Idiosyncratic Asset Return and Wage Risk of US Households

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This paper documents the degree of idiosyncratic asset return risk, serial correlation, and correlation with wage risk for US households. Novel panel-data measures for returns on household assets are proposed. Sizeable idiosyncratic return risk is documented to exist concurrently with permanent heterogeneity in household-specific returns and exhibits negative serial correlation. On average, the idiosyncratic risk to wages and total asset returns are not correlated. However, this masks the correlated wage and return risk to private business assets and secondary housing assets and capital gains to primary housing. These estimates inform the covariance structure of idiosyncratic asset returns and wage risk.

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1 Introduction

Uninsured idiosyncratic risk in labor income is a common structural assumption in quantitative studies of inequality (Aiyagari, 1994; Caballero, 1991; Huggett, 1996). Considerable attention has been devoted to the estimation of uninsured labor income risk over the life cycle (Baker, 1997; Haider, 2001; Guvenen, 2007; Blundell et al., 2008; Moffitt and Gottschalk, 2011). More recently, attention has returned to the possibility that heterogeneity in returns can explain wealth inequality (Kesten, 1973). However, due to the absence of household-level panel data on returns, much less is known regarding the nature of idiosyncratic heterogeneity in asset returns. This is further complicated in models that include both labor income and return heterogeneity (Cagetti and De Nardi, 2009; Benhabib et al., 2011, 2015; Cao and Luo, 2017) due the potential correlation of uninsured idiosyncratic risk.

This paper fills this gap by proposing new panel-data measures of household-level returns on assets in the US. Three questions are asked using these returns. First, what is the degree of idiosyncratic return heterogeneity in household-level asset returns? Second, is idiosyncratic asset return risk correlated with labor income risk? Third, does idiosyncratic risk display serial correlation? Empirical evidence is provided for the entire household asset portfolio and by asset classes.

These questions are examined using joint system estimation of a permanent-transitory wage process with an asset return process that allows for serial correlation and correlation across innovations. These dual processes are estimated using an iterative generalized method of moments (GMM) estimator on household-level micropanel data on asset returns and wages from the newly revised Panel Study of Income Dynamics (PSID) from 1999–2017. This data builds upon recent studies of household- and individual-level asset returns (Cao and Luo, 2017; Bach et al., 2020; Fagereng et al., 2020). However, the measures of the asset returns proposed in this paper are the first to examine total household assets as well as returns by asset class. These measures are also the first to include capital gains that are net of investment, rental income for housing assets, and household-specific measures of tax deductibility. These advances in measurement are shown to be critical to understanding the nature of idiosyncratic risk.

Despite the potential importance of the covariance structure of idiosyncratic risk for portfolio allocation and consumption insurance, the evidence of the correlation between asset returns and labor income is limited. As noted by Benhabib et al. (2019), the primary reason for this is that "data on stochastic returns are relatively hard to find" (p. 20). In the absence of household-level data, studies have used occupational-level wages (Davis and Willen, 2000),[1] or aggregate asset returns (Heaton and Lucas, 2000; Campbell et al., 2001).[2] The few exceptions focus on returns to specific asset classes. For example, Cocco et al. (2005) document that aggregate income, but not idiosyncratic income, is correlated with changes in primary housing prices in the PSID between 1970 and 1992. However, appreciations in asset prices are not the same as returns as appreciations could reflect households' net investment in response to income shocks. In this paper, asset appreciation, capital gains net of investment, and total returns are documented to differ. This allows for the first examination of the correlations between idiosyncratic labor income and total asset returns for each asset class.

Empirical evidence of household-level heterogeneity in asset returns has been documented for primary housing by Case and Shiller (1989) and Flavin and Yamashita (2002).[3] These studies have documented that the variability in household-level housing returns is two to three times larger than that derived from aggregate housing price returns. Idiosyncratic heterogeneity in housing returns can arise, for example, due to bargaining power in negotiations, the behavior of real estate agents, and profits from home improvements.

Similarly, evidence on returns heterogeneity has been documented for private business wealth (Quadrini, 2000; Kartashova, 2014; Moskowitz and Vissing-Jørgensen, 2002; Bach et al., 2020) and for returns to total household assets (Bach et al., 2020; Fagereng et al., 2020). Bach et al. (2020) estimate that the share of idiosyncratic risk represents 78.9 percent and 27.2 percent of the standard deviations for overall private business wealth and overall assets, respectively. The findings across these studies support evidence of sizeable idiosyncratic risk above and beyond aggregate risk.

This paper documents sizeable transitory idiosyncratic risk in returns to total household assets. The standard deviation of the transitory innovation to total household assets is estimated to be 8.2 percentage points. This transitory idiosyncratic asset return risk exists concurrently with household-specific (between-household) returns recently documented in Fagereng et al. (2020) and Snudden (2021). Thus, quantitative macro models seeking to capture the dynamics of returns heterogeneity would need to model both the household-specific and the transitory idiosyncratic components. This is analogous to models that allow for idiosyncratic innovations to labor income

[1] Davis and Willen (2000) find a positive correlation with stock returns.

[2] Heaton and Lucas (2000) highlight the positive correlation between equity returns and the income of self-employed persons. Campbell et al. (2001) find a positive correlation between labor income risk and stock market returns only for specific population groups.

[3] Returns to primary housing wealth have also been examined using the PSID by Palia et al. (2014) and for expected returns using Swedish administrative tax data by Bach et al. (2020). However, returns to wealth include households' decisions on endogenous leverage, a dimension removed in this paper.

around a life-cycle earnings profile.

Sizeable idiosyncratic asset returns risk is also documented for the idiosyncratic returns processes for private businesses, primary and secondary housing, and public equities. The standard deviation of the transitory innovation to primary housing assets is the smallest at 9.5 percentage points. This is followed by secondary housing, public equities, and private business assets of 29, 40 and 74.7 percentage points, respectively. This confirms that a high share of idiosyncratic risk in asset returns exists in the US, similar to that in the Swedish data of Bach et al. (2020).

Importantly, on average, households do not have correlated idiosyncratic risk to returns on assets and wages. However, this masks the correlated wage and return risk within asset classes. Permanent shocks to wages are positively correlated with shocks to private business returns but are negatively correlated with transitory shocks to secondary housing returns. For secondary housing assets, the negative correlation between the transitory return and permanent wage innovations is partly due to the rental option in housing. Secondary housing assets are thus unique as they can provide insurance against permanent wage shocks. This highlights the importance of encompassing measures of housing returns that include secondary housing, capital gains, and rental income.

A negative moving average coefficient is documented for idiosyncratic risk to total asset returns. This arises from a negative moving average coefficient for capital gains to primary housing. The serial correlation is observed for all subsamples except for young households and households that do not own primary housing assets. Young households also experience positive correlations between transitory shocks to wages and returns that arise due to capital gains to primary housing.

Despite the importance of the covariance structure of the idiosyncratic risk for portfolio allocation and consumption insurance, the lack of panel data has precluded direct evidence of the nature of the idiosyncratic return risk. The covariance matrix of the idiosyncratic risks measured in this paper maps directly into standard models of portfolio choice. The results document the idiosyncratic background risks associated with portfolio allocations of financial assets (Merton, 1971; Gollier and Pratt, 1996; Heaton and Lucas, 1996; Bertaut and Haliassos, 1997). This also lends credence to studies of the background risks from housing (Grossman and Laroque, 1990; Brueckner, 1997; Fratantoni, 2001; Flavin and Yamashita, 2002; Cocco, 2005; Yao and Zhang, 2005) and private business assets (Heaton and Lucas, 2000) that explain the stockholding puzzle. Notably, the empirical evidence supports the existence of idiosyncratic background risks from all asset classes and highlights correlations with permanent labor income not previously accounted for.

The evidence also directly informs the covariance structure and the magnitude of the uninsured idiosyncratic risks to returns and labor income found in quantitative models used to study wealth inequality and social mobility (Cagetti and De Nardi, 2009; Benhabib et al., 2011, 2015; Cao and Luo, 2017). Transitory idiosyncratic risk to returns on assets exists concurrently with the household-specific returns documented by Fagereng et al. (2020) and Snudden (2021). Evidence also supports the assumption of uncorrelated labor and asset returns (Cagetti and De Nardi, 2009; Benhabib et al., 2011, 2015). That said, studies that separately account for asset allocation in private business and secondary housing assets need to account for correlated shocks between assets returns and labor income.

The structure of this paper is as follows. Section 2 introduces the model of idiosyncratic wages and asset returns. Section 3 proposes innovative measures of asset returns. Section 4 reports the estimates and conducts tests of robustness and sensitivity to life-cycle and demographic characteristics. Section 5 summarizes and discusses the implications of the findings.

2 Empirical Model

An idiosyncratic permanent-transitory wage process is adopted from the literature on idiosyncratic wage risk (Lillard and Weiss, 1979; Baker, 1997; Haider, 2001; Guvenen, 2007; Blundell et al., 2008; Moffitt and Gottschalk, 2011). The idiosyncratic wage process is estimated in a system with an asset return process. Both the wage and return processes allow for serial correlation of the transitory innovations. The system estimation allows for correlation across wage and return innovations.

