Essays on Household Portfolio Choice

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Dissertation for the Degree of Doctor of Philosophy, Ph.D
Stockholm School of Economics 2009.

ISBN 978-91-7258-809-7

Keywords: tenure choice, labor income risk, unemployment, home price risk, home value, real estate, stock market participation, mutual funds, labor productivity, wage volatility, hedging.

Printed in Sweden by:
Intellecta Infolog, Göteborg 2009

Distributed by:
EFI, The Economic Research Institute
Stockholm School of Economics
Box 6501, SE-113 83 Stockholm, Sweden
www.hhs.se/efi

To my family

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Acknowledgements

Obtaining a Ph.D. degree is a long and bumpy journey. At times, I felt frustrated at what seemed an impossible task, but most of the time I enjoyed the intellectual stimulation, the creativity and freedom of academic life, and the joy of progress and personal development. I truly enjoyed spending all these years at the Stockholm School of Economics. Nevertheless, I have now reached the final destination of this journey. It is an important milestone, but on the horizon there are new destinations yet to be reached.

Many people have supported me over these years, and you all deserve special thanks. First, I want to thank my supervisor Peter Englund for all his valuable comments and suggestions over the years. Peter has helped me tremendously in organizing my thoughts and ideas, and he has always encouraged me and given me tips on how to improve my work. I would also like to thank Paolo Sodini for all his helpful comments, and Anneli and Marita for always being so friendly and helpful with administrative tasks.

In the first years of my research, I spent most of my time with Ph.D. students from the Department of Economics. In particular, Robert and Erik became good friends, and we challenged each other to perform our best on the initial tough exams. At the Department of Finance, Henrik, Joakim, Linus S., Linus K., and all the other Ph.D. students also became great friends.

I am grateful to Professor Nancy Wallace and Professor John Quigley for inviting me to spend a year at the University of California at Berkeley. This was a very rewarding year, on both the personal and professional levels. I gained considerable knowledge of subprime mortgages, mortgage-backed securities, and the impending financial crisis.

I loved spending a year in the vibrant university town of Berkeley. However, living in a country far away from home can be a lonely experience, so I want to thank Sebastien, Carles, Barney, Nish, Javed, and all the other Ph.D. students at the Department of Finance for making me feel like one of them. In the future, I would love to return to the San Francisco Bay Area.

I would also like to thank my family for all their support and love, especially at moments when my thoughts were more on upcoming exams, troubling regression models, and complex theories than on social interaction. My grandmother, Hildegun, deserves special thanks for always believing in me and for having supported me in reaching my goals since I was a little kid.

Finally, I am grateful for the financial support I received from Bankforskningsinstitutet and the Jan Wallander and Tom Hedelius Research Foundation, generous support that made this journey possible.

Stockholm, September 2009
Thomas Jansson

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Chapter 1

Introduction

The main theme of this thesis is household portfolio choice, and the focus is on labor income and household investments in owner-occupied housing, directly owned stocks, and risky mutual funds. In all three papers, I made use of access to high-quality, register-based Swedish data on household employment and portfolio holdings.

A household's decision whether to own or rent its home is not only a consumption issue, as it significantly affects the composition of the household's risky asset portfolio. Housing consumption demand creates a highly leveraged position in real estate, especially for young homeowners. In fact, housing is the most important household asset: in 2003, real estate holdings accounted for almost 70% of the total value of household assets in Sweden.

Meanwhile, for most households, labor income is the main source of income. Labor income cannot, however, be capitalized, which generates an insurable background risk. The main risk of labor income is that of unemployment, which is consistent with empirical evidence of strong real wage rigidity in Sweden, and with the fact that employee stock ownership plans and profit-sharing programs are relatively uncommon among Swedish employees.

Furthermore, the stock market participation rate in Sweden is very high compared with that of other countries. In 1999, the total participation rate was 54% in Sweden, much higher than in France (23%), Italy (15%), the Netherlands (24%), the U.K. (34%), or even the USA (48%).[1]

The first paper, "Housing and Labor Income Risk," studies the impact of labor income risk on household investments in owner-occupied housing. In a basic theoretical framework, I demonstrate that the optimal value of owner-occupied housing increases with the covariance between individual unemployment risk and local housing prices.[2]

Using Swedish data, annual unemployment risks from 1985–2003 and co-

[1]Source: Guiso, L., M. Haliassos, and T. Jappelli. (2003). "Household stockholding in Europe: where do we stand and where do we go?," *Economic Policy* 18(36), 123–170.

[2]Note that a positive covariance between unemployment risk and housing prices implies a negative covariance between labor income and housing prices.

variance between these unemployment risks and local housing prices are estimated at an individual level. The empirical results strongly indicate that the probability of ownership as well as the value of owner-occupied housing owned, conditional on ownership, is significantly higher for high-covariance households.

Contrary to first intuition, it is also demonstrated that married couples who work in the same industry invest more in owner-occupied housing on average, conditional on owning, than do couples who work in different industries. On the other hand, the probability of owning is somewhat lower for same-industry couples.

The second paper, "Housing and the Composition of the Financial Portfolio," studies the impact of real estate on financial portfolio composition, treating household investments in owner-occupied housing as exogenously given by the consumption demand.

Since local macroeconomic shocks tend to hit both households and firms within a certain geographical area in a similar way via asset prices and labor income, it is plausible to assume that home prices are more highly correlated with returns on local stocks than global stocks. Under these assumptions, I demonstrate in a simple theoretical model that, when the exogenous consumption demand for housing increases, households optimally respond by increasing their exposure to global stocks and reducing their exposure to local stocks.

Unfortunately, we cannot identify local and global stocks in the data. However, we know the households' holdings of directly owned stocks and of equity mutual funds. We also know that, due to the higher information and transaction costs of international stock trades, direct stock holdings consist primarily of local stocks. On the other hand, equity mutual funds are globally diversified.

Using Swedish data, the empirical results strongly indicate that households that are highly exposed to the local housing market in the form of owner-occupied housing significantly reduce their exposure to the local Swedish stock market and increase their exposure to globally diversified equity mutual funds, on average. In fact, both the probabilities of holding directly owned stocks and equity mutual funds and the relative shares of total stock holdings invested in each asset class are shown to be affected in an economically significant way.

The third and final paper, "Hedging Labor Income Risk," a joint effort with Sebastien Betermier, Christine A. Parlour, and Johan Walden, studies the impact of labor income risk on household investments in risky assets. Our results suggest that human capital is an important determinant of household portfolio holdings.

Our empirical tests are based on the theoretical predictions of Parlour and

Walden (2008).[3] Briefly stated, their paper develops a general equilibrium model incorporating multiple industry sectors in which workers accept employment contracts offered by firms and their effort is used as a production input. Firms face a moral hazard problem in that they cannot observe the effort level of employees, so optimal wage contracts include risky compensation.

The theory explicitly links the level of labor productivity in a sector to (*i*) both the level and volatility of wages offered employees, and (*ii*) the portfolios that these employees hold in equilibrium. Firms that require high labor productivity choose a highly variable wage structure that is linked to performance so as to induce effort from their employees. As a result, employees of high-productivity firms choose to reduce their exposure to risky assets in their investment portfolios.

Using Swedish data, we find that although there is only a weak link between the levels of employee labor productivity, wage structure, and household portfolio holdings, there is a strong link between changes in these variables. Households adjust their portfolios in response to job changes. In particular, for households where both adults switch their industries of employment in the same year, an increase in wage volatility of 1% will lead to an average decrease in the share of risky assets of 1.07%.

This means that a household in which the employed adults change jobs from the industry with the least variable wage (recycling metal waste) to the industry with the most variable wage (fund management) will, all else being equal, reduce its share of risky assets by more than 25%, or USD 7,750, on average. Similarly, a household that switches from a low-labor-productivity industry to one with high labor productivity decreases its risky asset share by 20% on average.

We also provide evidence concerning the link between the labor productivity of particular industries and wage volatility; we find that industries requiring high levels of labor productivity also have wages that are (*i*) more volatile and (*ii*) higher on average.

[3]Parlour, C. A. and J. Walden (2008), "Capital, Contracts and the Cross Section of Stock Returns," *Working paper, UC Berkeley.*

Chapter 2

Housing and Labor Income Risk

Abstract

In a basic theoretical framework, I demonstrate that the optimal value of owner-occupied housing increases with the covariance between individual unemployment risk and local housing prices. Using a unique Swedish register-based database on employment and portfolio holdings, a positive relationship between the value of owner-occupied housing and the covariance between unemployment risk and local housing prices is found empirically. Both tenure choice and conditional demand are affected. A one-standard-deviation increase in the unemployment risk–house price covariance implies an increase in the value of owner-occupied housing of approximately SEK 96,000 (USD 13,300). I also demonstrate, both theoretically and empirically, that married couples who work in the same industry invest more on average in owner-occupied housing, conditional on owning, than do couples who work in different industries. On the other hand, the probability of ownership is somewhat lower for same-industry couples.

2.1 Introduction

A household's decision whether to own or rent its home is not only a consumption issue, as it significantly affects the composition of the household's portfolio of risky assets. Housing consumption demand creates a highly leveraged position in real estate, especially for younger households. This dual role of housing as both a consumption and an investment good is emphasized in numerous papers, for example, Henderson and Ioannides (1983), Flavin and Yamashita (2002), and Cocco (2005).

In fact, housing is the most important household asset. In 2003, real estate holdings accounted for almost 70% of the total value of household assets in Sweden (see Table 1). Owner-occupied single-family homes alone accounted for almost 42% of total household assets, while only 7% were invested in stocks and 9% in mutual funds.

Meanwhile, labor income is the main source of income for most households. Labor income cannot, however, be capitalized, which generates an uninsurable background risk (Heaton and Lucas, 2000).

Since labor income is the main source of income and housing the most important asset, we expect the housing decision to incorporate labor income risk. In other words, if there is a positive correlation between housing and labor income shocks, the housing asset is riskier.[1] In fact, in Sweden there is a strong positive correlation between labor income shocks and local housing prices on average; however, there is considerable variation in the cross section.

The most important risk of labor income is the risk of becoming unemployed. As pointed out in Carroll, Dynan, and Krane (2003), income variability measures may be poor uncertainty proxies since they usually include large controllable elements. Unemployment shocks are, on the other hand, more exogenous. In fact, Shore and Sinai (2009) use unemployment risk as their measure of labor income risk.

In Sweden, wage volatility, given employment, is very low. In fact, Dickens et al. (2007) demonstrate that Sweden has the most widespread real wage rigidity of 16 studied countries (including the U.S.),[2] due to high union density, centralized wage agreements, etc. This rigidity is strengthened by the fact that employee stock ownership plans (ESOPs) and profit-sharing programs are relatively uncommon in Sweden, even compared with other European countries. To conclude, the main risk of involuntary reduction in real wages faced by Swedish employees is that of unemployment (see section 2.3.1 for more details).

Furthermore, as pointed out by Massa and Simonov (2006), Swedish employment protection legislation is not as strict as one may think; the Swedish

[1] Renting, however, is also risky, as pointed out by Sinai and Souleles (2005).

[2] Even in the U.S., there is widespread nominal wage rigidity, though real rigidity is very weak.

labor market is actually quite similar to that of the United States in terms of companies' freedom to reduce their workforces in the event of work shortage. In fact, the shortest termination notice period in Europe is found in Sweden, and unemployment benefits are capped at a relatively low level, increasing labor income risk for middle- and high-income individuals (see section 2.3.1 for details).

Unemployment risk is indeed inescapable for most Swedish households, and must be accounted for in financial decisions. Individual unemployment risk varies over time, and is demonstrated empirically to depend on factors such as age, education, region of residence, gender, marital status, industry, and country of birth.

Using a unique Swedish register-based database on employment and portfolio holdings, I demonstrate that households with large negative covariances between individual unemployment risk and local housing prices on average reduce their investment in housing.[3] First, the probability of ownership is significantly lower (i.e., tenure choice is affected). Second, the value of owner-occupied housing owned, given ownership, is significantly reduced on average. The empirical results are in line with the theoretical predictions, and are robust to different model specifications.

To summarize, a one-standard-deviation increase in the unemployment risk–house price covariance implies an increase in the value of owner-occupied housing of approximately SEK 96,000 (USD 13,300). The effects appear to be greatest among middle-income households, which is consistent with the conditions of Swedish public unemployment benefit schemes.

I also demonstrate, both theoretically and empirically, that married couples who work in the same industry invest more on average in owner-occupied housing, conditional on owning, than do couples who work in different industries. On the other hand, the probability of ownership is somewhat lower for same-industry couples.

One possibility, though, is that borrowing constraints are imposed on households with large negative covariances by banks and other credit institutions. In other words, the results might be driven by lender policies and not by individual household decisions. However, similar results are found for homeowners with very low absolute levels of debt.

The remainder of the paper is structured as follows; section 2.2 reviews previous literature, section 2.3 describes the institutional setting, section 2.4 outlines the theoretical framework, section 2.5 presents the data and the methodological framework, section 2.6 presents the main results, section 2.7 concerns married couples, and section 2.8 concludes.

[3]Note that a negative covariance between unemployment risk and housing prices implies a positive covariance between labor income and housing prices.

2.2 Previous Literature

There is an extensive literature on tenure choice and conditional housing demand, though few papers explicitly treat house price risk and/or background risks, such as labor income risk.

Though the economic significance for homeowners of being able to hedge their exposure to house price risk through index-based real estate derivatives was identified by Case, Shiller, and Weiss (1993), such derivative markets have been unsuccessful in practice. Turner (2003) finds empirically, using data from the American Housing Survey (AHS), that expected house price risk reduces demand for owing housing. In fact, a one-standard-deviation increase in anticipated house price volatility corresponds to a 7% decline in the probability of homeownership and in housing demand.

On the other hand, Sinai and Souleles (2005) point out that the notion that homeownership is very risky ignores the fact that the alternative to owning, i.e., renting, is also risky. That is, owning a house introduces house price risk, but in turn provides a hedge against fluctuations in future housing costs. Sinai and Souleles demonstrate that rent risk can actually dominate house price risk, in which case greater housing market volatility can in fact increase the demand for owning.

The net risk of owning declines with a household's expected horizon in its house and with the correlation between current and future housing costs. Empirically, Sinai and Souleles (2005) find that both house prices, relative to rents, and the probability of homeownership increase with net rent risk.

Furthermore, the traditional view is that increased labor income risk induces lower consumption and higher savings (a precautionary savings motive). However, these models generally assume that the current consumption level can be changed without cost. In reality, large costs are incurred by changing, for example, one's current housing consumption, i.e., large transaction and moving costs.

A growing literature treats the consequences of various consumption commitments. Shore and Sinai (2009) argue that the unemployment risks of spouses are more highly correlated if they share the same occupation or work in the same industry than if they do not. In other words, the probability of both spouses being concurrently employed or unemployed is higher when both spouses share the same occupation or industry.

Shore and Sinai (2009) demonstrate in a theoretical model that, due to the high transaction and moving costs of changing owner-occupied housing, if only one spouse is unemployed, it may be optimal for the household to stay in its current home and reduce its consumption of other goods. If both spouses are concurrently unemployed, however, the household is more likely to pay the transaction costs and reduce its housing consumption by moving to a smaller house. Hence, spouses whose unemployment risks are more highly

correlated (resulting in increased household labor income risk) may actually spend more on housing, ex ante, than do less correlated couples.

In fact, Shore and Sinai (2009) find empirically that couples sharing the same occupation or working in the same industry invest at least 2.1% more on average in owner-occupied housing than do couples not sharing the same occupation or industry. Tenure choice is also affected: Shore and Sinai demonstrate that the probability of ownership is lower for same-occupation couples. However, Shore and Sinai's analysis ignores the effect of the covariance between unemployment risk and housing prices on the optimal investment in owner-occupied housing. This matter is explored in depth in section 2.7.

Few papers explicitly consider the correlation between house price risk (or rent risk) and labor income risk. Ortalo-Magné and Rady (2002) analyze household tenure choice within a dynamic model in which future incomes, housing prices, and rents are uncertain. They demonstrate that the lower the covariance between household earnings and rents, the more likely the household is to buy. Tenure choice is also found to be affected by investment horizon: if a household expects to live in its current home for an extended period, or if the covariance between the user cost of a household's current home and future potential homes is high, the household is more likely to become a homeowner.

Both Cocco (2005), who models portfolio choice in the presence of housing, and Yao and Zhang (2005), who study optimal dynamic portfolio decisions, explicitly consider the impact of the covariance between housing prices and labor income on portfolio choice. However, both papers use a single population variance–covariance matrix.

The first paper to interact house price and labor income risks at an individual (industry) level is Davidoff (2006). Davidoff demonstrates that households whose labor incomes strongly covary with local housing prices are less inclined to become homeowners, and given a purchase, choose to buy a less expensive home. Empirically, Davidoff finds that a one-standard-deviation increase in the covariance between income and home prices is associated with a decrease of approximately USD 7,500 in the value of owner-occupied housing among U.S. households. Individual labor income–house price correlation is proxied by the correlation between the aggregated wages of an industry and local housing prices.

2.3 Institutional Setting

2.3.1 Labor Market

Legal Framework

The legal framework of the highly unionized[4] Swedish labor market consists of three elements: labor legislation, collective centralized bargaining agreements, and individual employment agreements.

The Swedish Employment Protection Act states that employment contracts are valid for an indefinite term. Fixed-term contracts may, however, be entered into under certain circumstances stipulated in law. There are no legal minimum wages, minimum wage levels in different sectors being imposed by collective bargaining agreements.

Notice of employee termination by the employer must be based on objective grounds, such as work shortage or gross neglect of obligations to the employer. Order of termination is determined based on employee seniority, employees with greater employment duration having priority over those with less (the "last-in, first-out principle"). Employees terminated because of work shortage have priority rights to reemployment in the company that previously employed them.

Wage Rigidity, ESOPs, and Profit Sharing Programs

The wage structure of the Swedish labor market is well known to be downwardly rigid, mainly due to strict labor market policies and strong labor unions. According to the conditions of collective bargaining agreements, employers cannot, for example, unilaterally impose wage cuts, even after the agreement has expired.

Empirical evidence of the highly rigid wage structure in Sweden is presented by, for example, Agell and Bennmarker (2003). They demonstrate that only 1.1% of Swedish employees actually received nominal wage cuts in the recession of the early 1990s, significantly fewer than in other countries experiencing similar crises.[5]

From an international perspective, Sweden has the most widespread real wage rigidity of 16 studied countries, including the United States (Dickens et al., 2007). Even in the United States there is widespread nominal wage rigidity, though real rigidity is very weak (see Figure 1).

[4] In Sweden, approximately 85% of blue-collar workers and 75% of white-collar workers are unionized.

[5] The unemployment rate in Sweden increased from 2.8% in 1990 to 13.6% in 1994. In the same period, inflation was low and stable.

In Figure 2 (left) we note a clear linear relationship (a correlation coefficient of 0.73) between real wage rigidity and union density. Actually, Sweden is in the upper right corner with the highest union density and the highest real wage rigidity encountered in the study. Furthermore, the relationship between real wage rigidity and employment protection legislation is graphed (Figure 2, right). In this case, however, the linear relationship is not that strong, with a non-significant correlation coefficient of 0.11. In fact, employment protection legislation in Sweden is less strict than in many other European countries.

Festing, Groening, Kabst, and Weber (1999) study the existence of employee stock ownership plans (ESOPs) and profit-sharing programs in four European countries. In Table 2 we note that ESOPs are less common in Sweden than in Germany, France, or the U.K. As expected, in all countries such plans are most common for management (in Sweden, 7.1% of all organizations offer ESOPs for managers).

Furthermore, the percentage of Swedish firms offering profit-sharing programs is higher than that of Swedish firms offering ESOPs. Nonetheless, only a small fraction of all firms offers such programs to different personnel categories (12–15%). The fraction of firms offering profit-sharing programs in Sweden is actually much lower than in the other studied countries.

From these facts, I conclude that ESOPs and profit-sharing programs are not as widespread among Swedish employees as among employees in most other European countries (and in the U.S.).

Unemployment Benefits

Public unemployment benefits in Sweden are funded by employer's fees, taxes, and, to a lesser degree, membership fees; the coverage rate is approximately 85%. Received benefits are taxable income. To summarize, Swedish unemployment benefits comprise three components:

1. A comprehensive public scheme providing a lower level of basic support (SEK 320 a day with a six-month minimum employment requirement)

2. A complementary income-based public compensation scheme, applicable to members of an unemployment insurance fund[6] who fulfill certain working conditions,[7] compensating for up to 80% of previous earnings

[6]To be admitted to an unemployment insurance fund, the applicant must have been employed for a minimum of 17 hours per week in four of five consecutive weeks (source: The Swedish Unemployment Insurance Board, IAF).

[7]These conditions require the applicant to have been employed for a minimum of six months (more than 70 hours per month) in the proceeding year, or for at least 450 hours over a six-month period (45 hours per month) (source: The Swedish Unemployment Insurance Board, IAF).

(to a maximum benefit of SEK 680 per day) for a maximum of 300 days (5-day week)[8]

3. Supplementary private insurance providing compensation above the ceiling of the public schemes, offered by, for example, trade unions.

From an international perspective, Swedish public unemployment benefits initially seem relatively generous, though the benefits are capped at a relatively low level (as explained above). The eligibility conditions, waiting periods, maximum durations, initial payment rates, and coverage rates for Sweden, Germany, and the United Kingdom are reported in Table 3.

2.3.2 Housing Market

The Swedish housing market can be divided into three main categories: owner-occupied single-family homes, cooperative apartments, and rental apartments. The largest household categories are owners of single-family homes and renters, each constituting 40% of households (see Table 4); owners of cooperative apartments account for 15% of households.

Owner-Occupied Homes

There are two ways to become a homeowner in Sweden: one buys either an owner-occupied single-family home or a cooperative apartment (condominiums are not yet legal in Sweden). Owner-occupied single-family homes and cooperative apartments are sold freely on the open market.

A member of a cooperative association possesses the right of use of a specific apartment for an indefinite term. The property is owned and managed by the association, which may hold debt. To cover maintenance costs and interest payments, a monthly fee is paid by the members.

Owners of cooperative apartments are excluded from my empirical analysis since there are no reliable sources of the true market value of such apartments.[9] Furthermore, there are no price indices for cooperative apartments in Sweden covering the period of analysis.

[8]However, for the first 100 days of a benefit period, the maximum amount is SEK 730 per day (equivalent to 80% of a monthly salary of SEK 20,075) (source: The Swedish Unemployment Insurance Board, IAF)

[9]The "true" market value of a cooperative apartment must include the apartment's share of the association's debt holdings, since larger debts imply higher future fees and a lower transaction price, ceteris paribus.

Rental Apartments

The rental apartment market in Sweden is dominated by non-profit municipal housing companies competing directly with private landlords, in both less popular suburbs and attractive inner-city locations (a "unitary market" system, as described in Kemeny, 1995). In fact, more than 50% of the total number of rental apartments in Sweden are owned by municipal housing companies.

Though there is no formal rent control, rents charged by municipal companies act as a ceiling on rents in similar, nearby privately owned properties (a maximum divergence of 4–5% is allowed). Rents in municipal housing companies are intended to cover management and maintenance expenses and to yield a fair return on invested capital; they are determined by negotiations with the local tenants' associations.

2.4 Theoretical Model

The impact of unemployment risk on housing choices may be analyzed using a simple two-period partial equilibrium model in which utility is gained from housing services, h, and a numeraire, x (consumption of other goods).[10] I assume an incomplete market where renters own no housing and homeowners own exactly as much housing as they consume. The interest rate, r, is assumed to be non-stochastic and saving and lending to be riskless. Second-period labor income, y_2, and housing prices, π_2, are stochastic. The housing demand in the second period is set at a fixed level (zero) and the labor supply is fixed.[11]

In the first period, individuals receive a non-stochastic labor income, y_1, and decide how much to save, S, the optimal quantity of housing to consume, h, and whether to buy or rent (tenure choice). If individuals find it optimal to rent, they pay $hRent_1$ for their housing consumption; if they instead find it optimal to own, they pay $h\pi_1$ to buy their homes.

Second-period labor income, y_2, equals $\bar{y}_2 V_2$ and is stochastic. V_2 is an idiosyncratic shock and $\bar{y}_2$ is labor income given employment. With a probability of p_2, the individual is unemployed in period 2 and $V_2 = V^{\min} < 1$. With a probability of $(1 - p_2)$, the individual is employed in period 2 and $V_2 = 1$. The probability of unemployment, p_2, is stochastic. In other words, $E[V_2] = E[1 - p_2(1 - V^{\min})]$.

Homeowners maximize expected utility given the above assumptions by

[10] The basic theoretical framework follows that of Henderson and Ioannides (1983).

