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Abstract

This paper documents the degree of idiosyncratic asset return heterogeneity, serial correlation, and correlation with wage heterogeneity for US households. Novel panel-data measurements for returns on household assets are proposed. Sizeable transitory idiosyncratic return heterogeneity is documented to exist concurrently with permanent heterogeneity in household-specific returns. On average, idiosyncratic permanent risk to wages and transitory risk to total asset returns are correlated. This arises primarily from correlated wage and return risk to primary housing assets, and is dependent on age and wealth. The estimates inform the covariance structure of idiosyncratic asset return and wage heterogeneity.

Keywords: Household finance, inequality, risk-taking, real estate, private equity, returns to assets, heterogeneity.
JEL classification: D14, D31, E21, E24, G11, J31

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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; Guvenen et al., 2021). More recently, attention has returned to the possibility that heterogeneity in returns can explain wealth inequality (Kesten, 1973; Bach et al., 2020; Fagereng et al., 2020). However, due to the absence of household-level panel data on returns in the United States, 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 to the potential correlation of uninsured idiosyncratic heterogeneity.

This paper fills this gap by proposing new panel-data measurements of household-level returns on assets in the US. The first direct estimate of the covariance matrix of US households' idiosyncratic asset return and wage risk is provided. Three questions are asked using these returns. First, is the persistent heterogeneity in returns between households permanent or, like wage processes, stochastic? Second, what is the degree of transitory idiosyncratic return heterogeneity in US household-level asset returns? Third, is idiosyncratic asset return risk correlated with labor income risk? These questions are explored for returns to the total household assets, as well as by asset classes.

These questions are examined using joint system estimation of a permanent-transitory wage and asset return processes that allows for serial correlation and correlation across innovations. These dual processes are estimated in a system using a 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) waves from 1999–2019.

This study proposes household-level asset return measurements for the United States (building upon, Quadrini, 2000; Flavin and Yamashita, 2002; Cao and Luo, 2017), and thus complements recent measurements provided for Scandinavian countries (Bach et al., 2020; Fagereng et al., 2020). It is important to explore similar household-level return measurements in the United States, given the differences in the economies, such as the generosity of social insurance and presence of wealth taxes in Scandinavian countries, and the higher wealth inequality in the U.S.. Moreover, heterogeneity of *returns on assets* are examined, whereas *returns on wealth* were the focus of the Scandinavian studies. The focus on returns to assets abstracts from the effects of leverage and debt serving. As such, the estimates provide insight into the asset income heterogeneity that exclude endogenous borrowing decisions.

This investigation clarifies the link between the persistent return heterogeneity in returns (Cao and Luo, 2017; Fagereng et al., 2020; Snudden, 2021) and transitory heterogeneity in excess returns (Bach et al., 2020). Specifically, little evidence is found to support the hypothesis that the persistent idiosyncratic return heterogeneity between households for total household assets is stochastic. Instead, the evidence supports the hypothesis that the persistent heterogeneity, documented in previous studies (Fagereng et al., 2020; Snudden, 2021) using fixed effects, is, in fact, permanent and not stochastic. The evidence suggests a parsimonious structure in which the permanent heterogeneity in returns between households exists concurrently with transitory idiosyncratic heterogeneity in returns within households.

This estimates document that this transitory idiosyncratic risk is sizeable for returns to total household assets. The standard deviation of the transitory innovation to total household assets is estimated to be 9.49 percentage points. 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 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 11.26 percentage points. This is followed by secondary housing, public equities, and private business assets of 35.6, 26.3 and 109.3 percentage points, respectively. This confirms that a high share of transitory idiosyncratic heterogeneity in asset returns exists in the US, similar to that in the Swedish data of Bach et al. (2020).

The results show the joint nature of idiosyncratic return and wage risk. Permanent shocks to wages are found to be positively correlated with transitory shocks to private business and primary housing returns. On average, a correlation of 0.07 is documented between idiosyncratic risk to returns on total household assets and heads of households' wages. This correlation is dependent on the age of the head and increases to 0.18 for households above the median age of 43. However, a correlation of idiosyncratic shocks to wages and returns is not exhibited for wealthier and high wage households. Young households also experience positive correlations between transitory shocks to wages and returns that arise due to capital gains to primary housing. The correlation of idiosyncratic wage and return risk for the household is thus dependent on age and wealth.

This empirical evidence compliments existing evidence of household-level heterogeneity in asset returns that has been documented for primary housing by Case and Shiller (1989) and Flavin and Yamashita (2002).[1] Our estimates confirm the results from these studies that the variability in household-level housing returns is two to three times larger than returns derived from aggregate housing price indexes. 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, the evidence of idiosyncratic return heterogeneity compliments what 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 support evidence of sizeable idiosyncratic risk in the U.S. above and beyond aggregate risk.

Despite the well documented 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),[2] or aggregate asset returns (Heaton and Lucas, 2000; Campbell et al., 2001).[3] The few exceptions focus on returns to specific asset classes. For example, Cocco et al. (2005) documents 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.

[1] 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.

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

[3] 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 of 0.32 to 0.52 for different levels of educational attainment between aggregate labor income risk and lagged excess returns on the New York Stock Exchange value-weighted stock market.

A key contribution of this study is to show how the PSID can provide 20 years of panel-data on asset returns at the household level that is representative for the US, for which similar return measurements currently only exist for Scandinavian countries (Bach et al., 2020; Fagereng et al., 2020). The proposed measurements use newly available information in recent waves and build upon return measurements in existing studies that examined subsets of asset classes in the PSID (for example, Quadrini, 2000; Flavin and Yamashita, 2002; Cocco, 2005; Cao and Luo, 2017). Despite being a survey and only a representative sample, the data does have some comparative advantages. For example, total household assets are inclusive of all household assets, not just taxable, such as private pensions, vacation properties, and collectables. Moreover, asset values are reported in each period and reflect the value that the household could receive if liquidated. This means hedonic pricing methods are not needed for housing, and the value of private businesses in the PSID may differ from the book value reported for tax purposes. Net investment, such as major upgrades to primary housing or private businesses, as well as rental income are also observed in the PSID, and shown to be important to understand the nature of idiosyncratic return heterogeneity. Observing net investment has the advantage that it avoids needing to make assumptions for the asset value used in the denominator of the asset return. The proposed asset returns measurements in the PSID for the U.S. thus complement the return measurements from Scandinavia and provide a unique perspective.

The household-level covariance matrix of idiosyncratic return and wage risks measured, for the first time, in this paper maps directly into standard models of portfolio choice. The results support the hypothesis of substantial idiosyncratic heterogeneity associated with portfolio allocations in financial assets (Merton, 1971; Gollier and Pratt, 1996; Heaton and Lucas, 1996; Bertaut and Haliassos, 1997). This also lends credence to the covariance structures for 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 have been proposed to help explain the stockholding puzzle. Notably, the empirical evidence supports the existence of transitory idiosyncratic risks from all asset classes and highlights correlations with permanent labor income not previously accounted for.

The estimates of the covariance structure of the idiosyncratic risk also relate to households' ability to self insure consumption. The sizable idiosyncratic risk beyond aggregate risk, as well as the positive correlation of idiosyncratic risk to returns and permanent labor income risk, suggest limitations of insuring with certain asset classes. Moreover, the magnitude of the asset income variation points to its potential importance as a source of consumption variation. The panel-data for returns will be useful to study the importance of idiosyncratic return heterogeneity for consumption insurance that has primarily focused on labor income (i.e. Guvenen, 2007; Blundell et al., 2008).

The evidence also directly informs the covariance structure and the magnitude of the uninsured idiosyncratic heterogeneity 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 heterogeneity to returns on assets exists concurrently with the permanent household-specific returns documented by Fagereng et al. (2020) and Snudden (2021). The persistent heterogeneity in returns between households is confirmed to be permanent and not stochastic, which suggests a parsimonious structure of idiosyncratic return heterogeneity. However, the evidence supports correlated idiosyncratic heterogeneity to labor and asset returns previously not accounted for in quantitative evaluations.

The structure of this paper is as follows. section 2 proposes innovative measurements of U.S. households asset returns. Section 3 introduces the model of idiosyncratic wages and 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 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 from 1999 to 2019.

2.1 Measurement

Returns to assets are observed for primary housing, ph, secondary housing, oh, private businesses, b, public equity, s, low-risk assets, f, and other assets, o. A detailed description of all return calculations can be found in appendix A. The nominal return to total household assets for household i at time t, is

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

where $J = \{b, ph, oh, s, f, o\}$, $y_{j,it}$ and $yg_{j,it}$ are dividends and capital gains, respectively, on asset j, 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, asset values at the time of the survey as well as net investment and income between the two surveys are reported in every wave. Thus, like in Cao and Luo (2017) but unlike Bach et al. (2020) and Fagereng et al. (2020), net investment is observable in every period for the measure of capital gains for housing and private businesses. This allows the netting out of the costs from renovations, say from an extension to a house, on the increase in housing value for the calculation of capital gains in the return. This also avoids the need to use hedonic pricing methods, which could understate idiosyncratic heterogeneity. This is a comparative advantage, as it avoids needing to make assumptions in the asset value used for the denominator of the asset return measure for the majority of the assets held by households.

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, $i_{ph,it}$. Two-year 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

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

Capital gains to stocks, private businesses, and secondary housing wealth, are defined as the difference in asset values, $\Delta a_{j,it}$, less net investments, $i_{j,it}$:

$$yg_{j,it} = (\Delta a_{j,it} - i_{j,it})/2, \tag{3}$$

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 holdings of public equity and for the primary residence in every wave. Asset values for private businesses and secondary housing, start in the 2011 wave. Fortunately, net worth and net investment are reported for the full sample. Thus, the definition of the change in the asset value is used to impute the asset values for secondary housing and private businesses prior to 2011, allowing for net investment to be debt financed. This closely matches the relationship between debt and net investment for the years 2011 to 2019. This does not affect the conclusions as the results are robust to estimated values or if the sample is restricted post 2011, which is discussed in section 4.6.

