancing, we turn to Figure 3, which plots separately the predicted time paths of risky assets (stocks and mutual funds) and safe assets (bonds and cash). The average household does significantly shift wealth from risky assets toward safe assets. As the household reaches the year of job loss we also note that it draws on both sources of assets. By the relative year 4, the levels of safe and risky assets are back at their levels in relative year -4. Of course, one should note that the risky assets are held by a smaller share of the households, so the issue of rebalancing does not equally apply to each household in our sample. Nonetheless, these time patterns are in line with our theoretical predictions.[21]

[20] Above we noted that the data applied by Gruber (2001) capture wealth at only two points in time, which has the disadvantage that the depletion will be underestimated to the extent that some of it takes place before the first or after the second point of observation. By a similar argument, applying *annual* data, as we do, prevents us from analyzing developments that occur and are partly or fully reversed within a calendar year, so our estimates of saving and dissaving are still lower bounds.

[21] Regressions on asset levels may be very sensitive to outliers, even after winsorizing at

[Figure 3 about here]

[Table 2 about here]

5.2 Placebo Sample

In Section 2 we discussed how the household fixed effects take out unobserved time-invariant household characteristics, such as the degree of risk-aversion, and how our calendar-year fixed effects take out the impacts of, for instance, inflation and the business cycle. However, are these two sets of fixed effects sufficient? One way of getting an impression of this is to test whether the same time paths are flat for a placebo sample of households who never experience unemployment and where the year of (artificial) job loss is randomly assigned. Following Jacobson et al. (1993) we redo our analyses using the larger sample that also include individuals in the placebo sample (i.e. individuals who do not become unemployed and who are thus randomly allocated an artificial job loss year).[22] In Figure 4 we plot the estimates for the relative years $(RY\text{s})$ in Equation (6). Indeed, we find that for our main sample the predicted time paths are close to identical to the earlier results and for the placebo sample the

the 99th percentile. A possible alternative therefore is to use the logarithm of asset holdings as dependent variable, although this makes regressions more sensitive to households with very low initial holdings and for whom small dollar accumulations can therefore show up as substantial relative changes in wealth (in addition to the issue of how to treat households with zero holdings). While we rely on levels for the results presented here, corresponding log specifications confirm the same patterns, suggesting that our results are not driven by outliers at either the top or the bottom of the wealth distribution. The same holds if we use as dependent variables the first differences or their logs.

[22] The union of these two subsamples constitutes our extended sample of 57,389 households or 746,057 household-year observations.

predicted time paths are flat.[23] This supports the validity of our specification.[24]

[Figure 4 about here]

5.3 Mass Layoff

As discussed in Section 3 our estimates are hard to interpret if the workers who become unemployed are affected by a third factor which also affects their financial wealth. Individuals going through some kind of personal crisis may, for example, become less prudent in their savings behavior, and could for the same underlying reasons lose their job not long after; biasing our estimate of wealth built up before job loss downward. On the other hand, our estimate would be biased upward, if households that recently managed to put an above-average amount of money on the side might not disagree to laid off Indeed, we may even imagine that a worker could be saving *because* he is planning to make himself become unemployed, in which case, it is not the anticipation of (involuntary) unemployment that causes saving, but the saving that causes the unemployment.

We attempt to shed some light on the empirical relevance of such endogeneity issues by repeating our analyses for a subsample of households whose job loss occurs in association with a major plant downsizing event.[25] To identify the

[23] We ran one regression for each of the four sections in Figure 4, including a full set of interaction terms for the workers in the placebo sample (as well as a forth order polynomial in age). The underlying regression results are available upon request.

[24] Some previous studies on the effect of job loss on earnings, like Jacobson et al. (1993), pool job losers and non-job-losers for their main estimates, estimating in essence a form of difference-in-differences model. As can be seen from the flat time paths in our placebo sample, this approach yields almost exactly the same estimates in our case. To keep things as simple and transparent as possible, we have chosen to report as our main estimates those based only on the sample with unemployment.

[25] As discussed in the literature, mass layoffs from bigger plants are unlikely to be influenced by any individual worker's health or intention to become unemployed. Relying on job loss

subset of households becoming unemployed in association with a mass layoff, we count the number of employees and define as mass layoff those cases in which the number of employees decreases by 50% or more from one calendar year to the next. As this would not have much meaning in the case of two-person plants or in plants that experience significant employment differences between any pair of years, we follow previous studies (see for instance Jacobson et al. (1993), von Wachter et al. (2011), Davis and von Wachter (2011), Huttunen et al. (2011) or Rege et al. (2009)) in imposing some additional requirements. First, we require that plants have employed at least 10 employees in one of the years 1999-2003. We also require that the plant has existed for at least four years and has not already experienced a mass lay-off in the above sense in one of the past three years. Finally, because it is rather common for Norwegian firms to move workers from one of its plants to another (Huttunen et al. (2011)), we compute this downsizing rate without counting employees who leave a plant merely to continue working at another plant of the same firm.