Idiosyncratic heterogeneity in before-tax real returns is calculated as follows. Real returns are regressed on a set of indicators for year and observable household characteristics, Z_{it}, portfolio shares are interacted with year fixed effects, P_{it}, and there is an indicator for each of the asset classes if the household sold an asset within an asset class, S_{it}. Observable household characteristics include age, marital status, family size, number of children, presence of an outside dependent, race, education level, region interacted with year, and an indicator for income from a family member other than the head or spouse. The idiosyncratic component of the return to total household assets is denoted by $\tilde{r}_{a,it}$:

$$r_{a,it} = f(Z_{it}, P_{it}) + \beta S_{it} + \tilde{r}_{a,it}, \tag{1}$$

where $f(\cdot)$ is a function that includes the year fixed effects and its interaction with portfolio shares. The inclusion of portfolio shares accounts for changes in the asset portfolio, something that is not required for each asset class. The return on assets for the specific asset category j is thus modelled as

$$r_{j,it} = f(Z_{it}) + \beta_j s_{j,it} + \tilde{r}_{j,it}, \tag{2}$$

where $s_{j,it}$ indicates if asset j was sold. The estimates of equation (2) for each asset class as well as the measure of the idiosyncratic returns, $\tilde{r}_{j,it}$, are detailed in Appendix C.

Similarly, log-real wages, W_{it}, are deconstructed into a part explained by observable characteristics and the idiosyncratic component, $\tilde{W}_{it}$:

$$W_{it} = g(Z_{it}) + \tilde{W}_{it}, \tag{3}$$

where $g(\cdot)$ is again a function of the observable household characteristics, Z_{it}. The identical set of observable household controls is used for the calculation of log-real wages as returns.

Idiosyncratic wages are modelled as the sum of a permanent component W_{it}^p, which follows a martingale with innovation $v_{it} \overset{iid}{\sim} (0, \sigma_v^2)$ and a transitory component $u_{it} \overset{iid}{\sim} (0, \sigma_u^2)$ that follows a moving average process α_w, where $u_{it} \perp v_{it} \; \forall \; i, \, t$:

$$\tilde{W}_{it} = W_{it}^p + u_{it} + \alpha_w u_{it-1},$$

$$W_{it}^p = W_{it-1}^p + v_{it},$$

$$W_{i0}^p, \quad given.$$

Combining the above equations to remove W_{it}^p gives the change in idiosyncratic wages,

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} + \alpha_w \Delta u_{it-1}, \tag{4}$$

where Δ is a difference operator.

The unexplained component of the return is assumed to be a transitory component $u_{j,it}^r \overset{iid}{\sim} (0, \sigma_{u_j^r}^2)$ with moving average parameter $\alpha_{r,j}$ and an initial condition $\epsilon_{j,i}^r \overset{iid}{\sim} (0, \sigma_{\epsilon_j^r}^2)$, $\forall \; i, \, t, \, j$:

$$\tilde{r}_{j,it} = u_{j,it}^r + \alpha_{r,j} u_{j,it-1}^r + \epsilon_{j,i}^r.$$

For the return to total household assets and for each risky asset category, a null variance is estimated for permanent innovations. In the absence of permanent shocks to the return on assets, the household-specific return, $\epsilon_{j,i}^r$ identifies and is interpreted as the initial condition of the return that persists across a household's lifetime. This is exactly the household-specific component documented and estimated by Fagereng et al. (2020) and Snudden (2021). The change in the unexplained component of the return on assets is given by

$$\Delta\tilde{r}_{j,it} = \Delta u^r_{j,it} + \alpha_{r,j}\Delta u^r_{j,it-1}. \tag{5}$$

Correlations are modelled between the transitory shocks to the return on assets, $u^r_{j,it}$, and real wages, u_{it}, denoted, ρ_{uu}. Also, a potential correlation exists between the permanent shock to wages, v_{it}, and the transitory shock to the return on assets, u^r_{it}, denoted as ρ_{vu}.

Equations (4) and (5) are estimated in a system via an iterated GMM with heteroskedastic and serial correlation robust standard errors and weight matrix. An identity weight matrix is used to obtain the first-step parameter estimates. The results are robust to a two-step GMM or alternative assumptions of the initial matrix. In total, there are 7 parameters to identify: shock variances σ^2_u, σ^2_v, and $\sigma^2_{u^r}$; correlations ρ_{uu} and ρ_{vu}; and moving average processes $\alpha_{r,j}$ and α_w.

The system of equations (4) and (5) is over-identified using eleven moment conditions including all available variances, covariances, and first and second lagged covariances, such as $\text{cov}(\Delta\tilde{r}, \Delta\tilde{r}_{t-1})$, $\text{cov}(\Delta\tilde{r}, \Delta\tilde{W}_{t-1})$, $\text{cov}(\Delta\tilde{r}, \Delta\tilde{r}_{t-2})$, $\text{cov}(\Delta\tilde{r}, and \Delta\tilde{W}_{t-2})$. These moment conditions are used for all model specifications, and the robustness of this assumption is discussed later in the paper. Appendix B provides proof of identification for all parameters.

The objective is to find the most parsimonious system that captures the structure in the data for each equation system. The three shock variances are included within all models: σ^2_u, σ^2_v, $\sigma^2_{u_r}$. Each of sixteen model-parameter combinations is estimated, one for each combination of the moving average and shock correlations, $\alpha_{r,j}$, α_w, ρ_{uu}, and ρ_{vu}. The most parsimonious system is defined as one of the sixteen model specifications that exhibits both individual parameter significance and fails to reject the null of the valid over-identifying restrictions of the Hansen J-test (Hansen, 1982; Hall, 2005). For the few cases where more than one specification satisfies all criteria, χ^2-difference tests (Bentler, 1990) are used to select among the nested models, the significance levels are discussed in detail, and additional robustness is examined (see Section 4.6).

3 Data

The Panel Study of Income Dynamics (PSID) is used to calculate before-tax real returns and log-real wages. The dataset provides household-level unbalanced panel data, using surveys conducted every two years between 1999 and 2017.

3.1 Measurement

Returns to assets are observed for primary housing, *ph*, secondary housing, *oh*, private businesses, *b*, public equity, *s*, risk-free assets, *f*, and other assets, *o*.[4] The total return to household assets is given as

$$r^a_{it} = \frac{\sum_{j \in J} \{y_{j,it} + yg_{j,it}\}}{\sum_{j \in J} a_{j,it-1}}, \tag{6}$$

where $J = \{b, ph, oh, s, f, o\}$, $y_{j,it}$ and $yg_{j,it}$ are dividends and capital gains, respectively, on asset j for household i between time *t-1* and t, and $a_{j,it-1}$ is the value of asset j for household i in time *t-1*.

In the PSID for private businesses, primary and secondary housing assets, and stocks, both asset values at the time of the survey as well as the flow of investment and income between the two surveys are reported in every wave. Thus, unlike previous studies, capital gains can be observed for these assets in every period. Capital gains for the primary residence are defined as the change in the reported value of the primary residence between the two years if the house was not sold, or the difference from the selling price and the last reported value if the primary residence was sold, less the value of renovations and upgrades. Capital gains to stocks, private businesses, and secondary housing wealth are defined as the difference in the respective asset values less net investments.

Net investment is the amount of money put into that asset class less the amount of money taken out of that asset class. For example, for a private business, a household's net investment is the difference between how much money the household put into the business and how much money the household got from selling all or part of the business. In the case of complete liquidation (say in the case of bankruptcy), the asset value would equal zero and the net investment would equal the amount received from liquidation. Thus, returns are observed in cases of total liquidation.

Asset values are available for every period for holdings of public equity and for the primary residence. Asset values are available for private businesses and secondary housing, starting in the 2011 wave. Prior to 2011, net worth is reported for secondary housing and private business assets, but asset values are not reported. Fortunately, however, net worth and net investment are reported. Thus, it is proposed to impute the asset values for secondary housing and private businesses prior

[4] A detailed description of the returns calculations can be found in Appendix A

to 2011, using simple accounting. The asset value $a_{j,it}$ can be imputed by using the change in net wealth $\Delta w_{j,it+1}$ and net investment $i_{j,it+1}$ as follows:

$$a_{j,it} = a_{j,it+1} - \Delta w_{j,it+1} - i_{j,it+1} \tag{7}$$

for $j \in \{b, oh\}$. This imputation implies that wealth accumulation from principal payments is included in net investment. This is confirmed for the years between 2012 and 2016, when asset values, net investment, and changes in net worth are all observed. The imputed private business and secondary housing asset values are used in calculations of the returns prior to 2011.

The method used for the returns to primary housing follows Flavin and Yamashita (2002) but also builds upon it in three ways. First, the tax rate is household- and year-specific and is calculated using the National Bureau of Economic Research tax simulator (Feenberg and Coutts, 1993). Second, capital gains include net investment, which includes major improvements and upgrades. This data is not available for the sample covered by Flavin and Yamashita (2002). Third, rental income is acknowledged as a source of income. Failure to account for rental income can understate the return to housing. These three differences are also true of the return to housing in Fagereng et al. (2020). Similar to the returns to primary housing, the measure of returns to secondary housing includes capital gains, the value of housing services, maintenance costs, and rental income.

The return to assets in asset class j is given by

$$r^a_{j,it} = \frac{y_{j,it} + yg_{j,it}}{a_{j,it-1}}, \tag{8}$$

for $j \in= \{b, ph, oh, s, f\}$. For risk-free and other assets, net investment is not observed and capital gains are assumed to be zero: $yg_{f,it} = yg_{o,it} = 0$. All models are estimated in real returns by deflating the nominal returns by the annualized total consumer price index provided by the Federal Reserve (CPI).

The total return on assets used in this paper is most similar to the measure of the return to individual "net worth" in Fagereng et al. (2020), who use the asset value in the denominator but net interest payments in the numerator. Total household assets in this paper also include information on durable wealth and other valuables, such as collections that are reported by the household that would not be reported in the European administrative tax datasets (Bach et al., 2020; Fagereng et al., 2020). It also differs in that net investment and asset values are observed in each period as opposed to only observing realized capital gains. The final innovation is that the PSID allows for a measure of returns by asset class.