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

$$DIV_{it} = (rr + \delta)a_{ph,it-1} + ptax_{ph,it}, \tag{4}$$

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

$$COST_{it} = \delta a_{ph,it-1} - (1 - \tau_{it})ptax_{ph,it}, \tag{5}$$

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, $utils_{ph,it}$:

$$RNT_{it} = y_{ph,it} - \kappa_{ph,i}(a_{ph,it-1}rr + utils_{ph,it}), \tag{6}$$

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 residences, the sum of dividends, costs of ownership, and rental income, excluding capital gains, be denoted by $y_{ph,it}$. The total return to the primary residence is thus

$$
\begin{aligned}
r^n_{ph,it} &= \frac{DIV_{it} - COST_{it} + RNT_{it} + yg_{ph,it}}{a_{ph,it-1}} \\
&= \frac{a_{ph,it-1} rr(1-\kappa_{ph,it}) + y_{ph,it} + \tau_{it} ptax_{ph,it} - \kappa_{ph,it} utils_{ph,it} + yg_{ph,it}}{a_{ph,it-1}} \\
&= \frac{y_{ph,it} + yg_{ph,it}}{a_{ph,it-1}}.
\end{aligned} \tag{7}
$$

The measure of returns to primary housing builds upon Flavin and Yamashita (2002) in three ways. First, the labor tax rate, that is used only for deducting property taxes, 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 was 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. The former two improvements were also not considered for 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 expenses, and rental income.

Net investment is observed for housing, business and equities, which account for 85 percent of total assets held by households. For the remainder, mainly low-risk assets, net investment is not observed. For this reason, we follow Fagereng et al. (2020) and assume that changes in asset values are due to net purchases (deposits/withdrawals) which implies that capital gains are zero. As this may affect the dividends, the net purchases are assumed to occur halfway through the period, and half of the net investment is included in the denominator for low-risk assets. The main results are found to be robust to these timing assumptions for returns.

The return to assets in an asset class j is given by

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

for $j \in \{b, ph, oh, s, f\}$. Finally, nominal returns are converted to real returns, using the annualized total consumer price index provided by the Federal Reserve (CPI):

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

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 private collections, that are reported by the household but are not observed in the European administrative tax data.

Wages, $W_{k,it}$, are calculated in the standard way as total labor income, $Y_{k,it}$, over total hours worked, $H_{k,it}$:

$$W_{k,it} = (Y_{k,it}/CPI_t)/H_{k,it}. \tag{9}$$

Where k denotes the person for whom the wage is calculated. This wage can be calculated for the head or the spouse. The head of the household is defined as the person with the most financial responsibility for the household, and their wage is used for the baseline in the analysis. Robustness is also considered where both the head and spouse are included separately, referred to as the wage of individuals, which matches the assumption of Fagereng et al. (2020). Total labor income includes labor income from businesses, farming, as well as non-business income. Non-business labor income includes salaries, hourly work, bonuses, and tips.

2.2 Sample Selection

The sample selection in the PSID follows Blundell et al. (2008) which focuses on households' idiosyncratic risk over the working age lifecycle. The main difference is that the baseline analysis does not require a continuous marital status and excludes retirees. Observations are biennial from 1998 to 2018, as per the survey frequency. There must be no change in the head of the household, and they must have been born after 1920, and have an age between 20 and 70. The mean and median head's age is 42 and 43, respectively. Households in the supplemental Survey of Economic Opportunity are excluded.

Observations are dropped if any component of the wages or asset returns or demographic data is missing, unknown, or not reported. 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. Retirees are excluded to ensure that the baseline estimates do not reflect wage shocks associated with transiting into retirement. The main results are robust to excluding students, or including retirees, as discussed in section 4.6.

Outliers are treated in a similar way to Blundell et al. (2008) for wages and Fagereng et al. (2020) for returns. A household is dropped if real labor income is below \$100 or if the level or growth of the real wage is beyond the 99th percentile. 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 \$500 or the change or level of the returns to assets is beyond the 99th percentile. The exception is for private business returns, which are excluded if the asset value is below \$5000. This selects towards private businesses with physical assets rather than small professional service businesses; robustness is explored in section 4.6.

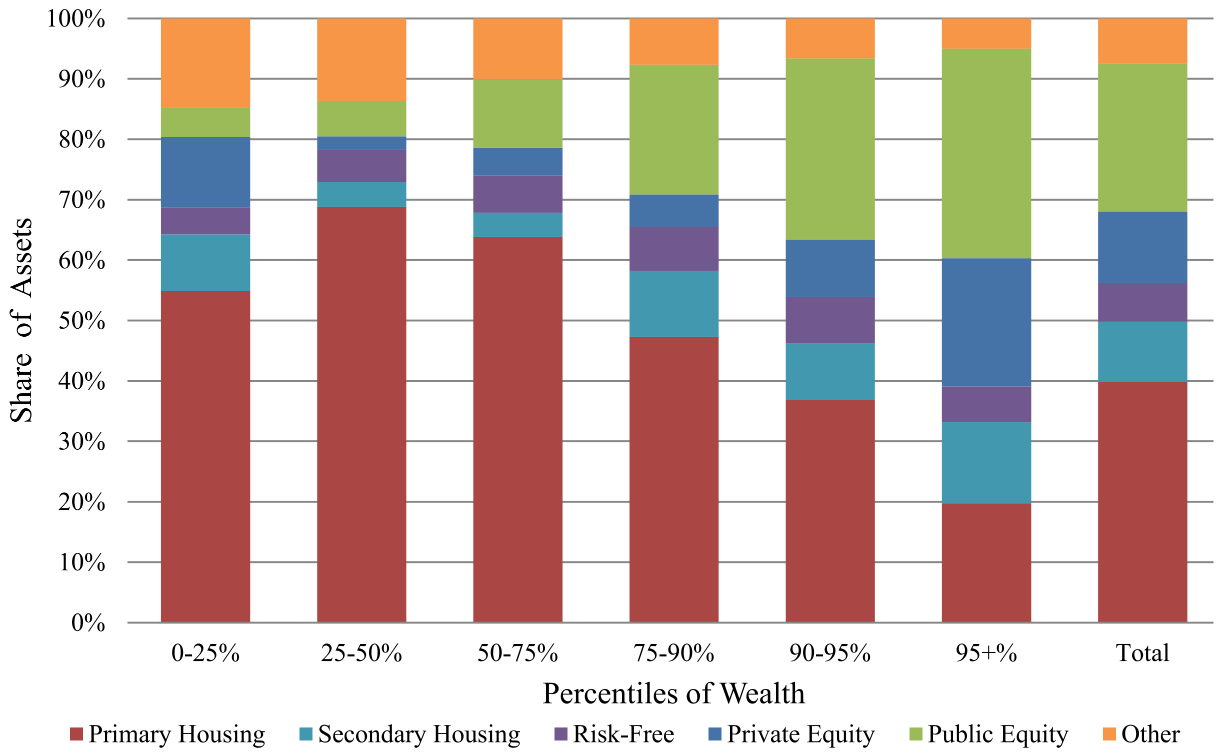
In addition to the above requirements, another event is attributed to measurement error and removed from the sample. For direct holdings of public equities, secondary housing and private businesses, an observation is dropped if the household reported ownership in the last period, but the current period's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

2.3 Data Summary

Figure 1 reports the average asset portfolio composition across the wealth distribution for households in the PSID from the 1999 to 2019 surveys. The asset portfolio composition held in every asset class depends on the level of wealth of the household. The reported categories of assets include primary and secondary housing assets, low-risk assets, private business equity, public equity and other assets. Immediately from the figure, we can see the importance of housing assets. Primary and secondary housing combined represent the majority of total household assets for households below the 90th percentile of wealth. On average, housing represents half of all assets held. Private business assets represent about 20 percent of the asset portfolio for households above the 95th percentile of wealth. Low-risk assets comprise only a small share of assets for all households along the wealth distribution.

The raw measure of wage growth, w_{it}, and the level of returns, $r_{j,it}$, for individuals are summarized in Table 1. The mean real wage growth is 3.4 percent, with a standard deviation of 39.1 percent. The return to total household assets, $r_{a,it}$, is described as *Total Assets* and has a mean of 3.3 percent and a standard deviation of 11.4 percentage points. For all asset returns, the between-household standard deviation is larger than the within-household standard deviation. In contrast

Figure 1. Asset Portfolio Composition



Note: For the survey years 1999-2019. "Public Equity" is the value of stocks held in publicly held corporations, mutual funds, or investment trusts and IRA's. "Low-risk" assets include checking or savings accounts, money market funds, certificates of deposits, government savings bonds, or Treasury bills. "Other" includes all other assets not listed elsewhere such as a valuable collection for investment purposes, or rights in a trust or estate, the value of cars, trucks, motor homes, trailers, or boats. All values are in real 2010 USD.

to real wage growth, which is left skewed, the returns to assets are right skewed. Real wage growth and returns display more kurtosis than a normal distribution, except for low-risk assets.

Table 1. Summary Statistics for Asset Returns and Wage Growth

	Obs	Indiv.	Mean	Standard Deviation			25p	75p	Skew-ness	Kurt-osis
				Total	Within	Between				
Wage Growth	31,016	5,413	3.4	39.1	13.8	37.3	-12.6	20.4	-0.2	6.2
Total Assets	23,990	4,539	3.3	11.4	5.8	10.2	-1.9	6.4	2.1	14.1
Private Business	1,443	324	48.5	137.0	91.2	117.1	-13.5	46.5	4.1	25.8
Primary Housing	25,977	4,524	5.8	12.4	5.3	11.6	0.2	10.5	0.9	8.2
Secondary Hous.	2,285	498	13.9	44.5	20.9	40.0	-6.9	21.0	3.1	17.0
Low Risk	29,169	5,172	-1.8	0.8	0.4	0.7	-2.4	-1.5	0.2	3.0
Public Equities	11,198	2,212	7.3	35.0	17.9	31.0	-3.0	2.5	3.9	23.9

Note: Real wage growth and return on assets for individuals (Indiv.) in percentage points, 1998-2018. Conditional on the minimum of three consecutive return observations, and the presence of both wage and return observations. 25p and 75p refer to the corresponding percentiles.

The mean return to private business assets is 48.5 percentage points, which is significantly larger than the 7.3 percentage point mean return to public equities. This is also reflected in the standard deviation of the return to private business assets, which is 137 percentage points, and significantly larger than the 35 percentage point standard deviation for public equities. The higher return to private business assets is consistent with the evidence from Kartashova (2014) using the Survey of Consumer Finances, which documented that the insignificant differences in public and private equity returns documented by Moskowitz and Vissing-Jørgensen (2002) were due to the period examined. Relative to the evidence in the above papers, these estimates are derived using panel data with net investment, and the higher return to private business assets is found to be robust over time.