[11] Bodie, Merton and Samuelson (1992) study the effect of flexible labor supply on portfolio choice.

choosing optimal levels of housing services, h, and savings, S:

$$\begin{aligned} \max_{h,S} EU &= u(x,h) + Ev\left(w\right) \\ s.t. \quad y_1 &= x + h\pi_1 + S \\ w &= \bar{y}_2 V_2 + h\pi_2 + (1+r)S \end{aligned} \tag{2.1}$$

where $u(x,h)$ is the utility derived from consumption of housing, h, and other goods, x, and $v\left(w\right)$ is the indirect utility derived from second-period wealth, w. u and v are assumed to be increasing and strictly quasi concave. Similarly, renters maximize expected utility by choosing optimal levels of h and S:

$$\begin{aligned} \max_{h,S} EU &= u(x,h) + Ev\left(w\right) \\ s.t. \quad y_1 &= x + hRent_1 + S \\ w &= \bar{y}_2 V_2 + (1+r)S \end{aligned} \tag{2.2}$$

If assuming mean-variance utility, expected indirect utility derived from second-period wealth, w, is:

$$Ev(w) = a\left(E\left(w\right)\right) + b\left(Var\left(w\right)\right), \tag{2.3}$$

where $a' > 0$ and $b' < 0$. Furthermore, if we assume $\bar{y}_2$ and $V^{\min}$ to be deterministic, the variance of second-period wealth w for homeowners can be expressed as follows:

$$\begin{aligned} Var(w) &= Var(\bar{y}_2 V_2) + 2Cov(h\pi_2, \bar{y}_2 V_2) + Var(h\pi_2) \\ &= \bar{y}_2^2 Var(V_2) - 2h\bar{y}_2\left(1 - V^{\min}\right) Cov(\pi_2, p_2) + h^2 Var(\pi_2). \end{aligned} \tag{2.4}$$

Using arguments similar to those in Davidoff (2006), one can then demonstrate that

$$\begin{aligned} sign\left(\frac{dh}{dCov(\pi_2,p_2)}\right) &= sign\left(U_{hCov(\pi_2,p_2)}\right) \\ &= sign\left[b'\left(\frac{\partial^2 Var(w)}{\partial h \partial Cov(\pi_2,p_2)}\right)\right] \\ &= sign(-2\bar{y}_2\left(1 - V^{\min}\right)b') > 0. \end{aligned} \tag{2.5}$$

That is, homeowners' optimal investments in owner-occupied housing increase in the second-period house price–unemployment risk covariance, $Cov(\pi_2, p_2)$. One can demonstrate that if $Cov(\pi_2, p_2)$ falls below a certain level, $Cov^*(\pi_2, p_2)$, renting is preferable to owning.

To conclude, the household's (i) probability of ownership (tenure choice) and (ii) optimal value of owner-occupied housing, conditional on ownership, increase with $Cov(\pi_2, p_2)$.

2.5 Data and Methodology

This section describes the available data sources and empirical methodology in more detail. In the first step, individual unemployment risks, p, and local housing prices, π, are estimated. The second, and major, empirical issue concerns estimating the individual covariance between individual unemployment risks and local housing prices, $Cov(\pi, p)$.

2.5.1 Data

LINDA[12]

I use a Swedish register-based longitudinal database denoted LINDA—Longitudinal INdividual DAta—a joint project of Uppsala University, The National Social Insurance Board, Statistics Sweden, and the Swedish Ministry of Finance. The sampling frame consists of all individuals living in Sweden.

LINDA contains a cross-sectional sample of approximately 300,000 individuals annually, representing approximately 3% of the Swedish population. The sampled individuals and their family members are tracked over the years. The sampling procedure ensures the panel is representative of the population as a whole, and that each yearly wave is cross-sectionally representative.[13]

The principal sources of data are the income registers[14] based on filed tax reports (available on annual basis from 1968) and the population censuses (available every fifth year from 1960 to 1990). Various measures of income, government transfers, market values of assets (including real estate, bonds, stocks, and mutual funds),[15] and individual characteristics, such as sex, marital status, education, municipality of residence, and country of birth, are reported.

LINDA also contains various labor market variables, such as employment status, labor income, industry and sector of employment (referring to the main industry and sector of employment in a particular year), unemployment insurance transfers, and workplace location.

In the empirical analysis, the 2003 wave of LINDA is used. Since interaction effects between unemployment risk and homeownership are less relevant

[12] LINDA is described in more detail in Edin and Fredriksson (2000).

[13] However, since individuals and not households are sampled, large households tend to be overrepresented in the final sample.

[14] In the income registers, all variables are defined primarily for tax purposes. Consequently, income variables, for example, are contingent on the tax legislation in a specific year, and cohabitants with no children in common are usually coded as single.

[15] For tax purposes, assets may be valued below their fair market values; however, both tax-assessed and market values have been included in LINDA since 1999.

to younger and older individuals, the sample is restricted to individuals aged 26–60.

Owners of cooperative apartments (described in section 2.3.2) are excluded, since there are no reliable sources for the true market value of such apartments. Furthermore, there are no price indices for cooperative apartments in Sweden covering the period of analysis. Sampled individuals who are self-employed, unemployed, or with no labor income reported are also excluded. The final sample consists of 147,906 households.

The personal characteristics of the household head (defined as the member of the household with the highest disposable income) are used to identify variables such as $Cov(\pi, p)$, age, and gender. Definitions and summary statistics for all explanatory variables are provided in the Appendix and in Tables 9 and 10.

The value of housing is defined as the aggregated market value of owner-occupied single-family homes owned by all members of the household. Homeowners are defined as households where the market value of housing owned is strictly positive. According to this definition, 97,936 of 147,906 households in the sample are classified as homeowners, the remainder being renters. The mean value of owner-occupied housing is SEK 867,851 (median SEK 645,280). Conditional on owning, the mean is SEK 1,310,656 (median SEK 1,047,190).

Housing Prices

Home price indices at the municipality level are calculated using *K/T ratios* (i.e., average ratios between purchase prices, K, and tax-assessed values, T), readily available from Statistics Sweden.[16]

As long as tax-assessed values remain constant over time and only purchase prices change, the calculation of local home price indices is straightforward. However, there have been several large adjustments to the overall level of tax-assessed values of owner-occupied single-family homes in Sweden, specifically, in 1990, 1996, and 2003. Statistics Sweden, however, provides keys for how to adjust old *K/T ratios* to be able to compare *K/T ratios* over time in a consistent way.

[16]The purchase prices and tax-assessed values of all transactions involving owner-occupied single-family homes in Sweden are readily available. However, since homes sold in a certain year may not be a random sample of the total housing stock and since the total housing stock composition may vary from year to year, the reported *K/T ratios* are adjusted by Statistics Sweden.

2.5.2 Unemployment Risk

Probit Model

As discussed above, unemployment risk is the most essential component of labor income uncertainty. By assumption, there is an underlying latent variable for each individual i at time t indicating the propensity to become unemployed:

$$u_{it}^* = z_{it}\beta + e_{it}, \tag{2.6}$$

where z is a vector of individual characteristics. A probit model is used, which implies that the error term, e, is assumed to be independent of z and standard normally distributed. In which case,

$$u = 1 \text{ if } u^* > 0$$

$$u = 0 \text{ if } u^* \leq 0$$

That is, individual i is unemployed if $u_i^* > 0$, and employed if $u_i^* \leq 0$.

Empirical Estimates

Using data from LINDA (see section 2.5.1), unemployment probabilities are estimated annually from 1985 to 2003. Individuals between 26 and 60 years of age with strictly positive labor income are included in the sample; the self-employed are excluded. The sample size varies between 203,349 and 300,220 individuals annually.

Individuals are classified as unemployed if they receive any public unemployment benefits in a specific year (the Swedish unemployment insurance system is described in more detail in section 2.3.1). Explanatory variables included in the probit model are marital status, sector, industry, age, gender, country of birth, A-region (Sweden is divided into 70 "A-regions," i.e., local labor markets, by Statistics Sweden), and education.[17]

Estimates of unemployment risk for every third year between 1985 and 2003 are reported in Table 5. The results are fairly robust over the years. However, the unemployment rate peak in the early 1990s recession is obvious; the percentage of sampled individuals receiving any form of unemployment benefits increased from 5% in 1985 to 15% in 1994.

Unemployment risk is significantly higher for women and unmarried individuals. Country of birth plays another important role, as individuals born in Sweden face a significantly lower unemployment risk. The high unem-

[17]Education, however, is only reported in LINDA from 1991 and onwards. Thus, education levels and fields of study from 1985 to 1990 are approximated using 1991 values. However, if there is information that the graduation year was between 1985 and 1991 (and so on), the 1991 education level is reduced by one step.

ployment rate among youth is also obvious in the data, and as expected, we observe large variations in unemployment risk across A-regions (estimates not reported).

Furthermore, we find large discrepancies in unemployment risk across industries and sectors. For example, the *fishing industry* and the *hotel and restaurant industry* are industries with high average unemployment risk, partly due to seasonal variation in employment rates. It is unsurprising that the *central government sector* is a relatively secure sector.

Using the unemployment probability estimates, time series of individual unemployment risks, $(\hat{p}_{i,1985} - \hat{p}_{i,2003})$, are estimated for each individual in the final sample (the 2003 wave of LINDA). These individual unemployment risk estimates are then used to estimate $C\hat{o}v\left(\pi_j, p_i\right)$ in equation (2.11).

Compensation in Case of Unemployment

$V^{\min}$ (see section 2.4) is thought of as unemployment insurance benefits, paid as a percentage of prior labor income (thereby taking into account the ceiling of the unemployment insurance scheme).

In case of unemployment, 80% of previous labor income up to a monthly salary of SEK 20,075 is compensated for by the complementary unemployment insurance scheme (see section 2.3.1 for details); in this income interval $V^{\min}$ equals 0.8. Above that threshold, however, no further compensation is provided by the public insurance scheme, so $V^{\min}$ decreases with income.

If two (or more) members of a household are employed, $V^{\min}$ is estimated for each. Calculating the income-weighted average value of $V^{\min}$ at the household level is then straightforward.

Though $V^{\min}$ is assumed to be constant across all individuals, given a certain level of income, it is also affected by unemployment duration and private unemployment insurance holdings, which are not accounted for in my estimates. Furthermore, not all individuals are members of an unemployment insurance fund. Hence, $V^{\min} = 0$ is used for all households as a base case; however, the actual estimated values of $V^{\min}$ are included in some housing value regressions.

2.5.3 Housing Prices

For simplicity, housing prices, π, in municipality j are assumed to be random walks with drift of g, as follows:

$$\frac{\pi_{jt}}{\pi_{j,t-1}} = g_j + \varepsilon_{jt},\ E(\varepsilon_{jt}) = 0 \tag{2.7}$$

$$E(\varepsilon_{jt}^2) = \sigma_j^2 \tag{2.8}$$

Data on local housing prices are available annually from Statistics Sweden (see section 2.5.1). Average real price growth and variance of housing prices indices, π_j, are estimated from 1986 through 2003 using the following equations:

$$\hat{g}_j = \sum_{t=1986}^{2003} \left[\frac{\pi_{jt}}{\pi_{j,t-1}} / 18 \right] \tag{2.9}$$

$$\hat{\sigma}_j^2 = \sum_{t=1986}^{2003} \left[\left(\frac{\pi_{jt}}{\pi_{j,t-1}} - \hat{g}_j \right)^2 / (18-1) \right] \tag{2.10}$$

2.5.4 Covariance between Unemployment Risk and Local Housing Prices

Model

The covariance between local housing prices, π_j, and individual unemployment risks, p_i, is estimated for each household head in the sample (the 2003 wave of LINDA), as follows:

$$\hat{Cov}(\pi_j, p_i) = \sum_{t=1986}^{2003} \left[\left(\frac{\pi_{jt}}{\pi_{j,t-1}} - \hat{g}_j \right) \times (\hat{p}_{it} - \hat{p}_{i,t-1}) \right] / (18-1) \tag{2.11}$$

The following assumptions are used:

1. Assumptions (2.7) and (2.8) in section 2.5.3.
2. Unemployment risk, p, is assumed to evolve over time as a random walk (with no drift),[18] as follows:

$$p_{it} = p_{i,t-1} + e_{it}, \; E(e_{it}) = 0 \tag{2.12}$$

$$Var(p_{it}) = E(e_{it}^2) = \sigma_i^2 \tag{2.13}$$

3. Further assumptions:

$$E(e_{it}\varepsilon_{j,t-v}) = E(e_{it}e_{i,t-v}) = E(\varepsilon_{jt}\varepsilon_{j,t-v}) = 0; \quad v \neq 0 \tag{2.14}$$

$$E(\varepsilon_j e_i) = \sigma_{ji} \tag{2.15}$$

[18] This is in line with the hysteresis hypothesis. Since unemployment rates did not seem to revert to a mean value after temporary shocks, Blanchard and Summers (1986) raised the question of hysteresis, implying that employment shocks would have permanent, or at least very persistent effects on future unemployment rates. If that is so, unemployment rates are expected to possess the characteristics of a unit root process. Their paper in fact found empirical evidence of a hysteresis effect in several European countries.

Empirical Estimates

The distributions of covariance estimates, $\hat{Cov}(\pi_j, p_i)$, are reported in Table 6. As expected, most estimates are negative and their distributions are negatively skewed with a mean of -0.00084 and a median of -0.00063. However, in line with theoretical implications, the average value of $\hat{Cov}(\pi_j, p_i)$ for renters, -0.00116, is almost twice the average value of $\hat{Cov}(\pi_j, p_i)$ for homeowners, -0.00068. This is the first indication in the data that $\hat{Cov}(\pi_j, p_i)$ seems to predict tenure choice.

Table 6 also reports summary statistics for different subsamples. By sector, the *central government sector* displays the least negative average covariance and the *private sector* the most negative average covariance. By industry, the least negative average covariance estimates are found for *fishing* (where it is actually positive), *electricity, gas, and water supply*, and *public administration and defense* (see Figure 3). In contrast, the most negative average covariance estimates are found in the *real estate, renting, and business activities* (see Figure 3), *construction*, and *hotel and restaurant* industries.

To simplify interpretation and comparison, the correlation coefficients between housing prices and unemployment risk, $Corr(\pi, p)$, are reported, using the following relationship:

$$Corr(\pi, p) = \frac{Cov(\pi, p)}{\sqrt{Var(\pi)} \times \sqrt{Var(p)}} \tag{2.16}$$

The sample distribution of $Corr(\pi, p)$ is positively skewed, with a mean of -0.50 and a median of -0.53 (see Table 6). Actually, only a few percent of the observations are positive. In line with theoretical implications, average correlation coefficients are more negative for renters than for owners.

Sampled individuals are also sorted into subsamples based on sector and industry. By sector, the *central government sector* displays the least negative average correlation coefficient (-0.38). By industry, the least negative average correlation coefficients are found for the *fishing* (0.11), *public administration and defense* (-0.12), and *agriculture, hunting,and forestry* (-0.22) industries. As expected, the unemployment risk of employees in the *real estate, renting, and business activities* industry is most negatively correlated with local housing prices, having an average correlation coefficient of -0.61. Most importantly, within a certain industry we observe large variations in the individual correlation coefficients.

In Table 7, average correlation coefficients are sorted into combinations of A-regions (i.e., local labor markets) and industries. The group with the most negative average pairwise correlation coefficients is dominated by the *real estate, renting, and business activities* industry and the group with the largest average positive correlation coefficients is dominated by *public administration and defense*. This is in line with the empirical evidence presented above.

Owner-Occupied Housing and Covariance between Unemployment Risk and Local Housing Prices

The individual estimates of $\hat{Cov}(\pi_j, p_i)$ are used to evaluate (i) ownership probabilities, and (ii) the value of owner-occupied housing. In Table 8, households are categorized according to the average home value in their municipality of residence[19] and by $\hat{Cov}(\pi_j, p_i)$.

As one might expect, the probability of homeownership decreases with the general price level of housing and increases with household disposable income. More importantly, we observe that the ownership probabilities are higher for above-median-covariance households than for below-median households in all home price intervals and in all income quartiles. Formal probit regressions on tenure choice are presented in section 2.6.1.

Furthermore, the mean value of owner-occupied housing in all categories is significantly larger for above-median-covariance households than for below-median households. The largest difference is found in municipalities where the average home value exceeds SEK 1,991,269. In this group, the average value of owner-occupied homes for above-median-covariance households is SEK 1,718,237, and for below-median-covariance households only SEK 919,816. Similar patterns are evident when conditioning on homeownership. Formal regressions on holdings of owner-occupied housing are presented in sections 2.6.2 and 2.6.3.

2.6 Empirical Results

In this section, empirical findings from tenure choice models are presented in section 2.6.1, and findings from regressions on housing value in sections 2.6.2 and 2.6.3.

2.6.1 Tenure Choice

To study tenure choice, the sample described in section 2.5.1 is used to run the following probit model:

$$homeowner_i = z_i'\theta + e_i, \tag{2.17}$$

where z_i is a vector of individual characteristics such as household income, age, household size, gender, marital status, municipality of residence, country of birth, and $\bar{y}_i \hat{Cov}(\pi_j, p_i)$. $\hat{Cov}(\pi_j, p_i)$ is the covariance between housing

[19] In the first quartile, mean municipal home value is below SEK 856,220, in the second quartile between SEK 856,220 and SEK 1,228,677, and in the fourth quartile above SEK 1,991,269.

prices, π_j, and unemployment risk, p_i, for household i living in municipality j and $\bar{y}_i$ is household income/10^5. A positive relationship between $C\hat{o}v(\pi_j, p_i)$ and the probability of owning is predicted by theory.

Empirical results are presented in Table 11. The dependent variable is homeownership. Summary statistics and definitions of the included variables are provided in Tables 9 and 10 and in the Appendix. Four specifications are reported: specifications (3) and (4) include interaction effects with income.

As expected, the probability of owning increases with household size and age. Married couples and individuals born in Sweden are more likely to own, while individuals who changed their place of residence or marital status in the previous four years are less likely to own. In 2003, unemployment risk was found to have a negative effect on homeownership, though, contrary to expectations, the estimated coefficient of the effect of average unemployment risk is positive. However, various factors directly affecting unemployment risk (such as industry, education, and age) are already controlled for.

The estimated coefficient of covariance between unemployment risk and housing prices, $\bar{y}_i C\hat{o}v(\pi_j, p_i)$, is positive and significant in specifications (2)–(4). Since the standard deviation of $y_i C\hat{o}v(\pi_j, p_i)$ is 322 (see Table 10) and the marginal effect is 9 in specification (3), an increase of one standard deviation in the covariance between housing prices and unemployment risk increases the average probability of owning by approximately 0.03 (linear approximation).

Specifications (2) and (4) include interaction variables between four income quartile dummies[20] and $\bar{y}_i C\hat{o}v(\pi_j, p_i)$. It turns out that the effect of $\bar{y}_i C\hat{o}v(\pi_j, p_i)$ is strongest for households in the second income quartile (corresponding to annual income of SEK 246,470–349,445), consistent with the conditions of the Swedish unemployment insurance scheme (described in more detail in section 2.3.1). The weakest effect is found for high-income households.

2.6.2 Value of Owner-Occupied Housing: All Households

To test the hypothesis that value of housing owned is affected by covariance between unemployment risk and local housing prices, $C\hat{o}v(\pi_j, p_i)$, the value of owner-occupied housing is regressed on $y_i\,(1 - V^{\min})\,C\hat{o}v(\pi_j, p_i)$ and on household characteristics. Summary statistics and definitions of included variables are reported in Tables 9 and 10 and in the Appendix. The empirical results of OLS and Tobit regressions are reported below.

[20] In the first quartile, annual household disposable income is below SEK 246,470, in the second quartile SEK 246,470–349,445, and in the fourth quartile above SEK 438,525.

OLS Regressions

The following OLS regression, using the sample described in section 2.5.1 is run:

$$value_i = \alpha + z_i'\theta + \varepsilon_i, \tag{2.18}$$

where $value_i$ is the market value of housing owned by household i and z_i is a vector of personal characteristics such as household income, age, household size, gender, marital status, country of birth, and $y_i(1 - V_i^{\min})C\hat{o}v(\pi_j, p_i)$. Municipality fixed effects are included in all regressions, allowing for divergences in the general price level of housing. A positive relationship is expected between $value$ and $y_i(1 - V_i^{\min})C\hat{o}v(\pi_j, p_i)$.

The empirical results of the first step, where $(1 - V^{\min})$ is set to 1 for all households, are reported in Table 12. Four specifications of the model are used.

As expected, the average value of owner-occupied housing increases with household size and age (estimates not reported). More importantly, the covariance estimate, $y_iC\hat{o}v(\pi_j, p_i)$, is found to be positive and significant, with a point estimate of 298 in specification (1). In specification (3), which includes income interaction effects, the point estimate is slightly higher at 331.

There is no doubt that the empirical impact of $y_iC\hat{o}v(\pi_j, p_i)$ on housing value is economically significant; a one-standard-deviation decrease of $y_iC\hat{o}v(\pi_j, p_i)$ implies a decrease in home value of approximately SEK 96,000.[21] As a benchmark, the average value of owner-occupied housing in the sample is SEK 867,851 (median SEK 645,280).

Specifications (2) and (4) include interaction effects between four income quartile dummies[22] and $y_iC\hat{o}v(\pi_j, p_i)$. The additional effect of $y_iC\hat{o}v(\pi_j, p_i)$ for low-income households (income quartile 1) is negative or close to zero. Interestingly, the strongest effect is found for households in the second income quartile. This is consistent with the structure of the Swedish unemployment insurance scheme, where the cap is set at a monthly income of approximately SEK 20,000 (see section 2.3.1 for details). For high-income households, this interaction effect is found to be negative.

The empirical results of the second step, where the household level of $V^{\min}$ estimated using the technique described in section 2.5.2, are reported in Table A1. All individuals are assumed to be members of an unemployment insurance fund and holdings of private unemployment insurances are disregarded. A low $V^{\min}$ value implies a relatively larger financial loss in case of unemployment, and vice versa.

The strongest effects of $(1 - V^{\min})\, y_iC\hat{o}v(\pi_j, p_i)$ are found for low- and

[21] The standard deviation of $y_iC\hat{o}v(\pi_j, p_i)$ is 322 (see Table 10) with a point estimate of 298 in specification (1) of the model.

[22] In the first quartile, annual household disposable income is below SEK 246,470, in the second quartile SEK 246,470–349,445, and in the fourth quartile above SEK 438,525.

middle-income households while high-income households display the weakest results (see columns 2 and 4). In other words, more financially constrained households seem to be more risk averse than are households with higher incomes. Alternately, low-income households may have longer periods of unemployment, on average, thereby worsening the financial consequences of unemployment.

In all regressions, the market value of owner-occupied housing is approximated by Statistics Sweden using the purchase price coefficient (*K/T ratio*) described above, and the tax-assessed value of the property. Hence, the value of housing owned by a single household is likely measured with some error, though there is no reason to believe that this measurement error is correlated with any explanatory variables. In that case, OLS still produces consistent estimators.

Measurement errors in the explanatory variables are more serious. The covariance between unemployment risk and housing prices is estimated using the local housing price index and the individually estimated time series of unemployment risks. Both these series are measured with error. Due to the potential for measurement error in the covariance between unemployment risk and housing prices, the estimated OLS coefficients are expected to be biased towards zero (attenuation bias).

Tobit Regressions

Since a large proportion of the sample owns zero housing, a Tobit specification is more accurate than an ordinary OLS regression model, as it takes into account the non-trivial proportion of the sample owning zero housing. The Tobit model expresses the value of housing owned in terms of an underlying latent variable:

$$value_i^\star = \alpha + z_i'\theta + \varepsilon_i, \qquad \varepsilon \mid z \sim NORMAL(0, \sigma^2) \tag{2.19}$$

$$value_i = \max(0, value_i^\star) \tag{2.20}$$

where $value_i$ is the market value of housing owned by household i and z_i is a vector of personal characteristics (described above). The Tobit model relies crucially on normality and homoscedasticity in the underlying latent variable model.

The empirical results of the Tobit model are reported in Table A3. The results are very similar to the OLS regression results reported in Table 12, although OLS and Tobit estimates are not directly comparable. Most importantly, the coefficient of $y_i \hat{Cov}(\pi_j, p_i)$ is positive and statistically significant in all Tobit specifications (with a marginal effect of 160–373).

2.6.3 Value of Owner-Occupied Housing: Homeowners Only

To test the hypothesis that the value of housing owned is affected by covariance between unemployment risk and local housing prices, $C\hat{o}v(\pi_j, p_i)$, the value of housing owned is regressed on $y_i\,(1 - V^{\min})\,C\hat{o}v(\pi_j, p_i)$ and on household characteristics, in this case restricted to homeowners only. Summary statistics and definitions of the included variables are reported in Tables 9 and 10 and in the Appendix. The empirical results of OLS and Heckman's two-step regressions are reported below.