By applying these standard choices from the literature we can divide our main sample of 5,513 job loss incidences into two subsamples. One subsample comprises the 1,075 workers who became unemployed in association with a major plant downsizing, and the other subsample comprises the remaining 4,438 workers who did not become unemployed in association with a major plant downsizing. With this split we include a complete sett of interactions in the main regressions from Table 2. The results are presented in Table 3. Given the strict selection, this sample is small, and hence it does not provide precise

in association with mass layoffs will not, however, remove selection issues at the plant level (see e.g. Jacobson et al. (1993), von Wachter et al. (2011), Davis and von Wachter (2011), Huttunen et al. (2011) or Rege et al. (2009)). Workers selected into plants that undertake mass layoffs, may, for example, be less risk-averse than other workers, or they may hold different expectations about future employment opportunities. It is also possible that the ability to foresee an upcoming unemployment spell differs for workers laid off in association with mass layoffs compared with other workers. We should keep these caveats in mind when interpreting the results.

estimates. But the estimated patterns are not statistically different from the ones we found using our main analytic sample (cf. Table 2).

6 Conclusion

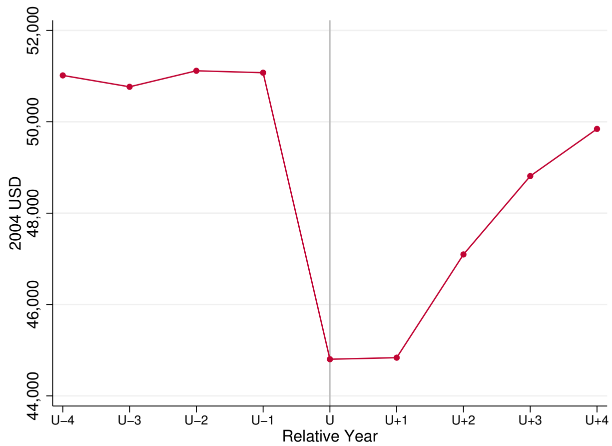
We have empirically investigated saving patterns and portfolio rebalancing toward safer assets before unemployment, as well as depletion of wealth after job loss. Consistent with the predictions of our simple theoretical model, we find, first, that the average household does deplete about USD 2,500 of financial wealth after a job loss. More strikingly, almost all of this is made up for by additional saving in the three years before the unemployment spell as well as in years 3 and 4 after job loss. Furthermore, we also find evidence of portfolio rebalancing in the years before unemployment. The latter two results suggest that the average household is indeed able to foresee the upcoming unemployment spell, and is then both able and willing to prepare for those rainy days. This shows that household's precautionary saving can hamper consumption and contribute to demand deficiency if there is fear of widespread future unemployment. Moreover, in countries with high participation in the risky asset markets among the labor force, uncertainty in the labor market may affect financial markets through this precautionary reallocation mechanism.

The presence of precautionary saving behavior indicates that at least some workers in our sample are able to foresee and prepare for the upcoming unemployment spell, which indicates that they are partly able to smooth consumption by drawing on their prior savings. While the estimated size of this wealth depletion may be thought to be relatively small compared to the drop in income associated with the job loss, its existence does nonetheless confirm that, private savings may serve as a substitute for publicly provided unemployment insurance. In this respect, however, at least four things should be noted.

First, the UI benefits in Norway are very generous by international standards: they typically replace more than 60% of earnings in the calendar year before job loss; and most households are eligible to receive UI for at least 2 years. Second, in our period of observation the Norwegian labor market is characterized by very low unemployment rates, implying relatively easy access to new employment for most of the job losers. Both we and others have found income to recover more rapidly after job loss than is the case in many other countries, with correspondingly modest impacts on the reduction of private financial savings from efforts to smooth consumption through spells of unemployment. In line with this, the households in our sample tend to not end up with permanently lower holdings of financial wealth as a consequence of their unemployment spell, presumably because of the relatively generous UI system and the largely temporary nature of their unemployment spells. Third, the households in our sample do not only enjoy a generous welfare system, but they also hold substantial financial wealth at the outset. On average, they hold assets worth more than a fourth of their annual labor income. Finally, we need to caution that our findings are all based on sample averages and thus do not rule out the possibility that some of the poorest households suffer considerably during unemployment or do end up with permanently lower wealth afterward.