Total household wages, W_{it}, are calculated as total household labor income, Y_{it}, over total hours worked, H_{it}:

$$W_{it} = Y_{it}/H_{it}. \tag{9}$$

Household labor income includes total head and spouse's labor income and household labor income from businesses. Non-business labor income is the sum of total labor income, including salaries, hourly work, bonuses, tips, etc.

3.2 Sample Selection

The baseline analysis considers households with a continuous marital status. Observations are dropped if there is a change in the head or spouse. By including only households with a continuous marital status, no attempt is made to model the asset return risk associated with divorce and marriage. Observations are biennial from 1999 to 2017, as per the survey frequency. Four consecutive waves of available data on asset income, wealth, and wages are required. This is necessary for the identification method described in Appendix B. Households are kept if the head was born after 1920 and the head's age is between 20 and 70. The mean and median age is 43. Households in the supplemental Survey of Economic Opportunity are also excluded.

Observations are dropped if any component of labor income, asset income, wealth or demographic data is missing, unknown, or not reported. These criteria are stringent, as 48.7 percent of the households that are typically used for the analysis of wages in the PSID fail to report aspects of their asset income and are thus dropped from the survey. This includes net investments into and out of direct holdings of public stocks, which is the most likely variable to be missing. No observations used in this study were found to be top coded or truncated at a high value. The requirement that there must be an observed household wage means that, in the sample, there are very few household heads who are students or retired. The main results are robust to excluding heads who retire or become students.

Outliers are treated in a similar way to that of Blundell et al. (2008) and Fagereng et al. (2020). A household is dropped if the household's total income is below $100 a year or if the level or growth of the real wage is beyond the 99 percent confidence interval. To account for extreme values that could skew the distribution, the top and bottom 5 returns observations are dropped. Then, returns observations are dropped if the asset value is below $100 or the change or level of the returns to assets is beyond the 99 percent confidence interval. The exception is for private business returns, which are excluded if the asset value is below $5000. This ensures that private businesses have physical assets; this is explored in detail in the discussion on robustness in Section 4.6.

In addition to the above requirements, another event is attributed to measurement error and removed from the sample. For direct holdings of public equities, secondary housing and private businesses, an observation is dropped if the household reported ownership in the last period but the current period's asset value is zero and the household did not report selling any of the asset. This requirement excludes a small number of households in the bottom tail of the return to assets and the main results are robust to this assumption.

3.3 Data Summary

Wage growth and the level of returns are summarized in Table 1. The mean real wage growth is 3 percent, with a standard deviation of 38.9 percent. The return to total household assets, $r_{a,it}$, are described as *Total Assets* and have a mean of 2.5 percent and a standard deviation of 9.3 percentage points. For all asset returns, the between-household standard deviation is larger than the within-household standard deviation. In contrast to real wage growth, which is left skewed, the returns to total household wealth are right skewed. Both wage growth and real wage growth display more kurtosis than a normal distribution.

Table 1. Summary Statistics for Asset Returns and Wage Growth

	Obs	House-holds	Mean	Standard Deviation			25p	75p	Skew-ness	Kurt-osis
				Total	Within	Between				
Wage Growth	19541	3162	3.0	38.9	13.7	37.3	-14.1	21.4	-0.2	5.4
Total Assets	9043	1533	2.5	9.3	4.2	8.4	-2.4	5.5	1.4	8.7
Private Business	484	89	32.9	87.9	41.1	77.7	-12.7	40.3	3.0	13.9
Primary Housing	11802	1873	5.3	10.7	3.8	10.1	-0.2	10.2	0.4	5.1
Secondary Hous.	839	158	11.1	33.0	14.0	30.5	-5.6	19.7	2.4	12.1
Risk Free	17962	2777	-1.7	1.1	0.6	0.9	-2.4	-1.5	1.3	5.4
Public Equities	5033	864	8.3	44.1	20.8	39.4	-3.0	2.7	5.2	40.9

Note: Real wage growth and return on assets in percentage points, 1999-2017. Conditional on a minimum of three consecutive return observations and the presence of both wage and return observations. 25p and 75p refer to the corresponding percentiles. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

The mean return to private business assets is 32.9 percentage points, which is significantly larger than the 8.3 percentage point mean return to public equities. This is also reflected in the standard deviation of the return to private business assets, which is 87.9 percentage points, significantly larger than the 44.2 percentage point standard deviation to public equities. The mean return to primary housing assets is 5.3 percentage points, with a standard deviation of 10.7 percentage points. The mean return to secondary housing assets is larger than primary housing assets, with a mean of 11.1 percentage points and a standard deviation of 33 percentage points. The mean return to risk-free assets is -1.7 percentage points, reflecting the amount in low-interest accounts and the low nominal policy rate over the second half of the sample.

4 Empirical Results

This section presents the estimates of idiosyncratic risk to asset returns and their correlation with idiosyncratic labor risk. There are three main questions. What is the degree of idiosyncratic risk to the returns on assets? Is idiosyncratic asset returns risk correlated with labor income risk? Is there serial correlation in asset returns? These questions are examined for each asset class. The full sample is then divided by household characteristics to see if the results pertain to specific subsamples.

4.1 Returns to Total Household Assets and by Asset Classes

The results for the system estimation of equations (4) and (5) for total household assets and for each asset class are summarized in Table 2. For all returns, the variances of the shocks to wages and returns are significant at the 5 percent level. For every return measure, the null hypothesis of valid over-identification restrictions is not rejected.

The first column of Table 2 reports the baseline estimates for the returns to total household assets. The standard deviations for the permanent and temporary shocks to wages are 20.3 and 18.9 percentage points, respectively, and are significant at the 1 percent level. The standard deviation for the transitory idiosyncratic shock to the return on total household assets is estimated to be 8.2 percentage points.

Neither idiosyncratic shock to wages is found to be significantly correlated with the transitory shock to total asset returns. The moving average coefficient for the shock to the return on total household assets is found to be -0.17 and statistically significant at the 1 percent level. Only in models that include the moving average process for returns are the J-tests of valid over-identifying restrictions not rejected at the 10 percent level.

The second column of Table 2 shows the system estimations for idiosyncratic returns to private

Table 2. Idiosyncratic Return Risk is Sizeable and Correlated with Wage Risk

Asset Return	Total	Business	Prim. Hous.	Sec. Hous.	P. Equities
σ_u	18.89	28.00	22.61	27.39	23.32
(Temporary wage shock)	(5.05)	(11.81)	(6.42)	(10.60)	(8.21)
σ_v	20.30	23.61	17.77	22.22	17.67
(Permanent wage shock)	(6.58)	(16.02)	(6.53)	(11.76)	(8.93)
σ_{ur}	8.19	74.65	9.53	29.04	40.04
(Temporary return shock)	(2.35)	(29.83)	(2.02)	(13.29)	(13.94)
α^w	-	-	0.11	-	0.17
(Wage moving average)	-	-	(0.040)	-	(0.054)
α^r	-0.17	-	-0.11	-	-
(Return moving average)	(0.060)	-	(0.033)	-	-
ρ_{uu^r}	-	-	-	0.30	-
(Corr. temporary shocks)	-	-	-	(0.097)	-
ρ_{vu^r}	-	0.29	-	-0.35	-
(Corr. v wage u returns)	-	(0.158)	-	(0.148)	-
N	4,834	280	7,261	476	2,585
Households	1,404	85	1,775	139	784
J-test p-value H_0: Valid	0.479	0.454	0.708	0.136	0.757

Note: Estimates are from system estimation using iterative GMM. Returns are in percentage points; idiosyncratic wages are in percent change. Prim. and Sec. refer to primary and secondary housing (hous.), respectively. P. refers to public and corr. refers to correlation. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

business assets and wages. The standard deviations for the permanent and temporary shocks to the wages of business owners are 23.6 and 28 percentage points, respectively, which are higher than for the average population. The standard deviation for the transitory shock to the return to private business assets is the highest of any asset class with a standard deviation of 74.7 percentage points. There is a positive correlation coefficient of 0.29 for the permanent shock to wages and the transitory shock to the return to private business assets. The correlation coefficient is significant at the 10 percent level and is examined in detail in Section 4.6. The third and fourth columns of Table 2 show the system estimations for primary and secondary housing assets. The standard deviations for the temporary shocks to the return on primary and secondary housing assets are estimated to be 9.5 and 29 percentage points, respectively. The return to primary housing assets does not exhibit significant correlation with the permanent or transitory shocks to wages. In contrast, the idiosyncratic return on secondary housing assets is correlated with a value of -0.35 for the permanent and 0.30 for the temporary shock to wages and both are significant at the 5 percent level. Returns to primary housing assets have a negative moving average coefficient of -0.11, significant at the 1 percent level. Secondary housing is the only asset class that provides insurance against permanent wage shocks, with a negative and robust correlation of the permanent shock to wages and the transitory shock to asset returns.

The fifth column of Table 2 shows the system estimation for public equities. The standard deviation of the transitory shock to returns is estimated to be 40 percentage points. The null of zero correlation between the shock to wages and the shock to public equity assets returns cannot be rejected at any reasonable level of significance. A positive moving average coefficient for wages, significant at the 1 percent level, is observed for both primary housing and public equities.

Consider the interpretation of these findings. The estimates suggest that, on average, households are able to allocate their asset portfolios to avoid a correlation between labor income shocks and assets returns. Only for private business and secondary housing assets does the evidence suggest that idiosyncratic shocks to wages and transitory shocks to returns are correlated. Secondary housing assets provide a unique asset class that allows for the permanent shock to wages to be hedged. The next section delves deeper into which households can adequately hedge this risk.