OLS Regressions

The following OLS regression, using the sample described in section 2.5.1 but restricted to homeowners only, is run:

$$(value_i \mid owner) = \alpha + z_i'\theta + \varepsilon_i, \tag{2.21}$$

where $value_i$ is the market value of housing owned by household i and z_i is a vector of personal characteristics (see above) including $y_i(1-V_i^{\min})C\hat{o}v(\pi_j, p_i)$. Municipality fixed effects are included in all regressions, allowing for divergences in the general price level of housing. A positive relationship is expected between $value$ and $y_i(1 - V_i^{\min})C\hat{o}v(\pi_j, p_i)$.

In Table 13, $(1 - V^{\min})$ is set to 1 for all households. In all four specifications (see above), the value of housing owned increases with household size and age (estimates not reported). The covariance coefficient, $y_iC\hat{o}v(\pi_j, p_i)$, is found to be strongly significant, with a point estimate of 145 in specification (1), and 184 in specification (3), which includes income interaction effects.

One possibility, though, is that borrowing constraints are imposed on households with large negative covariances by banks and other credit institutions. In other words, the results might be driven by lender policies and not by individual household decisions. However, for homeowners with very low absolute levels of debt (below SEK 9,000) the estimated coefficient of $y_iC\hat{o}v(\pi_j, p_i)$ is 359 (specification (1)).

In Table A2, the value of housing owned is regressed on $(1 - V^{\min})\,y_iC\hat{o}v(\pi_j, p_i)$ and on household characteristics using OLS. In estimating the household level of $V^{\min}$, the method described in section 2.5.2 is used. All individuals are assumed to be members of an unemployment insurance fund and holdings of private unemployment insurances are disregarded. Specifications (2) and (4) include four income quartile dummies and the interaction effects between these dummies and $y_iC\hat{o}v(\pi_j, p_i)$.

The additional effect on $(1 - V^{\min})\,y_iC\hat{o}v(\pi_j, p_i)$ for households with the lowest disposable incomes (income quartile 1) is strong and highly significant. Since the additional effect is weaker or negative for middle- and high-income

households, we can draw the conclusion that low-income households tend to be very risk averse, conditional on homeownership and $V^{\min}$. Alternately, low-income households may have longer periods of unemployment, on average, thereby worsening the financial consequences of unemployment.

Heckman's Two-Step Regression

Since there may be problems with sample selection in regressions restricted to homeowners only, i.e., regression (2.21), a Heckman's two-step selection method is used. For homeowners, we observe the value of preferred housing; for current renters, however, we do not observe anything. As ownership may be systematically correlated with unobservable characteristics, using only homeowners may produce biased estimators.

In the first step, ownership probabilities are estimated using a probit model. Next, the inverse Mill's ratio, λ, is estimated for each individual and is included as an explanatory variable in the second step (the OLS regression):

$$value_i = \alpha + z'_{2i}\theta + \sigma_{12}\lambda(z'_{1i}\beta_1) + v_i \tag{2.22}$$

As a base case for the second step (OLS) of the Heckman model (that is, omitting the inverse of Mill's ratio), specification (1) from Table 13 is used. In that specification, the estimated coefficient of $y_i\hat{Cov}(\pi_j, p_i)$ is 145. Since the results are robust when including the inverse Mill's ratio (the coefficient of $y_i\hat{Cov}(\pi_j, p_i)$ is 142), I conclude that sample selection is not a serious matter in this case.

2.7 Married Couples

So far we have only considered the characteristics (including the covariance between unemployment risk and local housing prices) of the household head, disregarding other household members. In this section, I take a household perspective and focus solely on married couples.

The main objective is to test whether the theory described above applies to married couples as well. However, a related question is whether couples in which both spouses work in the same industry or share the same occupation tend to invest more or less in owner-occupied housing than do couples in which both spouses work in different industries or occupations. Since there is very limited data on occupations in my database, my analysis is focused on industry and sector only.

My second objective is hence to study whether same-industry couples are more likely to own and whether they spend more on owner-occupied housing, conditional on owning, than do different-industry couples. As will be

explained in detail below, the population variance of individual household covariance estimates will have an important impact.

Theory, methodology, and empirical implications are described in section 2.7.1, while section 2.7.2 presents empirical results.

2.7.1 Theory and Methodology

Household Covariance

In line with the theoretical framework outlined above, the covariance between unemployment risk and local housing prices for a household consisting of *spouse* 1 and *spouse* 2 can be described as follows:

$$y_h Cov(\pi_j, p_h) = y_1 Cov(\pi_j, p_1) + y_2 Cov(\pi_j, p_2) \tag{2.23}$$

where $y_h = y_1 + y_2$, $p_h = \left(\frac{(p_1 y_1 + p_2 y_2)}{y_h}\right)$, π_j is a local housing price index, and *spouse* 1 is defined as the spouse with the highest reported income. In other words, the household covariance is a weighted average of the covariances of the two spouses, weighted by their individual incomes.

Population Variance of Household Covariance Estimates

The covariance between unemployment risk and local housing prices for a household consisting of *spouse* 1 and *spouse* 2 conditional on the sectors and industries of both spouses, can be expressed as follows:

$$y_h Cov_{h,ikjl} \equiv (y_h Cov(\pi_j, p_h) | ind_1 = i, ind_2 = j, sec_1 = k, sec_2 = l)$$

where ind_i and sec_i are the industry and sector of *spouse* i.

It follows from equation (2.23) that the conditional population variance of the household covariance estimates, $y_h Cov_{h,ikjl}$, is simply:

$$Var(y_h Cov_{h,ikjl}) = \begin{pmatrix} Var\left(y_1 Cov_{1,ik}\right) + Var\left(y_2 Cov_{2,jl}\right) \\ +2Cov(y_1 Cov_{1,ik}, y_2 Cov_{2,jl}) \end{pmatrix} \tag{2.24}$$

That is, the conditional population variance depends on the correlation between $Cov(\pi, p_1)$ and $Cov(\pi, p_2)$; the higher correlation, the higher variance, ceteris paribus.

I argue, in line with Shore and Sinai (2009), that spouses' unemployment risks are more highly correlated if they work in the same industry and sector than if they work in different industries and sectors. This is obvious in the data (see Table 14).

The average coefficients of correlation between spouses' actual unemployment episodes are significantly higher for couples working in the same in-

dustry and sector than for couples working in different industries and sectors (0.168 versus 0.074). The same is true for average correlations between spouses' (estimated) unemployment risks (0.587 versus 0.373) and between $Cov(\pi, p_1)$ and $Cov(\pi, p_2)$ (0.723 versus 0.424).

From this empirical evidence, I assume with great confidence that

$$\begin{pmatrix} Corr(y_1 Cov_{1,ik}, y_2 Cov_{2,jl} | ik = jl) > \\ Corr(y_1 Cov_{1,ik}, y_2 Cov_{2,jl} | ik \neq jl) \end{pmatrix}$$

implying that

$$Var\left(y_h Cov_{h,ikjl} | ik = jl\right) > Var\left(y_h Cov_{h,ikjl} | ik \neq jl\right) \tag{2.25}$$

In other words, if married couples work in the same industry and sector, the conditional population variance is higher than if they work in different industries and sectors. That is, couples working in different industries and sectors gives rise to a "diversification" effect (i.e., lowering the population variance of individual household covariance estimates). In the next sections, I will demonstrate that this has important implications for both tenure choice and conditional demand.

Tenure Choice

To simplify my theoretical analysis, I assume that $Cov(\pi, p)$ is normally distributed and has a threshold value, a, such that above a the household owns its home with certainty and below a the household rents. Hence, I can use the well-known properties of a truncated normal distribution. The probability that a household rents (or owns) is then simply

$$\Pr(renter) = \Phi(h) \qquad \Pr(owner) = 1 - \Phi(h) \tag{2.26}$$

where $h = \left(\frac{a - E(Cov)}{StdDev(Cov)}\right)$ and Φ is the CDF of a standard normal.

Furthermore, since more than 50% of all households own their homes (86% in the sample), I can assume that $a < E(Cov)$, that is, $h < 0$. Under these assumptions, it follows that

$$\left(\frac{\partial \Pr(owner)}{\partial StdDev(Cov)}\right) < 0. \tag{2.27}$$

Hence, from equations (2.25) and (2.27) it follows that if both spouses work in the same industry and sector, the probability that the household owns is lower (and the probability that the it rents is higher) if not controlling for household covariance, i.e., $y_h Cov_{h,ikjl}$. Interestingly, these are the same as the empirical predictions made in Shore and Sinai (2009).

Conditional Demand

Furthermore, we would like to know the expected value of $Cov(\pi, p)$, conditional on homeownership. Once again, for simplicity I use the properties of the truncated normal distribution. The expected value is then simply

$$E(Cov|Cov > a) = E(Cov) + StdDev(Cov)Z(h), \tag{2.28}$$

where $Z(h)$ is the inverse Mill's ratio $[\phi(h)/\Phi(h)]$. It can be demonstrated that

$$\left(\frac{E(Cov|Cov > a)}{\partial StdDev(Cov)}\right) > 0. \tag{2.29}$$

Using conditions (2.25) and (2.29), I can demonstrate that

$$\left(\begin{array}{c} E\left(y_h Cov_{h,ikjl}|ik = jl, Cov_{h,ikjl} > a\right) > \\ E\left(y_h Cov_{h,ikjl}|ik \neq jl, Cov_{h,ikjl} > a\right) \end{array}\right) \tag{2.30}$$

Hence, we expect that same-industry couples will invest more in owner-occupied housing than will different-industry couples, conditional on owning, $(a > 0)$, and if not controlling for household covariance, i.e., $y_h Cov_{h,ikjl}$.

Different Industries and Sectors

The outcome may differ between sectors and industries. This fact can be exemplified by studying two sectors of the economy: sector g (i.e., the central government sector) and sector p (i.e., the private sector). In the following analysis, it is assumed that $(-1 < h < 0)$.

In case $E(Cov|sector = g) > E(Cov|sector = p)$, it can be demonstrated that

$$\left(\frac{\partial^2 \Pr(owner)}{\partial StdDev(Cov)\partial E(Cov)}\right) < 0. \tag{2.31}$$

Hence, if both spouses work in the same industry and sector a more negative effect on the probability of owning is expected in the high-mean sector (the central government sector) than in the low-mean sector (the private sector). Furthermore, it can be demonstrated that

$$\left(\frac{\partial^2 E(Cov|Cov > a)}{\partial StdDev(Cov)\partial E(Cov)}\right) < 0. \tag{2.32}$$

That is, if both spouses work in the same industry and sector a more positive effect on the expected value of Cov, conditional on owning, $a > 0$, is expected in the low-mean sector (the private sector) than in the high-mean sector (the central government sector).

In case $StdDev(Cov|sector = p) > StdDev(Cov|sector = g)$, it can be demonstrated that

$$\left(\frac{\partial^2 \Pr(owner)}{\partial \left(StdDev(Cov)\right)^2}\right) > 0. \tag{2.33}$$

Hence, if both spouses work in the same industry and sector a more negative effect on the probability of homeownership is expected in the low-variance sector (the central government sector) than in the high-variance sector (the private sector). Furthermore, it can be demonstrated that

$$\left(\frac{\partial^2 E(Cov|Cov > a)}{\partial \left(StdDev(Cov)\right)^2}\right) > 0. \tag{2.34}$$

That is, if both spouses work in the same industry and sector a more positive effect on the expected value of Cov, conditional on owning, is expected in the high-variance sector (the private sector) than in the low-variance sector (the central government sector).

Empirical Implications

As I have demonstrated more formally above, if not controlling for the covariance between household income and local housing prices, we obtain the following empirical implications (note that these implications are very similar to those of Shore and Sinai, 2009; see more in section 2.2):

1. Same-industry couples spend more on owner-occupied housing on average than do different-industry couples ex ante, conditional on homeownership
2. Same-industry couples have a lower probability of becoming homeowners
3. Average spending on rent by same- and different-industry couples does not differ, conditional on renting (I cannot test this empirically, however, due to lack of data)
4. Heterogeneous effects between industries and sectors in the economy arise from differences in expected value and conditional variance of $Cov(\pi, p)$ (not tested by Shore and Sinai, 2009). The strongest positive effect on conditional demand is expected in the private sector, while the strongest negative effect on the probability of becoming homeowner is expected in the central government sector

However, when estimating household covariance, measurement error is very likely. Due to temporary shocks (e.g., temporary part-time work and sickness), the reported income of spouse 2, y_2^{rep}, likely underestimates the

long-term average income of spouse 2, y_2, by an error term, y_2^e. For *spouse* 1, such measurement errors are assumed to be nonexistent or small.[23]

In case of measurement error in $y_2 Cov(\pi_j, p_2)$, the estimated beta will be lower than the actual beta, i.e., there will be attenuation bias. In that case, the empirical implications outlined above will be valid even after controlling for $y_1 Cov(\pi_j, p_1)$ and $y_2^{rep} Cov(\pi_j, p_2)$. The empirical results are presented below.

2.7.2 Empirical Results

For the empirical analysis, the same sample selection criteria apply as above (see section 2.5.1 for details). However, this case includes only married couples (including same-sex couples) living together. Furthermore, if any spouse is unemployed or earns less than SEK 10,000 a year, that household is excluded. The final sample consists of 52,928 households, and 45,205 of these are classified as homeowners. *Spouse* 1 is defined as the spouse with the highest reported income (i.e., *household head*). Summary statistics are provided in Tables 9, 15, and 16.

Tenure Choice

To study tenure choice among married couples, the sample described above is used to run the following probit model:

$$homeowner_i = \alpha + x_i'\theta + I_i + \varepsilon_i, \tag{2.35}$$

where x is a vector of household characteristics (such as household size) and individual characteristics (e.g., industry, sector, income, age group, unemployment risk, and $y\hat{Cov}(\pi_j, p)$) of each spouse, and I is a vector of indicator variables (e.g., same-industry). The empirical results of regression (2.35) are reported in Table 17.

In all specifications, $y_{1i}\hat{Cov}(\pi_j, p_{1i})$ is positive and weakly significant. For *spouse* 2, however, $y_{2i}\hat{Cov}(\pi_j, p_{2i})$ is found to be insignificant.

Specification (1) includes an indicator variable for same-industry couples, I^{ind}. In line with Shore and Sinai (2009), a negative and significant effect is found; the expected probability of ownership is 1% lower for a same-industry than for a different-industry couple.

As we could observe in the correlation table (Table 14), the strongest correlations are expected for couples working in the same industry *and* in the same sector. Therefore, indicator variables for same sector, I^{sector}, and for same industry *and* sector, $I^{ind}I^{sector}$, are added in specification (2). However, the indicator variables are found to be insignificant in this specification.

[23] Recall that *spouse* 1 is defined as the spouse with the highest reported income.

Furthermore, I would like to look into whether there are heterogeneous effects among different sectors of the economy. Therefore, interaction variables between $I^{ind}I^{sector}$ and indicator variables for the private sector, $I^{private}$, the local government sector, $I^{loc.gov.}$, and the central government sector, $I^{cent.gov.}$, are added in specification (3).

A significant negative effect is found for couples working in the central government sector: the expected probability of ownership is 4% lower for a same-industry than for a different-industry couple in that sector. No significant effects are found for couples working in the local government and private sectors. This is in line with expectations, however, as the strongest negative effect on tenure choice is expected for the high-mean-and-low-variance sector, i.e., the central government sector (see section 2.7.1).

Value of Owner-Occupied Housing

The sample described above is used to run the following OLS regression (restricted to homeowners only):

$$(value_i|owner) = \alpha + x_i'\theta + I_i + \varepsilon_i, \tag{2.36}$$

where *value* is the market value of owner-occupied housing, x is a vector of household characteristics (such as household size) and individual characteristics (e.g., industry, sector, income, age group, unemployment risk, and $yC\hat{o}v(\pi_j, p)$) of each spouse, and I is a vector of indicator variables (e.g., same-industry). The empirical results of regression (2.36) are reported in Table 18. Positive coefficients are expected for $y_1C\hat{o}v(\pi_j, p_1)$, $y_2C\hat{o}v(\pi_j, p_2)$, and I.

In all specifications, $y_{1i}C\hat{o}v(\pi_j, p_{1i})$ is strongly positive (approximately 185) and significant. Hence, the effect seems consistent with previous results for the whole sample. For *spouse* 2, however, $y_{2i}C\hat{o}v(\pi_j, p_{2i})$ is found to be insignificant. As explained above, a potential problem is that $y_{2i}C\hat{o}v(\pi_j, p_{2i})$ is measured with error, since y_{2i} is likely to be affected by negative shocks. This could explain the lack of significance in the conditional demand regressions (i.e., attenuation bias, see section 2.7.1).

Specification (1) includes an indicator variable for same-industry couples, I^{ind}. In line with Shore and Sinai (2009), a positive and significant effect is found. Actually, couples working in the same industry invest on average SEK 65,745 more in owner-occupied housing than do different-industry couples, conditional on homeownership. Since the average home value, conditional on owning, in the sample (including married couples only) is SEK 1,468,622, the effect is both statistically and economically significant.

Nevertheless, as we could observe in the correlation table (Table 14), the strongest correlations, and thereby results, are expected for couples working in the same industry *and* in the same sector. Therefore, indicator variables

for same sector, I^{sector}, and for same industry *and* sector, $I^{ind}I^{sector}$, are added in specification (2).

In fact, the interaction variable $I^{ind}I^{sector}$ is found to be highly significant. On average, couples working in the same industry *and* sector spend SEK 109,333 more on owner-occupied housing, conditional on homeownership. However, the indicator variable for same industry, I^{ind}, is found to be insignificant in this specification. Hence, same industry *and* sector seems to be the most relevant measure of unemployment risk correlation.

Furthermore, I would like to look into whether there are heterogeneous effects among different sectors of the economy. Therefore, interaction variables between $I^{ind}I^{sector}$ and indicator variables for the private sector, $I^{private}$, the local government sector, $I^{loc.gov.}$, and the central government sector, $I^{cent.gov.}$, are added in specification (3).

A strong and significant effect is found for the private sector. In fact, spouses working in the same industry and in the private sector spend on average SEK 126,048 more on owner-occupied housing than do couples working in the private sector but in different industries. Furthermore, spouses working in the same industry and in the local government sector spend on average SEK 47,687 more on owner-occupied housing than do couples working in the local government sector but in different industries.

No significant effects are found for the central government sector. This is, however, in line with our expectation that the strongest effects would be found in the low-mean and high-variance sector, i.e., the private sector.

2.8 Conclusions

This paper demonstrates theoretically that the optimal value of owner-occupied housing increases with the covariance between individual unemployment risk and local housing prices.[24] My setting incorporates the fact that the most important labor income risk is that of unemployment. This is consistent with strong empirical evidence of real wage rigidity in Sweden, and with the fact that employee stock ownership plans (ESOPs) and profit-sharing programs are relatively uncommon among Swedish employees.

Furthermore, Swedish employment protection legislation is not as strict as one may think; the Swedish labor market is actually quite similar to that of the United States in terms of companies' freedom to reduce their workforces in the event of work shortage. In fact, the shortest termination notice period in Europe is found in Sweden, and unemployment insurance benefits are capped at a relatively low level.

[24]Note that a positive covariance between unemployment risk and housing prices implies a negative covariance between labor income and housing prices.

Using a unique Swedish register-based database, a positive relationship between the value of owner-occupied housing and the covariance between unemployment risk and local housing prices is found empirically among Swedish households. Both tenure choice and conditional demand are affected. To summarize, a one-standard-deviation increase in the unemployment risk–house price covariance implies an increase in the value of owner-occupied housing of approximately SEK 96,000 (USD 13,300). The results are robust to different model specifications.

The empirical effects turn out to be greatest among middle-income households, which is consistent with the conditions of the Swedish public unemployment benefit schemes. Furthermore, similar results are found for households with very low absolute levels of debt, households less likely to face credit constraints. Hence, the results seem to be driven by individual household decisions and not by banks' and other credit institutions' lending policies.

I also demonstrate, both theoretically and empirically, that married couples in which both spouses work in the same industry on average invest more in owner-occupied housing, conditional on owning, than do couples in which both spouses work in different industries. On the other hand, the probability of ownership is somewhat lower for same-industry couples.

It is hoped that this paper builds our empirical insight into the large cross-sectional variation in household portfolios of risky assets, with a focus on real estate holdings. The insights from this study may be used in further research, for example, in measuring the efficiency of household portfolios of risky assets and estimating the possible gains accruing from the development of various real estate derivatives. A possible future extension would be to include risky financial assets, such as stocks and bonds, in the model.

A Appendix

Age group: Dummies for (1) 26–30 years old, (2) 31–35 years old, (3) 36–40 years old, (4), 41–45 years old, (5) 46–50 years old, (6) 51–55 years old, and (7) 56–60 years old

Civil status change: Dummy for whether the individual has changed civil status since January 1, 1999

Country of birth: Dummies for (1) Sweden, (2) Nordic countries, (3) EU15 + 6 OECD countries, and (4) all other countries

Education (field of study): (1) General education, (2) teaching methods and teacher education, (3) humanities and arts, (4) social sciences, law, commerce, and administration, (5) natural sciences, mathematics, and computing, (6) engineering and manufacturing, (7) agriculture and forestry; veterinary medicine, (8) health care and nursing; social care, and (9) services

Education (level): (1) Primary and lower secondary education less than nine years, (2) primary and lower secondary education nine (or 10) years, (3) upper secondary education, (4) post-secondary education less than two years, (5) post-secondary education, two years or more, and (6) postgraduate education

Income: Disposable income

Industry: Dummies for (1) agriculture, hunting, and forestry, (2) fishing, (3) mining and quarrying, (4) manufacturing, (5) electricity, gas, and water supply, (6) construction, (7) wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods, (8) hotels and restaurants, (9) transport, storage, and communication, (10) financial intermediation, (11) real estate, renting, and business activities, (12) public administration and defense, compulsory social security, and extra-territorial organizations and bodies, (13) education, health, and social work, and (14) other community, social and personal service activities

Marital status: Dummy for whether the individual is married

Move: Dummy for whether the individual has changed place of residence since January 1, 1999

Region: Dummies for 70 A-regions (local labor markets)

Sector: Dummies for (1) central government sector, (2) local government (municipality) sector, and (3) private sector

Table A1: OLS Regressions on Housing Value

	(1) Housing value	(2) Housing value	(3) Housing value	(4) Housing value
$y(1-V^{min})Cov(\pi,p)$	439***	590***	559***	541***
	[82]	[80]	[78]	[80]
$y(1-V^{min})Cov(\pi,p)$[INCQ1]		-81		743***
		[92]		[126]
$y(1-V^{min})Cov(\pi,p)$[INCQ2]		530***		736***
		[70]		[76]
$y(1-V^{min})Cov(\pi,p)$[INCQ4]		-252***		-400***
		[67]		[72]
Family size	79,194***	66,313***	56,140***	40,130***
	[3,357]	[2,479]	[9,195]	[10,286]
y[Family size]			0.05*	0.07**
			[0.03]	[0.03]
Female	-60,408***	-41,262***	-31,406	15,215
	[6,655]	[6,582]	[20,449]	[20,466]
y[Female]			-0.08	-0.18***
			[0.06]	[0.06]
Move	-51,345***	-50,043***	-49,960***	-49,073***
	[6,184]	[6,130]	[6,129]	[6,087]
Civil status change	-54,468***	-42,823***	-56,804***	-46,743***
	[5,965]	[5,932]	[6,117]	[6,071]
Married	230,764***	193,853***	316,455***	225,767***
	[7,338]	[7,029]	[29,884]	[30,966]
y[Married]			-0.23***	-0.04
			[0.08]	[0.08]
Local government sector	18,568*	19,808*	69,388**	71,711**
	[10,592]	[10,509]	[33,756]	[32,473]
y[Local government sector]			-0.16	-0.18*
			[0.10]	[0.10]
Private sector	54,768***	60,825***	114,573***	116,816***
	[8,920]	[8,831]	[27,417]	[25,902]
y[Private sector]			-0.18**	-0.21***
			[0.08]	[0.08]
$y(1-V^{min})p(2003)$	-8.75***	-6.64**	-18.15***	-15.28***
	[3.17]	[3.12]	[3.20]	[3.52]
$y(1-V^{min})p(average)$	18.17***	14.04***	29.15***	27.72***
	[3.72]	[3.85]	[3.52]	[3.86]
$y(1-V^{min})Var(p)$	-106.28	-24.44	-120.41	-213.21**
	[130.02]	[114.89]	[106.32]	[104.32]
Constant	-41,295	556,391	-305,215	283,580
Observations	147,906	147,906	147,906	147,906
Adjusted R^2	0.427	0.433	0.433	0.438

This table presents empirical results of OLS regressions on values of owner-occupied single-family homes. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, $Cov(\pi,p)$ is covariance between local housing prices and unemployment risk, $p(2003)$ is unemployment risk in 2003, $p(average)$ is average unemployment risk (1985–2003), V^{min} is the share of income not covered by unemployment insurance benefits in case of unemployment, and y is household disposable income. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table A2: OLS Regressions on Housing Value; Homeowners Only