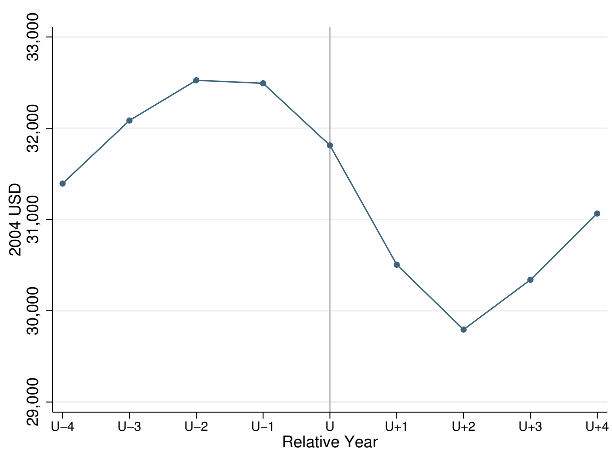
A Figures and Tables

Figure 1: **Labor Income around Unemployment**



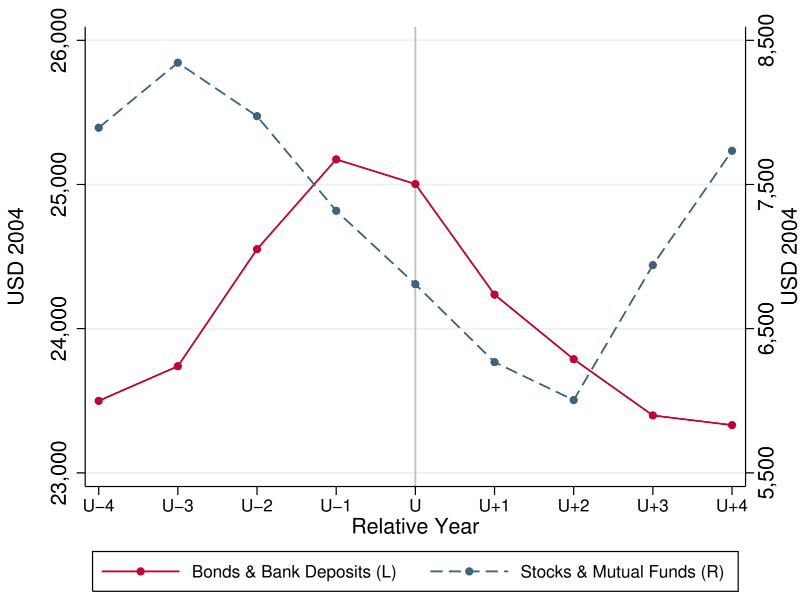
Note: The graph shows the predicted time path of household labor income from four years before to four years after the year of job loss, based on the estimates reported in Table 2.

Figure 2: **Financial Wealth around Unemployment**



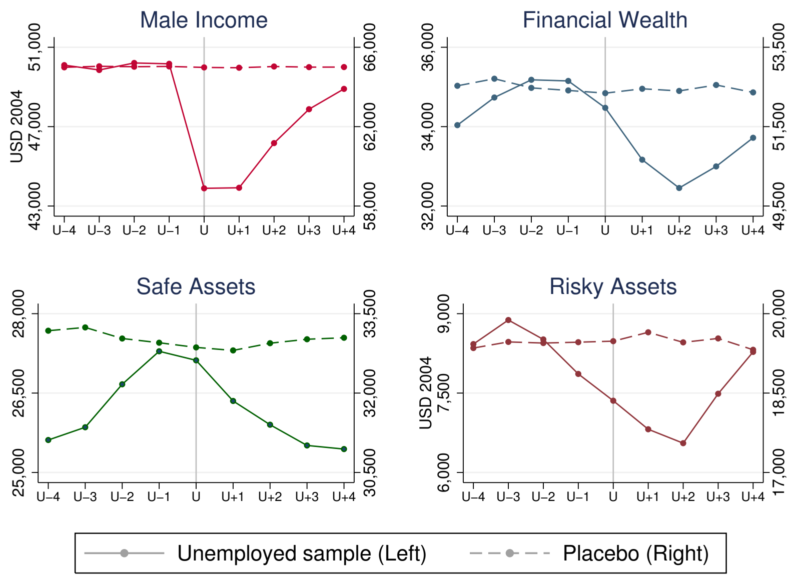
Note: The graph shows the predicted time path of household financial wealth from four years before to four years after the year of job loss, based on the estimates reported in Table 2.