4.2 Capital Gains

This section repeats the baseline exercise for the capital gains proportion of returns so as to inform whether the correlations and serial correlations in the returns arise due to capital gains or to flow income. For the capital gains portion of returns, the denominator remains the same but the numerator only includes capital gains. Specifically, the annualized capital gains portion of returns, $rg_{j,it}$, is defined as

$$rg_{j,it} = \frac{a_{j,it} - a_{j,it-1} - i_{j,it}}{2a_{j,it-1}}, \tag{10}$$

where $a_{j,it}$ is the value of asset j of household i in time t, and $i_{j,it}$ is the household's i net investment within asset class j at time t. The returns from capital gains are converted to real returns and idiosyncratic returns are calculated the same as total returns, following equations 1 and 2. Households are included if there is no missing information on idiosyncratic returns from capital gains and if these returns are subject to the same outlier restrictions as total returns. Equations (4) and (5) are estimated as systems that use the return on capital gains for each asset type and are summarized in Table 3.

The second column of Table 3 shows the system estimation for idiosyncratic wages and asset returns from capital gains to private business. Business profits exacerbate variability in private

Table 3. Total Capital Gains are Correlated with Wage Innovations

Asset Return	Capital Gains Portion of Return				
	Total	Business	Prim. Hous.	Sec. Hous.	P. Equities
σ_u	19.25	28.14	22.81	26.63	23.47
(Temporary wage shock)	(4.75)	(11.70)	(6.09)	(10.22)	(8.21)
σ_v	20.00	23.01	18.00	20.94	17.61
(Permanent wage shock)	(6.24)	(16.43)	(6.26)	(11.73)	(8.96)
σ_{ur}	11.57	56.95	11.53	34.11	28.28
(Temporary return shock)	(4.04)	(22.40)	(2.83)	(13.97)	(11.17)
α^w	-	-	0.11	-	0.18
(Wage moving average)	-	-	(0.036)	-	(0.053)
α^r	-0.18	-	-0.15	-	-0.20
(Return moving average)	(0.081)	-	(0.039)	-	(0.108)
ρ_{uu^r}	-	-	0.05	0.18	-
(Corr. temporary shocks)	-	-	(0.016)	(0.082)	-
ρ_{vu^r}	-	-	-	-0.22	-
(Corr. v wage u returns)	-	-	-	(0.116)	-
N	6,063	280	8,670	602	2,569
Households	1,705	85	2,033	172	778
J-test p-value H_0: Valid	0.102	0.518	0.125	0.321	0.931

Note: Estimates are from the system estimation that uses iterative GMM. Idiosyncratic rates of return are in percentage points; idiosyncratic wages are in percent change. Prim. and Sec. refer to primary and secondary housing (hous.), respectively. P. refers to public and corr. refers to correlation. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

business returns as the standard deviation for the transitory shock to capital gains is lower than that of the total return to private business assets. Importantly, unlike for the total return to private business assets, transitory shocks to capital gains to private business are not correlated with either of the shocks to wages. This suggests that it is the dividends and profits of private businesses, and not capital gains, that are correlated with wage income.

The estimates for total capital gains and capital gains to public equities are reported in the first and fifth columns of Table 3. For the capital gains portion of total returns, the standard deviation is larger than that of total returns, suggesting that the dividend proportion of the returns dampens the return volatility. The opposite is true for public equities, in which the standard deviation of the shock to the return from capital gains is less than that for the total return. Consistent with the total return, neither return from capital gains exhibits correlation with the wage shocks.

Unlike for total returns, shocks to the return from capital gains on primary housing assets are significantly correlated at the one percent level with the temporary shock to wages. This arises from a positive correlation between the growth rate of the idiosyncratic appreciation in housing and wages and is slightly mitigated by a positive correlation between the net investment in primary housing and changes in a wages. The reason the positive correlation is not reflected in the total return on housing is due to rental income which exhibits a -9.6% correlation with that of wages. Secondary housing assets continue to exhibit correlated capital gains and wage shocks. Hence, both the capital gains and the rental income from secondary properties are negatively correlated with the permanent shock to wages. Together, the evidence supports the need to include net investment and rental income in the calculation of returns on housing. As explored later on, the positive correlation between primary housing assets and wages is specific to younger households and the positive correlation coefficient for primary housing is sensitive to changes in the age composition of the sample.

4.3 Ownership

In an examination of the returns to asset class j, the correlations of the returns to asset classes and to wages have been considered. Correlations have also been observed for private business assets and housing assets. In this section, we examine whether ownership of these assets implies that these correlations also arise for returns to total household assets. Specifically, the return to total household assets for households that own or do not own specific asset classes is reported in Table 4.

The negative moving average coefficient for idiosyncratic shocks to total assets returns is observed only for owners of primary housing. Neither subsample exhibits correlation with either the wage shock or the return shock to total household assets. Notably, households that do not own primary housing experience much smaller standard deviations of the transitory idiosyncratic component of assets returns compared to households that own primary housing assets. Primary homeowners have over five times the idiosyncratic variability in total assets returns compared to non-homeowners.

The higher risk to total assets returns not only arise from primary home ownership but also households that do not own homes are much less likely to own other risky assets such as private businesses. For example, the idiosyncratic risk to total household assets are also lower for households that do not own private businesses or secondary housing assets 4. Compared to the overall sample, these households have slightly less variability in idiosyncratic returns to total household assets and this is consistent with the high risk in these asset classes. These households also continue to experience negative serial correlation of the transitory idiosyncratic return. Overall, the results

Table 4. Negative Moving Average in Returns Associated with Home Ownership

Return	Total Household Assets			
Ownership Sample	Pr. Home	x Pr. Home	x Business	x Sec. Hous.
σ_u	18.23	22.04	19.02	18.98
(Temporary wage shk)	(5.35)	(7.81)	(5.10)	(5.18)
σ_v	19.80	19.60	19.33	19.80
(Permanent wage shk)	(7.12)	(9.93)	(6.58)	(6.67)
σ_{ur}	9.03	1.67	8.04	7.76
(Temporary return shk)	(2.75)	(1.19)	(2.30)	(2.36)
α^r	-0.21	-	-0.15	-0.19
(Return moving average)	(0.072)	-	(0.059)	(0.068)
N	3,410	1,103	4,528	4,366
Households	1,002	332	1,306	1,264
J-test p-value H_0: Valid	0.116	0.617	0.608	0.531

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic rates of return are in percentage points, idiosyncratic wages are in percent change. Pr. Home and x Pr. Home refers to households that do and do not own primary housing assets, respectively, whereas x Business and x Sec. Hous. refers to households that own neither private businesses nor secondary housing assets, respectively. shk refers to shock. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

reinforce the role of housing and business assets as sources of large idiosyncratic risk and the importance of home ownership for the negative correlation in the idiosyncratic returns to assets.

4.4 Life-Cycle Factors

When modelling idiosyncratic assets returns risks, should the degree of risk depend on life-cycle factors such as age and wealth? To this end, various age, education, and wealth subsamples are explored. While the estimated observable household characteristics in equations (1) and (3) account for how age and education affect the level of assets returns, the degree of the idiosyncratic risk and its correlation with the idiosyncratic wage risk, may still differ.

Older and younger households are distinguished by their age relative to the median head-of-household age of 42, see Table 5. Younger households have lower variances in shocks to wages compared to the baseline sample. This occurs despite similar variances in shocks to transitory assets returns. Interestingly, younger households have a positive correlation between the transitory shock to wages and the returns to total household assets, and this is significant at the 5 percent level. There is also no evidence of serial correlation in either the wage or the return processes for younger households in any model specification at any reasonable level of significance. In contrast, older

Table 5. Younger Households have Correlated Wage and Return Risk

Return	Total Household Assets			
Sample	Younger	Older	Low Wealth	High Wealth
σ_u	17.25	20.29	20.08	17.49
(Temporary wage shk)	(5.61)	(6.18)	(6.08)	(5.80)
σ_v	17.87	22.14	19.40	21.22
(Permanent wage shk)	(7.11)	(8.39)	(7.77)	(8.02)
σ_{ur}	8.24	8.21	6.98	9.06
(Temporary return shk)	(2.41)	(2.97)	(2.59)	(2.96)
α^r	-	-0.27	-0.19	-0.16
(Return moving ave)	-	(0.106)	(0.101)	(0.081)
ρ_{uu^r}	0.07	-	-	-
(Corr. temporary shks)	(0.033)	-	-	-
N	2,338	2,277	2,031	2,264
Households	712	637	603	647
J-test p-value H_0: Valid	0.119	0.525	0.347	0.803

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic rates of return are in percentage points; idiosyncratic wages are in percent change. ave. refers to average and shk. refers to shock. Young and Older refer to households above and below the median age. Low and High Wealth refer to households above and below the median level of wealth. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

households do not experience correlation between innovations to wages and returns. Interestingly, their return process displays a negative -0.27 moving average coefficient that is significant at the 5 percent level.

Dividing the sample by wealth, relative to the median, or by education does not affect the serial correlation of the shock to returns on total assets or the correlation with the wage shocks. Among high-wealth and more educated households, there is a larger standard deviation of the permanent shock to wages but a smaller standard deviation of the transitory shock to wages. Evidence of negative serial correlation in asset returns at the 10 percent significance level is observed for both subsamples and is consistent with the full sample. Overall, this suggests that the correlation and moving average properties are more related to age than to wealth and education.

4.5 Public and Private Insurance

Thus far, the analysis has considered total household wages. This section examines the sensitivity of the results to alternative measures of wages and explores how household composition and social assistance affect idiosyncratic risk. Specifically, to explore the role of a secondary income earner in a household, the head's wage income is considered alongside the incomes of married and single households. Finally, to explore the role of private and public insurance, alternative wage measures are considered, among which include family transfers and social security income.