The mean return to primary housing assets is 5.8 percentage points, with a standard deviation of 12.4 percentage points. The standard deviation is similar to but slightly lower than the 14 percentage points for the period 1968 to 1992 calculated by Flavin and Yamashita (2002). The inclusion of individualized tax rates, net investment, and rental income in this paper results in lower variability in returns between 1998 and 2018 compared to the return measure of Flavin and Yamashita (2002). However, it still reinforces the finding that aggregate housing indexes underestimate idiosyncratic risk on housing. For example, the Case and Shiller and Freddie Housing indexes, have standard deviations of 7.7 and 6.4 percent, respectively, between 1998 and 2014. This highlights a potential advantage of the PSID which does not need to resort to extrapolating primary housing returns from aggregated indexes, such as in Fagereng et al. (2020), which may understate the degree of household heterogeneity in the returns.

The mean return to secondary housing assets is larger than primary housing assets, with a mean of 13.9 percentage points and a standard deviation of 44.5 percentage points. Secondary housing assets are owned by 17 percent of households, suggesting that this asset class is important to capture overall return heterogeneity for households. The mean (real) return to low-risk assets is -1.8 percentage points, reflecting the amount in low-interest accounts and the low nominal policy rate over the second half of the sample.

Concerns that the wealthiest percentiles of households are underrepresented in the sample are partially mitigated by using the most recent waves, which have no incidences of top-coding. Pfeffer et al. (2016) find meaningful differences only for the one to two percent of the wealthiest households in more-recent waves, when comparing the Survey of Consumer Finances (SCF) to the PSID. In addition, Bricker et al. (2016) suggest that the SCF may overstate the wealth held by the top one percent by about 10 percent. Bach et al. (2020) documents that the cross-sectional standard deviation of the realized returns to wealth begins to increase at the 90th wealth percentile, which is also found in the PSID. Hence, the PSID is representative up to at least the 98th percentile and is shown to capture the shifting risk appetite of the wealthy.

The demographic characteristics of households for which returns are observed are consistent with wage samples, see Table A1. However, the ownership of primary business and secondary housing, as well as the wealthiest households, are slightly underrepresented for the returns to total household assets relative to the sample for wages. This is because, unlike for the calculation of wages, which just require labor income and hours, the calculation of return to total household assets requires observations for dozens of variables. The more a household owns, the more likely to that some information was not recorded that is required to calculate their total asset returns. This primarily affects the top ten percent of the wealthiest households, for which, on average, it is twice as likely to lose an observation for the return to total assets relative to the bottom 90 percent of the sample. Because of this, frequency weights applied to wealth and ownership rates are used in estimation of the return to total household assets to align the sample with that of a standard unrestricted sample for wages. These differences in wealth and ownership rates do not occur for the samples for the returns to other assets (such as primary housing or risk-free assets) and hence weights are not used for these estimates.

3 Empirical Model

An idiosyncratic permanent-transitory income process is adopted from the literature on idiosyncratic wage heterogeneity (Lillard and Weiss, 1979; Baker, 1997; Haider, 2001; Guvenen, 2007; Blundell et al., 2008; Moffitt and Gottschalk, 2011). The log-real wages, W_{it}, are deconstructed into a part explained by observable characteristics and the idiosyncratic component, $\tilde{W}_{it}$:

$$W_{it} = g(Z_{it}) + \tilde{W}_{it}, \tag{10}$$

where $g(\cdot)$ is a function of the observable household characteristics, Z_{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.

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

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

$$W^p_{it} = W^p_{it-1} + v_{it},$$

$$W^p_{i0}, \quad given.$$

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

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} + \alpha_w \Delta u_{it-1}, \tag{11}$$

where Δ is a difference operator.

Idiosyncratic heterogeneity in before-tax real returns closely follows Fagereng et al. (2020), and is consistent with the measure for wages. Real returns are regressed on a set of indicators for portfolio shares that are interacted with year fixed effects, P_{it}, and the same set of observable household characteristics used for wages, Z_{it}. Alternative assumptions for idiosyncratic heterogeneity are explored in section 4.6 and obtain qualitatively similar results. The idiosyncratic component of the return to total household assets is denoted by $\tilde{r}_{a,it}$:

$$r_{a,it} = f(Z_{it}, P_{it}) + \tilde{r}_{a,it}, \tag{12}$$

where $f(\cdot)$ is a function that includes the year fixed effects and their 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

$$r_{j,it} = f(Z_{it}) + \tilde{r}_{j,it}. \tag{13}$$

The estimates of equation (13) for each asset class as well as the measure of the idiosyncratic returns, $\tilde{r}_{j,it}$, are reported in section 3.1.

Idiosyncratic returns are also modelled as the sum of a permanent component $\epsilon_{j,it}$, which follows a martingale with innovation $v^r_{j,it} \overset{iid}{\sim} (0, \sigma^2_{v^r_j})$ and a transitory component $u^r_{j,it} \overset{iid}{\sim} (0, \sigma^2_{u^r_j})$ that follows a moving average process $\alpha_{r,j}$, where $u^r_{it} \perp v^r_{it}\ \forall\ i,\ t$:

$$\tilde{r}_{j,it} = \epsilon_{j,it} + u^r_{j,it} + \alpha_r u^r_{j,it-1},$$

$$\epsilon_{j,it} = \epsilon_{j,it-1} + v^r_{j,it},$$

$$\epsilon_{j,i0}, \quad given.$$

Again, combining the above equations to remove $\epsilon_{j,it}$ gives the change in idiosyncratic returns,

$$\Delta\tilde{r}_{j,it} = v^r_{j,it} + \Delta u^r_{j,it} + \alpha_r \Delta u^r_{j,it-1}. \tag{14}$$

This model for returns allows us to quantify the nature of the heterogeneity in asset returns in two ways.

First, it is plausible that the household-specific component documented by Fagereng et al. (2020) and Snudden (2021), using fixed effect estimates, may itself be stochastic. These household-specific fixed-effects in returns reflect permanent household demographic characteristics, including education and gender, as well as a household's persistent portfolio choices. It is plausible that, like wages, the persistent component is best modelled as being subject to idiosyncratic innovations. If a positive variance is found for permanent shocks, $\sigma^2_{v^r_j}$ this would provide evidence that the household-specific returns are not truly permanent. In contrast, if $\sigma^2_{v^r_j} = 0$, meaning an absence of permanent shocks to the return on assets, the household-specific return of Fagereng et al. (2020) and Snudden (2021), $\epsilon_{j,i}$ identifies and is interpreted as the initial condition of the return that persists across a household's lifetime, $\epsilon_{j,i} \overset{iid}{\sim} (0, \sigma^2_{\epsilon_j})$, $\forall\ i,\ t,\ j$. In this case, the model of idiosyncratic returns simplifies, and is parsimoniously modeled as the sum of the permanent household-specific component and the transitory shock process:

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

Secondly, the empirical model for returns allows us to quantify if the degree of transitory idiosyncratic risk exists concurrently with the permanent heterogeneity in asset returns. If the variance of the transitory idiosyncratic shocks are positive, $\sigma^2_{u^r_j} > 0$, then the evidence would suggest that the permanent return heterogeneity documented in previous studies (Fagereng et al., 2020; Snudden, 2021) exists concurrently with transitory idiosyncratic return heterogeneity. Moreover, this measure of idiosyncratic shocks is consistent with parsimonious income processes commonly used in quantitative models (for example, Aiyagari, 1994; Blundell et al., 2008; Benhabib et al., 2015; Gabaix et al., 2016). As such, the estimates of idiosyncratic heterogeneity test assumptions on joint wage and return income processes already in use.

Correlations are modeled between the transitory shocks to the return on assets, $u^r_{j,it}$, and real wages, u_{it}, denoted, ρ_{uu}. Likewise, correlations are modeled 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 (11) and (14) are estimated in a system using iterative GMM with heteroskedastic and serial correlation robust standard errors and weight matrix. The iterative estimator is used to achieve gains in finite-sample efficiency, following Hall (2005). The iterative GMM estimator obtains parameter estimates based on the initial weight matrix, computes a new weight matrix based on those estimates, and iterates on this step until convergence. 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 8 parameters to identify: shock variances σ^2_u, σ^2_v, $\sigma^2_{u^r}$, and $\sigma^2_{v^r}$; correlations ρ_{uu} and ρ_{vu}; and moving average processes $\alpha_{r,j}$ and α_w.

Three consecutive waves of available data on asset returns and wages are required, and four in the case of the moving average process for either wages or returns. This is necessary for the identification as proved in appendix B. The system of equations (11) and (14) is over-identified using eleven moment conditions including all available variances, covariances, and first and second lagged covariances, such as $\text{cov}(\Delta\tilde{r}, \Delta\tilde{r}_{t-1})$, $\text{cov}(\Delta\tilde{r}, \Delta\tilde{W}_{t-1})$, $\text{cov}(\Delta\tilde{r}, \Delta\tilde{r}_{t-2})$, $\text{cov}(\Delta\tilde{r}, \Delta\tilde{W}_{t-2})$. All moment conditions are used for model specifications that include serial correlation, and the robustness of this assumption is discussed later in the paper.

The estimates inform the appropriate structure of covariance risk for each return and wage combination. Any positive shock variances are included within all models: σ^2_u, σ^2_v, $\sigma^2_{v_r}$, $\sigma^2_{u_r}$. Each of the 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 results are reported for the full system estimation, as well the most parsimonious systems, which are defined as the model specification that exhibits both individual and joint parameter significance and fails to reject the null of the valid over-identifying restrictions of the Hansen J-test (Hansen, 1982; Hall, 2005).

3.1 Idiosyncratic Returns

Estimates used to calculate idiosyncratic returns, equations (12) and (13), are reported in Table 2. The first column reports the estimates for the returns to total household assets. Portfolio shares are interacted with time fixed effects, are significant, but are not shown for brevity. The regression has an adjusted-R^2 of 0.115. 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 0.63 percentage points.