	(1) Housing value	(2) Housing value	(3) Housing value	(4) Housing value
$y(1-V^{min})Cov(\pi,p)$	215***	342***	179**	319***
	[72]	[76]	[74]	[76]
$y(1-V^{min})Cov(\pi,p)$[INCQ1]		1,152***		1,765***
		[179]		[226]
$y(1-V^{min})Cov(\pi,p)$[INCQ2]		298***		465***
		[78]		[91]
$y(1-V^{min})Cov(\pi,p)$[INCQ4]		-120**		-302***
		[60]		[69]
Family size	51,832***	51,317***	33,119***	32,857***
	[2,754]	[2,667]	[11,581]	[12,560]
y[Family size]			0.05	0.04
			[0.03]	[0.03]
Female	-23,456***	-23,565***	8,006	9,075
	[7,187]	[7,370]	[26,580]	[27,246]
y[Female]			-0.08	-0.08
			[0.07]	[0.07]
Move	7,001	6,474	7,366	6,782
	[7,830]	[7,814]	[7,794]	[7,782]
Civil status change	-15,747**	-15,090**	-16,580***	-15,534**
	[6,279]	[6,261]	[6,312]	[6,308]
Married	100,554***	97,421***	163,249***	144,482***
	[6,928]	[7,311]	[36,516]	[39,768]
y[Married]			-0.14	-0.10
			[0.10]	[0.10]
Local government sector	-2,028	-3,309	67,729	53,305
	[11,467]	[11,483]	[43,600]	[43,511]
y[Local government sector]			-0.19*	-0.16
			[0.11]	[0.11]
Private sector	49,983***	54,623***	71,390**	92,404***
	[9,570]	[9,686]	[32,201]	[32,417]
y[Private sector]			-0.08	-0.12
			[0.08]	[0.08]
$y(1-V^{min})p(2003)$	-7.18**	-7.32**	-8.26**	-8.71**
	[3.57]	[3.59]	[3.26]	[3.39]
$y(1-V^{min})p(average)$	13.66***	13.62***	16.76***	17.17***
	[4.59]	[4.67]	[3.74]	[3.83]
$y(1-V^{min})Var(p)$	-87.11	-79.04	-226.02**	-228.47**
	[108.88]	[111.24]	[108.27]	[107.33]
Constant	84,296	1,261,436	-128,854	925,774
Observations	97,936	97,936	97,936	97,936
Adjusted R^2	0.576	0.576	0.579	0.580

This table presents empirical results of OLS regressions on values of owner-occupied single-family homes, in this case restricted to homeowners only. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, $Cov(\pi,p)$ is covariance between local housing prices and unemployment risk, $p(2003)$ is unemployment risk in 2003, $p(average)$ is average unemployment risk (1985–2003), V^{min} is the share of income not covered by unemployment insurance benefits in case of unemployment, and y is household disposable income. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table A3: Tobit Regressions on Housing Values

	(1) Housing value	(2) Housing value	(3) Housing value	(4) Housing value
yCov(π,p)	160***	227***	373***	302***
	[17]	[23]	[21]	[24]
yCov(π,p)[INCQ1]		293***		325***
		[42]		[48]
yCov(π,p)[INCQ2]		215***		219***
		[25]		[26]
yCov(π,p)[INCQ4]		-60***		-30
Family size	93,769***	69,828***	127,023***	79,841***
	[2,019]	[2,088]	[4,320]	[4,687]
y[Family size]			-0.12***	-0.04***
			[0.01]	[0.01]
Female	-109,208***	-57,852***	-39,818***	12,126
	[5,961]	[6,095]	[11,679]	[11,795]
y[Female]			-0.06**	-0.13***
			[0.03]	[0.03]
Move	-81,454***	-80,822***	-79,806***	-79,628***
	[6,382]	[6,370]	[6,366]	[6,356]
Civil status change	-23,778***	-24,061***	-41,573***	-33,325***
	[5,967]	[5,960]	[5,976]	[5,973]
Married	294,523***	222,065***	461,238***	344,299***
	[5,649]	[5,887]	[12,449]	[13,054]
y[Married]			-0.64***	-0.40***
			[0.03]	[0.03]
Local government sector	15,302	19,646*	140,433***	139,244***
	[10,519]	[10,486]	[25,492]	[25,538]
y[Local government sector]			-0.34***	-0.34***
			[0.06]	[0.06]
Private sector	8,603	47,482***	160,189***	156,279***
	[8,821]	[8,926]	[20,837]	[21,010]
y[Private sector]			-0.27***	-0.25***
			[0.05]	[0.05]
yp(2003)	-5.54***		-9.11***	-8.14***
	[0.57]		[0.70]	[0.69]
yp(average)	13.71***		13.29***	11.40***
	[0.64]		[0.72]	[0.72]
yVar(p)	-118.99***		-62.82**	-30.58
	[25.48]		[27.83]	[27.75]
Constant	-1,557,731	-689,723	-1,812,204	-1,126,990
Observations	147,906	147,906	147,906	147,906
Log likelihood	-1.529e+06	-1.528e+06	-1.528e+06	-1.527e+06
Pseudo R^2	0.0252	0.0258	0.0258	0.0263

This table presents empirical results of tobit regressions on values of owner-occupied single-family homes. Marginal effects evaluated at the mean are reported. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk (1985–2003), V^{min} is the share of income not covered by unemployment insurance benefits in case of unemployment, and *y* is household disposable income. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

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Table 1: Aggregate Wealth

	1999		2003	
Real estate	**2,253**	**(56.3%)**	**3,278**	**(68.8%)**
Single-family homes	*1,347*	*(33.6%)*	*1,984*	*(41.6%)*
Cooperative apartments	*247*	*(6.2%)*	*446*	*(9.4%)*
Other real estate	*659*	*(16.5%)*	*848*	*(17.8%)*
Financial assets	**1,530**	**(38.2%)**	**1,397**	**(29.3%)**
Bank accounts	*365*	*(9.1%)*	*458*	*(9.6%)*
Mutual funds	*401*	*(10.0%)*	*419*	*(8.8%)*
Stocks	*517*	*(12.9%)*	*328*	*(6.9%)*
Other financial assets	*247*	*(6.2%)*	*192*	*(4.0%)*
Other assets	**222**	**(5.5%)**	**89**	**(1.9%)**
Total assets	**4,005**	**(100%)**	**4,765**	**(100%)**
Debt	**1,056**		**1,477**	
Net wealth	**2,949**		**3,288**	

This table presents aggregate wealth in Sweden in billions of Swedish kronor (SEK) at the end of 1999 and 2003. Percentages of total assets are shown in parentheses. Source: Statistics Sweden.

Table 2: ESOPs and Profit-Sharing Programs

	Management		Professional/ Technical		Clerical/ Administrative		Manual	
	ESOPs	*Profits*	*ESOPs*	*Profits*	*ESOPs*	*Profits*	*ESOPs*	*Profits*
Germany	11.6%	60.6%	8.1%	26.5%	7.7%	17.1%	5.9%	11.8%
France	14.8%	75.9%	7.6%	74.9%	7.0%	74.7%	6.2%	59.8%
Sweden	7.1%	15.3%	3.8%	12.5%	4.1%	14.2%	3.3%	11.7%
U.K.	30.5%	26.1%	21.4%	22.1%	19.1%	21.0%	16.6%	18.0%

This table presents the proportion of organizations in four European countries offering employee stock ownership plans (*ESOPs*) and profit-sharing programs (*Profits*) by personnel category. The data are from the 1995 wave of the Cranfield Network on European Human Resource Management dataset (Cranet-E). Source: Festing, Groening, Kabst, and Weber (1999).

Table 3: Unemployment Insurance Policies

Country	Year	Eligibility conditions	Waiting period	Maximum Duration	Initial payment rate (% of earnings)	Coverage rate
SWEDEN	1990	E: 4 months in last year C: 12 months	5 days	14 months	90% of gross earnings	0.74
	1995	E: 6 months in last year C: 12 months	5 days	14 months	75% of gross earnings	n/a
	2002	E: 6 months in last year C: 12 months	5 days	14 months	80% of gross earnings	0.85
GERMANY	1990	E: 12 months C: 12 months in 3 years	None	12 months	63% of net earnings	0.74
	1995	E: 12 months C: 12 months in 3 years	None	12 months	60% of net earnings	0.77
	2002	E: 12 months C: 12 months in 3 years	None	12 months	60% of net earnings	0.70
U.K.	1990	C: 2 years	3 days	12 months	21% of average production worker	0.80
	1995	C: 2 years	3 days	6 months	18% of average production worker	n/a
	2002	C: 2 years	3 days	6 months	14% of average production worker	0.82

This table presents conditions of public unemployment insurance policies in Sweden, Germany, and the U.K. *E* is the employment condition, *C* is the contribution condition, and *Coverage* is the percentage of unemployed individuals covered by unemployment insurance. Source: Duman (2005).

Table 4: Tenure Choice

Type of building	Number of households (in 1,000s)	Home-owners	Coop owners	Renters	Others	N/a
All	3,830	41%	15%	40%	4%	1%
One- or two-dwelling building	1,861	82%	3%	11%	4%	0%
Three- or more dwelling building	1,969	2%	26%	67%	4%	2%

This table presents the shares of Swedish households by type of building and tenure in 1990. *Coop owners* refers to owners of cooperative apartments.
Source: Bostads- och byggnadsstatistik årsbok 2006, Statistics Sweden, 2006.

Table 5: Unemployment Risks

	(1985) Unemployed	(1988) Unemployed	(1991) Unemployed	(1994) Unemployed	(1997) Unemployed	(2000) Unemployed	(2003) Unemployed
Female	0.015***	0.021***	0.012***	0.019***	0.048***	0.049***	0.030***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]	[0.001]
Married	-0.025***	-0.023***	-0.028***	-0.042***	-0.043***	-0.038***	-0.031***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Age 31–35 years	-0.011***	-0.012***	-0.016***	-0.041***	-0.035***	-0.022***	-0.012***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
Age 36–40 years	-0.016***	-0.018***	-0.025***	-0.068***	-0.064***	-0.040***	-0.028***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
Age 41–45 years	-0.019***	-0.021***	-0.034***	-0.083***	-0.080***	-0.055***	-0.040***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]	[0.002]
Age 46–50 years	-0.020***	-0.023***	-0.038***	-0.098***	-0.093***	-0.064***	-0.050***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Age 51–55 years	-0.021***	-0.022***	-0.037***	-0.102***	-0.098***	-0.066***	-0.055***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Age 56–60 years	-0.021***	-0.023***	-0.037***	-0.107***	-0.095***	-0.057***	-0.051***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Born in other Nordic countries	0.022***	0.018***	0.026***	0.043***	0.035***	0.036***	0.026***
	[0.003]	[0.002]	[0.002]	[0.004]	[0.004]	[0.004]	[0.004]
Born in EU15 + 6 OECD countries	0.034***	0.023***	0.032***	0.051***	0.049***	0.038***	0.029***
	[0.005]	[0.005]	[0.005]	[0.007]	[0.007]	[0.007]	[0.006]
Born in all other countries	0.061***	0.062***	0.089***	0.169***	0.208***	0.169***	0.106***
	[0.005]	[0.004]	[0.003]	[0.004]	[0.004]	[0.004]	[0.003]
Local government sector	0.010***	0.005***	0.003	-0.002	0.002	0.017***	0.004
	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]
Private sector	0.016***	0.009***	0.015***	0.053***	0.050***	0.040***	0.029***
	[0.002]	[0.001]	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]
Fishing	0.203**	0.088*	0.222***	-0.005	0.029	0.070***	0.022
	[0.088]	[0.046]	[0.065]	[0.021]	[0.021]	[0.024]	[0.018]
Mining & quarrying	-0.029***	-0.028***	-0.032***	-0.057***	-0.054***	-0.053***	-0.040***
	[0.002]	[0.001]	[0.003]	[0.005]	[0.005]	[0.004]	[0.004]

Table 5 (cont.)

	(1985) Unemployed	(1988) Unemployed	(1991) Unemployed	(1994) Unemployed	(1997) Unemployed	(2000) Unemployed	(2003) Unemployed
Manufacturing	-0.039***	-0.035***	-0.038***	-0.101***	-0.105***	-0.075***	-0.067***
	[0.002]	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]
Electricity, gas, & water supply	-0.031***	-0.029***	-0.045***	-0.112***	-0.104***	-0.086***	-0.073***
	[0.001]	[0.001]	[0.001]	[0.003]	[0.003]	[0.003]	[0.003]
Construction	0.011***	-0.011***	-0.015***	0.012**	0.014**	-0.007	-0.015***
	[0.004]	[0.002]	[0.003]	[0.006]	[0.006]	[0.005]	[0.004]
Wholesale & retail trade	-0.027***	-0.023***	-0.024***	-0.054***	-0.053***	-0.033***	-0.024***
	[0.002]	[0.001]	[0.002]	[0.004]	[0.004]	[0.004]	[0.004]
Hotels & restaurants	-0.005	-0.005	0.008*	0.029***	0.016**	0.010	0.014**
	[0.004]	[0.003]	[0.004]	[0.008]	[0.008]	[0.007]	[0.007]
Transport, storage, & communication	-0.027***	-0.027***	-0.028***	-0.060***	-0.050***	-0.032***	-0.034***
	[0.001]	[0.001]	[0.002]	[0.004]	[0.004]	[0.004]	[0.003]
Financial intermediation	-0.033***	-0.031***	-0.031***	-0.051***	-0.072***	-0.066***	-0.062***
	[0.001]	[0.001]	[0.002]	[0.004]	[0.003]	[0.003]	[0.002]
Real estate & business activities	-0.023***	-0.023***	-0.023***	-0.017***	-0.029***	-0.024***	-0.013***
	[0.002]	[0.001]	[0.002]	[0.005]	[0.004]	[0.004]	[0.004]
Public administration & defense	-0.013***	-0.023***	0.010**	-0.064***	-0.068***	-0.061***	-0.057***
	[0.003]	[0.001]	[0.004]	[0.005]	[0.004]	[0.004]	[0.003]
Education, health, & social work	-0.023***	-0.020***	-0.005	0.022***	0.022***	0.008*	0.003
	[0.002]	[0.003]	[0.003]	[0.005]	[0.005]	[0.005]	[0.005]
Community, social, & personal services	-0.016***	-0.016***	-0.009***	-0.029***	-0.009*	-0.003	-0.005
	[0.002]	[0.002]	[0.003]	[0.005]	[0.005]	[0.005]	[0.005]
Observations	203,349	232,019	300,220	293,076	291,745	288,627	288,184
Share unemployed	0.0499	0.0462	0.0637	0.154	0.152	0.126	0.107
Log likelihood	-35,981	-38,888	-64,850	-114,117	-110,145	-96,515	-89,637
Pseudo R^2	0.108	0.105	0.0892	0.0949	0.114	0.117	0.0878

This table presents empirical results of probit regressions on unemployment risk. For each year, 1985 through 2003, the probability of receiving unemployment benefits is estimated using the annual waves of the LINDA database. Marginal effects (evaluated at the mean) for 1985, 1988, 1991, 1994, 1997, 2000, and 2003 are reported. Standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. The base group is male, unmarried, age 26–30 years, born in Sweden, works in the agriculture, hunting, and forestry industry, and belongs to the central government sector. Dummy variables for A-regions (*local labor markets*) and education are included in all regressions but not reported here (see the Appendix for details).

Table 6: Covariance and Correlation Coefficients

	Number of obs.	COVARIANCE (multiplied by 100)					CORRELATION				
		Mean	Median	StdDev	Min	Max	Mean	Median	StdDev	Min	Max
All observations	147,906	-0.084	-0.063	0.076	-0.686	0.543	-0.50	-0.53	0.20	-0.91	0.61
By tenure											
Renters	49,970	-0.116	-0.093	0.092	-0.686	0.295	-0.55	-0.59	0.19	-0.91	0.48
Homeowners	97,936	-0.068	-0.053	0.061	-0.620	0.543	-0.47	-0.50	0.20	-0.91	0.61
By sector											
Central government sector	14,835	-0.050	-0.035	0.060	-0.529	0.133	-0.38	-0.42	0.26	-0.90	0.53
Local government sector	37,644	-0.079	-0.061	0.067	-0.569	0.262	-0.55	-0.59	0.20	-0.90	0.53
Private sector	95,427	-0.092	-0.069	0.080	-0.686	0.543	-0.49	-0.52	0.19	-0.91	0.61
By industry											
Agriculture, hunting, & forestry	1,955	-0.051	-0.044	0.056	-0.355	0.192	-0.22	-0.23	0.19	-0.67	0.44
Fishing	107	0.058	0.060	0.125	-0.196	0.543	0.11	0.08	0.18	-0.24	0.61
Mining & quarrying	2,703	-0.071	-0.062	0.049	-0.378	0.036	-0.48	-0.51	0.16	-0.79	0.21
Manufacturing	32,152	-0.044	-0.035	0.037	-0.388	0.189	-0.39	-0.41	0.17	-0.80	0.55
Electricity, gas, & water supply	1,268	-0.015	-0.011	0.015	-0.141	0.027	-0.35	-0.36	0.17	-0.81	0.28
Construction	11,225	-0.151	-0.134	0.085	-0.641	0.084	-0.55	-0.59	0.15	-0.89	0.36
Wholesale & retail trade	16,467	-0.082	-0.066	0.062	-0.470	0.123	-0.51	-0.54	0.17	-0.88	0.45
Hotels & restaurants	914	-0.168	-0.144	0.108	-0.565	0.138	-0.53	-0.55	0.16	-0.82	0.25
Transport, storage, & communication	9,819	-0.081	-0.066	0.061	-0.501	0.078	-0.55	-0.59	0.18	-0.90	0.34
Financial intermediation	4,734	-0.081	-0.066	0.057	-0.513	0.059	-0.53	-0.56	0.14	-0.79	0.35
Real estate & business activities	12,901	-0.138	-0.117	0.089	-0.686	0.107	-0.61	-0.64	0.15	-0.91	0.27
Public administration & defense	4,096	-0.009	-0.005	0.031	-0.266	0.133	-0.12	-0.12	0.21	-0.73	0.53
Education, health, & social work	44,919	-0.089	-0.068	0.075	-0.637	0.262	-0.55	-0.59	0.19	-0.90	0.49
Community, social, & personal services	4,646	-0.123	-0.100	0.090	-0.532	0.136	-0.56	-0.60	0.19	-0.85	0.32

This table presents summary statistics on local housing price–unemployment risk covariance and correlation coefficient estimates. Results are reported by tenure, sector, and industry. *StdDev* is standard deviation. Note that the covariance estimates are multiplied by 100.

Table 7: Average Correlations

A-region	Industry	Obs.	Average correlation
Panel A: Most negative			
Kristianstad	Real estate & business activities	113	-0.7206
Enköping	Real estate & business activities	109	-0.7181
Enköping	Construction	142	-0.7089
Örebro	Real estate & business activities	241	-0.6987
Norrköping	Real estate & business activities	219	-0.6941
Enköping	Transport, storage, & communication	77	-0.6880
Enköping	Wholesale & retail trade	150	-0.6822
Eskilstuna	Education, health, & social work	606	-0.6821
Visby	Construction	77	-0.6803
Enköping	Community, social, & personal services	26	-0.6785
Stockholm/Södertälje	Real estate & business activities	4,178	-0.6761
Eskilstuna	Real estate & business activities	188	-0.6757
Eskilstuna	Community, social, & personal services	48	-0.6747
Örnsköldsvik	Mining & quarrying	23	-0.6726
Visby	Education, health, & social work	392	-0.6723
Örnsköldsvik	Real estate & business activities	36	-0.6695
Ljungby	Real estate & business activities	32	-0.6678
Helsingborg/Landskrona	Education, health, & social work	1,010	-0.6661
Visby	Real estate & business activities	39	-0.6653
Umeå	Real estate & business activities	146	-0.6632
Panel B: Most positive			
Kristianstad	Public administration & defense	45	-0.0058
Umeå	Public administration & defense	49	-0.0000
Karlshamn	Agriculture, hunting, & forestry	21	0.0003
Linköping/Skara	Public administration & defense	51	0.0015
Östersund	Public administration & defense	82	0.0050
Eksjö/Nässjö/Vetlanda	Public administration & defense	55	0.0091
Kalmar/Nybro	Public administration & defense	45	0.0405
Halmstad	Public administration & defense	102	0.0423
Örebro	Public administration & defense	91	0.0470
Karlstad	Public administration & defense	85	0.0530
Nyköping	Public administration & defense	40	0.0577
Skövde	Public administration & defense	85	0.0623
Gävle/Sandviken	Public administration & defense	49	0.0766
Göteborg	Fishing	25	0.0905
Karlshamn	Public administration & defense	31	0.0922
Kiruna/Gällivare	Public administration & defense	21	0.1082
Köping	Public administration & defense	27	0.1106
Karlskrona	Public administration & defense	146	0.1136
Sundsvall	Public administration & defense	55	0.1149
Härnösand/Kramfors	Public administration & defense	25	0.1387

This table presents pairs of A-regions (*local labor markets*) and industries sorted by average correlation coefficient. Note that groups containing fewer than 20 observations are not included.

Table 8: Home Values and Ownership Probabilities

	Housing value			Ownership probability				
					Income quartile			
	Obs.	Mean	Median	All	1	2	3	4
Panel A: Quartile 1 (average municipality housing value below SEK 856,220)								
All households	36,124	502	500	0.79	0.49	0.83	0.91	0.94
Cov(π,p) > median	*24,464*	*527*	*519*	*0.83*	*0.54*	*0.85*	*0.92*	*0.94*
Cov(π,p) < median	*11,660*	*450*	*454*	*0.72*	*0.43*	*0.79*	*0.89*	*0.92*
Homeowners only	28,684	632	585					
Cov(π,p) > median	*20,263*	*636*	*587*					
Cov(π,p) < median	*8,421*	*623*	*581*					
Panel B: Quartile 2 (average municipality housing value SEK 856,220–1,228,677)								
All households	37,746	741	772	0.71	0.36	0.71	0.86	0.91
Cov(π,p) > median	*20,078*	*843*	*860*	*0.79*	*0.44*	*0.77*	*0.88*	*0.92*
Cov(π,p) < median	*17,668*	*624*	*641*	*0.63*	*0.31*	*0.66*	*0.84*	*0.88*
Homeowners only	26,952	1,038	969					
Cov(π,p) > median	*15,851*	*1,068*	*990*					
Cov(π,p) < median	*11,101*	*994*	*938*					
Panel C: Quartile 3 (average municipality housing value SEK 1,228,677–1,991,269)								
All households	36,627	1,007	1,033	0.64	0.26	0.60	0.80	0.88
Cov(π,p) > median	*15,699*	*1,254*	*1,284*	*0.76*	*0.35*	*0.68*	*0.84*	*0.90*
Cov(π,p) < median	*20,928*	*822*	*711*	*0.56*	*0.23*	*0.55*	*0.76*	*0.85*
Homeowners only	23,613	1,563	1,436					
Cov(π,p) > median	*11,955*	*1,647*	*1,509*					
Cov(π,p) < median	*11,658*	*1,476*	*1,366*					
Panel D: Quartile 4 (average municipality housing value above SEK 1,991,269)								
All households	37,409	1,212	0	0.50	0.15	0.39	0.62	0.80
Cov(π,p) > median	*13,712*	*1,718*	*1,712*	*0.67*	*0.27*	*0.52*	*0.69*	*0.83*
Cov(π,p) < median	*23,697*	*920*	*0*	*0.40*	*0.12*	*0.34*	*0.58*	*0.77*
Homeowners only	18,687	2,427	2,154					
Cov(π,p) > median	*9,158*	*2,573*	*2,283*					
Cov(π,p) < median	*9,529*	*2,287*	*2,043*					

This table presents average and median values of owner-occupied single-family homes and homeownership probabilities sorted by the average value of owner-occupied single-family homes in the municipality of residence, by the covariance between local housing prices and unemployment risk, and by income quartiles. Housing values are reported in thousands of Swedish kronor (SEK). Household disposable income in the first quartile is below SEK 246,470, in the second quartile between SEK 246,470 and 349,445, and in the fourth quartile above SEK 438,525. The median value of the covariance between local housing prices and employment risk, *Cov(π,p),* is -6.35e-04.