Table 6. Within-Household Wage Insurance

Return	Total Household Assets			
Wage Type	Household	Head Only	Married	Single
σ_u	18.89	19.50	18.54	20.57
(Temporary wage shk)	(5.05)	(5.57)	(5.30)	(7.45)
σ_v	20.30	22.22	19.23	21.92
(Permanent wage shk)	(6.58)	(7.57)	(6.84)	(9.64)
σ_{ur}	8.19	8.24	8.37	7.20
(Temporary return shk)	(2.35)	(2.37)	(2.67)	(2.56)
α^r	-0.17	-0.14	-0.22	-
(Return moving ave.)	(0.060)	(0.058)	(0.079)	-
N	4,834	4,587	3,536	1,298
Households	1,404	1,341	1,022	382
J-test p-value H_0: Valid	0.479	0.547	0.390	0.828

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic rates of return are in percentage points, idiosyncratic wages are in percent change. ave. refers to average and shk. refers to shock. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

Table 6 reports the results for the returns to total household assets and wages for the full sample and for the wages of heads of households only. The head's wage measure excludes the labor income and hours of the secondary earner. The moving average for wages remains statistically insignificant, and the moving average coefficient for returns maintains significance at the 5 percent level and is similar in size at -0.14. Heads' wages have a higher standard deviation for the permanent and transitory wage shock relative to total household wages, suggesting the role of the secondary earner in smoothing volatility in household wages. The correlation of the shocks remains statistically insignificant in any specification.

The third and fourth columns of Table 6 report the system estimates when the sample is split between married and single households. For married households, the wage and return risk are found to be slightly below those of the total sample. In contrast, single households are found to have higher permanent and transitory wage risk but lower transitory return risk. Single households are also found not to display a significant moving average process for returns. In contrast, the moving average coefficient is estimated to be larger for married households at -0.22, compared to the -0.17 in the baseline sample. As marriage and home ownership are highly correlated, the lack of serial correlation for single households is likely due to the lack of home ownership in this sample.

Table 7. Insurance from Social Security and Transfers

Return	Total Household Assets			
Wage Type	Household	+SSI	+Tranfers	+SSI+T.
σ_u	18.89	18.95	20.08	19.86
(Temporary wage shk)	(5.05)	(5.10)	(5.28)	(5.30)
σ_v	20.30	20.83	19.86	20.76
(Permanent wage shk)	(6.58)	(6.82)	(6.85)	(7.07)
σ_{ur}	8.19	8.18	8.15	8.17
(Temporary return shk)	(2.35)	(2.32)	(2.34)	(2.33)
ρ_{uu^r}	-	0.04	-	0.05
(Corr. temporay shks)	-	(0.023)	-	(0.023)
α^r	-0.17	-0.16	-0.16	-0.16
(Return moving ave.)	(0.060)	(0.059)	(0.062)	(0.061)
N	4,834	4,832	4,809	4,777
Households	1,404	1,404	1,401	1,388
J-test p-value H_0: Valid	0.479	0.341	0.270	0.208

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic rates of return are in percentage points, idiosyncratic wages are in percent change. corr., ave., and shk refer to correlation, average and shock, respectively. +Transfers include private transfers in the measure of labor income. +SSI includes social security income, whereas +SSI+T. includes both social security income and transfers. Heteroskedastic and serial correlation robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

Both private and public insurance may hedge against labor income risk. Table 7 reports the system estimation for equations (4) and (5) when the wage measure includes social security receipts (+SSI) and private transfers from family members outside of the household (+T.) in the measure of labor income. Including transfers in the measure of labor income increases the standard deviation of the transitory wage risk but reduces the standard deviation of the permanent wage risk. This is consistent with private transfers hedging some of the permanent labor income risk. Private transfers have an insignificant effect on the return risk or wage correlation, compared to the baseline.

Social security benefits in the United States include an old age pension, survivors' benefits, and disability insurance. The effect of including household social security income in the measure of wages, by itself, and that of including private transfers are presented in the second and fourth columns of Table 7. Social security receipt slightly increases the standard deviations of both wage shocks. The inclusion of social security income also induces a positive correlation of the idiosyncratic transitory return and wage correlation compared to the baseline. In the model where wages include both transfers and social security income, a correlation of 0.05, significant at the 5 percent level, between the idiosyncratic transitory return and wage shocks is observed.

4.6 Robustness

This section summarizes the sensitivity of the results to the robustness checks on the baseline assumptions. This includes robustness for the treatment of outliers, a minimum number of consecutive observations, and assumptions regarding data construction. Generally, the main size of the standard deviations, the moving average, and the wage and return correlations are robust to most assumptions of the data treatment. The result that is the most sensitive to the data treatment is the significance of the moving average for wages.

When more outliers are dropped, such as at the 5 percent or 0.1 percent level, the standard deviation of the idiosyncratic shocks changes in the corresponding direction. Similarly, if the minimum value of the asset or labor income is increased, then the standard deviation of the idiosyncratic shocks declines. The robustness of the minimum value is examined for all returns at \$500, \$,1000, \$5,000 or \$50,000. In all of these cases, the significance of the observed moving averages in the returns and wages continues to be observed. The only result that is sensitive to these assumptions is the correlation between wages and returns for private business assets. At and below a \$1,000 minimum value of business assets, the variability in the returns to private business assets nearly doubles and the correlation between the permanent shocks to wages and the transitory shocks to returns is no longer observed at the 10 percent level. At minimum asset values larger than \$5,000, the sample size becomes small and the standard deviation of the permanent shock to wages is no longer significant. The baseline minimum of \$5,000 provides a sample of private businesses with some physical capital while also preserving the sample size.

Given that the baseline sample consists of households with heads aged 20 to 70, a natural question is whether some of the risk or correlation is driven by heads who are either students or retired. However, when students, retirees, or both are dropped from the sample, there is a loss of only a few hundred observations and the results remain qualitatively unchanged. This arises since the baseline requires a positive household wage. Hence, in the baseline estimates, the only case that is present where the head is retired is when the spouse is still earning a wage.

Throughout the analysis, correlation is considered between the idiosyncratic shocks to wages and the shocks to the asset returns. It may be possible that the idiosyncratic returns on assets within asset classes are correlated with other asset classes. However, only the idiosyncratic asset returns for primary and secondary housing assets display a small pairwise correlation of 0.10 which is statistically significant at the 10 percent level. This is consistent with the observed correlation between wage risk and housing return risk, so the correlations of idiosyncratic asset return risk across asset classes are not modelled.

The baseline model in the analysis uses a moving average process for the transitory shocks to wages and returns. An alternative process of serial correlation is an autoregressive process for both wages and returns. In such a model, the autoregressive parameter for the wage process is estimated to be unity with precision. The results confirm that some potential serial correlation exists in returns, but the variances of the shocks are found to be statistically insignificant. The evidence of a positive moving average in wages also suggests against the use of autoregressive functions. While the results are available from the author, these processes are best modelled using the superior small sample properties of the moving average process.

The results are also robust to the choice of moment conditions. Throughout this paper, equations (4) and (5) are over-identified using eleven moment conditions that include all of the available variances, covariances, and first and second lagged covariances. However, for the systems without moving average parameters, only 5 moments are required. The downside of using additional moments is that 5 consecutive waves must be observed, whereas only 4 consecutive observations are required when the moving averages are excluded. However, in either case, the J-test for valid over-identifying restrictions rejects, at the 5 percent level, the return to total household assets for any model that excludes the moving average in these returns.

For the calculation of the return on assets, some households have insufficient data with which to impute the value of businesses and secondary housing assets prior to the 2012 wave. On average, households that own these assets are three times more wealthy than the sample so missing these households could reduce the variance in the total returns to assets. However, the magnitudes of the estimates are robust between the sample periods 1998–2010 and 2008–2016 as are the serial correlation and the correlations between return and wage risk. The main difference is that in the later half of the sample, the moving average coefficient for wages is larger and more statistically significant.

Finally, the results are robust to the method of calculation used for the idiosyncratic returns to assets, equation 1. This includes when portfolio shares are not accounted for in the total return to household assets. Thus, shifts in portfolio allocation do not introduce correlations between asset returns and wage shocks. The qualitative results for all of the idiosyncratic returns are robust to the cohort affects and to the alternative assumptions for the functional forms for age and regional controls.

5 Conclusion

This study developed new measures of household-level returns to total assets and by asset class that include capital gains net of investment and rental income. This has allowed for a joint estimation of return and wage risks to study the degree of idiosyncratic assets returns risk, their serial correlation, and their correlation with idiosyncratic wage risk. The empirical evidence can be used to discipline the structure and calibration of quantitative models of uninsured idiosyncratic income risk.

Sizeable idiosyncratic return risk is observed for total household returns and by asset class. This transitory idiosyncratic asset return risk exists concurrently with household-specific returns (Fagereng et al., 2020; Snudden, 2021). Quantitative models of uninsured idiosyncratic risks that seek to capture household-specific returns need to include both household-specific and transitory idiosyncratic components. This is analogous to models that allow for idiosyncratic innovations to labor income around a life-cycle earnings profile.

These findings can be used to inform the debate on optimal portfolio allocation and the causes and consequences of wealth inequality and mobility. The substantial idiosyncratic risks that exist within all asset classes suggests that background risks may arise from all asset classes. These background risks are found to be especially high for entrepreneurial assets (Heaton and Lucas, 2000), primary housing (Cocco, 2005; Flavin and Yamashita, 2002) and secondary housing assets (Brueckner, 1997; Yao and Zhang, 2005).

Permanent shocks to wages and transitory shocks to returns on assets are correlated for private business and housing assets. This idiosyncratic return and wage risk correlation is the first direct measure of a household-level covariance matrix for the determination of portfolio allocation. Generally, households are able to avoid a correlation between idiosyncratic wage and return risks in total household assets. Studies that have included idiosyncratic risks for both returns and wages (Cagetti and De Nardi, 2009; Benhabib et al., 2011, 2015) can abstract from the correlation across these shocks.