Figure 3: **Safe and Risky Assets around Unemployment**



Note: The graph shows the predicted time paths of the households' holdings of safe assets (bonds and deposits) and risky assets (stocks and mutual funds) from four years before to four years after the year of job loss, based on the estimates reported in Table 2.

Figure 4: **Unemployed vs. Placebo**



Note: The figure displays the predicted time paths of household labor income, financial wealth, safe assets, and risky assets for households in our main sample and households in the placebo sample from four years before to four years after the yearof job loss. As those in the placebo sample have on average higher income and higher wealth, we use different vertical intercepts, but the scaling is the same.

Table 1: Summary Statistics Main Sample

	Mean	Std Dev	Median
Demographics:			
Age Husband	40.72	5.488	41
Job loss year	2001	1.464	2001
Share Low Education	0.37		
Share High School Education	0.39		
Share College Education	0.24		
Income (2004 USD):			
Male Income	55,196	28,762	53,325
Female Income	25,092	20,394	26,930
Household Income	80,288	39,070	81,928
Asset Holdings (2004 USD):			
Risky Assets	7,424	31,469	0
Safe Assets	13,820	24,103	5,556
Financial Wealth	21,245	43,638	6,858
Industry decomposition:			
Manufacturing	0.32		
Construction	0.09		
Wholesale retail	0.17		
Transport / communication	0.07		
Real estate.	0.10		
Education	0.03		

Note: Based on our main sample of 5,513 households four years prior to the year of job loss (cf. Section 4), all occurring in the period 1999-2003. Where applicable, values are in 2004 USD. Minor industry categories are omitted from the table. Shares of educational achievements are calculated with about 1% of sample missing an observation for this variable.

Table 2: Main Regression Results: Income, Financial Wealth, Safe & Risky Assets

	Male Income	Finw Wealth	Safe Assets	Risky Assets
U-4	-505.3	1415.8	676.6	739.1
	(219.7)**	(465.8)***	(307.5)**	(304.8)**
U-3	-754.8	2106.5	916.5	1190.0
	(292.7)***	(608.5)***	(413.5)**	(403.5)***
U-2	-404.3	2547.3	1728.2	819.1
	(353.8)	(708.9)***	(506.3)***	(470.5)*
U-1	-446.4	2514.5	2351.1	163.4
	(406.5)	(812.8)***	(594.9)***	(541.0)
U	-6718.1	1834.2	2180.2	-346.0
	(440.3)***	(895.0)**	(651.2)***	(600.4)
U+1	-6684.4	526.7	1413.2	-886.5
	(430.7)***	(904.1)	(650.9)**	(618.4)
U+2	-4424.8	-184.2	965.2	-1149.4
	(399.8)***	(845.0)	(600.9)	(564.0)**
U+3	-2709.3	361.6	575.4	-213.8
	(355.4)***	(802.8)	(570.7)	(548.2)
U+4	-1676.5	1087.3	508.2	579.1
	(290.7)***	(756.0)	(515.1)	(527.8)
Constant	51520.6	29978.1	22823.3	7154.7
	(314.1)***	(671.3)***	(488.0)***	(439.0)***
Observations:				
Unique Households	5,513	5,513	5,513	5,513
Household*Year	71,669	71,669	71,669	71,669

Note: The table displays the estimates for the relative-year dummies (U denotes year of job loss) of the four dependent variables from OLS regressions on our main sample (cf. Section 4) of 5,513 households. Regressions include household and calendar-year fixed effects. Values are in 2004 USD and clustered standard errors (on household) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. F-tests for differences between coefficients of different relative years: Male Income: p(U-1>=U)=0.000, p(U<=U+4)=0.000, p(U-1>=U+4)=0.000. Financial Wealth: p(U-4<=U-1)=0.030, p(U-1>=U+2)=0.000, p(U+2<=U+4)=0.014. Safe Assets: p(U-3<=U-1)=0.000, p(U-1>=U+2)=0.001. Risky Assets: p(U-3>=U-1)=0.005, p(U-1>=U+2)=0.001.