Table 9: Summary Statistics on Individual Characteristics

	All households	Married couples	
	Household head	*Spouse 1*	*Spouse 2*
Female	0.38	0.25	0.75
Married	0.56	1.00	1.00
Move	0.15	0.11	0.11
Civil status change	0.16	0.14	0.14
Age 26–30 years	0.09	0.03	0.04
Age 31–35 years	0.14	0.11	0.13
Age 36–40 years	0.19	0.19	0.20
Age 41–45 years	0.16	0.19	0.20
Age 46–50 years	0.15	0.19	0.19
Age 51–55 years	0.13	0.17	0.15
Age 56–60 years	0.13	0.12	0.09
Born in Sweden	0.90	0.93	0.92
Born in other Nordic countries	0.03	0.02	0.03
Born in EU15 + 6 OECD countries	0.01	0.01	0.01
Born in all other countries	0.06	0.04	0.05
Central government sector	0.10	0.11	0.09
Local government sector	0.25	0.21	0.45
Private sector	0.65	0.68	0.46
Agriculture, hunting, & forestry	0.01	0.01	0.01
Fishing	0.00	0.00	0.00
Mining & quarrying	0.02	0.02	0.01
Manufacturing	0.22	0.24	0.12
Electricity, gas, & water supply	0.01	0.01	0.00
Construction	0.08	0.09	0.03
Wholesale & retail trade	0.11	0.11	0.10
Hotels & restaurants	0.01	0.00	0.01
Transport & communication	0.07	0.07	0.04
Financial intermediation	0.03	0.04	0.03
Real estate & business activities	0.09	0.10	0.07
Public administration & defense	0.03	0.04	0.02
Education, health, & social work	0.30	0.25	0.52
Community & personal services	0.03	0.02	0.03

This table presents average values of dummy variables for individual characteristics. The numbers of observations are 147,906 in the all household sample and 52,928 in the married couple sample. *Spouse 1* is the household head.

Table 10: Summary Statistics

	Mean	StD	Min	Max
Housing value	868	1,025	0	46,403
Housing value|homeowner	1,311	1,003	2	46,403
Family size	3	1	1	14
Age of household head	43	9	26	60
Household disposable income	366	311	0	61,575
Cov(π,p)	–0.00084	0.00076	–0.00686	0.00543
yCov(π,p)	–278	322	–42,262	1,286
p(2003)	0.10	0.07	0.00	0.65
yp(2003)	31,843	30,250	28	4,926,026
p(average)	0.10	0.08	0.00	0.75
yp(average)	31,060	28,783	22	4,119,364
Var(p)	0.00056	0.00071	0.00000	0.01432
yVar(p)	171	235	0	17,750
$(1\text{-}V^{min})$	0.33	0.13	0.20	0.99

This table presents summary statistics on household characteristics for the sample consisting of all households (147,906 observations, 97,936 of which refer to homeowners). *Cov(π,p)* is the covariance between local housing prices and the unemployment risk of the household head, *p(2003)* is the unemployment risk of the household head in 2003, *p(average)* is the average unemployment risk of the household head in 1985–2003, y is household disposable income, and V^{min} is the share of income not covered by unemployment insurance benefits in case of unemployment. Housing values and household disposable incomes are reported in thousands of Swedish kronor (SEK).

Table 11: Probit Regressions on Homeownership

	(1) Homeowner	(2) Homeowner	(3) Homeowner	(4) Homeowner
$\bar{y}$ *Cov(π,p)*	-0.322	4.876***	9.158***	7.179***
	[1.360]	[1.589]	[1.569]	[1.724]
$\bar{y}$ *Cov(π,p)*[INCQ1]		1.932		0.573
		[2.595]		[3.040]
$\bar{y}$ *Cov(π,p)*[INCQ2]		8.263***		7.788***
		[1.588]		[1.657]
$\bar{y}$ *Cov(π,p)*[INCQ4]		-3.303**		-1.234
		[1.417]		[1.587]
Family size	0.043***	0.032***	0.070***	0.046***
	[0.001]	[0.001]	[0.004]	[0.004]
$\bar{y}$ [Family size]			-0.010***	-0.005***
			[0.001]	[0.001]
Female	-0.045***	-0.021***	-0.017*	0.005
	[0.004]	[0.004]	[0.010]	[0.009]
$\bar{y}$ [Female]			-0.004	-0.007***
			[0.003]	[0.002]
Move	-0.075***	-0.075***	-0.076***	-0.075***
	[0.004]	[0.004]	[0.004]	[0.004]
Civil status change	-0.023***	-0.023***	-0.035***	-0.030***
	[0.004]	[0.004]	[0.004]	[0.004]
Married	0.151***	0.118***	0.242***	0.182***
	[0.004]	[0.004]	[0.011]	[0.010]
$\bar{y}$ [Married]			-0.032***	-0.019***
			[0.003]	[0.003]
Local government sector	0.026***	0.026***	0.070***	0.079***
	[0.007]	[0.007]	[0.019]	[0.016]
$\bar{y}$ [Local government sector]			-0.014**	-0.018***
			[0.006]	[0.005]
Private sector	0.006	0.024***	0.086***	0.083***
	[0.006]	[0.006]	[0.018]	[0.016]
$\bar{y}$ [Private sector]			-0.018***	-0.016***
			[0.005]	[0.004]
$\bar{y}$ *p(2003)*	-0.107**	-0.121***	-0.264***	-0.242***
	[0.049]	[0.041]	[0.055]	[0.052]
$\bar{y}$ *p(average)*	0.352***	0.202***	0.368***	0.315***
	[0.051]	[0.045]	[0.055]	[0.053]
$\bar{y}$ *Var(p)*	-3.022	3.055*	-1.496	-0.001
	[1.850]	[1.765]	[1.966]	[1.903]
Observations	147,906	147,906	147,906	147,906
Log likelihood		-65,079	-64,453	-64,592
Pseudo R^2		0.312	0.319	0.317

This table presents empirical results of probit regressions on ownership of owner-occupied single-family homes. Marginal effects evaluated at the mean are reported. Standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. The base group is male, no move or civil status change, unmarried, and works for the central government sector. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk (1985–2003), and $\bar{y}$ is household disposable income/10e5. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table 12: OLS Regressions on Housing Value

	(1) Housing value	(2) Housing value	(3) Housing value	(4) Housing value
yCov(π,p)	298***	348***	331***	328***
	[33]	[29]	[27]	[29]
yCov(π,p)[INCQ1]		-142***		9
		[35]		[53]
yCov(π,p)[INCQ2]		150***		181***
		[23]		[27]
yCov(π,p)[INCQ4]		-71***		-105***
		[27]		[31]
Family size	75,288***	65,044***	47,196***	41,861***
	[3,065]	[2,381]	[9,743]	[10,838]
y[Family size]			0.06**	0.05*
			[0.03]	[0.03]
Female	-70,046***	-44,899***	-46,994**	-12,798
	[7,904]	[7,540]	[20,817]	[20,395]
y[Female]			-0.04	-0.09
			[0.06]	[0.06]
Move	-49,300***	-48,531***	-48,402***	-47,139***
	[6,168]	[6,119]	[6,126]	[6,088]
Civil status change	-50,440***	-39,535***	-53,446***	-43,601***
	[5,951]	[5,931]	[6,099]	[6,066]
Married	239,563***	199,752***	340,120***	271,743***
	[8,818]	[7,868]	[31,136]	[33,968]
y[Married]			-0.29***	-0.17*
			[0.09]	[0.10]
Local government sector	5,408	9,791	47,890	55,864*
	[10,659]	[10,590]	[33,564]	[32,006]
y[Local government sector]			-0.13	-0.16*
			[0.10]	[0.10]
Private sector	49,804***	57,239***	103,858***	86,286***
	[9,416]	[9,641]	[26,897]	[24,992]
y[Private sector]			-0.15*	-0.10
			[0.08]	[0.08]
yp(2003)	-5.82***	-5.73***	-9.26***	-9.09***
	[1.42]	[1.36]	[1.14]	[1.21]
yp(average)	10.33***	8.85***	13.56***	13.03***
	[1.50]	[1.49]	[1.10]	[1.16]
yVar(p)	-33.18	46.13	-45.00	-16.35
	[35.41]	[35.80]	[29.92]	[29.90]
Constant	-249,087	398,225	-327,278	244,274
Observations	147,906	147,906	147,906	147,906
Adjusted R^2	0.427	0.434	0.433	0.438

This table presents empirical results of OLS regressions on values of owner-occupied single-family homes. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk (1985–2003), and *y* is household disposable income. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table 13: OLS Regressions on Housing Value; Homeowners only

	(1) Home value	(2) Home value	(3) Home value	(4) Home value
yCov(π,p)	145***	170***	184***	188***
	[32]	[29]	[26]	[26]
yCov(π,p)[INCQ1]		256***		312***
		[64]		[90]
yCov(π,p)[INCQ2]		70***		79***
		[24]		[30]
yCov(π,p)[INCQ4]		-31		-46
		[24]		[31]
Family size	48,515***	49,811***	24,321**	34,443***
	[2,727]	[2,581]	[11,987]	[13,068]
y[Family size]			0.06*	0.04
			[0.03]	[0.03]
Female	-17,454**	-17,876**	-5,509	-11,609
	[8,194]	[8,647]	[26,364]	[26,659]
y[Female]			0.00	0.01
			[0.07]	[0.07]
Move	8,662	8,029	8,820	8,657
	[7,817]	[7,805]	[7,800]	[7,790]
Civil status change	-11,753*	-12,077*	-13,251**	-14,087**
	[6,377]	[6,353]	[6,298]	[6,311]
Married	95,296***	95,407***	176,838***	183,015***
	[7,847]	[8,430]	[37,283]	[41,246]
y[Married]			-0.23**	-0.24**
			[0.10]	[0.11]
Local government sector	-8,226	-8,073	53,166	47,814
	[11,622]	[11,633]	[44,033]	[43,876]
y[Local government sector]			-0.17	-0.16
			[0.11]	[0.11]
Private sector	54,267***	56,847***	56,320*	64,362**
	[10,368]	[10,827]	[31,955]	[32,126]
y[Private sector]			0.01	-0.01
			[0.08]	[0.08]
yp(2003)	-4.66***	-4.69***	-5.72***	-5.78***
	[1.67]	[1.68]	[1.17]	[1.20]
yp(average)	6.41***	6.39***	6.92***	7.10***
	[1.92]	[1.95]	[1.19]	[1.23]
yVar(p)	22.73	27.62	4.09	0.66
	[38.65]	[40.03]	[30.64]	[31.11]
Constant	21,458	1,114,481	-221,844	733,227
Observations	97,936	97,936	97,936	97,936
Adjusted R^2	0.575	0.576	0.579	0.580

This table presents empirical results of OLS regressions on values of owner-occupied single-family homes, in this case restricted to homeowners only. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. Dummy variables for age group, country of birth, education, and municipality, and interaction variables between municipality and income and income squared are included in all regressions but not reported here. Specifications (3) and (4) also include interaction variables between income and age group, income and country of birth, and income and education. *INCQ1*, *INCQ2*, and *INCQ4* refer to the first, second, and fourth income quartiles, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk in 1985–2003, and *y* is household disposable income. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table 14: Unemployment Correlations

	Same sector	Different sectors
Unemployment		
Same industry	0.168***	0.136***
Different industries	0.073***	0.074***
p(2003)		
Same industry	0.587***	0.426***
Different industries	0.321***	0.373***
Cov(π, p)		
Same industry	0.723***	0.517***
Different industries	0.377***	0.424***

This table reports Pearson correlation coefficients between various risk measures for spouse 1 (i.e., the household head) and spouse 2. In this case, the married couple sample also includes unemployed individuals, for a total of 62,221 married couples. *** denotes significant at 1%. *Unemployment* refers to actual payments of unemployment insurance benefits, *p*(2003) is unemployment risk in 2003, and *Cov(π, p)* is the covariance between local housing prices and unemployment risk. Industries and sectors are described in the Appendix.

Table 15: Married Couples Working in the Same Industry and Sector

	All households	Central government sector	Local government sector	Private sector
Same industry	0.27	0.23	0.49	0.21
Same sector	0.46	0.20	0.49	0.49
Same industry and sector	0.22	0.11	0.42	0.18

This table reports the share of married couples working in the same industry and/or sector by the sector of spouse 1 (i.e., the household head). The sample consists of 52,928 married couples. Industries and sectors are described in the Appendix.

Table 16: Summary Statistics; Married Couples

	Spouse 1 (household head)				Spouse 2			
	Mean	**StdDev**	**Min**	**Max**	**Mean**	**StdDev**	**Min**	**Max**
Housing value	1,254	1,096	0	46,403				
Housing value|homeowner	1,469	1,045	6	46,403				
Family size	4	1	2	12				
Household disposable income	462	313	42	30,322				
Income of spouse 2 as share of income of spouse 1	0.71	0.20	0.00	1.00				
Age	45	8	26	60	44	8	26	60
Income	266	290	16	29,959	172	62	10	6,680
Cov(π,p)	–0.00063	0.00057	–0.00596	0.00226	–0.00071	0.00059	–0.00628	0.00401
yCov(π,p)	–159	267	–41,980	700	–117	100	–1166	551
p(2003)	0.07	0.05	0.00	0.51	0.09	0.06	0.00	0.56
yp(2003)	16,687	21,645	93	3,294,187	14,165	10,076	63	175,558
p(average)	0.07	0.05	0.00	0.56	0.09	0.06	0.00	0.72
yp(average)	15,451	19,237	115	2,942,941	13,716	9,661	120	170,928
Var(p)	0.00034	0.00049	0.00000	0.01179	0.00039	0.00054	0.00000	0.01094
yVar(p)	79	146	0	17,632	61	81	0	1,828

This table reports summary statistics on spouse 1 (i.e., the household head) and spouse 2 characteristics. *Cov(π,p)* is the covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk in 1985–2003, and *y* is disposable income. The sample includes 52,928 married couples, 45,205 of which are classified as homeowners. Housing values and incomes are in thousands of Swedish kronor (SEK).

Table 17: Probit Regressions on Homeownership; Married Couples

	(1) Homeowner		(2) Homeowner		(3) Homeowner	
	Coeff.	**[Marg.]**	**Coeff.**	**[Marg.]**	**Coeff.**	**[Marg.]**
$\bar{y}$ *Cov(π,p)* Spouse 1	26.96*	[4.61]	26.99*	[4.62]	26.68*	[4.55]
	[15.64]		[15.64]		[15.65]	
$\bar{y}$ *Cov(π,p)* Spouse 2	8.87	[1.52]	8.81	[1.51]	9.18	[1.57]
	[21.63]		[21.63]		[21.64]	
Male	0.03	[0.01]	0.03	[0.01]	0.03	[0.01]
	[0.03]		[0.03]		[0.03]	
Household size	0.10***	[0.02]	0.10***	[0.02]	0.10***	[0.02]
	[0.01]		[0.01]		[0.01]	
Income share	-0.41***	[-0.07]	-0.41***	[-0.07]	-0.41***	[-0.07]
	[0.09]		[0.09]		[0.09]	
$\bar{y}$ *Prob(2003)* Spouse 1	-1.19**	[-0.20]	-1.19**	[-0.20]	-1.19**	[-0.20]
	[0.49]		[0.49]		[0.49]	
$\bar{y}$ *Prob(2003)* Spouse 2	0.09	[0.02]	0.10	[0.02]	0.10	[0.02]
	[0.66]		[0.66]		[0.66]	
$\bar{y}$ *Prob(average)* Spouse 1	1.54***	[0.26]	1.53***	[0.26]	1.54***	[0.26]
	[0.54]		[0.54]		[0.54]	
$\bar{y}$ *Prob(average)* Spouse 2	0.74	[0.13]	0.74	[0.13]	0.73	[0.12]
	[0.73]		[0.73]		[0.73]	
$\bar{y}$ *Var(p)* Spouse 1	-38.57*	[-6.60]	-38.35*	[-6.56]	-38.15*	[-6.51]
	[21.60]		[21.60]		[21.61]	
$\bar{y}$ *Var(p)* Spouse 2	-4.13	[-0.71]	-3.75	[-0.64]	-4.15	[-0.71]
	[30.09]		[30.10]		[30.10]	
Same industry	-0.04**	[-0.01]	-0.05	[-0.01]		
	[0.02]		[0.04]			
Same sector			-0.01	[-0.00]		
			[0.02]			
Same industry & sector			0.02	[0.00]		
			[0.05]			

Table 17 (cont.)

	(1) Homeowner		(2) Homeowner		(3) Homeowner	
	Coeff.	**[Marg.]**	**Coeff.**	**[Marg.]**	**Coeff.**	**[Marg.]**
Same sector					0.09	[0.01]
Central government sector					[0.09]	
					-0.01	[-0.00]
Local government sector					[0.08]	
					-0.05	[-0.01]
Private sector					[0.05]	
Same industry & sector						
Central government sector					-0.21**	[-0.04]
					[0.10]	
Local government sector					0.05	[0.01]
					[0.07]	
Private sector					-0.04	[-0.01]
					[0.03]	
Constant	-5.03		-5.03		-4.92	
Observations	52,665		52,665		52,665	
Log likelihood	-17,071		-17,071		-17,069	
Pseudo R^2	0.222		0.222		0.222	

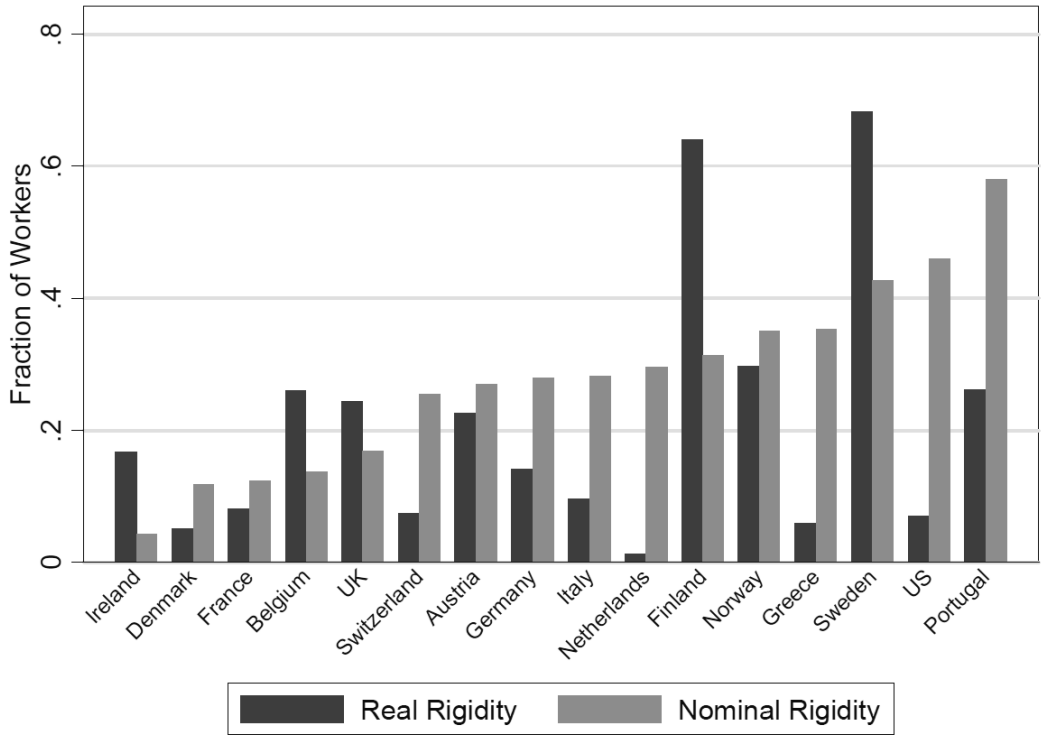
This table presents empirical results of probit regressions on ownership of owner-occupied single-family homes using the sample of married couples. Coefficients and marginal effects (evaluated at the mean using individuals living in municipalities where the probability of homeownership is below 95%) are reported. Standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. For each spouse, dummy variables for age group, country of birth, education, municipality, move, and civil status change, and interaction variables between income and municipality, income and age group, income and country of birth, and income and education are also included. *Spouse 1* is the spouse with the highest reported disposable income, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk (1985–2003), $\bar{y}$ is disposable income/10e5, and *income share* is income of spouse 2 as share of income of spouse 1. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Table 18: OLS Regressions on Housing Value; Married Couples

Dependent variable	(1) Housing value	(2) Housing value	(3) Housing value
yCov(π,p) Spouse 1	186***	184***	185***
	[70]	[70]	[70]
yCov(π,p) Spouse 2	60	60	60
	[93]	[93]	[93]
Male	-30,348*	-28,416*	-27,897*
	[16,620]	[16,604]	[16,546]
Household size	50,894***	50,517***	50,371***
	[3,852]	[3,844]	[3,845]
Income share	-230,746**	-233,527**	-234,326**
	[91,628]	[91,558]	[91,516]
yp(2003) Spouse 1	-3	-3	-2
	[2]	[2]	[2]
yp(2003) Spouse 2	-14***	-14***	-14***
	[3]	[3]	[3]
yp(average) Spouse 1	4	4	4
	[3]	[3]	[3]
yp(average) Spouse 2	19***	18***	18***
	[3]	[3]	[3]
yVar(p) Spouse 1	-47	-34	-33
	[100]	[100]	[100]
yVar(p) Spouse 2	-31	-10	-13
	[121]	[121]	[121]
Same industry	65,745***	-2,792	
	[8,709]	[18,806]	
Same sector		-47,338***	
		[9,909]	
Same industry & sector		109,333***	
		[21,447]	
Same sector			
Central government sector			-1,977
			[34,746]
Local government sector			-43,757
			[28,780]
Private sector			-14,040
			[18,761]
Same industry & sector			
Central government sector			25,535
			[44,972]
Local government sector			47,687*
			[25,155]
Private sector			126,048***
			[14,009]
Constant	2,579,353	2,733,558	2,268,484
Observations	45,205	45,205	45,205
Adjusted R^2	0.599	0.600	0.600

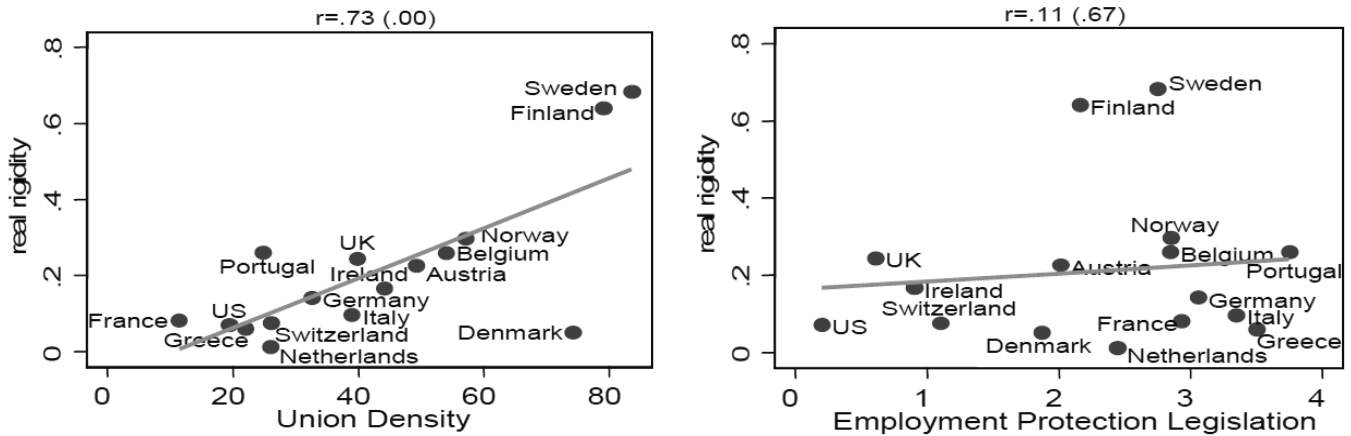
This table presents empirical results of OLS regressions on values of owner-occupied single-family homes using the sample of married couples. Robust standard errors are shown in square brackets. * denotes significant at 10%, ** at 5%, and *** at 1%. For each spouse, dummy variables for age group, country of birth, education, municipality, move, and civil status change, and interaction variables between income and municipality, income squared and municipality, income and age group, income and country of birth, and income and education are also included. *Spouse 1* is the spouse with the highest reported disposable income, *Cov(π,p)* is covariance between local housing prices and unemployment risk, *p(2003)* is unemployment risk in 2003, *p(average)* is average unemployment risk in 1985–2003, *y* is disposable income, and *income share* is income of spouse 2 as share of income of spouse 1. All other variables are described in the Appendix. All amounts are in Swedish kronor (SEK).