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Online Appendices (not intended for publication)

A The New Measures of Returns

The redesigned Panel Study of Income and Dynamics (PSID) data is the main dataset for the calculation of household-level real rates of return. For the purpose of this paper, the main innovation of the PSID was the regular and detailed collection of asset income, wealth, and net investment. Households were surveyed every two years for the period 1999 to 2017. Rates of return are annualized and available for 2000 to 2016. The year 1998, or the initial household observation, is lost due to the calculation of the returns.

The PSID provides detailed socio-economic information on gender, age, marital status, education level, employment status, and geographic location. Data on labor and asset income are retrospective to the year prior, whereas wealth in assets and debt are reported at the time of the interview. Interviews are conducted early in the year (around March). The head of the household is defined as a person over age 15 with the most financial responsibility for the household.

A.1 Capital Gains Imputation

A difficulty previous studies incurred in calculating returns is that asset income is reported as a total for a year, whereas wealth is observed at a point in time. Wealth can be put into or removed from a particular asset category; for example, through the accumulation of capital gains in wealth. In the Scandinavian tax database used by Bach et al. (2020) and Fagereng et al. (2020), wealth is reported at the end of the year, income is reported for the year, and capital gains are reported when realized. However, in the PSID asset values, net investment and flow income that took place during the period between the two surveys are reported in every wave for the asset classes other than risk-free assets. Thus, unlike previous studies, capital gains can be observed for these assets in every period. All capital gains are annualized.

For each asset class, the wealth in the asset is defined as the value of the asset less the debt associated with the asset. The asset value and wealth are net of fees and commissions. For example, the wealth in the primary residence, $w_{ph,it}$ is defined as the reported value of the primary residence, $a_{ph,it}$, less the primary mortgage debt, $d_{ph,it}$: $w_{ph,it} = a_{ph,it} - d_{ph,it}$.

For the primary residence, capital gains are defined as the change in the reported value of the primary residence, $a_{ph,it} - a_{ph,it-1}$, between the two years if the house was not sold, or the difference from the selling price, $a^*_{ph,it}$, on the last reported value if the primary residence was sold, $a^*_{ph,it} - a_{ph,it-1}$, less the value of renovations and upgrades, $i_{ph,it}$. Capital gains are measured between the waves and then annualized to match the asset income flows. Capital gains on primary housing, $yg_{ph,it}$ are

$$yg_{ph,it} = (\mathbb{1}_{\{sold=1\}} a^*_{ph,it} + \mathbb{1}_{\{sold=0\}} a_{ph,it} - a_{ph,it-1} - i_{ph,it})/2. \tag{11}$$

Capital gains to stocks, $yg_{s,it}$, private businesses, $yg_{b,it}$, and secondary housing wealth, $yg_{oh,it}$ are defined as the difference in net worth, $\Delta a_{j,it}$, less the net amount invested, $i_{j,it}$:

$$yg_{j,it} = (\Delta a_{j,it} - i_{j,it})/2, \tag{12}$$

for $j \in \{s, b, oh\}$.

Net investment is the amount of money put into an asset, less the amount of money taken out of that asset class. For example, for private businesses, a household's net investment is the difference between how much money the household put into the business and how much money the household got from selling all or part of the business. In the case of complete liquidation (say in the case of bankruptcy), the asset value $a_{j,it}$ would equal zero and the net investment would equal the amount received from the liquidation, $i_{j,it}$. Thus, returns are observed in the cases of total liquidation.

Asset values are available for every period for holdings of public equities and for primary residences. Asset values are available for private businesses and secondary housing, starting in the 2011 wave. Prior to 2011, net worth is reported for secondary housing and private business assets but not for asset values. Fortunately, however, net worth and net investment were reported. Thus, the asset values for secondary housing and private businesses can be imputed prior to 2011 by using simple accounting. The asset value $a_{j,it}$ can be imputed by using the change in net wealth $\Delta w_{j,it+1}$ and net investment $i_{j,it+1}$ as follows:

$$a_{j,it} = a_{j,it+1} - \Delta w_{j,it+1} - i_{j,it+1}, \tag{13}$$

for $j \in \{b, oh\}$. This inference implies that the wealth accumulation from principal payments is included in net investment. This is confirmed for 2012–2016, when asset values, net investment, and change in net worth are all observed. The imputed private business and secondary housing asset values are used in the calculation of returns for the survey waves prior to 2011.

A.2 Asset Return and Wage Measures

The returns proposed in this study are pre-tax real returns to assets and wealth. In addition to returns to total household assets and wealth, returns are analysed for five asset categories: risk-free assets, primary and secondary housing, private businesses, and public equity. Observing and comparing returns to assets versus wealth allows one to parse the role of borrowing costs and leverage in the heterogeneity of returns to wealth. Merely focusing on the returns to assets ignores that leverage is a household's endogenous decision.

The return to primary housing include capital gains, the value of housing services, maintenance costs, and rental income. Let the dividend value from a residence in housing be denoted by DIV_{it} where

$$DIV_{it} = (rr + \delta)a_{ph,it-1} + ptax_{ph,it}, \tag{14}$$

and rr is the real interest rate, δ is the depreciation rate, and $ptax_{ph,it}$ is the value of property taxes. Following Flavin and Yamashita (2002), it is assumed that $rr = 0.05$. The cost of ownership is given by

$$COST_{it} = \delta a_{ph,it-1} - (1 - \tau_{it})ptax_{ph,it}, \tag{15}$$

where τ_{it} is the marginal income tax rate. It is assumed that the cost of maintenance and repairs from depreciation are equal for both landlords and homeowners, which implies that a house has a constant physical condition. Finally, households can rent out a fraction of their primary residence, RNT_{it}, and accrue rental income, $y_{ph,it}$, less reduced flow consumption and the additional cost of utilities, $utils_{ph,it}$:

$$RNT_{it} = y_{ph,it} - \kappa_{ph,i}(a_{ph,it-1}rr + utils_{ph,it}), \tag{16}$$

where $\kappa_{ph,i}$ is the share of the primary residence rented out. Rental income is reported for all housing assets. Rental income is attributed to the primary residence, $y_{ph,it}$, if the household does not own a secondary property, and to secondary income, $y_{oh,it}$, if the household owns a secondary property. Absent direct observations of the share of the primary residence rented out, it is assumed that $\kappa_{ph,i} = 0.5$ if rental income is accrued and $\kappa_{ph,i} = 0$ if no rental income is accrued.

For ease of exposition, let the net income from primary and secondary residences, the numerators of $r^a_{ph,it}$ and $r^a_{oh,it}$, excluding capital gains, be denoted by $yt_{ph,it}$ and $yt_{oh,it}$, respectively. The total return to the primary residence is thus

$$
\begin{aligned}
r^{n,a}_{ph,it} &= \frac{yg_{ph,it} + DIV_{it} - COST_{it} + RNT_{it}}{a_{ph,it-1}} \\
&= \frac{a_{ph,it-1}rr(1-\kappa_{ph,it}) + y_{ph,it} + \tau_{it}ptax_{ph,it} - \kappa_{ph,it}utils_{ph,it} + yg_{ph,it}}{a_{ph,it-1}} \\
&= \frac{yt_{ph,it} + yg_{ph,it}}{a_{ph,it-1}}.
\end{aligned}
\tag{17}
$$

The return to the primary housing asset differs from the one in Flavin and Yamashita (2002) in three ways. First, the tax rate is household and year specific and is calculated using the National Bureau of Economic Research tax simulator (Feenberg and Coutts, 1993). Second, capital gains are net of investment, which includes major improvements and upgrades. This data was not available for the sample covered by Flavin and Yamashita (2002). Third, rental income is acknowledged as a source of income. Failure to acknowledge rental income can understate the return to housing. These three differences are also true of the return to housing in Fagereng et al. (2020).[5]

The return to secondary housing is modelled to allow for the property to be owner-occupied, rented out full time, or rented out intermittently. Specifically, the asset return to secondary housing, $r^{a}_{oh,it}$, is given by

$$
r^{n,a}_{oh,it} = \begin{cases} (a_{oh,it-1}rr + \tau_{it}ptax_{oh,it} + yg_{oh,it})/a_{oh,it-1}, & \text{if occupied} \\ (y_{oh,it} - a_{oh,it-1}\delta - ptax_{ohit} + yg_{oh,it})/a_{oh,it-1}, & \text{if rented out} \end{cases}
\tag{18}
$$

where $ptax_{oh,it}$ are the property taxes on the secondary housing. It is assumed that the tenant pays for the cost of utilities. The PSID includes information on the repairs and maintenance of the primary residence, beginning in 2005. To incorporate this information, the average depreciation rate, δ, is set to 1.7 percent, the average value of the repairs and the depreciation costs for the years observed. For the baseline sample, 10.3 percent of homeowners own secondary properties, and 42.2 percent of secondary properties report rental income.

The PSID contains detailed information on mortgage rates for primary housing. A nominal mortgage interest rate is calculated as the debt-weighted average of the first and second mortgage. The calculation of the mortgage interest payments utilizes information on monthly mortgage payments, the current interest rate on the loan, the year the mortgage was obtained, and the years left

[5]Fagereng et al. (2020) impute housing values based on aggregate housing prices and use the average imputed house price between years in the denominator of the rate of return.

to pay it out, follow the TAXSIM recommendations for calculating mortgage deductibility.