Table 3: Income, Financial Wealth, Safe & Risky Assets for Mass Layoff subsample

	Male Income	Finw Wealth	Safe Assets	Risky Assets
U-4	25.50	-1832.0	-928.1	-904.0
	(425.1)	(845.7)**	(619.7)	(580.4)
U-3	276.4	-1820.0	-750.6	-1069.4
	(568.8)	(1172.2)	(853.0)	(774.1)
U-2	494.3	-2041.4	-107.8	-1933.6
	(701.8)	(1539.2)	(1085.6)	(1102.3)*
U-1	718.5	-1427.8	1266.9	-2694.8
	(821.5)	(1802.5)	(1300.2)	(1316.8)**
U	-4531.6	-1683.5	1135.3	-2818.8
	(901.1)***	(2039.5)	(1397.7)	(1471.9)*
U+1	-5271.1	-2503.6	1017.8	-3521.5
	(876.0)***	(2011.9)	(1407.3)	(1437.2)**
U+2	-3329.0	-3867.5	-109.2	-3758.3
	(796.6)***	(1925.4)**	(1283.9)	(1348.0)***
U+3	-1794.4	-3720.8	-969.6	-2751.1
	(716.2)**	(1841.5)**	(1258.9)	(1243.9)**
U+4	-1217.3	-3531.4	-1359.7	-2171.7
	(576.6)**	(1544.1)**	(1107.2)	(992.1)**
Constant	51480.0	30118.9	22862.5	7256.4
	(312.2)***	(678.1)***	(489.0)***	(450.9)***
Observations:				
Unique Households	5,513	5,513	5,513	5,513
of which in Mass Layoff	1,075	1,075	1,075	1,075
Household*Year	71,669	71,669	71,669	71,669

Note: The table displays the estimates for the relative-year dummies (U denotes year of job loss) of the given dependent variables on the sample of 1,075 households (out of the total of 5,513 households) separated from their work through a mass layoff. All coefficients are interacted with the sample of households that were separated from their work outside the mass layoff sample. Values are in 2004 USD, and clustered standard errors (on household) reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Online Appendix for Basten, Fagereng and Telle 2012

July 25, 2012

1 Analytical Solution of the Model

In the maximization problem presented in the paper, we replace c_1 with the two different states that consumption may take in period 1, depending on the employment status (Employed (E) or Unemployed (U)):

$$\underset{s}{Max} \qquad EU = u(c_0) + \beta[(1-p_1)u(c_1^E) + p_1 u(c_1^U)], \tag{1}$$

subject to:

$$0 \leqslant s \leqslant 1 \tag{2}$$

$$c_0 = (w + y_l)(1 - s) \tag{3}$$

$$c_1^U = y_l + s(w + y_l)R \tag{4}$$

$$c_1^E = y_h + s(w + y_l)R \tag{5}$$

The first order condition (FOC) for s then yields an Euler equation relating the marginal utility of consumption in period 0 to that in period 1.

$$\frac{\delta EU}{\delta s} : u'(c_0) = R\beta \left[(1-p_1)u'(c_1^E) + p_1 u'(c_1^U)\right] \tag{6}$$

Taking the total differential with respect to p_1 and assuming, for simplicity and without loss of generality, a return $R = 1$, gives:

$$\begin{aligned} & - u''(c_0)(w+y_l)\frac{\delta s}{\delta p_1} \\ & = \beta \left[-u'(c_1^E) + u'(c_1^U) + \left\{(1-p_1)u''(c_1^E)(w+y_l) + p_1 u''(c_1^U)(w+y_l)\right\} \frac{\delta s}{\delta p_1} \right] \end{aligned} \tag{7}$$

Hence,

$$\begin{aligned} & \frac{\delta s}{\delta p_1} \\ & = \frac{-u'(c_1^E) + u'(c_1^U)}{-u''(c)(w+y_l) - \beta\left\{(1-p_1)u''(c_1^E)(w+y_l) + p_1 u''(c_1^U)(w+y_l)\right\}} > 0 \end{aligned} \tag{8}$$

Both numerator and denominator are positive because of the concavity of the utility function ($u''(c) < 0$), and the saving rate is increasing in the probability of remaining unemployed. Hence we have proven Proposition 1.

Now we move the timing back one period, considering the household in period -1 before the job loss occurred. Rewriting the maximization problem by substituting for the four different consumption states that the household may face in the next period depending on high (H) vs. low (L) risky asset return and the employment (U or E) status, we get:

$$\underset{s_{-1},\alpha}{Max} u((y_{-1}(1-s_{-1}))+ \tag{9}$$

$$\beta[(1-p_0)(1-q)u(c_1^{EH})+(1-p_0)q\cdot u(c_1^{EL})+p_0(1-q)\cdot u(c_1^{UH})+p_0 q\cdot u(c_1^{UL})]$$

subject to

$$0 \leqslant s, \alpha \leqslant 1 \tag{10}$$

where c_1^{EH} denotes consumption in period 1, given that the household is employed and risky asset returns turned out to be high. By contrast, c_1^{UL} denotes the other extreme case where the household is unemployed and risky asset returns turned out to be low.