Table 2. Estimation of Idiosyncratic Returns

	Total Assets	Business	Prim. Housing	Sec. Housing	Public Equity	Low Risk
Outside Dependents	0.44	-49.08	0.56	-15.38	6.77*	0.04
	(0.904)	(42.3)	(0.83)	(9.42)	(3.73)	(0.036)
Other Income	0.25	0.93	-0.30	-3.92	-0.72	0.02**
	(0.193)	(10.3)	(0.20)	(2.64)	(0.94)	(0.009)
Advanced Degree	0.63**	34.56	-0.59*	-29.77***	-2.14	0.24***
	(0.270)	(52.2)	(0.33)	(7.84)	(2.72)	(0.017)
Single	-0.25	22.86	-0.01	10.38	0.51	-0.11***
	(0.450)	(32.8)	(0.69)	(13.54)	(3.05)	(0.024)
African-American	0.11	-0.04	0.91**	4.58	1.38	-0.12***
	(0.272)	(43.8)	(0.35)	(5.04)	(2.27)	(0.015)
Male	0.21	24.60	-1.10**	-3.79	-0.23	-0.01
	(0.342)	(30.8)	(0.54)	(10.00)	(2.14)	(0.018)
N	29,583	1,852	31,928	2,934	13,808	35,500
Adj. R^2	0.115	0.065	0.102	0.034	0.011	0.458

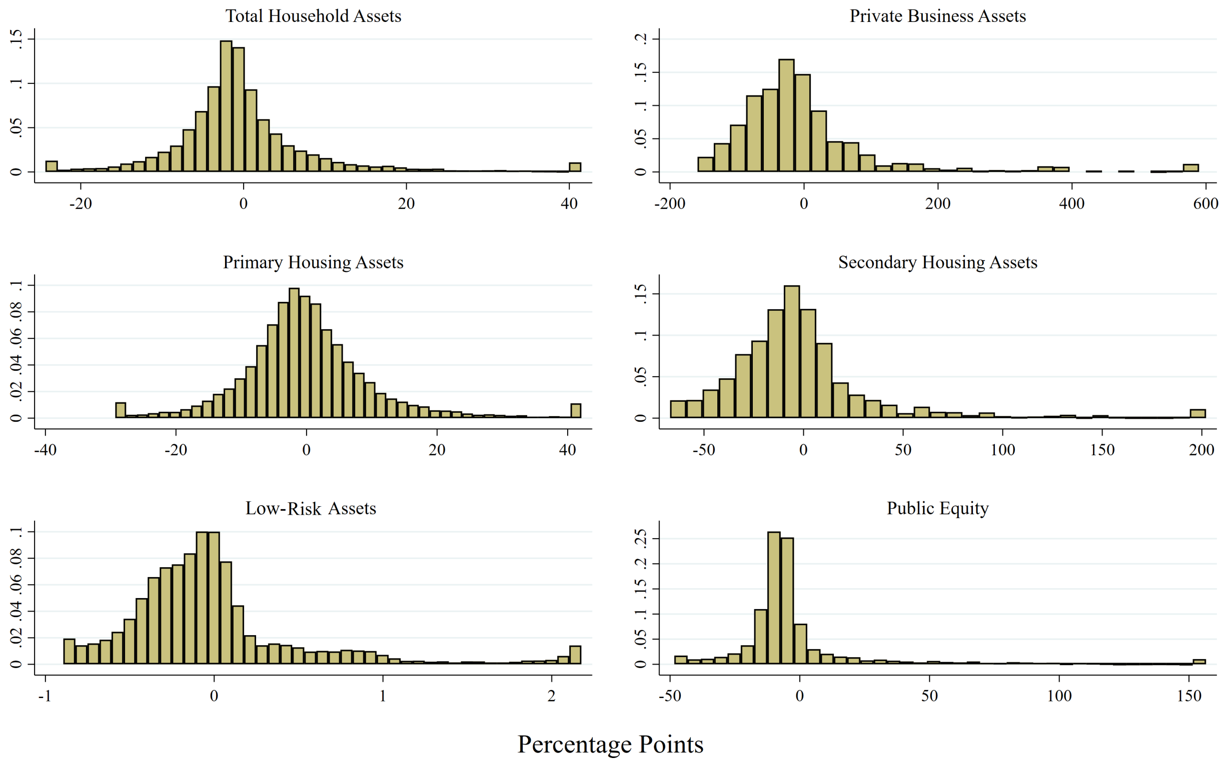
Note: Coefficient estimates from OLS regressions of demographic factors for each asset return in percentage points. All regressions also include control indicators for year, age, and region. The return to total household assets interacts portfolio shares with year fixed effects. HAC-robust standard errors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

The second to sixth columns of Table 2 repeat the exercise for returns on assets within each asset class. Generally, the adjusted R^2 are low, with the highest values being 0.102 for the returns to primary housing assets, and 0.458 for returns for low-risk assets. Low-risk assets exhibit a positive coefficient on advanced degree holders and negative coefficients on African-American and single individuals. The negative coefficient on secondary housing returns for advanced degree holders is due to a lower share of these households using these assets for rental income. Figure 2 displays histograms of the corresponding estimates of idiosyncratic returns on assets, the residuals from equations 12, and 13.

4 Results

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

Figure 2. Histograms of Idiosyncratic Returns



Note: Idiosyncratic returns on assets, the residuals from equations 12, and 13. Returns are in percentage points and bunched at the 99th percentile.

4.1 Estimates of Idiosyncratic Risk

The system estimates of equations (11) and (14) using the head's wage and return to total household assets are summarized in Table 3. Estimates are reported for the specifications with and without the permanent shock to returns and alternative assumptions on the correlation of the shocks.

The standard deviations for the permanent and temporary shocks to head's wages are all significant at the 1 percent level. The estimates are consistent with previous estimates on idiosyncratic wage risk using the PSID (Lillard and Weiss, 1979; Baker, 1997; Haider, 2001; Guvenen, 2007; Blundell et al., 2008; Moffitt and Gottschalk, 2011).

The standard deviation for the transitory idiosyncratic shock to the return on total household assets is sizable and significant at the 1 percent level in all model specifications. This documents that transitory idiosyncratic risk to returns on assets exists concurrently with household-specific return heterogeneity. The most parsimonious model specification documents a correlation of 0.07 between the idiosyncratic risk to returns on total household assets and heads of households' wages.

The moving average coefficient for the transitory shock to the return on total household assets

Table 3. Little Evidence of Permanent Idiosyncratic Risk to Total Asset Returns

Asset Return	Total Assets					
	1	2	3	4	5	6
σ_u	23.64	23.63	23.62	23.62	23.61	23.60
(Temporary wage shock)	(6.40)	(6.40)	(6.40)	(6.40)	(6.40)	(6.39)
σ_v	17.04	17.21	17.37	17.09	17.26	17.48
(Permanent wage shock)	(7.01)	(7.01)	(7.03)	(7.01)	(7.01)	(7.04)
$\sigma_u r$	9.36	9.49	9.48	8.86	9.02	8.90
(Temporary return shock)	(2.37)	(2.37)	(2.38)	(2.97)	(2.95)	(3.00)
$\sigma_v r$	-	-	-	3.33	3.27	3.57
(Permanent return shock)	-	-	-	(2.75)	(2.74)	(2.77)
α_w	0.11	0.11	0.11	0.11	0.11	0.11
(Wage moving average)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
α_r	-0.18	-0.17	-0.18	-0.23	-0.22	-0.24
(Return moving average)	(0.045)	(0.043)	(0.044)	(0.068)	(0.063)	(0.069)
ρ_{uu}	-	-	0.03	-	-	0.04
(Corr. temporary shocks)	-	-	(0.030)	-	-	(0.034)
ρ_{vu}	-	0.07	0.03	-	0.07	0.01
(Corr. v wage u returns)	-	(0.027)	(0.054)	-	(0.028)	(0.060)
Observations	6,541	6,541	6,541	6,541	6,541	6,541
Persons	1,787	1,787	1,787	1,787	1,787	1,787
J-test p-value H_0: Valid	0.047	0.298	0.274	0.060	0.400	0.497

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic returns are in percentage points; idiosyncratic head's wages are in percent change. Heteroskedastic and serial correlation robust standard errors are in parentheses. Observations are weighted to match the wealth and ownership shares of an unrestricted PSID wage sample.

is consistently found to be small and negative. The moving average coefficient for the transitory shock to head's wages is found to be 0.11 and statistically significant at the 1 percent level. Models that do not include the moving average processes for returns and wages reject the J-tests of valid over-identifying restrictions at the 0.1 percent level.

The permanent shock to returns is statistically insignificant at even the 10 percent level. We fail to reject the null hypothesis of a null variance to permanent shocks. An absence of permanent shocks to the return on assets suggests that the household-specific fixed-effects in returns documented by Fagereng et al. (2020) and Snudden (2021), identifies and can be interpreted as the initial condition of the return that persists across a household's lifetime.

The parameter estimates for the returns to all asset classes are reported in Table 4. For brevity, only the most parsimonious structure is reported, but the parameter estimates of the full system are provided in Tables C1 and C2. For all returns, the variances of the shocks to head's wages and the transitory shock to returns are significant at the 5 percent level. Only for the returns to low-risk assets is there evidence of a positive variance to the shocks to the permanent idiosyncratic

Table 4. Idiosyncratic Return Risk is Sizeable and Correlated with Permanent Wage Innovations

Asset Return	Total	Business	Prim. Hous.	Sec. Hous.	P. Equities	Low Risk
σ_u	23.63	31.37	24.26	25.11	25.74	24.08
(Temporary wage shock)	(6.40)	(13.60)	(6.61)	(10.92)	(9.58)	(6.50)
σ_v	17.21	32.73	18.02	27.58	17.55	17.82
(Permanent wage shock)	(7.01)	(17.46)	(6.72)	(13.57)	(10.24)	(7.16)
σ_{ur}	9.49	109.27	11.26	35.61	26.27	0.39
(Temporary return shock)	(2.37)	(44.63)	(2.67)	(11.40)	(8.63)	(0.11)
σ_{vr}	-	-	-	-	-	0.15
(Permanent return shock)	-	-	-	-	-	(0.11)
α_w	0.11	-	0.10	-	0.19	0.10
(Wage moving average)	(0.036)	-	(0.034)	-	(0.059)	(0.034)
α_r	-0.17	-	-0.15	-	-	0.11
(Return moving average)	(0.043)	-	(0.039)	-	-	(0.032)
ρ_{vu}	0.07	0.28	0.08	-	-	-
(Corr. v wage u returns)	(0.027)	(0.097)	(0.030)	-	-	-
Observations	6,541	551	8,513	926	2,474	9,128
Persons	1,787	158	1,970	270	751	2,251
J-test p-value H_0: Valid	0.298	0.310	0.488	0.239	0.000	0.336

Note: Idiosyncratic returns are in percentage points; idiosyncratic head's 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.

returns. Other than for returns to public equities, the null hypothesis of valid over-identification restrictions is unable to be rejected.

The second column of Table 4 shows that the standard deviations of idiosyncratic wages and returns to private business assets are the highest among the alternative return and wage samples. There is a positive correlation coefficient of 0.28, significant at the 1 percent level, for the permanent shock to head's wages and the transitory shock to the return to private business assets. This finding of a correlation is consistent with an existing finding of a positive correlation between aggregate equity returns and the income of self-employed persons (i.e. Heaton and Lucas, 2000).