If an individual in the household actively participates in a private business, the PSID assigns half of business income to assets and half to labor. If an individual reports business income but does not actively participate in the business, the PSID assigns all of the business income to business asset income. If the household reports a loss in total business income, then the loss is attributed only to business asset income. The PSID does not distinguish between labor and asset income from farming, so it is assumed that farm owners actively contribute labor to farm activities and that farm income is, thus, split evenly between labor and asset income, as for the case of businesses. The flow profits from private businesses are denoted $y_{b,it}$. The return to business assets is defined as the sum of income from businesses and farms plus capital gains:

$$r^a_{b,it} = \frac{y_{b,it} + yg_{b,it}}{a_{b,it-1}}. \tag{19}$$

The PSID does not report on net investment in risk-free assets. The value of the risk-free asset is thus calculated following Fagereng et al. (2020) by assuming that wealth is the average between the current and last period. The average value of assets in risk-free assets is thus $\bar{w}_{it} = (w_{f,it} + w_{f,it-1})/2$.

Interest income is reported by the household but is not allocated to a particular asset category. Interest income from bonds, $y_{c,it}$, is allocated between direct holdings and safe assets and is distinguished using the 3-month U.S. Treasury bill rate, $r^n_{tres,t}$. The interest income from bonds that are associated with risk-free assets is the smaller value of the Treasury bill rate times the value of the risk-free assets or the value reported from bond interest income. That is

$$y_{c,it} = \begin{cases} y_{c,it}, & \text{if } r^{n,a}_{tres,t}\bar{a}_{f,it} \leq y_{c,it} \\ r^{n,a}_{tres,t}\bar{a}_{f,it}, & \text{otherwise.} \end{cases} \tag{20}$$

The remainder of the reported interest income, $y_{q,it} = y_{c,it} - y_{f,it}$, is then allocated to IRAs and direct public equity holdings. The return to risk-free assets, $r^a_{f,it}$, is thus defined as

$$r^{n,a}_{f,it} = \frac{y_{f,it}}{\bar{a}_{f,it}}. \tag{21}$$

Similarly, the return to public equity, $r_{s,it}$, is the sum of dividends, $y_{s,it}$ interest income, $y_{q,it}$, and capital gains from stocks, $yg_{s,it}$, over the value of IRAs $\bar{w}_{ira,it}$ and direct holdings of public equities, $w_{s,it-1}$:

$$r_{s,it}^{n,a} = \frac{y_{s,it} + y_{q,it} + yg_{s,it}}{\bar{w}_{ira,it} + w_{s,it-1}}. \tag{22}$$

It is assumed that households do not leverage wealth in public equities or risk-free assets and, thus, their returns to wealth and assets are equivalent. There are two main differences with the current measure of stocks, other than the country, in comparison to the datasets of Bach et al. (2020) and Fagereng et al. (2020). The first is that pension assets are included in the value of financial assets. The second is that capital gains are computed per period, in contrast to the imputed realized capital gains.

Total household asset income includes the returns to primary and secondary housing, $yt_{ph,it}$ and $yt_{oh,it}$, private business income, $y_{b,it}$, dividends, $y_{s,it}$, interest income, $y_{c,it}$, other asset income, $y_{o,it}$, and trusts, $y_{tr,it}$. Let income from total assets, excluding capital gains, be denoted by $y_{a,it}$

$$y_{a,it} = yt_{ph,it} + yt_{oh,it} + y_{b,it} + y_{s,it} + y_{c,it} + y_{o,it} + y_{tr,it}. \tag{23}$$

Similarly let total capital gains be denoted by, $yg_{a,it}$

$$yg_{a,it} = yg_{ph,it} + yg_{oh,it} + yg_{s,it} + yg_{b,it}. \tag{24}$$

The total return to assets, r_{it}^{a}, includes flow income, excluding capital gains from all assets, plus the capital gains from primary and secondary housing, and public and private equity:

$$r_{it}^{n,a} = \frac{y_{a,it} + yg_{a,it}}{a_{b,it-1} + a_{ph,it-1} + a_{oh,it-1} + a_{s,it-1} + \bar{a}_{f,it} + \bar{a}_{ira,it} + \bar{w}_{o,it} + \bar{w}_{v,it}}. \tag{25}$$

The reported total assets of household i at time t includes the value of other assets the household holds, but it is not possible to separately calculate returns on these other assets. This includes wealth in all vehicles, $w_{v,it}$, (including boats and motor homes). The value of households' private annuities and employer-based pensions or IRAs, $a_{ira,it}$, are reported. Finally, all other assets, $w_{o,it}$, are reported including any other savings or assets, such as the cash value in a life insurance policy, a valuable collection for investment purposes, or rights in a trust or estate.

The returns to assets represents the pre-tax returns not including deductibility of interest payments. Thus, the measure is the exogenous returns to the assets if the household had fully paid off the assets. The total returns to assets is closely related to the measure reported by Fagereng et al. (2020), who use the value of the assets in the denominator but include primary housing interest payments in the numerator. The measure of the return to assets in this paper also includes information on durable wealth and other valuables, such as collections that are reported by the household that would not traditionally be reported as assets income for tax purposes.

Finally, nominal returns to assets for all asset classes $j \in \{b, ph, oh, s, f\}$ and for total household returns $j = a$ are converted to real returns, using the annualized total consumer price index provided by the Federal Reserve (CPI):

$$r_{j,it} = \frac{1 + r^n_{j,it}}{1 + \pi_t} - 1.$$

Total household real wages, W_{it}, are calculated as real total household labor income, Y_{it}, over total hours worked, H_{it},

$$W_{it} = Y_{it}/H_{it}. \tag{26}$$

Household labor income includes total head and spousal labor income and household labor income from businesses. Non-business labor income is the sum of total labor income including salaries, hourly work, bonuses, tips, etc.

B Proof of System Identification

We begin this appendix by showing how many moments are required to identify the models with and without moving averages. Within all possible model specifications, the following shock variances are included: σ^2_u, σ^2_v, $\sigma^2_{u_r}$. In the case of models without moving averages, only two additional potential parameters are tested for; these are ρ_u and ρ_{vu}. In this case, there are four admissible model-parameter combinations and the model can be linearly estimated. When allowing for moving averages, four potential parameters are tested for: α_r, α_w, ρ_u and ρ_{vu}. In this case, there are sixteen admissible model-parameter combinations and the model is estimated using a non-linear iterative generalized method of moments. The linear and non-linear cases are shown separately.

System Identification of Models Without Moving Averages

1. Suppose the dynamics of log-real wages and the returns on total wealth are given by the following equations:

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} \tag{27}$$

$$\Delta\tilde{r}_{it} = \Delta u^r_{it} \tag{28}$$

2. The notation for asset class j in the rate of return is dropped for ease of exposition. There

are seven moment conditions when the variance, covariances, and first lagged covariances are included. These moment conditions are as follows:

$$E[((\Delta\tilde{r}_{it})^2 - 2\sigma^2_{u_r}] = 0 \tag{29}$$

$$E[(\Delta\tilde{r}_{ti})(\Delta\tilde{r}_{it-1}) + \sigma^2_{u_r}] = 0 \tag{30}$$

$$E[((\Delta\tilde{W}_{it})^2 - \sigma^2_v - 2\sigma^2_u] = 0 \tag{31}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-1}) + \sigma^2_u] = 0 \tag{32}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it}) - 2\rho_u\sigma_u\sigma_{u_r} - \rho_{vu}\sigma_v\sigma_{u_r}] = 0 \tag{33}$$

$$E[(\Delta\tilde{r}_{it-1})(\Delta\tilde{W}_{it}) + \rho_u\sigma_u\sigma_{u_r}] = 0 \tag{34}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-1}) + \rho_u\sigma_u\sigma_{u_r} + \rho_{vu}\sigma_v\sigma_{u_r}] = 0 \tag{35}$$

3. *Proof of identification:* Suppose that the variances of the shocks are constant over time. The variances and means of the distribution of assets are allowed to vary over time and are observable. There are five parameters to be identified. These include shock variances σ^2_u, σ^2_v, $\sigma^2_{u_r}$, along with correlations ρ_u and ρ_{vu}. The following is a direct proof of the over-identification of those parameters by the above moment conditions.

   The identification of σ^2_u and $\sigma^2_{u^r}$ can be achieved by using $\mathrm{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-1})$, and $\mathrm{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-1})$, respectively:

$$\sigma^2_u = -\,\mathrm{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-1}), \tag{36}$$

$$\sigma^2_{u_r} = -\,\mathrm{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-1}). \tag{37}$$

   This allows for the variance of the permanent shock to wages, σ^2_v, to be identified using $\mathrm{Var}(\Delta\tilde{W}_{it})$:

$$\sigma^2_v = \mathrm{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it}) - 2\sigma^2_u. \tag{38}$$

   Then the correlation of the shocks, ρ_u and ρ_{vu}, can be identified using the following covariances:

$$\rho_u = -\frac{\mathrm{Cov}(\Delta\tilde{r}_{it-1}, \Delta\tilde{W}_{it})}{\sigma_u\sigma_{u_r}} = 0 \tag{39}$$

$$\rho_{vu} = \frac{\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{W}_{it}) - 2\rho_u\sigma_u\sigma_{u_r}}{\sigma_v\sigma_{u_r}} \tag{40}$$

Note that only five equations were needed for identification. QED.