The FOCs are:

$\frac{\delta EU}{\delta s_{-1}}$:

$$u'(y_{-1}(1-s_{-1}))=\beta\left\{\begin{array}{c}(1-q)(\alpha R_h+(1-\alpha)R)[(1-p_0)\cdot u'(c_1^{EH})+p_0\cdot u'(c_1^{UH})]\\ +q(\alpha R_l+(1-\alpha)R)[(1-p_0)\cdot u'(c_1^{EL})+p_0\cdot u'(c_1^{UL})]\end{array}\right\} \tag{11}$$

$\frac{\delta EU}{\delta \alpha}$:

$$\frac{R_h-R}{R-R_l}=\frac{q}{1-q}\frac{(1-p_0)\cdot u'(c_1^{EL})+p_0\cdot u'(c_1^{UL})}{(1-p_0)\cdot u'(c_1^{EH})+p_0\cdot u'(c_1^{UH})} \tag{12}$$

For notational convenience, we define the following terms, where the subscripts for p and s are omitted:

$$\Omega_L(p, s, \alpha) = (1 - p) \cdot u'(c_1^{EL}) + p \cdot u'(c_1^{UL}) \tag{13}$$

$$\Omega_H(p, s, \alpha) = (1 - p) \cdot u'(c_1^{EH}) + p \cdot u'(c_1^{UH}) \tag{14}$$

$$R_H = (1 - q)(\alpha R_h + (1 - \alpha)R) \tag{15}$$

$$R_L = q(\alpha R_l + (1 - \alpha)R) \tag{16}$$

$$C = \frac{R_h - R}{R - R_l}\frac{1 - q}{q} \tag{17}$$

Then we can rewrite the FOCs into

$$\Omega_H \frac{R_h - R}{R - R_l}\frac{1 - q}{q} = \Omega_L = \Omega_H \cdot C \tag{18}$$

and

$$u'(1 - s) = \beta \left\{R_H \cdot \Omega_H + R_L \cdot \Omega_L\right\} \tag{19}$$

Inserting into the other, and setting $\beta = 1$ and $y_{-1} = 1$, we get:

$$u'(1 - s) = R_H \cdot \Omega_H + R_L \cdot \Omega_H \cdot C = \Omega_H \left[R_H \cdot +R_L \cdot C\right] = B \cdot \Omega_H$$

where $B = (1-q)\frac{R(R_{h-}R_l)}{R-R_l} > 0$.

In compact notation, the two FOCs are as follows:

$$u'(1-s) = B \cdot \Omega_H \tag{20}$$

$$\Omega_L = \Omega_H \cdot C \tag{21}$$

$$B \cdot \Omega_H(p, s, \alpha) - u'(1-s) = 0 \tag{22}$$

$$C \cdot \Omega_H(p, s, \alpha) - \Omega_L(p, s, \alpha) = 0 \tag{23}$$

Taking the total differential wrt. to p of the first:

$$B \cdot \left[\frac{\delta\Omega_H}{\delta p} + \frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} + \frac{\delta\Omega_H}{\delta\alpha}\frac{\delta\alpha}{\delta p}\right] = -u''(1-s)\frac{\delta s}{\delta p} \tag{24}$$

This can be written as:

$$B\frac{\delta\Omega_H}{\delta\alpha}\frac{\delta\alpha}{\delta p} = -u''(1-s)\frac{\delta s}{\delta p} - B\frac{\delta\Omega_H}{\delta p} - B\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} \tag{25}$$

The total differential of the second FOC is as follows:

$$C \cdot \left[\frac{\delta\Omega_H}{\delta p} + \frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} + \frac{\delta\Omega_H}{\delta\alpha}\frac{\delta\alpha}{\delta p}\right] = \frac{\delta\Omega_L}{\delta p} + \frac{\delta\Omega_L}{\delta s}\frac{\delta s}{\delta p} + \frac{\delta\Omega_L}{\delta\alpha}\frac{\delta\alpha}{\delta p} \tag{26}$$