The third and fourth columns of Table 4 show the system estimations for primary and secondary housing assets. The standard deviations for the temporary shocks to the return on housing assets are sizable, with the standard deviation for secondary housing three times that of primary housing. The return to primary housing assets exhibits a significant correlation of 0.08 with the permanent shocks to wages. This confirms that a part of the correlation between primary housing price appreciation and labor income in the PSID documented by Cocco et al. (2005) translates to return measurements that include net investment, and as well as the use of wage measures. Transitory shocks to primary housing returns and head's wages exhibit moving average coefficients similar to that for total returns.

The fifth and sixth columns of Table 4 show the system estimation for the return to public equities and low-risk assets. The standard deviation of the transitory shocks are estimated to be 26.27 and 0.39 percentage points, respectively. Idiosyncratic risk to returns for these financial assets do not exhibit a significant correlation with either idiosyncratic wage innovation. This suggests that the correlation between aggregate labor income risk and stock market returns documented by Campbell et al. (2001) may not translate to idiosyncratic risk on average.

Consider the interpretation of these findings. These estimates are the first empirical documentation of the joint covariance matrix of the idiosyncratic risks to wages and returns. The evidence supports the existence of idiosyncratic risks from all asset classes, not just primary homeownership (Grossman and Laroque, 1990; Brueckner, 1997; Fratantoni, 2001; Flavin and Yamashita, 2002; Cocco, 2005; Yao and Zhang, 2005) or private business assets (Heaton and Lucas, 2000). The estimates suggest that, on average, households exposure to private businesses and primary housing in their asset portfolios on average result is a positive correlation between the permanent shock to head's wages and total assets returns. This heterogeneity and correlation with wages provides empirical support to such influences for portfolio allocation of financial assets (Merton, 1971; Gollier and Pratt, 1996; Heaton and Lucas, 1996; Bertaut and Haliassos, 1997). The correlated wage risk may inhibit household's ability to use these assets to insure consumption. Together, the evidence shows the importance of household-level idiosyncratic heterogeneity in returns not reflected in aggregate indexes.

4.2 Capital Gains

This section repeats the baseline exercise but for the capital gains proportion of returns to inform whether the results arise due to capital gains. Capital gains comprise the majority of the income in the numerator of asset returns (on average 80 percent for businesses and 55 percent for housing), and explain most of the variation in returns. For the capital gains portion of returns, the asset value in the denominator of the returns remains the same, but the numerator only includes capital gains net investment and excludes flow income. Specifically, the annualized capital gains portion of returns, $rg^n_{j,it}$, is defined as

$$rg^n_{j,it} = \frac{\Delta a_{j,it} - i_{j,it}}{2a_{j,it-1}}, \tag{15}$$

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 12 and 13. 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 (11) and (14) are estimated as a system and use the return on capital gains for each asset type and are summarized in Table 5.

Table 5. Capital Gains are Correlated with Wage Innovations

Return from Capital Gains	Total	Business	Prim. Hous.	Sec. Hous.	P. Equities
σ_u	22.80	31.36	24.34	24.81	26.12
(Temporary wage shock)	(6.50)	(13.57)	(6.61)	(10.50)	(9.55)
σ_v	17.24	32.74	18.02	27.46	17.38
(Permanent wage shock)	(6.79)	(17.60)	(6.73)	(12.85)	(10.32)
σ_{u^r}	12.57	100.50	11.26	35.52	19.94
(Temporary return shock)	(3.96)	(43.92)	(2.69)	(11.20)	(8.58)
α_w	0.11	-	0.10	-	0.20
(Wage moving average)	(0.040)	-	(0.034)	-	(0.056)
α_r	-0.11	-	-0.15	-	-0.29
(Return moving average)	(0.047)	-	(0.039)	-	(0.149)
ρ_{vu}	0.07	0.22	0.08	-	-
(Corr. v wage u returns)	(0.034)	(0.082)	(0.030)	-	-
Observations	7,145	553	8,583	1,024	2,277
Persons	1,939	159	2,033	285	698
J-test p-value H_0: Valid	0.757	0.457	0.491	0.420	0.008

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. Total household returns are weighted to match the wealth and ownership shares of an unrestricted PSID wage sample. Heteroskedastic and serial correlation robust standard errors are in parentheses.

Flow income from private business and public equities reduce total return variability, as the standard deviation for the transitory shock to capital gains is lower than that of the total returns to these assets. Importantly, the transitory capital gain innovations to private business and primary housing are correlated with permanent shocks to wages. Overall, the positive correlation of capital gains for these assets is reflected in the capital gains return to total household assets. The serial correlation of the capital gain returns and the heads' wage is consistent with the findings for total returns, Table 4.

Returns excluding capital gains were examined, but not reported here for brevity. In this case, the return to total household assets failed to exhibit a correlation with wage innovations. Again, this suggests that the correlation arises primarily from capital gains. Only the return excluding capital gains to primary housing was correlated with the permanent wage innovation, with a coefficient value of 0.14. However, the primary housing return variation is significantly lower when capital gains are excluded. This again reinforces the role of primary housing in driving the return and wage correlation.

One of the advantages of the measurements of returns in the PSID is that net investment is observed for the calculation of capital gains. We can quantify the importance by redoing the analysis of capital gains, Table 5, but removing net investment in the measure of capital gains from equation 15. In this case, the standard deviation of the transitory shock to returns increases for housing, businesses, and equities. This suggests that accounting for net investment in capital gains is important for estimates of the covariance matrix of idiosyncratic wage and return risk.

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 documented to arise due to private business and primary housing assets. In this section, we examine whether ownership of these assets implies that these correlations also arise in the households' total asset returns. Specifically, the system estimates for the return to total household assets for heads of households that own or do not own specific asset classes are reported in Table 6.

Owners of primary housing and those that do not own private businesses or secondary housing exhibit a correlation of the permanent innovation to the head's wage with the transitory innovation to total household assets. Interestingly, the sample of private business owners do not have the positive correlation in total household returns. This is partly driven by more extensive equity holdings of these households, and secondary housing assets, the sample for the later displays a negative correlation. The negative correlation for secondary housing is partly due to households renting secondary housing assets after experiencing a negative permanent shock to wages, although this only shows up in the return to secondary housing in certain samples.

Households that do not own primary housing experience notably smaller standard deviations of the transitory idiosyncratic shock to returns compared to households that own primary housing assets. Primary homeowners have close to four times the idiosyncratic variability in total assets returns compared to non-homeowners. The higher risk from primary homeownership is also due to these households being more likely to own other risky assets, such as private businesses. For

Table 6. Idiosyncratic Risk is not just Entrepreneurs

Ownership Sample	Pr. Home	x Pr. Home	Business	x Business	Sec. Hous.	x Sec. Hous
σ_u	23.84	23.10	32.20	20.40	22.41	23.93
(Temporary wage shock)	(6.74)	(7.87)	(12.14)	(5.96)	(10.74)	(6.72)
σ_v	16.29	22.62	28.51	17.00	23.25	16.50
(Permanent wage shock)	(7.51)	(10.60)	(16.65)	(6.74)	(12.66)	(7.32)
σ_{u^r}	10.48	2.87	15.49	8.75	13.51	8.86
(Temporary return shock)	(2.76)	(1.56)	(4.69)	(2.35)	(5.39)	(2.40)
α_w	0.14	-	-	-	-	0.12
(Wage moving average)	(0.039)	-	-	-	-	(0.038)
α_r	-0.19	-	-	-0.17	-	-0.16
(Return moving average)	(0.049)	-	-	(0.051)	-	(0.048)
ρ_{vu}	0.09	0.11	-	0.06	-0.15	0.13
(Corr. v wage u returns)	(0.035)	(0.051)	-	(0.029)	(0.068)	(0.033)
Observations	4,552	1,411	422	5,772	651	5,861
Persons	1,259	414	150	1,590	211	1,594
J-test p-value H_0: Valid	0.262	0.336	0.111	0.794	0.447	0.222

Note: Idiosyncratic rates of return are in percentage points, idiosyncratic head's wages are in percent change. Ownership and non ownership (x) of primary home (Pr. Home), private businesses (Business), and secondary housing (Sec. Hous.) assets. Observations are weighted to match the wealth and ownership shares of the unrestricted PSID wage sample. Heteroskedastic and serial correlation robust standard errors are in parentheses.

example, the idiosyncratic risk to total household assets is also lower for households that do not own private businesses or secondary housing assets. These results reinforce the role of primary housing and business assets as sources of large transitory idiosyncratic return heterogeneity.

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, age, education, employment, and wealth subsamples are explored. While the estimated observable household characteristics in equations (12) and (10) 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 can still be dependent on these factors.

Older and younger household subsamples are distinguished by their age relative to the median, Table 7. Younger head of households have slightly lower variances of wages shocks compared to the baseline sample but a similar variance of the return shocks. There is also no evidence of serial correlation in the return processes for younger households. Interestingly, younger households have a positive correlation between the transitory shock to wages and the returns to total assets, and this is significant at the 1 percent level. This arises from a positive correlation of the transitory

Table 7. Correlated Wage and Return Risk is Dependent on Age and Wealth

Sample	Wealth Quartile Q1	Q2	Q3	Q4	Younger	Older
σ_u	23.74	21.05	20.03	25.17	22.67	23.54
(Temporary wage shock)	(8.31)	(6.84)	(6.09)	(8.57)	(7.51)	(7.92)
σ_v	20.44	14.31	19.10	17.26	14.63	17.60
(Permanent wage shock)	(10.90)	(8.80)	(8.75)	(9.39)	(8.27)	(8.45)
σ_{ur}	5.69	9.55	8.53	10.75	9.09	9.12
(Temporary return shock)	(2.05)	(3.52)	(3.07)	(3.28)	(2.25)	(3.04)
α_w	-	-	-	0.18	0.12	0.09
(Wage moving average)	-	-	-	(0.055)	(0.051)	(0.056)
α_r	-	-0.24	-0.21	-	-	-0.25
(Return moving average)	-	(0.093)	(0.099)	-	-	(0.081)
ρ_{uu}	-	-	-	-	0.07	-0.06
(Corr. temporary shocks)	-	-	-	-	(0.029)	(0.045)
ρ_{vu}	-	0.22	-	-	-	0.18
(Corr. v wage u returns)	-	(0.078)	-	-	-	(0.087)
Observations	1,393	1,947	1,964	1,237	3,340	3,201
Persons	391	513	523	360	904	883
J-test p-value H_0: Valid	0.889	0.748	0.261	0.050	0.493	0.143

Note: Estimates are from system estimation using iterative GMM. Idiosyncratic rates of return to total household assets are in percentage points, idiosyncratic wages are in percent change. Observations are weighted to match the wealth and ownership shares of the unrestricted PSID wage sample. Heteroskedastic and serial correlation robust standard errors are in parentheses.

wage and return shocks for public equities and housing assets of 0.07 and 0.08, respectively.