System Identification of Models With Moving Averages

1. Now allow for moving average processes in wages and returns. The dynamics of log-real wages and the return on total wealth are given by the following equations:

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} + \alpha_w \Delta u_{it-1}, \tag{41}$$

$$\Delta\tilde{r}_{it} = \Delta u^r_{it} + \alpha_r \Delta u^r_{it-1}. \tag{42}$$

2. There are eleven moment conditions of variances, covariances, and first and second lagged covariances. These moment conditions are as follows:

$$E[((\Delta\tilde{W}_{it})^2 - \sigma_v^2 - 2(\alpha_w^2 - \alpha_w + 1)\sigma_u^2] = 0 \tag{43}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-1}) + (\alpha_w - 1)^2\sigma_u^2] = 0 \tag{44}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-2}) + \alpha_w\sigma_u^2] = 0 \tag{45}$$

$$E[((\Delta\tilde{r}_{it})^2 - 2(\alpha_r^2 - \alpha_r + 1)\sigma_{u_r}^2] = 0 \tag{46}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{r}_{it-1}) + (\alpha_r - 1)^2\sigma_{u_r}^2] = 0 \tag{47}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{r}_{it-2}) + \alpha_r\sigma_{u_r}^2] = 0 \tag{48}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it}) - \rho_{vu}\sigma_v\sigma_{u_r} - (2\alpha_w\alpha_r - \alpha_r - \alpha_w + 2)\rho_u\sigma_u\sigma_{u_r}] = 0 \tag{49}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-1}) - (2\alpha_r - \alpha_r\alpha_w - 1)\rho_u\sigma_u\sigma_{u_r} - (\alpha_r - 1)\rho_{vu}\sigma_v\sigma_{u_r})] = 0 \tag{50}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-2}) + \alpha_r(\rho_u\sigma_u\sigma_{u_r} + \rho_{vu}\sigma_v\sigma_{u_r})] = 0 \tag{51}$$

$$E[(\Delta\tilde{r}_{it-1})(\Delta\tilde{W}_{it}) - (2\alpha_w - \alpha_r\alpha_w - 1)\rho_u\sigma_u\sigma_{u_r}] = 0 \tag{52}$$

$$E[(\Delta\tilde{r}_{it-2})(\Delta\tilde{W}_{it}) + \alpha_w\rho_u\sigma_u\sigma_{u_r}] = 0 \tag{53}$$

3. *Proof of identification:* Suppose that the variances of the shocks are constant over time. The variances and means of the distribution of assets are allowed to vary over time and are

observable. There are seven parameters to be identified. These include shock variances σ_u^2, σ_v^2, $\sigma_{u_r}^2$, along with correlations ρ_u and ρ_{vu}, and moving averages α_w and α_r. The following is a direct proof of the over-identification of those parameters by the above moment conditions.

The identification of the moving average and transitory shock variances can be achieved by using first and second auto-covariances:

$$\alpha_w = \frac{b - 2c - \sqrt{b}\sqrt{b + 4c}}{2}, \tag{54}$$

$$\sigma_u^2 = \frac{2c - b - \sqrt{b}\sqrt{b + 4c}}{2c}, \tag{55}$$

for $\text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-2}) \neq 0$, where $b = \text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-2})$ and $c = \text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-2})$. The uniqueness follows from $\sigma_u^2 > 0$ and that the covariances are real numbers. The same moments for returns can be used to identify α_r and $\sigma_{u_r}^2$ for $\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-2}) \neq 0$. This allows for the variances of the permanent shocks σ_v^2 to wages to be identified using $\text{Var}(\Delta\tilde{W}_{it})$:

$$\sigma_v^2 = \text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it}) - 2b + 2c. \tag{56}$$

Then the correlations of the shocks ρ_u and ρ_{vu} can be identified using the covariances, for example from

$$\rho_u = -\frac{\text{Cov}(\Delta\tilde{r}_{it-2}, \Delta\tilde{W}_{it})}{\alpha_w \sigma_u \sigma_{u_r}} \tag{57}$$

$$\rho_{vu} = -\frac{\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{W}_{it-2}) + \alpha_r \rho_u \sigma_u \sigma_{u_r}}{\alpha_r \sigma_v \sigma_{u_r}} \tag{58}$$

Note that only seven equations were needed for identification. QED.

C Idiosyncratic Returns: Estimation

Estimates of equations (1) and (2) are now described and presented in Table 8. The first column reports the estimates for the returns to total household assets. Portfolio shares are interacted with time fixed effects. Indicators are also included for each asset class if the asset had been sold since the last wave. The regression has an adjusted R^2 of 0.147. Generally, very few observable household characteristics display statistical significance. The presence of an advanced education degree increases the total rate of return on assets by a significant 1.2 percentage points. Coefficients on single heads, male heads, and African-American heads of households do not display statisti-

Table 8. Estimation of Idiosyncratic Returns

	Total Assets	Business	Prim. Housing	Sec. Housing	Public Equity
If sold	-	-31.02	-5.23	-11.03	6.78
	-	(20.5)	(0.37)	(3.60)	(1.58)
Outside Dependents	1.90	-46.41	-0.09	-10.97	0.08
	(1.102)	(42.1)	(0.25)	(10.07)	(1.70)
Other Income	-0.05	-0.40	1.06	0.07	8.94
	(0.233)	(10.9)	(0.99)	(2.99)	(6.64)
Advanced Degree	1.18	-49.72	0.23	-1.87	1.46
	(0.307)	(36.2)	(0.41)	(8.12)	(4.54)
Single	-0.30	-2.31	0.90	-7.14	2.61
	(0.432)	(29.5)	(0.64)	(9.74)	(4.05)
African-American	-0.22	25.59	0.67	-2.54	-2.58
	(0.282)	(33.1)	(0.41)	(5.71)	(3.66)
Male	0.15	-7.03	0.01	-4.32	4.18
	(0.305)	(23.7)	(0.47)	(6.41)	(2.63)
N	14234	716	15513	1371	8058
Adj. R^2	0.147	0.043	0.142	0.002	0.007

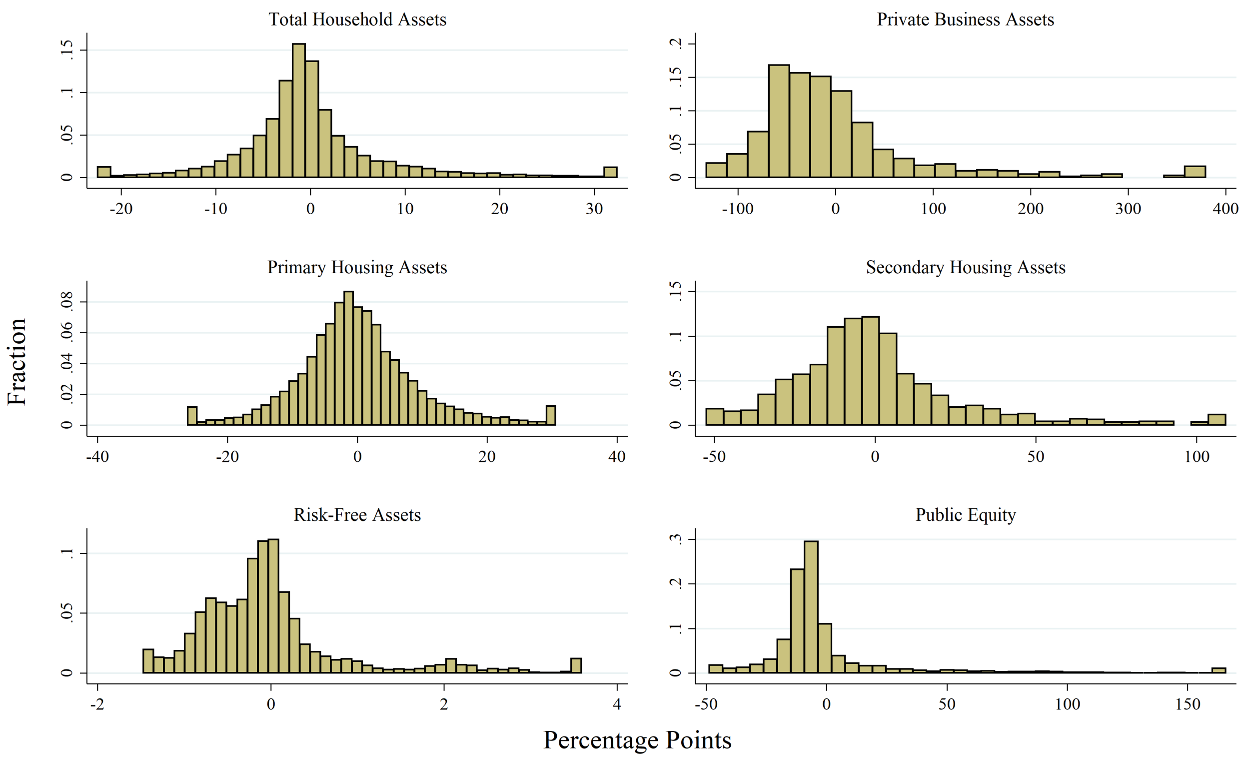
Note: Coefficient estimates from OLS regressions of demographic factors for each asset return in percentage points. All regressions also include control indicators for year, age, region, and indicators if assets were sold in that period. The return to total household assets interacts portfolio shares with year fixed effects. HAC-robust standard errors are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent level, respectively.

cal significance. Year fixed effects continue to remain significant (although not reported here) in explaining the returns to total household assets.

The second to fifth columns of Table 8 repeat the exercise for returns on assets within each asset class. The adjusted R^2 measures are quite low, with the highest value of 0.14 for the returns to primary housing assets. The indicator for whether that asset had been sold since the last wave may capture reporting bias, underestimated commissions and costs from selling, or address the timing of liquidation. The selling of a household asset is found to be significantly associated with a decline in the return, whereas the selling of a public equity is associated with an increase in the return. Interestingly, other reported indicators are not significantly associated with the return on assets for each asset class.

Figure 1 displays histograms of the estimates of the idiosyncratic returns on assets from the regressions estimated in Table 8.

Figure 1. Histograms of Idiosyncratic Returns



Truncated at the 1 and 99 percentile.