Solving for $\frac{\delta\alpha}{\delta p}$:

$$\frac{\delta\alpha}{\delta p} = \frac{C\frac{\delta\Omega_H}{\delta p} + C\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} - \frac{\delta\Omega_L}{\delta p} - \frac{\delta\Omega_L}{\delta s}\frac{\delta s}{\delta p}}{\left(\frac{\delta\Omega_L}{\delta\alpha} - C\frac{\delta\Omega_H}{\delta\alpha}\right)} \tag{27}$$

and inserting $\frac{\delta\alpha}{\delta p}$, the first FOC gives:

$$\begin{aligned} &B\frac{\delta\Omega_H}{\delta\alpha}\left(\frac{C\frac{\delta\Omega_H}{\delta p} + C\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} - \frac{\delta\Omega_L}{\delta p} - \frac{\delta\Omega_L}{\delta s}\frac{\delta s}{\delta p}}{\left(\frac{\delta\Omega_L}{\delta\alpha} - C\frac{\delta\Omega_H}{\delta\alpha}\right)}\right) \\ &= -u''(1-s)\frac{\delta s}{\delta p} - B\frac{\delta\Omega_H}{\delta p} - B\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} \end{aligned} \tag{28}$$

Multiplying both sides by $\left(\frac{\delta\Omega_L}{\delta\alpha} - C\frac{\delta\Omega_H}{\delta\alpha}\right)$ and rearranging gives:

$$\begin{aligned} &B\frac{\delta\Omega_H}{\delta\alpha}\left(C\frac{\delta\Omega_H}{\delta p} + C\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p} - \frac{\delta\Omega_L}{\delta p} - \frac{\delta\Omega_L}{\delta s}\frac{\delta s}{\delta p}\right) \\ &= \left(-u''(1-s)\frac{\delta s}{\delta p} - B\frac{\delta\Omega_H}{\delta p} - B\frac{\delta\Omega_H}{\delta s}\frac{\delta s}{\delta p}\right)\left(\left(\frac{\delta\Omega_L}{\delta\alpha} - C\frac{\delta\Omega_H}{\delta\alpha}\right)\right) \end{aligned} \tag{29}$$

We can now solve for $\frac{\delta s}{\delta p}$:

$$\frac{\delta s}{\delta p} = \frac{B\left(\frac{\delta\Omega_L}{\delta p}\frac{\delta\Omega_H}{\delta\alpha} - \frac{\delta\Omega_H}{\delta p}\frac{\delta\Omega_L}{\delta\alpha}\right)}{u''(1-s)\left(\frac{\delta\Omega_L}{\delta\alpha} - C\frac{\delta\Omega_H}{\delta\alpha}\right) + B\left(\frac{\delta\Omega_H}{\delta s}\frac{\delta\Omega_L}{\delta\alpha} - \frac{\delta\Omega_H}{\delta\alpha}\frac{\delta\Omega_L}{\delta s}\right)} > 0 \tag{30}$$

We can verify that $\frac{\delta\Omega_L}{\delta p}$, $\frac{\delta\Omega_H}{\delta p}$, $\frac{\delta\Omega_L}{\delta\alpha}$, B , $C > 0$ and $\frac{\delta\Omega_H}{\delta\alpha}$, $u''(1-s)$, $\frac{\delta\Omega_H}{\delta s}$, $\frac{\delta\Omega_L}{\delta s} < 0$, given $R_h > R_s > R_l$. Hence, both numerator and denominator are negative and $\frac{\delta s}{\delta p} > 0$, which proves Proposition 2.

A higher probability of low income in the second period increases the saving rate out of period-one income and solving this for the first FOC for $\frac{\delta s}{\delta p}$ we obtain:

$$B \cdot \left[\frac{\delta \Omega_H}{\delta p} + \frac{\delta \Omega_H}{\delta s}\frac{\delta s}{\delta p} + \frac{\delta \Omega_H}{\delta \alpha}\frac{\delta \alpha}{\delta p}\right] = -u''(1-s)\frac{\delta s}{\delta p} \tag{31}$$

$$\frac{\delta s}{\delta p} = \frac{B \cdot \left[\frac{\delta \Omega_H}{\delta p} + \frac{\delta \Omega_H}{\delta \alpha}\frac{\delta \alpha}{\delta p}\right]}{\left(-u''(1-s) - B\frac{\delta \Omega_H}{\delta s}\right)}$$

and rearranging the other FOC we obtain:

$$\left(C\frac{\delta \Omega_H}{\delta s} - \frac{\delta \Omega_L}{\delta s}\right)\frac{\delta s}{\delta p} = \frac{\delta \Omega_L}{\delta p} - C\frac{\delta \Omega_H}{\delta p} + \left(\frac{\delta \Omega_L}{\delta \alpha} - C\frac{\delta \Omega_H}{\delta \alpha}\right)\frac{\delta \alpha}{\delta p} \tag{32}$$