Figure 1. Real and Nominal Wage Rigidity



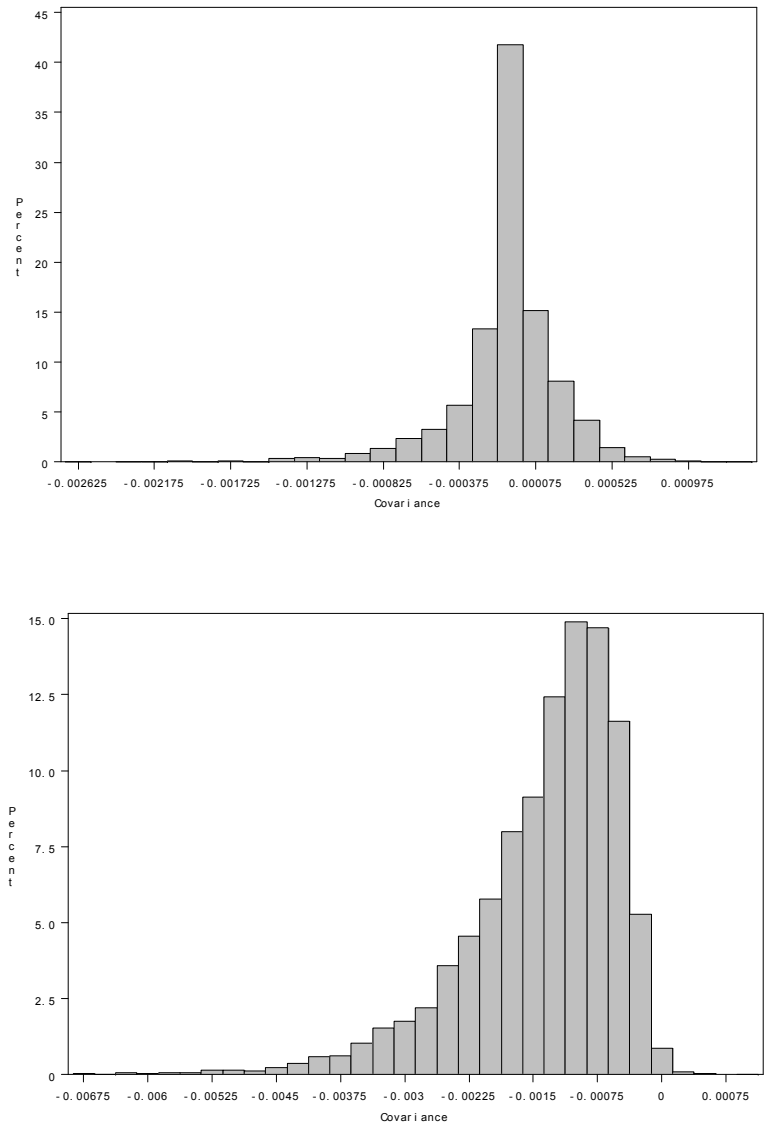
This figure presents the fraction of workers potentially affected by real and nominal wage rigidity by country. Source: Dickens, Goette, Groshen, Holden, Messina, Schweitzer, Turunen, and Ward (2007).

Figure 2. Correlation of Institutional Variables with Real Wage Rigidity



This figure presents the correlation between real wage rigidity and union density (left) and between real wage rigidity and employment protection legislation (right). Source: Dickens, Goette, Groshen, Holden, Messina, Schweitzer, Turunen, and Ward (2007).

Figure 3: Distribution of Covariance Estimates



This figure shows the distribution of covariance estimates for the *public administration and defense* industry (upper) and for the *real estate, renting, and business activities* industry (lower).

Chapter 3

Housing and the Composition of the Financial Portfolio

Abstract

This paper demonstrates that, when the exogenous consumption demand for housing increases, households optimally respond by increasing their exposure to global stocks and reducing their exposure to domestic stocks. Due to higher information and transaction costs for international stock trades, direct holdings consist primarily of domestic stocks. Equity mutual funds, on the other hand, invest in both domestic and global stocks. Consequently, a household that is highly exposed to the local housing market is expected to lower its exposure to the local economy by reducing its share of total stock holdings invested in directly owned stocks and to increase its exposure to the global stock market by increasing its share of total stock holdings invested in global equity mutual funds. The empirical results, obtained using a unique Swedish database, strongly indicate that Swedish households that are highly exposed to the local owner-occupied housing market significantly reduce their exposure to directly owned stocks and increase their exposure to globally diversified equity mutual funds.

3.1 Introduction

A household's decision whether to own or rent its home is not only a consumption issue, as it significantly affects the composition of the household's risky asset portfolio. Housing consumption demand creates a highly leveraged position in real estate, especially for younger households. This dual role of housing as both a consumption and an investment good is emphasized in numerous papers, for example, Henderson and Ioannides (1983), Flavin and Yamashita (2002), and Cocco (2005). An important issue, addressed in the present paper, is to what extent this high exposure to owner-occupied housing affects the composition of households' financial portfolios.

There is an extensive literature on the consequences of entrepreneurial income, homeownership, and other so-called background risks for a household's willingness to invest in risky financial assets (see, e.g., Heaton and Lucas, 2000; Flavin and Yamashita, 2002). Though several theoretical and empirical papers have examined the relationship between owner-occupied housing and the share of risky assets in households' financial portfolios, no paper, to my knowledge, distinguishes between the effects of homeownership on holdings of local versus global stocks.

It is an empirical fact, however, that households tend to invest a disproportionately large share in local companies (the so-called home bias). For example, Ivkovic and Weisbenner (2005) find that the average share of local investments (defined as firms headquartered within 250 miles of the investor) is almost one third of total investments among U.S. investors, nearly 20 percentage points higher than the average percent of all firms headquartered within that distance from the investor. Bodnaruk (2009), who analyzes the portfolios of individual Swedish investors who recently changed their place of residence, finds that the farther away an investor moves from the closest branch of a company held in the investor's portfolio before the change of residence, the more of its stocks the investor abnormally sells after the move relative to investors who do not move.

Since local macroeconomic shocks tend to hit both households and firms within a certain geographical area in a similar way via asset prices and labor income, it is plausible to assume that home prices are more highly correlated with the returns on domestic stocks than with the returns on global stocks.[1] Under these assumptions, it is demonstrated using a simple theoretical model that, when the consumption demand for housing increases, households optimally respond by increasing their exposure to global stocks and reducing their exposure to domestic stocks.

Unfortunately, we cannot identify domestic and global stocks in the data. However, we know the households' holdings of directly owned stocks and of

[1]Empirical evidence of positive correlations between home prices and domestic stocks is found in Sweden and the U.K., for example (see section 3.4.2).

equity mutual funds. We also know that, due to higher information and transaction costs for international stock trades, direct stock holdings consist primarily of domestic stocks. On the other hand, equity mutual funds are globally diversified. Consequently, a household that is highly exposed to the local housing market is expected to lower its exposure to the local economy by reducing its share of total stock holdings invested in directly owned stocks and to increase its exposure to the global stock market by increasing its share of total stock holdings invested in global equity mutual funds.

The empirical analysis uses a unique register-based Swedish database on employment and portfolio holdings. In fact, a high stock market participation rate (approximately 54% of all households in Sweden invest in the stock market directly or indirectly),[2] and access to high-quality data collected from Swedish tax authorities, make Sweden a highly suitable country for a study of this kind.

The empirical results strongly indicate that, on average, Swedish households that are highly exposed to the local housing market in the form of owner-occupied housing significantly reduce their exposure to the Swedish stock market and increase their exposure to globally diversified equity mutual funds. In fact, both the probabilities of holding directly owned stocks and equity mutual funds and the relative shares of total stock holdings invested in each asset class are shown to be affected. Interestingly, for other types of real estate, such as investment properties or properties abroad, there are no signs of a similar switch from directly owned domestic stocks to equity mutual funds. For properties abroad, we instead see weak evidence of the opposite effect.

To summarize, for single-family homes over net wealth we observe a significant positive marginal effect on the relative share of total stock holdings invested in equity mutual funds of 13–14%, and a negative effect on the relative share of total stockholdings invested in directly owned stocks of the same magnitude. Due to the longitudinal feature of the database, one can also follow a single household over time to uncover consistent evidence.

The remainder of the paper is structured as follows; section 3.2 reviews related literature, section 3.3 describes the institutional setting, section 3.4 outlines the theoretical framework, section 3.5 presents the data and the methodological framework, section 3.6 presents the main results, and section 3.7 concludes.

[2]In fact, stock market participation rates in Sweden are among the highest in the world. Compared to the U.S., both direct and total participation rates are higher in Sweden (see Table 1).

3.2 Related Literature

Flavin and Yamashita (2002) emphasize that the consumption demand for housing may differ from the optimal investment share in housing. Due to the consumption demand and market incompleteness, these authors introduce an exogenous housing constraint, h (the house-to-net-worth ratio), on the household optimization problem. Using a mean-variance framework and assuming a correlation of zero between housing and financial assets, they demonstrate that the optimal share invested in stocks is hump-shaped in h.

Yamashita (2003), using data from the 1989 Survey of Consumer Finances (SCF) to test the implications of Flavin and Yamashita (2002), finds empirically that the impact of h is negative and significant (using both the observed and predicted values of h), and that the mortgage-payment-to-income ratio is positive and significant. When including h^2, the effect of h turns out to be stronger, though, h^2 is positive but insignificant. Yamashita also uses the 1983–1989 SCF panel data, though in this case none of the coefficients of interest turns out to be statistically significant.

Cocco (2005), using data from the 1989 wave of the Panel Study of Income Dynamics (PSID), finds in a cross-sectional Tobit regression model that home value relative to financial net worth has a negative and significant effect on stockholdings and that mortgage debt relative to financial net worth has a positive effect.

Another type of risk is committed expenditure risk; homeowners with mortgage debt commit to make future mortgage payments out of risky labor income. Using the 1989 SCF, Fratantoni (1998) finds that households with higher mortgage-payment-to-income ratios hold less of their financial wealth in risky assets. For renters, however, the rent-to-income ratio does not turn out to be as important.

In papers using more recent data, however, the empirical evidence is much weaker than in the papers described above using 1989 data. For example, Yao and Zhang (2005) find, using 1984–2001 PSID data, that the home-value-to-net-wealth ratio has a negative effect on stock market participation but no significant effect on equity proportions in the financial portfolio.

Faig and Shum (2006) also find, using 1992–2001 SCF data, that housing value relative to total net worth has a negative but insignificant effect on the share of financial wealth in total stock holdings. Furthermore, housing and investment real estate relative to total net worth have no explanatory effects on the probability of holding stocks.

One important fact, overlooked in the previous literature, is that the relative share of risky assets invested in mutual funds has increased significantly over recent decades. In the United States, holdings of indirect equity relative to total financial assets have increased from 26% in 1989 to 48% in 2001 (see Table 2). On the other hand, direct stockholdings as a share of financial

assets have been much more stable at approximately 20%.

Accordingly, older data indicate a higher proportion of direct stockholdings and a lower proportion of mutual fund holdings than do more recent data. This fact may explain the ambiguous empirical results regarding the effect of homeownership on financial portfolio composition presented in the above papers, and justifies separate analyses of the impact of owner-occupied housing on holdings of directly owned stocks and of equity mutual funds.

One of the few empirical papers that analyze the determinants of ownership of directly owned stocks and mutual funds is that of Alessie, Hochguertel, and van Soest (2004); however, they do not consider the relative shares of the financial portfolio invested in directly owned stocks and mutual funds or, more importantly, analyze the effects of homeownership.

3.3 Institutional Setting

3.3.1 Financial and Net Wealth

Descriptive Statistics

Aggregate wealth statistics for Sweden are reported in Table 3. At the end of 1999 (2003), 56.3% (68.8%) of total household assets were held in real estate, with owner-occupied single-family homes and cooperative apartments as the most important household assets. The remaining 43.7% (31.2%) of household wealth was invested in financial assets and in other types of assets.

24% (33%) of household financial assets were held in bank accounts. The most important risky financial assets were mutual funds and directly owned stocks, each accounting for 26.2% (30.0%) and 33.8% (23.5%) of total household financial assets. Other financial assets, such as capital insurance products, bonds, and derivatives, accounted for smaller shares of the total.

Stock Market Participation Rates

Compared with other countries, the stock market participation rate in Sweden is very high. In 1999, the total participation rate was 54% in Sweden, much higher than in France (23%), Italy (15%), the Netherlands (24%), the U.K. (34%), or even the USA (48%) (see Table 1).

In Sweden, a main reason for the high participation rate is the long history of investing in equity mutual funds. Back in 1984, when stock investments accounted for only a small share of the average household's financial wealth, Allemansfonder were introduced on the Swedish market. These mutual funds, which let the average household participate in the stock market, quickly became very popular. The interest in these funds of the public was stimulated

by favorable tax treatment and a booming Swedish stock market in the late eighties.

This long tradition of mutual fund investing and an increasing desire to diversify globally have resulted in a wide range of mutual funds offered to Swedish households by local banks and by an increasing number of international financial institutions, such as Fidelity, JP Morgan, and Merrill Lynch. In 2007, approximately 4,000 mutual funds were marketed in Sweden, of which around 500 invested in Swedish assets only. In fact, the number of foreign mutual funds (approximately 3,500) available to Swedish households is in line with the number of foreign mutual funds available, for example, in France (3,916), but is much higher than in other European countries, such as Italy (2,461), the U.K. (615), Spain (440), and Belgium (231).[3]

Capital Taxes

According to the Swedish tax code, dividends and capital gains are subject to a 30% flat tax independent of the holding period; the same tax rules apply to holdings of directly owned stocks and equity mutual funds.

3.3.2 Housing Market

The Swedish housing market can be divided into three main categories: owner-occupied single-family homes, cooperative apartments, and rental apartments. The largest household categories are owners of single-family homes and renters, each constituting 40% of households (see Table 4); owners of cooperative apartments account for 15% of households.

Owner-Occupied Housing

There are two ways to become a homeowner in Sweden: one buys either an owner-occupied single-family home or a cooperative apartment (condominiums are not yet legal in Sweden). Owner-occupied single-family homes and cooperative apartments are sold freely on the open market.

A member of a cooperative association possesses the right of use of a specific apartment for an indefinite term. The property is owned and managed by a cooperative association, which may hold debt. To cover maintenance costs and interest payments, a monthly fee is paid by the members.

Rental Apartments

The rental apartment market in Sweden is dominated by non-profit municipal housing companies competing directly with private landlords, in both less

[3]Source: The Swedish Investment Fund Association

popular suburbs and attractive inner-city locations (a unitary market system, as described in Kemeny, 1995). In fact, more than 50% of the total number of rental apartments in Sweden are owned by municipal housing companies.

Though there is no formal rent control, rents charged by municipal companies act as a ceiling on rents in similar, nearby privately owned properties (a maximum divergence of 4–5% is allowed). Rents charged by municipal housing companies are intended to cover management and maintenance expenses and to yield a fair return on invested capital; they are determined by negotiation with local tenants' associations.

Due to the ceiling on rents, there is a lack of rental apartments available for rent, mainly in Stockholm but also in other larger cities. This encourages many households to buy their homes, even though their first choice may have been to rent, which stimulates the consumption demand for owner-occupied housing in Sweden.

3.4 Theory and Empirical Implications

3.4.1 Theory

To examine the effect of owner-occupied housing on the composition of the portfolio of risky financial assets, an incomplete market where households are unable to separate their consumption and investment demands for housing is assumed. In other words, homeowners face an exogenous constraint on their investment in housing due to the consumption demand for housing.

Households choose between owning and renting their homes and choose how much to invest in risk-free assets and in local versus global stock markets. The local market is defined as the geographical area where the household resides, for example, a metropolitan area, but could also be defined as a country or part of a larger country (e.g., a state in the U.S.). The local economy is open to investments from abroad, and local residents are allowed to invest both locally and abroad. The local and global stock market indices are assumed to be positively correlated.

In contrast to Flavin and Yamashita (2002), positive correlations between housing and local stocks are assumed. Furthermore, mortgage debt holdings are not modeled explicitly, but rather treated as exogenously given by the consumption demand for housing.

Model

Households are allowed to invest in local stocks, S_l, global stocks, S_g, risk-free assets, B, and owner-occupied housing, H. Households can borrow money to finance investments in housing, M. By assumption, $0 \leq M \leq H$. To simplify,

no bonds are available. A household's net wealth, NW, can then be expressed as:

$$NW = X_l + X_g + X_b + H - M \tag{3.1}$$

where X_l is the amount invested in local stocks, X_g is the amount invested in global stocks, X_b is the amount invested in risk-free assets, H is the value of owner-occupied housing, and M is the value of mortgage debt.

To keep things as simple as possible, a mean-variance framework is used. The individual household maximizes:

$$\max_{\boldsymbol{x}} \left[(h\mu_H - m\mu_M + \boldsymbol{x}\boldsymbol{\mu}) - \frac{A}{2} [\boldsymbol{x}, h, m]' \Sigma [\boldsymbol{x}, h, m] \right] \tag{3.2}$$

subject to the constraints:

$$\begin{aligned} h &= \hat{h} \\ m &= \hat{m} \end{aligned}$$

where $\boldsymbol{x} = [x_l, x_g, x_b]$, $\boldsymbol{\mu} = [\mu_l, \mu_g, \mu_b]$, $x_l = X_l/NW, x_g = X_g/NW, x_b = X_b/NW, h = H/NW$, $m = M/NW$, NW is net wealth, A is the (relative) risk aversion parameter, Σ is the variance-covariance matrix, $\hat{h}$ is the exogenous housing consumption demand constraint, and $\hat{m}$ is the constraint on mortgage debt holdings.

Optimal Shares Invested in Local and Global Stocks

Using the above model, it is straightforward to demonstrate that the optimal share of net wealth invested in local stocks, x_l, is as follows:

$$x_l = \left(\frac{1}{1 - \rho_{l,g}^2} \right) \left[\begin{array}{c} c_l - \hat{h} \left(\left(\frac{\sigma_{l,h}}{\sigma_l^2} \right) - \left(\frac{\sigma_{l,g}}{\sigma_l^2} \frac{\sigma_{g,h}}{\sigma_g^2} \right) \right) + \\ \hat{m} \left(\left(\frac{\sigma_{l,m}}{\sigma_l^2} \right) - \left(\frac{\sigma_{l,g}}{\sigma_l^2} \frac{\sigma_{g,m}}{\sigma_g^2} \right) \right) \end{array} \right] \tag{3.3}$$

and that the optimal share of net wealth invested in global stocks, x_g, satisfies the following condition:

$$x_g = \left(\frac{1}{1 - \rho_{l,g}^2} \right) \left[\begin{array}{c} c_g - \hat{h} \left(\left(\frac{\sigma_{g,h}}{\sigma_g^2} \right) - \left(\frac{\sigma_{l,g}}{\sigma_g^2} \frac{\sigma_{l,h}}{\sigma_l^2} \right) \right) + \\ \hat{m} \left(\left(\frac{\sigma_{g,m}}{\sigma_g^2} \right) - \left(\frac{\sigma_{l,g}}{\sigma_g^2} \frac{\sigma_{l,m}}{\sigma_l^2} \right) \right) \end{array} \right] \tag{3.4}$$

where $c_l = c_l(\mu_l, \mu_g, \sigma_l^2, \sigma_g^2, \delta)$, $c_g = c_g(\mu_l, \mu_g, \sigma_l^2, \sigma_g^2, \delta)$, μ_l is the expected return on local stocks, μ_g is the expected return on global stocks, δ is individual characteristics (e.g. the relative risk aversion parameter, A, familiarity, and information and transaction costs), $\rho_{l,g}$ is the correlation coefficient between the local and the global stock market indices, σ_l^2 is the variance of the local

stock market index, σ_g^2 is the variance of the global stock market index, $\sigma_{l,g}$ is the covariance between the local and the global stock market indices, $\sigma_{l,h}$ is the covariance between the local stock market index and home prices, $\sigma_{l,m}$ is the covariance between the local stock market index and mortgage debt, $\sigma_{g,h}$ is the covariance between the global stock market index and home prices, and $\sigma_{g,m}$ is the covariance between the global stock market index and mortgage debt.

Note that the optimal shares of net wealth invested in the local and global stock markets consist of a constant part and two hedging terms. The constant part is a function of risk aversion, individual characteristics, and the expected returns and variances of the global and local stock markets. However, the hedging terms relating to housing and mortgage debt holdings are independent of individual characteristics and risk aversion, and are hence equal for all households.

3.4.2 Partial Derivatives: Local and Global Stocks

Empirical Correlations

According to equations (3.3) and (3.4), the optimal portfolio shares invested in local and global stocks depend on the correlations between home prices and local and global stocks. Local macroeconomic shocks tend to hit both households and firms within a certain geographical area in a similar way through impact on, for example, firms' profitability, land prices, households' financial wealth, and labor income. These shocks could be industry specific; consider, for example, the connection between the success of local high-tech firms and home prices in Silicon Valley.

The literature, as mentioned in section 3.1, presents empirical evidence of home bias, i.e., households' tendency to own stocks of firms headquartered (or having a production facility) relatively close to the investor. In other words, ideally, we would like to know the average correlation between housing and the actual portfolios of local stocks retained by households in the same region. Unfortunately, this is impossible to determine due to lack of data.

As a proxy, one can look at the correlation between the returns on local home prices and a broader stock market index, such as the domestic stock market index. This has been done in Sweden by Englund, Hwang, and Quigley (2002), who find some empirical evidence that the returns on owner-occupied single-family homes in the Stockholm region and on a general Swedish stock market index are positively correlated; at the 10-quarter horizon, the correlation coefficient is estimated to be 0.17; at longer horizons, however, the correlation is closer to zero. Stronger, and more consistent, positive correlations between the returns on owner-occupied homes in London and on a U.K. stock market index are found by Iacoviello and Ortalo-Magné

(2003). At the 10-quarter horizon, the estimated correlation coefficient is 0.30, and for longer horizons, 20 and 40 quarters, the correlation coefficients are even higher: 0.40 and 0.48, respectively.

U.S. studies generally estimate the correlation between regional home prices and a broad U.S. stock market index, such as the S&P 500, and not the correlation between home prices and a more local stock market index (e.g., at the state level). Flavin and Yamashita (2002), for example, estimate the correlation between the Case and Shiller home price index and the S&P 500 stock market index in four metropolitan areas in the U.S. Positive correlations are found in Chicago (0.20) and Atlanta (0.42). In Dallas and San Francisco, however, the correlations are close to zero (somewhat negative).

At the aggregate level, the correlation between home prices and stocks is found to be very close to zero. In this case, however, PSID data are used. Since home values in the PSID data are estimated by the homeowners, there are, as mentioned by Flavin and Yamashita, potential measurement errors.

To summarize, there is weak empirical evidence supporting the assumption that home prices are more highly correlated with the returns on local stocks than with the returns on global stocks.

Furthermore, according to equations (3.3) and (3.4), the optimal portfolio shares invested in local and global stocks depend on the correlation between domestic stock prices and mortgage debt. In this case, the empirical evidence is strong: in Sweden a correlation coefficient of approximately 0.3 between the domestic stock market index and bonds[4] is found by Englund et al. (2002), and in the United States, Flavin and Yamashita (2002) find a correlation coefficient of 0.47 between stocks and mortgage debt.

Impact of Owner-Occupied Housing

In the following analysis, it is assumed that the correlations between home prices and the local stock market, $\rho_{l,h}$, and the correlation between the local and global stock markets, $\rho_{l,g}$, are strictly positive. Furthermore, the correlation between home prices and the global stock market index, $\rho_{g,h}$, is assumed to be sufficiently close to zero to satisfy the following condition: $\rho_{g,h} < \rho_{l,g}\rho_{l,h}$.

From equations (3.3) and (3.4), and from the above assumptions, it follows that the partial derivative of the optimal share of net wealth invested in the local stock market, x_l, with regard to housing, $\hat{h}$, is negative:

$$\left(\frac{\partial x_l}{\partial \hat{h}}\right) = -\left(\frac{\sigma_h}{\sigma_l(1-\rho_{l,g}^2)}\right)\left(\rho_{l,h} - \rho_{l,g}\rho_{g,h}\right) < 0 \tag{3.5}$$

and that the partial derivative of the optimal share of net wealth invested in

[4]Mortgage debt is assumed to have similar characteristics as domestic bonds.

the global stock market, x_g, with regard to $\hat{h}$ is positive:

$$\left(\frac{\partial x_g}{\partial \hat{h}}\right) = -\left(\frac{\sigma_h}{\sigma_g(1-\rho_{l,g}^2)}\right)\left(\rho_{g,h} - \rho_{l,g}\rho_{l,h}\right) > 0. \tag{3.6}$$

That is, when the exogenous housing consumption demand constraint increases, households optimally respond by increasing their shares of net wealth invested in global stocks and reducing their shares of net wealth invested in local stocks.

From the above analysis it follows that the partial derivative of the relative share of total stock holdings (i.e., local and global stocks) invested in local stocks, x_l^*, with regard to $\hat{h}$ is negative:

$$\left(\frac{\partial x_l^*}{\partial \hat{h}}\right) < 0 \tag{3.7}$$

and that the partial derivative of the share of total stock holdings invested in global stocks, x_g^*, with regard to $\hat{h}$ is positive:

$$\left(\frac{\partial x_g^*}{\partial \hat{h}}\right) > 0, \tag{3.8}$$

where $x_l^* = X_l/(X_l + X_g)$ and $x_g^* = X_g/(X_l + X_g)$.