In contrast, older households experience a positive correlation coefficient, 0.18, between permanent innovations in wages and transitory innovations in returns, over twice as high as the total sample. Again, this arises from ownership in private business and primary housing ownership. Older households also experience a negative correlation coefficient, -0.06, between transitory innovations in wages and transitory innovations in returns. The negative correlation arises from other asset income and from public equities. The correlations of the transitory innovations of both the young and old subsamples average out in the full sample. Older households also drive the serial correlation in returns in the total sample.

On average, older heads of households are 3.2 times more wealthy than younger households. The results indicate that the correlation of the permanent wage and transitory return shock is present in just the second quartile of the wealth distribution. Transitory idiosyncratic return risk is lowest for the first quartile of wealth, starts declining after the median, and then increases for the wealthiest households. The evolution of transitory idiosyncratic risk is consistent with the findings of Bach et al. (2020) whom document higher standard deviations starting at the 90th wealth percentile.

Table 8. Covariance Structure Depend on Employment Characteristics

Sample	No College	College	Low Wage	High Wage	Part Time	Full Time
σ_u	23.42	23.07	27.95	19.86	14.56	24.24
(Temporary wage shock)	(6.89)	(7.06)	(8.36)	(5.32)	(6.93)	(6.58)
σ_v	15.65	17.94	15.77	16.73	24.91	16.32
(Permanent wage shock)	(8.87)	(7.73)	(9.34)	(6.78)	(11.09)	(7.19)
σ_{u^r}	9.23	9.49	9.19	9.60	8.32	9.57
(Temporary return shock)	(3.02)	(2.67)	(3.14)	(2.46)	(2.97)	(2.44)
α_w	-	0.13	0.17	-	-	0.10
(Wage moving average)	-	(0.047)	(0.040)	-	-	(0.036)
α_r	-0.19	-0.16	-0.22	-0.12	-	-0.17
(Return moving average)	(0.080)	(0.052)	(0.081)	(0.045)	-	(0.045)
ρ_{uu}	-	-	-	-	0.12	-
(Corr. temporary shocks)	-	-	-	-	(0.077)	-
ρ_{vu}	0.11	0.07	0.14	-	-	0.08
(Corr. v wage u returns)	(1.000)	(0.033)	(0.057)	-	-	(0.030)
Observations	2,412	4,129	3,172	3,369	528	6,013
Persons	626	1,161	876	911	166	1,621
J-test p-value H_0: Valid	0.049	0.122	0.069	0.237	0.369	0.507

Note: Idiosyncratic rates of return are in percentage points; idiosyncratic head's wages are in percent change. Wealth and age refers to above and below the median. Observations are weighted to match the wealth and ownership shares of the unrestricted PSID wage sample. Heteroskedastic and serial correlation robust standard errors are in parentheses.

On average, households with a college education are 2.3 times more wealthy than non-college educated households. However, the positive correlation of the permanent wage and transitory return innovations are present for all education levels, Table 8. As age is similar for those with and without college education, this suggests that the wage and return correlations are more related to age and wealth than to education.

The estimates for samples with high and low wages based on a head's average wage relative to the median is reported in Table 8. A sample split is also considered for households that report working less than 40 hours or more than 40 hours. The part-time sample is small, but this is consistent with recent labor force surveys that for employed head of households, 92 percent of families have at least one family member employed full-time.[4] The results indicate that the baseline sample represents full-time workers. Moreover, only the low wage sample exhibits the positive correlation of the permanent wage and transitory return innovations. This again arises from housing assets, which represent the majority of the asset portfolio for these households

[4]U.S. Bureau of Labor Statistics, USDL-24-0743.

4.5 Within-Household Insurance

Thus far, the analysis has considered the head of the household's wages. This section examines the sensitivity of the results to alternative measures of wages to consider within-household insurance. Specifically, to explore the role of a secondary income earner in a household, the head's and spouse's wage are compared separately and when both are included in the sample. A sample of the wage of heads of households who are married or single is also considered.

Table 9. Secondary Earners Reduce Within-Household Wage-Return Correlation

Wage Sample	Head	Spouse	Individual	Married	Single
σ_u	23.63	24.01	23.57	23.60	23.25
(Temporary wage shock)	(6.40)	(7.58)	(5.88)	(6.84)	(9.24)
σ_v	17.21	15.82	16.94	16.77	18.32
(Permanent wage shock)	(7.01)	(8.17)	(6.38)	(7.52)	(9.87)
$\sigma_u r$	9.49	9.20	9.32	9.67	8.25
(Temporary return shock)	(2.37)	(2.96)	(2.26)	(2.62)	(2.52)
α_w	0.11	0.09	-	-	0.12
(Wage moving average)	(0.036)	(0.047)	-	-	(0.077)
α_r	-0.17	-0.24	-0.23	-0.22	-
(Return moving average)	(0.043)	(0.075)	(0.043)	(0.053)	-
ρ_{vu}	0.07	-	-	0.06	0.10
(Corr. v wage u returns)	(0.027)	-	-	(0.033)	(0.044)
Observations	6,541	4,120	11,855	5,938	1,974
Persons	1,787	944	2,739	1,287	503
J-test p-value H_0: Valid	0.298	0.119	0.017	0.099	0.320

Note: Idiosyncratic rates of return to total household assets are in percentage points, idiosyncratic wages are in percent change. Observations are weighted to match the wealth and ownership shares of the unrestricted PSID wage sample. Heteroskedastic and serial correlation robust standard errors are in parentheses.

Relative to the baseline estimates of the heads' wages, the spouses wage exhibits a slightly lower standard deviations for the permanent wage shocks. Moreover, the spouses wages do not exhibit the positive correlation with the transitory innovation to returns. This is reflected in individual wages, as the correlation of permanent innovations in wages and transitory innovation in returns is not significantly different from zero.

The last two columns of Table 9 report the system estimates for the heads wage when the sample is split between married and single heads of households. Single households display a significant moving average coefficient for wages but not for returns, the opposite of married heads. However, both married and single households exhibit the positive correlation with the transitory innovation to returns.

4.6 Robustness

This section summarizes the sensitivity of the results to changes in the baseline assumptions. This includes an examination of robustness for the treatment of outliers, the 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.

Changes in the intensity to which outliers are dropped, such as at the 5 percent or 0.1 percent level, results in the standard deviation of the idiosyncratic shocks changing in the corresponding direction. The minimum asset value of $500 follows Fagereng et al. (2020) and when the minimum value of the asset or labor income is increased, then the standard deviation of the idiosyncratic shocks declines accordingly. The result that is most sensitive to these assumptions is the correlation between wages and returns for private business assets. At a $500 minimum value of business assets, the standard deviation in the returns to private business assets increases, and the correlation between the permanent shocks to wages and the transitory shocks to returns is only significant at the 12 percent level. 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 risk or correlation is driven by heads who are students. However, when students are dropped from the sample, there is a loss of only 31 observations and the results remain qualitatively unchanged. This arises since the baseline requires that a wage is observed. Similarly, retirees are excluded since those reporting wages are primarily due to observing the last year of employment, and to a lesser extent the part-time work of retirees. Inclusion of these retirees adds 231 observations, and results in an increase in the permanent shock to wages of two percentage points. The baseline estimates do not reflect wage shocks associated with transiting into retirement.

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 an asset class are correlated with other asset class. However, only the idiosyncratic asset returns for low-risk assets and public equity display a small pairwise correlation of 0.05 which is statistically significant at the 1 percent level. Thus, the correlations of idiosyncratic asset return risk across asset classes are not modelled in the analysis.

The baseline model in the analysis uses a moving average process for the transitory shocks to wages and returns. An autoregressive process for both wages and returns was considered. In such a model, the autoregressive parameter for the wage process is estimated to be unity with precision. This is not surprising, given that even when wages are log-differenced, there exists a positive moving average coefficient for the transitory wage innovations. The results confirm that some potential negative serial correlation exists in returns, but the models fail to reject the null of the valid over-identifying restrictions of the Hansen J-test (Hansen, 1982; Hall, 2005). While the results are available from the author, the observations 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, when the moving average processes are included, equations (11) and (14) are over-identified using eleven moment conditions that include all the available variances, covariances, and first and second lagged covariances. 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 returns. The results are robust to using the leading covariances.

The asset values for private businesses and secondary housing are imputed before the 2012 wave, which necessitated an assumption on how net investment passes through into debt for those asset classes. The baseline assumption for the return to total assets is robust to estimated values using reported observations between 2012-2018. The estimates support the pass-through of net investment into debt. Alternative assumptions of the pass-through only influence the variability of the return to secondary housing and private business asset classes. The baseline results for the return to total assets are robust to alternative assumptions, and all qualitative findings are robust for the 2008–2018 estimation sample.

Finally, the results are robust to the method of calculation used for the idiosyncratic returns to assets, equation 12. This includes when either observed household characteristics, portfolio shares, or an indicator if an asset was sold, are controlled for in the total return to household assets, as long as year-fixed effects are included. Thus, shifts in portfolio allocation do not introduce correlations between asset returns and wage shocks. The qualitative results for all the idiosyncratic returns are robust to alternative assumptions for the functional forms for age and regional controls.

5 Conclusion

The household-level returns to total assets and by asset class for the U.S. developed in this study allowed for a joint estimation of return and wage heterogeneity. The empirical evidence of the covariance structure can be used to discipline and calibrate of quantitative models with uninsured idiosyncratic income heterogeneity.

Importantly, transitory idiosyncratic asset return heterogeneity exists concurrently with permanent heterogeneity in household-specific returns (Fagereng et al., 2020; Snudden, 2021). Quantitative models of uninsured idiosyncratic asset income heterogeneity that include household-specific returns should also account for the transitory idiosyncratic component. This is analogous to models that allow for transitory idiosyncratic innovations to labor income around a life-cycle earnings profile.