Substituting the first FOC and multiplying by$\left(-u''(1-s) - B\frac{\delta \Omega_H}{\delta s}\right)$ we obtain:

$$\begin{aligned}&\left(C\frac{\delta \Omega_H}{\delta s} - \frac{\delta \Omega_L}{\delta s}\right)\left(B \cdot \frac{\delta \Omega_H}{\delta p} + B\frac{\delta \Omega_H}{\delta \alpha}\frac{\delta \alpha}{\delta p}\right) \\ &= \left[\frac{\delta \Omega_L}{\delta p} - C\frac{\delta \Omega_H}{\delta p} + \left(\frac{\delta \Omega_L}{\delta \alpha} - C\frac{\delta \Omega_H}{\delta \alpha}\right)\frac{\delta \alpha}{\delta p}\right]\left(-u''(1-s) - B\frac{\delta \Omega_H}{\delta s}\right)\end{aligned} \tag{33}$$

Rearranging terms gives:

$$\begin{aligned}&B\left(\frac{\delta \Omega_H}{\delta s}\frac{\delta \Omega_L}{\delta p}\right) + u''(1-s)\left(\frac{\delta \Omega_L}{\delta p} - C\frac{\delta \Omega_H}{\delta p}\right) \\ &= \frac{\delta \alpha}{\delta p}\left[u''(1-s)\left(C\frac{\delta \Omega_H}{\delta \alpha} - \frac{\delta \Omega_L}{\delta \alpha}\right) + B\left(\frac{\delta \Omega_L}{\delta s}\frac{\delta \Omega_H}{\delta \alpha} - \frac{\delta \Omega_H}{\delta s}\frac{\delta \Omega_L}{\delta \alpha}\right)\right]\end{aligned} \tag{34}$$

Hence,

$$\frac{B\left(\frac{\delta\Omega_H}{\delta s}\frac{\delta\Omega_L}{\delta p}-\frac{\delta\Omega_H}{\delta p}\frac{\delta\Omega_L}{\delta s}\right)+u''(1-s)\left(\frac{\delta\Omega_L}{\delta p}-C\frac{\delta\Omega_H}{\delta p}\right)}{\left[\underbrace{u''(1-s)\left(C\frac{\delta\Omega_H}{\delta\alpha}-\frac{\delta\Omega_L}{\delta\alpha}\right)}_{+}+B\underbrace{\left(\frac{\delta\Omega_L}{\delta s}\frac{\delta\Omega_H}{\delta\alpha}-\frac{\delta\Omega_H}{\delta s}\frac{\delta\Omega_L}{\delta\alpha}\right)}_{+}\right]}=\frac{\delta\alpha}{\delta p} \tag{35}$$

At the optimum we know that $\frac{\delta\Omega_L}{\delta p} = C\frac{\delta\Omega_H}{\delta p}$, and we are left to evaluate $\frac{\delta\Omega_H}{\delta s}\frac{\delta\Omega_L}{\delta p}-\frac{\delta\Omega_H}{\delta p}\frac{\delta\Omega_L}{\delta s}$,

Inserting into the expression we have:

$$\frac{\delta\Omega_H}{\delta s}\frac{\delta\Omega_L}{\delta p}-\frac{\delta\Omega_H}{\delta p}\frac{\delta\Omega_L}{\delta s} \tag{36}$$
$$=\left[(1-p)\cdot u''(c_1^{EH})+p\cdot u''(c_1^{UH})\right]\cdot(\alpha R_h+(1-\alpha)R)\cdot\left[u'(c_1^{UL})-u'(c_1^{EL})\right]-$$
$$\left[(1-p)\cdot u''(c_1^{EL})+p\cdot u''(c_1^{UL})\right]\cdot(\alpha R_l+(1-\alpha)R)\cdot\left[u'(c_1^{UH})-u'(c_1^{EH})\right]$$

We see that both parts of the expression are negative,

$u'(c_1^{UL})-u'(c_1^{EL}) > u'(c_1^{UH})-u'(c_1^{EH})$, because of the concavity of the utility function, and the way the consumption states are built up. $(\alpha R_h+(1-\alpha)R) > (\alpha R_l+(1-\alpha)R)$ by definition. Further $0 > (1-p)\cdot u''(c_1^{EH})+p\cdot u''(c_1^{UH}) > (1-p)\cdot u''(c_1^{EL})+p\cdot u''(c_1^{UL})$.

Hence, we have shown that $\frac{\delta\alpha}{\delta p} < 0$, which is Proposition 3. The higher the risk of low income in the next period, the smaller the share of risky financial assets.