Impact of Mortgage Debt

In the following analysis, the correlation between mortgage debt and the local stock market index, $\rho_{l,m}$, is assumed to be strictly positive. Furthermore, the correlation between mortgage debt and the global stock market index, $\rho_{g,m}$, is assumed to be sufficiently low to satisfy the following condition: $\rho_{g,m} < \rho_{l,g}\rho_{l,m}$, where $\rho_{l,g}$ is the correlation between local and global stock market indices.

From equations (3.3) and (3.4), and from the above assumptions, it follows that the partial derivative of x_l (the optimal share invested in local stocks) with regard to mortgage debt, $\hat{m}$, is positive:

$$\left(\frac{\partial x_l}{\partial \hat{m}}\right) = \left(\frac{\sigma_m}{\sigma_l(1-\rho_{l,g}^2)}\right)\left(\rho_{l,m} - \rho_{l,g}\rho_{g,m}\right) > 0 \tag{3.9}$$

and that the partial derivative of x_g (the optimal share invested in global stocks) with regard to mortgage debt, $\hat{m}$, is negative:

$$\left(\frac{\partial x_g}{\partial \hat{m}}\right) = \left(\frac{\sigma_m}{\sigma_g(1-\rho_{l,g}^2)}\right)\left(\rho_{g,m} - \rho_{l,g}\rho_{l,m}\right) < 0. \tag{3.10}$$

In other words, when $\hat{m}$ increases, households optimally respond by reducing their shares of net wealth invested in global stocks and increasing their shares of net wealth invested in local stocks.

Furthermore, the partial derivative of the share of total stock holdings (i.e., local and global stocks) invested in local stocks, x_l^*, with regard to mortgage debt, $\hat{m}$, is positive:

$$\left(\frac{\partial x_l^*}{\partial \hat{m}}\right) > 0 \tag{3.11}$$

and the partial derivative of the share of total stock holdings invested in global stocks, x_g^*, with regard to mortgage debt, $\hat{m}$, is negative:

$$\left(\frac{\partial x_g^*}{\partial \hat{m}}\right) < 0. \tag{3.12}$$

3.4.3 Directly Owned Stocks and Equity Mutual Funds

Since we cannot identify local and global stocks in the data, directly owned stocks and equity mutual funds are used as proxies. In the remainder of the paper, we treat the local stock market as equivalent to the domestic stock market.

For domestic investments, the choice is between investing in either directly owned domestic stocks or domestic equity mutual funds. By assumption, however, households cannot invest directly in global stocks due to high transaction and information costs; that is, if a household wants to diversify globally, the only possibility is to invest in a globally diversified equity mutual fund.[5]

Each household is assumed to invest a constant fraction, α, of its domestic stock holdings, X_l, in directly owned stocks, and the remainder, $(1-\alpha)$, in an equity mutual fund holding domestic stocks. Therefore, directly owned stocks amounts to αX_l, while the total amount invested in equity mutual funds equals the amount of domestic stocks invested in equity mutual funds plus the total amount invested in global stocks, i.e., $(1-\alpha) X_l + X_g$. To take transaction and information costs into account, the amount of domestic holdings held in directly owned stocks is zero if $\alpha X_l < \bar{X}$.

Empirical Implications

As a base case, assume that all domestic stocks are held directly and only global stocks are held through equity mutual funds, i.e., $\alpha = 1$ and $\alpha X_l > \bar{X}$. The partial derivative of directly held stocks as a share of total stock holdings

[5]This is consistent with Swedish data. According to Calvet, Campbell, and Sodini (2007), only 1.8% of all financial assets were invested in directly owned foreign stocks in 2002.

with regard to owner-occupied housing, $\hat{h}$, is then negative and the partial derivative of equity mutual fund holdings as a share of total stock holdings with regard to $\hat{h}$ is positive, as derived in section 3.4.2 (with opposite signs for mortgage debt holdings).

Where $(0 < \alpha < 1)$ and $\alpha X_l > \bar{X}$, the expected empirical results are of the same sign, though weaker than the base case since households adjust not only their total holdings of directly owned stocks and equity mutual funds with regard to housing and mortgage debt, but also the composition of equity mutual funds by switching from domestic to global equity mutual funds, and vice versa. Hence, the empirical results are expected to increase in α.

Finally, if $\alpha = 0$ or $\alpha X_l < \bar{X}$, i.e., all domestic and global stocks are held in mutual funds and no stocks are directly owned, no empirical conclusions can be drawn.

To summarize, the relative share of total stock holdings (i.e., directly owned stocks and equity mutual funds) invested in directly owned stocks is expected to decrease in owner-occupied housing while the relative share of total stock holdings invested in equity mutual funds is expected to increase in owner-occupied housing. The opposite empirical results are expected for mortgage debt holdings. Since the direct stock market participation rate increases with financial wealth (see section 3.5.2), the empirical results for wealthier households are expected to be more in line with the theoretical implications.

Furthermore, since the amount held in directly owned stocks is zero if $\alpha X_l < \bar{X}$ and X_l (the amount invested in domestic stocks) has been shown to decrease for owners of owner-occupied housing, ceteris paribus, the probability of owning stocks directly is expected to decrease with an increased amount invested in owner-occupied housing.

3.5 Data and Methodology

3.5.1 Data

LINDA[6]

I use a Swedish register-based longitudinal database denoted LINDA—Longitudinal INdividual DAta—a joint project of Uppsala University, The National Social Insurance Board, Statistics Sweden, and the Swedish Ministry of Finance. The sampling frame consists of all individuals living in Sweden.

LINDA contains a cross-sectional sample of approximately 300,000 individuals annually, representing approximately 3% of the Swedish population.

[6]LINDA is described in more detail in Edin and Fredriksson (2000).

The sampled individuals and their family members are tracked over the years. The sampling procedure ensures the panel is representative of the population as a whole, and that each yearly wave is cross-sectionally representative.[7]

The principal sources of data are the income registers[8] based on filed tax reports (available on an annual basis since 1968) and the population censuses (available every fifth year from 1960 to 1990). Various measures of income, government transfers, market values of assets (e.g., real estate, bonds, stocks, and mutual funds),[9] and individual characteristics, such as sex, marital status, education, municipality of residence, and country of birth, are reported.

LINDA also contains various labor market variables, such as employment status, labor income, industry and sector of employment (referring to the main industry and sector of employment in a particular year), and unemployment insurance transfers.

Home Prices

Home price indices at the municipality level are calculated using *K/T ratios* (i.e., average ratios between purchase prices, K, and tax-assessed values, T), readily available from Statistics Sweden.[10]

As long as tax-assessed values remain constant over time and only purchase prices change, the calculation of local home price indices is straightforward. However, there have been several large adjustments to the overall level of tax-assessed values of owner-occupied single-family homes in Sweden, specifically, in 1990, 1996, and 2003. Statistics Sweden, however, provides keys for how to adjust old *K/T ratios* to be able to compare *K/T ratios* over time in a consistent way.

[7]However, since individuals and not households are sampled, large households tend to be overrepresented in the final sample.

[8]In the income registers, all variables are defined primarily for tax purposes. Consequently, income variables, for example, are contingent on the tax legislation in a specific year, and cohabitants with no children in common are usually coded as single.

[9]For tax purposes, assets may be valued below their fair market values; however, both tax-assessed and estimated market values have been included in LINDA since 1999. Market values of real estate are estimated by Statistics Sweden using tax-assessed values and data on transaction prices.

[10]The purchase prices and tax-assessed values of all transactions involving owner-occupied single-family homes in Sweden are readily available. However, since homes sold in a certain year may not be a random sample of the total housing stock and since the total housing stock composition may vary from year to year, the reported *K/T ratios* are adjusted by Statistics Sweden.

Samples

To test the empirical implications of the theoretical model outlined in section 3.4.3, two cross-sectional samples (1999 and 2003) and one longitudinal sample are used.

In the cross-sectional empirical analysis, the population samples in the 1999 and 2003 waves of LINDA are restricted to households in which the household head (defined as the member of the household with the highest disposable income) is between the ages of 26 and 60 and earns a positive labor income. Household disposable income, net wealth, and holdings of risky financial assets[11] have to exceed SEK 1,000.[12] Furthermore, households in which at least one member died or emigrated are excluded. The final cross-sectional samples consist of 101,161 households in 1999 and 109,861 households in 2003.

For the longitudinal studies, a sample of households that are part of both the 1999 and 2003 waves of LINDA is compiled. The same selection rules as above apply. Furthermore, only owners of single-family homes (home value has to exceed SEK 50,000 in 1999 and 2003) with no other real estate holdings are included in the sample. Household size has to remain constant from 1999 to 2003, and households in which the head is unemployed either in 1999 or in 2003 are excluded. Total stock holdings have to exceed SEK 1,000 in 1999 and zero in 2003.

To avoid biased estimates, all households that moved or made major improvements or other changes (e.g., built swimming pool or sold parts of their lots) to their existing homes between 1999 and 2003 have to be excluded from the sample. As a first step, all households for which we have information that location of residence or civil status changed between 1999 and 2003 are excluded. Unfortunately, this information is incomplete, i.e., we only know whether a household has moved from one parish to another.

To exclude households that moved within the same parish or made other major improvements/changes to their existing homes, excess housing return, α, is estimated:

$$\alpha_i = (H_{i,2003}/H_{i,1999}) - (\hat{H}_{i,2003}/\hat{H}_{i,1999})$$

where $(H_{i,2003}/H_{i,1999})$ is the actual return on owner-occupied single-family homes between 1999 and 2003 at the household level and $(\hat{H}_{i,2003}/\hat{H}_{i,1999})$ is the average return on owner-occupied single-family homes at the municipality level using home price data from Statistics Sweden.

To reduce the sample size by 20%, households with an absolute value of α

[11] Risky financial assets include directly owned stocks, equity mutual funds, mixed mutual funds, interest-bearing instruments, capital insurance products, and other financial assets.

[12] USD/SEK = 0.13810 (interbank rate, 31 December 2003)

exceeding 28% or a housing-to-net-wealth ratio exceeding 20 are excluded.[13] The final longitudinal sample consists of 14,037 households.

3.5.2 Descriptive Statistics

Individual Characteristics

In the cross-sectional samples, the average household contains approximately three members. Furthermore, the average household head is 44 years old, approximately six out of 10 household heads are married, one third is female, two thirds work in the private sector, 94% are born in Sweden, 7–8% receive unemployment benefits, and nearly 40% have college, or higher, education (summary statistics on individual characteristics are presented in Table 5).

In the longitudinal sample, which is restricted to owners of single-family homes, the average household size is 3.66 and the average household head is 42 years old.

Income and Financial Wealth

In the cross-sectional samples, the average household disposable income increased from SEK 341,000 in 1999 to SEK 393,000 in 2003 (see Table 6 for summary statistics). Over the same period, the average value of directly owned stocks fell from SEK 179,000 to SEK 94,000: over this period, the annual mean returns on the Stockholm Stock Exchange (OMX Affärsvärldens generalindex) were –12% in 2000, –17% in 2001, –37% in 2002, and 30% in 2003.

The value of *equity mutual funds*, however, remained fairly constant, i.e., SEK 132,000 and 127,000 per household in 1999 and 2003, respectively. In 1999, however, *equity mutual funds* only included pure equity mutual funds, while in 2003, *equity mutual funds* also included mixed mutual funds. Hence, the average holdings of equity and mixed mutual funds decreased from SEK 151,000 in 1999 to SEK 127,000 in 2003. The average annual returns on equity mutual funds (mixed mutual funds) sold in Sweden were –10% (–4%) in 2000, –12% (–9%) in 2001, –35% (–26%) in 2002, and 22% (14%) in 2003.[14]

The average value of *total stock holdings* (i.e., directly owned stocks and equity mutual funds) decreased from SEK 311,000 in 1999 to SEK 222,000 in 2003. However, if holdings of mixed mutual funds are included in the value of total stock holdings in both in 1999 and 2003, we observe a more significant decrease in average holdings from SEK 330,000 in 1999 to SEK 222,000 in 2003.

[13] If all households are included, the empirical results are, as expected, much weaker. However, the exclusion of 15% or 25% of the sample has only minor effects.

[14] Source: Svensk Fondstatistiks Fondindex and Fondbolagens förening

The average value of the *risky financial asset portfolio* (i.e., the value of total stock holdings, mixed mutual funds, interest-bearing instruments, capital insurance products, and other financial assets) decreased from SEK 402,000 in 1999 to SEK 286,000 in 2003. Over the same period, the average value of the *financial asset portfolio* (i.e., the value of the risky financial asset portfolio plus the value of imputed bank account holdings) decreased from SEK 524,000 to SEK 440,000.

In the longitudinal sample, households were less wealthy; on average, total stock holdings amounted to SEK 201,000 (SEK 217,000 if the value of mixed equity funds was included), the value of the financial portfolio to SEK 364,000, and average household disposable income to SEK 335,000.

Bank Accounts As a general rule, banks are not required to report bank account holdings to the tax authorities if the annual interest income does not exceed SEK 100. Nevertheless, in some cases, bank account holdings are reported in the data even though the annual interest income is less than SEK 100. Hence, one way to partially correct for the fact that a disproportionately large share of the sample in the LINDA database reports zero bank account holdings is to use imputed instead of reported bank account holdings, in a way similar to that of Calvet, Campbell, and Sodini (2007).

The imputed bank account holdings are simply the fitted values from an OLS regression, where the sample consists of all individuals in the data reporting a positive bank account holding, but an interest rate income not exceeding SEK 100. The explanatory variables are age, age squared, gender, and disposable income. To avoid endogeneity problems, no wealth variables are included in the regression.

For all individuals in the final sample reporting a bank account holding of zero, the imputed (if strictly positive) instead of reported bank account holdings are used in the empirical analysis, capped at a level of SEK 100,000. The average increase in household bank account holdings derived using imputed instead of reported bank account holdings is SEK 18,000 in the 1999 sample and SEK 22,000 in the 2003 and in the longitudinal samples (see Table 6).

In all definitions of financial and net wealth, as well as in all empirical results presented in this paper, the imputed instead of reported bank account holdings are used. The empirical results, however, are not dependent on the method of estimating bank account holdings.

Stock Market Participation Rates In 1999, 54% of all Swedish households participated in the stock market (see Table 1). The participation rates in the samples are even higher because of the restrictions on the level of risky financial assets, net wealth, and income (see section 3.5.1 for details), imposed since the primary interest of this paper is to investigate to what extent

household holdings of owner-occupied homes and other types of real estate affect the composition of total household stock holdings.

In the cross-sectional sample of 1999, in fact 95% of all sampled households owned directly owned stocks or equity mutual funds (see Table 7). In 2003, this share was even higher at 96%.[15] Notably, more than half of all households owned stocks directly, i.e., 50% in 1999 and 58% in 2003.

The direct stock ownership rate increases significantly with the amount of risky financial assets, which is consistent with the higher transaction and information costs of direct stock ownership than of equity mutual fund ownership. For households with risky financial assets above the 75^{th} percentile,[16] approximately 80% of all households owned stocks directly and more than 90% owned equity mutual funds. A large fraction of all households in this group held both directly owned stocks and equity mutual funds (70% in 1999 and 79% in 2003), and only 1% did not own any directly owned stocks or equity mutual funds.

The longitudinal sample is restricted to households participating in the stock market in both 1999 and 2003.

Real Estate

Households can invest in different types of real estate, such as owner-occupied homes and commercial properties. In the data, total real estate holdings are divided into eight main categories:

1. Owner-occupied single-family homes ("one- or two-dwelling units")
2. Cooperative apartments
3. Summer houses ("dwellings for seasonal and secondary use")
4. Agricultural properties[17] ("agricultural and forestry units")
5. Multi-dwelling buildings ("multi-dwelling and commercial buildings")
6. Industrial buildings
7. Properties abroad
8. Sites (only reported in 1999)

[15] In 1999, *equity mutual funds* only includes pure equity mutual funds; in 2003, however, mixed mutual funds are also included.

[16] SEK 326,483 in 1999 and SEK 253,768 in 2003

[17] In agricultural properties, the value of owner-occupied housing is not included.

In the cross-sectional samples of 1999 and 2003, nearly nine out of 10 households own some kind of real estate; approximately 72–73% of all households own a single-family home, 13–15% own a cooperative apartment, 13–14% own an agricultural property, and around 20% own a summer house. Other types of real estate are much less commonly owned. The longitudinal sample intentionally includes only households that own owner-occupied single-family homes and no other real estate (see Table 8 for summary statistics).

In the 1999 sample, average real estate holdings (defined as the aggregated market value of real estate owned by all household members) reached SEK 1,062,000. In 2003, the average value of real estate holdings had increased to SEK 1,449,000, caused by large increases in the average price level. Prices of owner-occupied single-family homes in Sweden increased, on average, by 11% in 2000, 8% in 2001, 6% in 2002, and 7% in 2003.[18] In the longitudinal sample, the average value of real estate holdings (i.e., owner-occupied single-family homes) was SEK 988,000.

In the cross-sectional samples, owner-occupied single-family homes, cooperative apartments, and agricultural properties were, on average, the most valuable categories of real estate; though, conditional on owning, multi-dwelling buildings were worth the most (approximately SEK 3.5 million).

Due to consumption demand and increasing home prices, the average owner of a single-family home in the data is increasingly exposed to real estate; the single-family-home-to-net-wealth ratio conditional on owning increased from 1.86 in 1999 to 2.01 in 2003 (see Table 9). In the longitudinal sample, this ratio is even higher at 2.30.

Debt

Since only aggregate debt holdings are reported in the data (the Swedish tax code does not distinguish between different types of debt), the following technique is used to estimate the mortgage debt linked to real estate:

$$Debt(home) = \min\left[Home,\ Debt\left(\frac{Home}{Total\ value\ real\ estate}\right)\right]$$

$$Other\ debt = \max\left[0, (Debt - Total\ value\ real\ estate)\right]$$

where *Home* is the value of the owner-occupied single-family home and *Debt* is the aggregate amount of household debt. The same technique is used to estimate debt levels for each real estate category. Summary statistics are presented in Table 8 (levels) and Table 9 (as shares of net wealth).

[18] Source: Statistics Sweden

Net Wealth

To summarize, in the cross-sectional samples, net wealth (i.e., the value of the financial asset portfolio plus the values of real estate holdings and other assets minus the value of debt) increased from SEK 1,205,000 in 1999 to SEK 1,305,000 in 2003 (see Table 6). This was caused by the large increase in average real estate holdings (from SEK 1,062,000 to SEK 1,449,000), despite the decrease in the average value of the financial asset portfolio (from SEK 524,000 to SEK 440,000) and the increase in the average debt level (from SEK 468,000 to SEK 626,000), as reported. Furthermore, the value of other assets decreased from SEK 87,000 to SEK 42,000.[19]

In the longitudinal sample, which is restricted to homeowners holding no other real estate assets, the average level of net wealth was significantly lower at SEK 840,000.

Note that holdings of private pension savings in tax-exempt accounts and in the premium pension system, which is part of the national pension system and administered by the Premium Pension Authority (PPM), are not included in the data.

3.5.3 Econometric Models

Ownership Probabilities of Directly Owned Stocks and Equity Mutual Funds

The first objective is to estimate the impact of real estate holdings on the probabilities of holding directly owned stocks and equity mutual funds. A seemingly unrelated regression (SUR) linear probability model is chosen, since it takes into account that the error terms may be correlated.[20]

The model for being an owner of directly owned stocks and of equity mutual funds is specified as follows:

$$Owner(directly\ owned\ stocks) = x'\beta_1 + h'\beta_{1h} + m'\beta_{1m} + \varepsilon_1 \quad (3.13)$$

$$Owner(equity\ mutual\ funds) = x'\beta_2 + h'\beta_{2h} + m'\beta_{2m} + \varepsilon_2 \quad (3.14)$$

where h is a vector of various real estate variables over net wealth and ownership dummy variables, m is a vector of mortgage debt and other debt variables over net wealth, and x is a vector of household characteristics, such

[19]This category includes financial and real assets not covered by the register data, for example, foreign assets.

[20]SUR is an extension of the linear regression model allowing for correlated error terms between equations (Zellner, 1962). The first choice, however, was a bivariate probit model. Unfortunately, there were convergence problems in the empirical analysis.

as income, age, and gender. The empirical results are presented in section 3.6.1.

Ownership Shares of Directly Owned Stocks and Equity Mutual Funds

The second purpose of this paper is to estimate the effect of real estate holdings on the relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds. To test the implications of the theoretical model (see section 3.4.3), a bivariate Tobit model, a Heckman's sample selection model, and a longitudinal model are used.

Bivariate Tobit Model There are the several reasons why a bivariate Tobit model is chosen.[21] First, a significant part of the sample owns no directly owned stocks or no equity mutual funds. Furthermore, since all shares have to sum to one, increasing the share of total stock holdings invested in directly owned stocks reduces the share available to invest in equity mutual funds, and vice versa. Owning one risky asset may also influence, positively or negatively, the probability of owning another risky asset.

To simultaneously estimate the relative shares of total stock holdings invested in directly owned stocks, s, and in equity mutual funds, mf, the bivariate Tobit model is specified as follows:

$$s^* = x'\beta_1 + h'\beta_{1h} + m'\beta_{1m} + \varepsilon_1 \tag{3.15}$$

$$mf^* = x'\beta_2 + h'\beta_{2h} + m'\beta_{2m} + \varepsilon_2 \tag{3.16}$$

under the following conditions:

$$\begin{aligned} [s \quad mf]' &= [0 \quad 0]' \quad \text{if } s^* \leq 0 \text{ and } mf^* \leq 0 \\ &= [s^* \quad 0]' \quad \text{if } s^* > 0 \text{ and } mf^* \leq 0 \\ &= [0 \quad mf^*]' \quad \text{if } s^* \leq 0 \text{ and } mf^* > 0 \\ &= [s^* \quad mf^*]' \quad \text{if } s^* > 0 \text{ and } mf^* > 0 \end{aligned}$$

where h is a vector of various real estate holdings over net wealth and ownership dummy variables, m is a vector of various debt over net wealth variables, and x is a vector of household size, income, and wealth and personal characteristics of the household head, such as age and education.

The error terms are assumed to be bivariate normally distributed with a

[21] The main advantage of the bivariate Tobit model is that it accounts for the covariance of the error terms.

mean of zero and a variance-covariance matrix Σ:

$$\varepsilon = [\varepsilon_1 \ \varepsilon_2] \sim N(0 \ \Sigma)$$

The empirical results of the bivariate Tobit model are presented in section 3.6.2.

Heckman's Sample Selection Model In the next step, the sample is restricted to households holding both directly owned stocks and equity mutual funds. Since there may be problems with sample selection in this case (i.e., ownership status may be systematically correlated with unobservable characteristics), a full maximum likelihood Heckman's sample selection model is run:

$$s = x'\beta_1 + h'\beta_{1h} + m'\beta_{1m} + \sigma_{13}\lambda_1 + \varepsilon_1, \ s > 0 \text{ and } mf > 0 \quad (3.17)$$

$$mf = x'\beta_2 + h'\beta_{2h} + m'\beta_{2m} + \sigma_{23}\lambda_2 + \varepsilon_2, \ s > 0 \text{ and } mf > 0 \quad (3.18)$$

using the following selection equation:

$$\Pr(mf > 0, s > 0) = x'\beta_3 + h'\beta_{3h} + m'\beta_{3m} + \varepsilon_3 \quad (3.19)$$

where s is the share of total stock holdings invested in directly owned stocks, mf is the share of total stock holdings invested in equity mutual funds, h is a vector of various real estate variables over net wealth and ownership dummy variables, m is a vector of various debt variables over net wealth, λ is the inverse Mills ratio, and x is a vector of household size, income, and wealth and personal characteristics of the household head, such as age and education.

The empirical results of the Heckman's sample selection model are reported in section 3.6.2.

Longitudinal Regression Model To determine empirically whether changes in the housing constraint over time have any effect on changes in the composition of total stock holdings, the following OLS regression is run using the longitudinal sample:

$$\Delta s = x'_{1999}\left(\boldsymbol{\beta}_{1x}d\right) + \Delta x'\left(\boldsymbol{\beta}_1 d\right) + \Delta h\left(\boldsymbol{\beta}_{1h}d\right) + \varepsilon \quad (3.20)$$

where $\Delta s = \left(s_{2003} - s_{1999}\right)$, $\Delta h = \left[\left(\tilde{H}_{2003} - H_{1999}\right)/NW_{1999}\right]$, $\Delta x = \left(x_{2003} - x_{1999}\right)$, NW is net wealth, s is the relative share of total stock holdings invested in directly owned stocks, H is the value of owner-occupied single-family homes, x is a vector of personal characteristics (e.g., age and

education), $\boldsymbol{\beta}$ is a coefficient matrix, and d is a vector of four dummy variables;[22] $\tilde{H}_{2003}$ is adjusted for inflation.

The empirical results of the longitudinal model are presented in section 3.6.2.