Substantial transitory idiosyncratic return heterogeneity is found to exist within all asset classes. This transitory idiosyncratic variability is 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). The empirical evidence herein supports significant covariance between asset returns and wage heterogeneity, the implications of which have been theoretically explored in the above-mentioned studies.

These findings inform the debate on the causes and consequences of wealth inequality and mobility (Cagetti and De Nardi, 2009; Benhabib et al., 2011, 2015). This evidence supports the presence of idiosyncratic return heterogeneity for the US. Studies that account for idiosyncratic return heterogeneity may be remiss to abstract from the presence of both permanent and transitory heterogeneity, as well the correlation with labor income.

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Online Appendices (not intended for publication)

A Measurement 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 2019. Rates of return are annualized and 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.

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 analyzed for five asset categories: low-risk assets, primary and secondary housing, private businesses, and public equity.

A.1 Capital Gains

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 low-risk assets. Thus, like Cao and Luo (2017), but unlike other studies (Flavin and Yamashita, 2002; Fagereng et al., 2020; Bach et al., 2020), capital gains that are *net of investment* can be observed for housing assets in every period.

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

$$yg_{ph,it} = (\mathbb{1}_{\{sold=1\}} a^*_{ph,it} + \mathbb{1}_{\{sold=0\}} a_{ph,it} - a_{ph,it-1} - i_{ph,it})/2. \tag{16}$$

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, $i_{j,it}$:

$$yg_{j,it} = (\Delta a_{j,it} - i_{j,it})/2, \tag{17}$$

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.

A.2 Return to Housing

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

$$DIV_{it} = (rr + \delta)a_{ph,it-1} + ptax_{ph,it}, \tag{18}$$

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

$$COST_{it} = \delta a_{ph,it-1} - (1 - \tau_{it})ptax_{ph,it}, \tag{19}$$

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, $utils_{ph,it}$:

$$RNT_{it} = y_{ph,it} - \kappa_{ph,i}(a_{ph,it-1}rr + utils_{ph,it}), \tag{20}$$

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 $r^n_{ph,it}$ and $r^n_{oh,it}$, excluding capital gains, be denoted by $yt_{ph,it}$ and $yt_{oh,it}$, respectively. The total return to the primary residence is thus

$$\begin{aligned} r^n_{ph,it} &= \frac{yg_{ph,it} + DIV_{it} - COST_{it} + RNT_{it}}{a_{ph,it-1}} \\ &= \frac{a_{ph,it-1} rr(1-\kappa_{ph,it}) + y_{ph,it} + \tau_{it} ptax_{ph,it} - \kappa_{ph,it} utils_{ph,it} + yg_{ph,it}}{a_{ph,it-1}} \\ &= \frac{yt_{ph,it} + yg_{ph,it}}{a_{ph,it-1}}. \end{aligned} \tag{21}$$

The return to the primary housing asset differs from 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 is shown to understate the return to housing. These three differences are also true of the return to housing in Fagereng et al. (2020). Fagereng et al. (2020) also impute housing values using hedonic pricing methods based on aggregate housing prices and use the average imputed house price between years in the denominator of the rate of return.

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, $r^n_{oh,it}$, is given by

$$r^n_{oh,it} = \begin{cases} (a_{oh,it-1} rr + \tau_{it} ptax_{oh,it} + yg_{oh,it})/a_{oh,it-1}, & \text{if occupied} \\ (y_{oh,it} - a_{oh,it-1}\delta - ptax_{ohit} + yg_{oh,it})/a_{oh,it-1}, & \text{if rented out} \end{cases} \tag{22}$$

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, 10.9 percent of homeowners own secondary properties, and 42.2 percent of secondary properties report rental income.

A.3 Return to Private Equity

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 nominal return to business assets is defined as the sum of income from businesses and farms plus capital gains:

$$r^n_{b,it} = \frac{y_{b,it} + yg_{b,it}}{a_{b,it-1}}. \tag{23}$$

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. Wealth in the asset is defined as the value of the asset less the debt associated with the asset: $w_{j,it} = a_{j,it} - d_{j,it}$. Fortunately, net worth and net investment are reported for the full sample as well as the asset values after 2012. By definition, the change in the asset value, $\Delta a_{j,it}$ is the sum of the changes in net worth, $\Delta w_{j,it}$ and debt, $\Delta d_{j,it}$. Thus, it is possible to impute the asset values for secondary housing and private businesses prior to 2011 using the change in net wealth and net investment as follows:

$$a_{j,it} = a_{j,it+1} - \Delta w_{j,it+1} - \gamma_{j,b} ib_{j,it+1} + \gamma_{j,s} is_{j,it+1} \tag{24}$$

for $j \in \{b, oh\}$. $\gamma_{j,b}$ and $\gamma_{j,s}$ represent the share of purchases that is financed by debt and the share of the sale value that goes to repays debt, respectively. For example, when $\gamma_{oh,b} = 1$ purchases of secondary housing are debt financed. This closely approximates the relationship between debt and investments for the years between 2012 and 2020, when all values are observed, and $\gamma_{j,b}$ and $\gamma_{j,s}$

can be estimated. The baseline analysis assumes that $\gamma_{j,b} = \gamma_{j,s} = 1$, but the results are robust to estimated values or when using the later part of the sample, which is discussed in section 4.6.

A.4 Return to Financial Assets

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 low-risk assets is the smaller value of the Treasury bill rate times the value of the low-risk assets or the value reported from bond interest income. That is

$$y_{c,it} = \begin{cases} y_{c,it}, & \text{if } r^n_{tres,t}\bar{a}_{f,it} \leq y_{c,it} \\ r^n_{tres,t}\bar{a}_{f,it}, & \text{otherwise.} \end{cases} \tag{25}$$

The remainder of the reported interest income, $y_{q,it} = y_{c,it} - y_{f,it}$, is then allocated to investment retirement accounts (IRAs) and direct public equity holdings.

The PSID does not report net investment in low-risk assets. The value of the low-risk 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 low-risk assets is thus $\bar{a}_{it} = (a_{f,it} + a_{f,it-1})/2$. The return to low-risk assets, $r^n_{f,it}$, is thus defined as

$$r^n_{f,it} = \frac{y_{f,it}}{\bar{a}_{f,it}}. \tag{26}$$

Similarly, the nominal return to public equity, $r^n_{s,it}$, 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 households' private annuities and employer-based pensions (IRAs), $\bar{a}_{ira,it}$, and direct holdings of public equities, $a_{s,it-1}$. :

$$r^n_{s,it} = \frac{y_{s,it} + y_{q,it} + yg_{s,it}}{\bar{a}_{ira,it} + a_{s,it-1}}. \tag{27}$$

It is assumed that households do not hold debt specifically to investment in public equities or low-risk assets. Unlike Bach et al. (2020) and Fagereng et al. (2020) private pension assets, IRAs, are included in the value of financial assets.

A.5 Return to Total Household Assets

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 $y_{a,it}$

$$y_{a,it} = yt_{ph,it} + yt_{oh,it} + y_{b,it} + y_{s,it} + y_{c,it} + y_{o,it} + y_{tr,it}. \tag{28}$$

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

$$yg_{a,it} = yg_{ph,it} + yg_{oh,it} + yg_{s,it} + yg_{b,it}. \tag{29}$$

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

$$r^n_{a,it} = \frac{y_{a,it} + yg_{a,it}}{a_{b,it-1} + a_{ph,it-1} + a_{oh,it-1} + a_{s,it-1} + \bar{a}_{f,it} + \bar{a}_{ira,it} + \bar{w}_{o,it} + \bar{w}_{v,it}}. \tag{30}$$

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), and wealth in all other assets, $w_{o,it}$. Other assets include 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 represent 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 and vehicles, 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):

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

A.6 Sample Characteristics

The composition of households in the PSID for whom wages are observed is now compared to the composition of households for whom both returns and wages are observed. We focus on both demographic and ownership shares within specific asset classes. The main purpose is to see if any sample of households for which both returns and wages are calculated may be over- or underrepresented, compared to a study that uses only the wage data in the PSID.

Table A1. Demographic and Ownership Sample Characteristics

Sample	Individuals		Primary Home Owner		Low-Risk Asset Owner	
	Wage Growth	Return on Total Assets	Wage Growth	Primary Home Return	Wage Growth	Low-Risk Return
Demographics						
Head's Age	42.8	42.5	44.0	44.6	43.0	43.2
Male Head	89.1%	88.7%	93.2%	93.9%	90.1%	91.5%
Married	83.2%	82.9%	90.4%	91.8%	84.6%	86.5%
High School Edu.	93.5%	91.5%	95.0%	95.6%	95.8%	96.5%
Post Sec. Edu.	41.4%	38.2%	44.2%	45.4%	44.3%	46.2%
Racially White	85.7%	84.4%	88.7%	89.5%	88.1%	88.7%
Ownership						
Positive Wealth	89.0%	87.8%	94.2%	94.8%	90.8%	91.8%
Private Business	15.8%	10.1%	17.3%	17.9%	16.7%	17.2%
Primary Hous.	78.0%	76.5%	100.0%	100.0%	81.1%	83.9%
Secondary Hous.	17.0%	10.7%	19.7%	20.5%	18.1%	18.8%
Public Equity	23.2%	17.9%	27.0%	28.3%	25.5%	25.8%
Low-Risk	88.5%	86.3%	91.9%	92.9%	100.0%	100.0%
Observations	35,299	28,826	27,532	24,402	31,227	27,364

Note: Columns describe the sample characteristics of households for which at least three consecutive observations of wages and returns are available for 1999-2019.

The first two columns of Table A1 summarize the sample characteristics of individuals for which a minimum of three consecutive "wage growth" or both wage growth and "return on total assets" observations are available. The later columns provide the corresponding samples for returns to primary housing and low-risk asset conditional on ownership in these asset classes.

Overall, the demographic characteristics of households are quite consistent across wage and joint returns and wage samples. The samples for ownership of primary homes and low-risk assets are closely aligned with the wage sample. However, for the joint sample of wages and returns to total household assets, certain ownership shares in private businesses, secondary housing, and public equities, are smaller than the wage sample. The reason is that unlike for the calculation of wages, which just require labor income and hours, the calculation of return to total household assets requires dozens of variables. The more a household owns, the more likely to that some information was not recorded that is required to calculate their total asset returns. Because of this, weighting by wealth and ownership are examined for the return to total household assets.

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_u^2, σ_v^2, $\sigma_{u_r}^2$. 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:

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} \tag{31}$$

$$\Delta\tilde{r}_{it} = \Delta u_{it}^{r} \tag{32}$$

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:

$$E[((\Delta\tilde{r}_{it})^2 - 2\sigma_{u_r}^2] = 0 \tag{33}$$

$$E[(\Delta\tilde{r}_{ti})(\Delta\tilde{r}_{it-1}) + \sigma_{u_r}^2] = 0 \tag{34}$$

$$E[((\Delta\tilde{W}_{it})^2 - \sigma_v^2 - 2\sigma_u^2] = 0 \tag{35}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-1}) + \sigma_u^2] = 0 \tag{36}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it}) - 2\rho_u\sigma_u\sigma_{u_r} - \rho_{vu}\sigma_v\sigma_{u_r}] = 0 \tag{37}$$

$$E[(\Delta\tilde{r}_{it-1})(\Delta\tilde{W}_{it}) + \rho_u\sigma_u\sigma_{u_r}] = 0 \tag{38}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-1}) + \rho_u\sigma_u\sigma_{u_r} + \rho_{vu}\sigma_v\sigma_{u_r}] = 0 \tag{39}$$

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_u^2, σ_v^2, $\sigma_{u_r}^2$, 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_u^2 and $\sigma_{u^r}^2$ can be achieved by using $\text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-1})$, and $\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-1})$, respectively:

$$\sigma_u^2 = -\,\text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it-1}), \tag{40}$$

$$\sigma_{u_r}^2 = -\,\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-1}). \tag{41}$$

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

$$\sigma_v^2 = \text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it}) - 2\sigma_u^2. \tag{42}$$

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

$$\rho_u = -\frac{\text{Cov}(\Delta\tilde{r}_{it-1}, \Delta\tilde{W}_{it})}{\sigma_u\sigma_{u_r}} = 0 \tag{43}$$

$$\rho_{vu} = \frac{\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{W}_{it}) - 2\rho_u\sigma_u\sigma_{u_r}}{\sigma_v\sigma_{u_r}} \tag{44}$$

   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:

$$\Delta\tilde{W}_{it} = v_{it} + \Delta u_{it} + \alpha_w\Delta u_{it-1}, \tag{45}$$

$$\Delta\tilde{r}_{it} = \Delta u_{it}^r + \alpha_r\Delta u_{it-1}^r. \tag{46}$$

2. There are eleven moment conditions of variances, covariances, and first and second lagged

covariances. These moment conditions are as follows:

$$E[((\Delta\tilde{W}_{it})^2 - \sigma_v^2 - 2(\alpha_w^2 - \alpha_w + 1)\sigma_u^2] = 0 \tag{47}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-1}) + (\alpha_w - 1)^2\sigma_u^2] = 0 \tag{48}$$

$$E[(\Delta\tilde{W}_{it})(\Delta\tilde{W}_{it-2}) + \alpha_w\sigma_u^2] = 0 \tag{49}$$

$$E[((\Delta\tilde{r}_{it})^2 - 2(\alpha_r^2 - \alpha_r + 1)\sigma_{u_r}^2] = 0 \tag{50}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{r}_{it-1}) + (\alpha_r - 1)^2\sigma_{u_r}^2] = 0 \tag{51}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{r}_{it-2}) + \alpha_r\sigma_{u_r}^2] = 0 \tag{52}$$

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

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-1}) - (2\alpha_r - \alpha_r\alpha_w - 1)\rho_u\sigma_u\sigma_{u_r} - (\alpha_r - 1)\rho_{vu}\sigma_v\sigma_{u_r})] = 0 \tag{54}$$

$$E[(\Delta\tilde{r}_{it})(\Delta\tilde{W}_{it-2}) + \alpha_r(\rho_u\sigma_u\sigma_{u_r} + \rho_{vu}\sigma_v\sigma_{u_r})] = 0 \tag{55}$$

$$E[(\Delta\tilde{r}_{it-1})(\Delta\tilde{W}_{it}) - (2\alpha_w - \alpha_r\alpha_w - 1)\rho_u\sigma_u\sigma_{u_r}] = 0 \tag{56}$$

$$E[(\Delta\tilde{r}_{it-2})(\Delta\tilde{W}_{it}) + \alpha_w\rho_u\sigma_u\sigma_{u_r}] = 0 \tag{57}$$

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:

$$\alpha_w = \frac{b - 2c - \sqrt{b}\sqrt{b + 4c}}{2}, \tag{58}$$

$$\sigma_u^2 = \frac{2c - b - \sqrt{b}\sqrt{b + 4c}}{2c}, \tag{59}$$

   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 $\sigma^2_{u_r}$ for $\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{r}_{it-2}) \neq 0$. This allows for the variances of the permanent shocks σ^2_v to wages to be identified using $\text{Var}(\Delta\tilde{W}_{it})$:

$$\sigma^2_v = \text{Cov}(\Delta\tilde{W}_{it}, \Delta\tilde{W}_{it}) - 2b + 2c. \tag{60}$$

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

$$\rho_u = -\frac{\text{Cov}(\Delta\tilde{r}_{it-2}, \Delta\tilde{W}_{it})}{\alpha_w \sigma_u \sigma_{u_r}} \tag{61}$$

$$\rho_{vu} = -\frac{\text{Cov}(\Delta\tilde{r}_{it}, \Delta\tilde{W}_{it-2}) + \alpha_r \rho_u \sigma_u \sigma_{u_r}}{\alpha_r \sigma_v \sigma_{u_r}} \tag{62}$$

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

C Additional Estimates

Table C1. Low-Risk Assets are Subject to Idiosyncratic Permanent Risk in Returns

Asset Return	Low-Risk Assets					
	1	2	3	4	5	6
σ_u	22.20	24.10	24.08	22.12	24.09	24.08
(Temporary wage shock)	(5.15)	(6.64)	(6.50)	(5.15)	(6.64)	(6.50)
σ_v	19.39	17.71	17.82	19.46	17.74	17.82
(Permanent wage shock)	(6.03)	(6.65)	(7.16)	(6.03)	(6.65)	(7.16)
$\sigma_{u\,r}$	0.38	0.41	0.39	0.36	0.39	0.39
(Temporary return shock)	(0.07)	(0.08)	(0.11)	(0.08)	(0.11)	(0.11)
$\sigma_{v\,r}$	-	-	-	0.21	0.15	0.15
(Permanent return shock)	-	-	-	(0.10)	(0.11)	(0.11)
α_w	-	0.10	0.10	-	0.10	0.10
(Wage moving average)	-	(0.035)	(0.034)	-	(0.035)	(0.034)
α_r	-	0.13	0.11	-	0.11	0.11
(Return moving average)	-	(0.025)	(0.032)	-	(0.032)	(0.032)
ρ_{uu}	-	-	-0.01	-	-	-0.01
(Corr. temporary shocks)	-	-	(0.024)	-	-	(0.024)
ρ_{vu}	-	-	0.05	-	-	0.05
(Corr. v wage u returns)	-	-	(0.045)	-	-	(0.045)
Observations	9,128	9,128	9,128	9,128	9,128	9,128
Persons	2,251	2,251	2,251	2,251	2,251	2,251
J-test p-value H_0: Valid	0.000	0.336	0.576	0.014	0.626	0.576

Note: Idiosyncratic returns are in percentage points; idiosyncratic head's 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.

Table C2. Full System Estimates for the Alternative Return Measures

Asset Return	Business	Prim. Hous.	Sec. Hous.	P. Equities
σ_u	41.50	24.28	26.70	25.84
(Temporary wage shock)	(19.72)	(6.62)	(15.23)	(9.57)
σ_v	16.45	18.00	20.27	17.22
(Permanent wage shock)	(20.81)	(6.72)	(16.32)	(10.25)
$\sigma_{u}r$	110.47	11.29	27.65	23.21
(Temporary return shock)	(58.01)	(2.67)	(16.22)	(10.75)
α_w	0.25	0.10	0.05	0.19
(Wage moving average)	(0.089)	(0.034)	(0.121)	(0.058)
α_r	0.10	-0.15	-0.39	-0.31
(Return moving average)	(0.160)	(0.039)	(0.249)	(0.171)
ρ_{uu}	-0.02	-0.02	0.19	-
(Corr. temporary shocks)	(0.145)	(0.031)	(0.122)	-
ρ_{vu}	0.47	0.12	-0.41	-0.03
(Corr. v wage u returns)	(0.543)	(0.057)	(0.341)	(0.059)
Observations	340	8,513	558	2,474
Persons	107	1,970	162	751
J-test p-value H_0: Valid	0.169	0.425	0.802	0.001

Note: Idiosyncratic returns are in percentage points; idiosyncratic head's 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. Permanent shocks were dropped from all models, as the variances were estimated to be negative. Heteroskedastic and serial correlation robust standard errors are in parentheses.

Table C3. Full System Estimates for the Capital Gains Return Measures

Asset Return	Total	Business	Prim. Hous.	Sec. Hous.	P. Equities
σ_u	23.97	41.64	24.35	26.98	26.08
(Temporary wage shock)	(6.24)	(19.69)	(6.62)	(14.44)	(9.55)
σ_v	18.41	16.92	18.02	18.37	17.44
(Permanent wage shock)	(6.98)	(20.83)	(6.73)	(16.12)	(10.33)
σ_{u^r}	13.62	96.61	11.27	27.43	19.63
(Temporary return shock)	(4.70)	(53.81)	(2.69)	(21.13)	(8.71)
σ_{v^r}	0.013	-	-	1.195	-
(Permanent return shock)	(4.88)	-	-	(17.33)	-
α_w	0.13	0.25	0.10	0.06	0.20
(Wage moving average)	(0.032)	(0.091)	(0.034)	(0.129)	(0.057)
α_r	-0.11	0.08	-0.14	-0.41	-0.32
(Return moving average)	(0.048)	(0.186)	(0.038)	(0.428)	(0.160)
ρ_{uu}	0.07	0.02	-0.01	0.12	0.04
(Corr. temporary shocks)	(0.027)	(0.146)	(0.032)	(0.104)	(0.071)
ρ_{vu}	-0.06	0.16	0.10	-0.13	-0.10
(Corr. v wage u returns)	(0.050)	(0.411)	(0.059)	(0.131)	(0.149)
Observations	7,131	340	8,521	632	2,464
Persons	1,925	107	1,971	183	751
J-test p-value H_0: Valid	0.344	0.305	0.379	0.768	0.002

Note: Idiosyncratic returns are in percentage points; idiosyncratic head's 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. Permanent shocks to returns were dropped from the model if the variance were estimated to be negative. Heteroskedastic and serial correlation robust standard errors are in parentheses.