3.6 Empirical Results

This section presents the empirical results of the regressions outlined in section 3.5.3. In all regressions, the real estate categories are *owner-occupied single-family homes, cooperative apartments, summer houses, agricultural properties, multi-dwelling buildings, industrial buildings, properties abroad,* and *sites* (only reported in 1999), as explained in section 3.5.2. The effect of being an owner of each category of real estate is estimated by including indicator variables in the regressions. In addition, all real estate and debt variables over net wealth are included.

Further explanatory variables are individual characteristics such as A-region,[23] marital status, gender, country of birth, age group, industry, sector, education level, household size, unemployment status, household disposable income, household disposable income squared, net wealth, and risky financial assets. Definitions of the variables are provided in the Appendix, and the summary statistics are reported in Tables 5–9.

The theoretical implications apply primarily to residential real estate subject to an exogenous housing constraint due to consumption demand and market incompleteness; for other types of real estate investments this constraint is less relevant. Furthermore, the correlation between returns on other types of real estate and on domestic and global stock markets are more ambiguous (consider properties abroad, for example). To sum up, the strongest empirical results are expected for owner-occupied single-family homes, cooperative apartments, and, to a certain extent, summer houses.

Empirical results regarding the ownership probabilities of directly owned stocks and equity mutual funds are presented in section 3.6.1 and on the ownership shares of directly owned stocks and equity mutual funds in section 3.6.2.

[22] The first dummy equals one if the values of household risky financial assets and of the single-family home both are below the 75^{th} percentile and zero otherwise; the second dummy equals one if the value of household risky financial assets is above the 75^{th} percentile and the value of the single-family home is below the 75^{th} percentile and zero otherwise; the third dummy equals one if the value of the single-family home is above the 75^{th} percentile and the value of household risky financial assets is below the 75^{th} percentile and zero otherwise; and the fourth dummy equals one if the values of household risky financial assets and of the single-family home are both above the 75^{th} percentile and zero otherwise.

[23] Sweden is divided into 70 A-regions (local labor markets) by Statistics Sweden.

3.6.1 Ownership Probabilities of Directly Owned Stocks and Equity Mutual Funds

The first objective is to test whether real estate holdings affect the probabilities of holding directly owned stocks and equity mutual funds. To that end, the ownership statuses of directly owned stocks and equity mutual funds[24] are regressed on various real estate and debt variables and on individual characteristics in a SUR linear probability model, as specified in regressions (3.13) and (3.14) in section 3.5.3. A household is defined as a direct stockholder (an equity mutual fund-holder) if it holds directly owned stocks (equity mutual funds) valued at more than SEK 1,000. Separate regressions are run for the cross-sectional samples of 1999 and 2003.

From the theoretical model it follows that the amount invested in owner-occupied housing, ceteris paribus, is expected to have a negative impact on the probability of holding directly owned stocks; for mortgage debt holdings, the opposite result is expected. Empirical results, for the whole sample and for households above the 75^{th} risky financial asset percentile, are presented in Table 10.[25]

The empirical results for the whole sample indicate that owning a single-family home has a positive effect on the probability of holding directly owned stocks (equity mutual funds) of 31% (16%) in 1999 and 37% (10%) in 2003. This positive effect may capture unobserved characteristics, such as sophistication, risk aversion, and the impact of interaction with neighbors.

However, the effects of single-family homes over net wealth on the probability of holding directly owned stocks (equity mutual funds) are –0.41 (–0.23) in 1999 and –0.42 (–0.12) in 2003. That is, single-family homes over net wealth has a more negative effect on the probability of holding directly owned stocks than on the probability of holding equity mutual funds, the difference being statistically significant at the 1% level. It is also found that mortgage debt holdings over net wealth has a more positive impact on the probability of holding directly owned stocks than on the probability of holding equity mutual funds, especially in 2003 (0.37 versus 0.11).

To summarize, owning a single-family home has a negative effect on the probability of holding directly owned stocks (equity mutual funds) if the single-family-home-to-net-wealth ratio exceeds 0.76 (0.63) in 1999 and 0.88 (0.83) in 2003.

Owning a cooperative apartment also has an initially positive effect on the probability of holding directly owned stocks (equity mutual funds) of 5% (4%) in 1999 and 10% (3%) in 2003. However, the effect of cooperative apartments

[24] In 1999, *equity mutual funds* only includes pure equity mutual funds. However, in 2003, *equity mutual funds* also includes mixed mutual funds.

[25] The 75^{th} percentile (risky financial assets) is SEK 326,483 in 1999 and SEK 253,768 in 2003.

over net wealth on the probability of holding directly owned stocks (equity mutual funds) is, as expected, negative: –0.24 (–0.12) in 1999 and –0.26 (–0.09) in 2003.

When it comes to other types of real estate, the empirical results are mixed. For some types of real estate, such as summer houses and sites, results similar to those for single-family homes and cooperative apartments are found, while for other types, such as properties abroad, the empirical estimates are mostly non-significant.

Furthermore, the probability of holding directly owned stocks increases with income, but decreases with squared income (the threshold is reached at an annual income of nearly SEK 26 million). Income has a much smaller effect, however, on the probability of holding equity mutual funds. Net wealth and risky financial assets have mixed empirical effects on the probabilities of holding directly owned stocks and equity mutual funds.

For wealthy households (i.e., households with risky financial assets above the 75^{th} percentile), the differences between the probabilities of holding directly owned stocks and holding equity mutual funds are similar to those for the whole sample, although the estimates are somewhat smaller; the effect of single-family homes over net wealth on the probability of being a direct stockholder (equity mutual fund-holder) is –0.24 (0.03) in 1999 and –0.09 (0.01) in 2003. That is, only the probability of holding directly owned stocks decreases, while the probability of holding equity mutual funds is, in practice, unaffected by investments in owner-occupied housing.

To summarize, the empirical results are in line with expectations; owner-occupied housing over net wealth has a significantly negative impact on the probability of holding directly owned stocks. For wealthy households, on the other hand, owner-occupied housing over net wealth has no effect on the probability of holding equity mutual funds. For other types of real estate, mixed empirical results are found.

3.6.2 Ownership Shares of Directly Owned Stocks and Equity Mutual Funds

The second objective is to the test the effects of owning different categories of real estate on the relative shares of total stock holdings (risky financial assets) invested in directly owned stocks and in equity mutual funds. Theoretically, owner-occupied housing is expected to have a negative effect on the relative share of total stock holdings invested in directly owned stocks and a positive effect on the relative share of total stock holdings invested in equity mutual funds. For mortgage debt holdings, the opposite results are expected. The strongest results are expected for owner-occupied single-family homes and for cooperative apartments, subject to an exogenous consumption demand

constraint, as described above.

Empirical results of the bivariate Tobit regression model, the Heckman's sample selection model, and the longitudinal regression model are presented below.

Bivariate Tobit Model

As a robustness check, two different measures of the relative shares invested in directly owned stocks and in equity mutual funds are used in the empirical analysis; the first measure is relative shares of total stock holdings, while the second is relative shares of risky financial assets (i.e., directly owned stocks, equity mutual funds, interest-bearing instruments, capital insurance products, and other financial assets).

The relative shares of total stock holdings (risky financial assets) invested in directly owned stocks and in equity mutual funds[26] are regressed on real estate and debt variables and on individual characteristics in a bivariate Tobit regression model, as specified in regressions (3.15) and (3.16) in section 3.5.3. The ownership shares of directly owned stocks and equity mutual funds are left-censored at zero and right-censored at one. To study the impact of financial wealth, the sample is divided into three sub-samples: all households and households above and below the 75^{th} risky financial asset percentile.[27] Separate regressions are run for the cross-sectional samples of 1999 and 2003.

The empirical results, presented in Table 11, focus solely on the relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds.[28] The sample is restricted to households owning more than SEK 1,000 in total stock holdings. Since the results for directly owned stocks and for equity mutual funds, in this case, are symmetric (that is, if the relative share of total stock holdings invested in directly owned stocks increases by, say 10%, the relative share of total stock holdings invested in equity mutual funds decreases by 10%), only the results for directly owned stocks are reported.

The empirical results for the whole sample indicate that owning a single-family home has a positive marginal impact on the relative share of total stock holdings invested in directly owned stocks of 11% in 1999 and 13% in 2003 (with the opposite results for the relative share of total stock holdings invested in equity mutual funds). This positive effect may capture unob-

[26] In 1999, *equity mutual funds* only includes pure equity mutual funds. However, in 2003, *equity mutual funds* also includes mixed mutual funds.

[27] The 75^{th} percentile (risky financial assets) is SEK 326,483 in 1999 and SEK 253,768 in 2003. The empirical results for households with risky financial assets below the 75^{th} percentile, however, are not reported, since most estimates turned out to be nonsignificant.

[28] The empirical results regarding relative shares of risky financial assets invested in directly owned stocks and in equity mutual funds are very similar, and are reported in Tables A1 and A2 in the Appendix.

served characteristics, such as sophistication, risk aversion, and the impact of interaction with neighbors.

For single-family homes over net wealth, however, we observe, in line with expectations, a significant negative marginal effect on the relative share of total stock holdings invested in directly owned stocks of –0.13 in 1999 and –0.14 in 2003.

For cooperative apartments, similar, although somewhat weaker, results are found; cooperative apartments over net wealth has a significant negative marginal effect on the relative share of total stock holdings invested in directly owned stocks by –0.10, in both 1999 and 2003.

For summer houses over net wealth in 1999, the pattern is similar to those for single-family homes and cooperative apartments over net wealth. For other real estate holdings (agricultural properties, multi-dwelling buildings, industrial buildings, properties abroad, and sites) over net wealth, however, we do not observe the switch from direct stockholdings to equity mutual fund holdings as we do for single-family homes and cooperative apartments, neither in 1999 nor in 2003. For agricultural properties, we instead see the opposite effect, agricultural properties over net wealth has a positive marginal impact on the share of total stock holdings invested in directly owned stocks by 0.16 in 1999 and 0.04 in 2003.

For debt, the expected patterns are observed; in both 1999 and 2003, mortgage debt holdings over net wealth has a positive and significant effect of 0.12 on the relative share of total stock holdings invested in directly owned stocks and a negative impact on the relative share invested in equity mutual funds of the same magnitude.

The relative share of total stock holdings invested in directly owned stocks increases with household disposable income and risky financial assets, but decreases with squared income. Net wealth, however, has no significant effect after controlling for income and risky financial assets.

For the sub-sample of wealthy households (i.e., households with risky financial assets above the 75^{th} percentile), single-family homes over net wealth has a significant negative marginal effect on the average share of total stock holdings invested in directly owned stocks of –0.26 (1999) and –0.11 (2003), with the opposite results for the relative share of total stock holdings invested in equity mutual funds. That is, the empirical results of owner-occupied housing on the relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds are much stronger for wealthy households than for the whole sample in 1999.

For cooperative apartments over net wealth, a significant decrease in the relative share of financial risky assets invested in directly owned stocks of –0.15 is found in 1999 and in 2003. A similar result, a –0.13 decrease in relative share, is found for multi-dwelling buildings over net wealth, but only in 1999. For other types of real estate, however, the estimates are small in

magnitude and do not follow the same patterns as are found for single-family homes and cooperative apartments.

Since the correlation between the housing market in Stockholm and the Swedish stock market index may be higher than the correlation between the housing markets in the rest of country and the Swedish stock market index,[29] separate empirical results for households in the Stockholm metropolitan area and for households in the rest of the country are reported in Table 12.

The empirical results are quite similar in the two sub-samples; the effect of single-family homes over net wealth on the relative share of total stock holdings invested in directly owned stocks in Stockholm (in the rest of the country) is –0.19 (–0.11) in 1999 and –0.11 (–0.14) in 2003, that is, stronger in Stockholm than in the rest of country in 1999, but weaker in Stockholm in 2003.

To summarize, the empirical results support the implications of the theoretical model; we observe that households that are highly exposed to owner-occupied housing significantly switch from holdings of directly owned stocks to holdings of equity mutual funds. The strongest results are found in 1999 for wealthy households. For other categories of real estate, mixed empirical results are found.

Heckman's Sample Selection Model

The relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds[30] are regressed on real estate and debt variables and on individual characteristics in a Heckman's sample selection model, as specified in regressions (3.17)–(3.19) in section 3.5.3. A full maximum likelihood model is used. The sample is restricted to households with directly owned stocks and equity mutual funds valued at more than SEK 1,000 each. Separate regressions are run for the cross-sectional samples of 1999 and 2003.

The empirical results for wealthy households (i.e., households with risky financial assets above the 75^{th} percentile),[31] reported in Table 13, indicate that owning a single-family home has a positive effect on the share of total stock holdings invested in directly owned stocks of 8% in 1999 and 6% in 2003 (with the opposite effect on the relative share invested in equity mutual funds). For single-family homes over net wealth, however, there is a significant negative effect on the relative share of total stock holdings invested in directly owned stocks of –0.23 in 1999 and –0.11 in 2003. These results are in line with

[29]The correlations between owner-occupied single-family homes and the Swedish stock market reported by Englund et al. (2002) are estimated using households in the Stockholm metropolitan area only.

[30]In 1999, *equity mutual funds* only includes pure equity mutual funds. However, in 2003, *equity mutual funds* also includes mixed mutual funds.

[31]Due to convergence problems, no results for the whole sample can be reported.

expectations and are very similar to the bivariate Tobit results reported in Table 11.

For cooperative apartments, similar results are found; cooperative apartments over net wealth has a significant negative effect on the relative share of total stock holdings invested in stocks of –0.17 (1999) and –0.11 (2003). For summer houses over net wealth, the same patterns are observed as for single-family homes and cooperative apartments over net wealth, though the estimates are lower: –0.15 (1999) and –0.04 (2003). Also for multi-dwelling buildings over net wealth, the results are similar, –0.19, but only in 1999. For industrial buildings over net wealth, however, a switch from direct stockholdings to equity mutual fund holdings is not observed in either 1999 or in 2003.

In contrast to the results found for owner-occupied housing, properties abroad over net wealth has a significant positive effect of 0.63, in 2003, on the relative share of total stock holdings invested in directly owned stocks and the opposite impact on the relative share of total stock holdings invested in equity mutual funds. In 1999, however, properties abroad over net wealth has no significant effects.

For debt, the expected patterns are observed; mortgage debt holdings over net wealth has a positive and significant effect on the relative share of total stock holdings invested in directly owned stocks of 0.22 (1999) and 0.11 (2003).

The share of total stock holdings invested in directly owned stocks increases with disposable income and risky financial assets, but decreases with squared income. Net wealth, however, has no significant effect after controlling for income and risky financial assets.

Longitudinal Regression Model

Changes in the relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds[32] are regressed on changes in the ratio of owner-occupied single-family homes over net wealth and on individual characteristics in an OLS regression model, as specified in regression (3.20) in section 3.5.3. The longitudinal sample is restricted to households with total stock holdings of more than SEK 1,000 in 1999 and more than zero in 2003.

The empirical results, reported in Table 14, indicate that changes in the ratio of owner-occupied single-family homes over net wealth for the less wealthy households, in terms of home value and financial wealth, have weak effects on changes in the relative shares of total stock holdings invested in directly owned stocks and in equity mutual funds.

[32]In 1999, *equity mutual funds* only includes pure equity mutual funds. However, in 2003, *equity mutual funds* also includes mixed mutual funds. In the longitudinal case, the value of mixed mutual funds has been added to the value of *equity mutual funds* in 1999.

The strongest results are found for wealthy households owning expensive homes (i.e., households with home values and risky financial assets above the 75^{th} percentile).[33] In this sub-sample, changes in the ratio of owner-occupied single-family homes over net wealth have a significant negative additional effect on the relative share of total stock holdings invested in directly owned stocks of -0.11, and thereby a significant positive additional effect on the relative share of total stock holdings invested in equity mutual funds of the same magnitude.

To conclude, if a single household is followed over time, results similar to those of the cross-sectional bivariate Tobit and Heckman's sample selection model regressions are observed for wealthy households; if there is an increase in the ratio of owner-occupied housing over net wealth, we find, in line with the theoretical implications, a significant switch from directly owned stocks to equity mutual funds.

3.7 Conclusions

Since owner-occupied housing is the most important household asset and most homeowners hold highly unbalanced portfolios, an important question addressed in this paper is to what extent this high exposure to real estate affects the composition of households' financial portfolios.

Since local macroeconomic shocks tend to hit both households and firms within a certain geographical area in a similar way through impact on, for example, firms' profitability, land prices, households' financial wealth, and labor income, it is plausible to assume that home prices are more highly correlated with the returns on domestic stocks than with the returns on global stocks.[34] Under these assumptions, it is demonstrated using a simple theoretical model that, when the consumption demand for housing increases, households optimally respond by increasing their exposure to global stocks and reducing their exposure to domestic stocks.

Unfortunately, we cannot identify domestic and global stocks in the data. However, we do know the households' holdings of directly owned stocks and of equity mutual funds. We also know that, due to higher information and transaction costs for international stock trades, direct stock holdings consist primarily of domestic stocks. On the other hand, equity mutual funds are globally diversified. Consequently, a household that is highly exposed to the local housing market is expected to lower its exposure to the local economy by reducing its share of total stock holdings invested in directly owned stocks and to increase its exposure to the global stock market by increasing its share

[33] The 75^{th} percentile (risky financial assets) is SEK 271,349.

[34] Empirical evidence of positive correlations between home prices and domestic stocks are found, for example, in Sweden and in the U.K.

of total stock holdings invested in global equity mutual funds.

To test this empirically, a unique register-based Swedish database is used. The empirical results strongly indicate that, on average, Swedish households that are highly exposed to the local housing market in the form of owner-occupied housing reduce their exposure to the Swedish stock market and increase their exposure to globally diversified equity mutual funds significantly. In fact, both the probabilities of holding directly owned stocks and equity mutual funds and the relative shares of total stock holdings invested in each asset class are affected. Interestingly, for other types of real estate, such as investment properties and properties abroad, there are no signs of a switch from directly owned local stocks to equity mutual funds.

To summarize, for single-family homes over net wealth we observe a significant positive marginal effect on the relative share of total stock holdings invested in equity mutual funds of 13–14%, and a negative effect on the relative share of total stockholdings invested in directly owned stocks of the same magnitude. Due to the longitudinal feature of the database, one can also follow a single household over time and consistent evidence is found.

Potential future developments of the model are to include other background risks, such as labor income risk, to evaluate the composition of the financial portfolio.

A Appendix

Age group: Dummies for (1) 26–30 years old, (2) 31–35 years old, (3) 36–40 years old, (4), 41–45 years old, (5) 46–50 years old, (6) 51–55 years old, and (7) 56–60 years old

Country of birth: Dummies for (1) Sweden, (2) Nordic countries, (3) EU15 + 6 OECD countries, and (4) all other countries

Education: Dummies for (1) primary and lower secondary education, (2) upper secondary education, (3) post-secondary education, (4) postgraduate education, and (5) education not known

Family size: Number of adults and children in the family

Industry: Dummies for (1) agriculture, hunting, and forestry, (2) fishing, (3) mining and quarrying, (4) manufacturing, (5) electricity, gas, and water supply, (6) construction, (7) wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods, (8) hotels and restaurants, (9) transport, storage, and communication, (10) financial intermediation, (11) real estate, renting, and business activities, (12) public administration and defense, compulsory social security, and extra-territorial organizations and bodies, (13) education, health, and social work, and (14) other community, social, and personal service activities

Marital status: Dummy for whether the individual is married

Region: Dummies for 70 A-regions (local labor markets)

Sector: Dummies for (1) central government sector, (2) local government (municipality) sector, and (3) private sector

Unemployed: Dummy for whether the household head receives unemployment benefits

Table A1: Shares of Risky Financial Assets Invested in Directly Owned Stocks and in Equity Mutual Funds, 1999

	All households				Risky financial assets > 75th percentile			
	Stocks		Mutual funds		Stocks		Mutual funds	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Owner (single-family home)	0.17***	[0.10]	-0.08***	[-0.05]	0.16***	[0.11]	-0.06***	[-0.05]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (cooperative apartment)	0.03***	[0.02]	-0.04***	[-0.02]	0.03***	[0.02]	-0.01	[-0.01]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (summer house)	0.08***	[0.04]	-0.04***	[-0.02]	0.07***	[0.05]	-0.04***	[-0.03]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (agricultural property)	0.03***	[0.02]	0.00	[0.00]	0.04***	[0.02]	-0.01*	[-0.01]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (multi-dwelling building)	0.13***	[0.06]	-0.05	[-0.02]	0.12***	[0.09]	-0.09***	[-0.08]
	(0.03)		(0.03)		(0.03)		(0.02)	
Owner (industrial building)	0.06**	[0.03]	-0.05*	[-0.03]	0.08***	[0.07]	-0.05*	[-0.04]
	(0.03)		(0.03)		(0.03)		(0.03)	
Owner (property abroad)	0.07	[0.05]	-0.05	[-0.05]	0.11**	[0.06]	-0.11***	[-0.07]
	(0.05)		(0.05)		(0.04)		(0.04)	
Owner (site)	0.07***	[0.04]	-0.04***	[-0.03]	0.07***	[0.05]	-0.04***	[-0.03]
	(0.01)		(0.01)		(0.01)		(0.01)	
(Single-family home)/NW	-0.20***	[-0.13]	0.15***	[0.08]	-0.36***	[-0.24]	0.25***	[0.19]
	(0.01)		(0.01)		(0.02)		(0.02)	
(Cooperative apartment)/NW	-0.12***	[-0.08]	0.18***	[0.10]	-0.16***	[-0.11]	0.14***	[0.11]
	(0.02)		(0.02)		(0.04)		(0.04)	
(Summer house)/NW	-0.14***	[-0.08]	0.09***	[0.04]	-0.26***	[-0.18]	0.13***	[0.10]
	(0.02)		(0.02)		(0.04)		(0.04)	
(Agricultural property)/NW	0.16***	[0.08]	-0.14***	[-0.13]	-0.05*	[-0.04]	0.00	[0.00]
	(0.02)		(0.02)		(0.03)		(0.03)	
(Multi-dwelling building)/NW	-0.11	[-0.05]	0.01	[-0.02]	-0.22***	[-0.16]	0.16**	[0.14]
	(0.07)		(0.07)		(0.07)		(0.07)	
(Industrial building)/NW	0.00	[0.01]	-0.11	[-0.11]	-0.23	[-0.19]	0.03	[0.04]
	(0.12)		(0.12)		(0.16)		(0.14)	
(Property abroad)/NW	-0.04	[-0.06]	0.28	[0.21]	-0.61	[-0.33]	0.30	[0.15]
	(0.30)		(0.31)		(0.48)		(0.44)	
Site/NW	-0.27***	[-0.15]	0.10	[0.05]	-0.25	[-0.16]	0.04	[0.01]
	(0.10)		(0.09)		(0.18)		(0.17)	
(Other debt)/NW	-0.00	[-0.00]	-0.00***	[-0.00]	0.00	[0.00]	-0.01**	[-0.01]
	(0.00)		(0.00)		(0.00)		(0.00)	

Table A1 (cont.)

	All households				Risky financial assets > 75th percentile			
	Stocks		Mutual funds		Stocks		Mutual funds	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Mortgage (single-family home)/NW	0.17***	[0.11]	-0.14***	[-0.07]	0.31***	[0.21]	-0.26***	[-0.21]
	(0.01)		(0.01)		(0.02)		(0.02)	
Debt (cooperative apartment)/NW	0.09***	[0.07]	-0.16***	[-0.09]	0.14***	[0.09]	-0.18***	[-0.15]
	(0.02)		(0.02)		(0.04)		(0.04)	
Debt (summer house)/NW	0.13***	[0.07]	-0.07***	[-0.04]	0.26***	[0.17]	-0.13***	[-0.10]
	(0.02)		(0.02)		(0.04)		(0.04)	
Debt (agricultural property)/NW	-0.12***	[-0.07]	0.11***	[0.12]	0.08**	[0.06]	0.01	[0.00]
	(0.02)		(0.02)		(0.03)		(0.03)	
Debt (multi-dwelling building)/NW	0.12*	[0.06]	-0.02	[0.01]	0.24***	[0.17]	-0.15**	[-0.13]
	(0.07)		(0.07)		(0.07)		(0.07)	
Debt (industrial building)/NW	-0.04	[-0.04]	0.17	[0.15]	0.21	[0.16]	-0.08	[-0.06]
	(0.14)		(0.13)		(0.19)		(0.18)	
Debt (property abroad)/NW	0.09	[0.10]	-0.34	[-0.27]	0.59	[0.30]	-0.35	[-0.18]
	(0.32)		(0.33)		(0.50)		(0.45)	
Debt (site)/NW	0.29***	[0.16]	-0.10	[-0.07]	0.22	[0.14]	-0.03	[-0.01]
	(0.10)		(0.09)		(0.18)		(0.17)	
Income/10e8	14.91***	[7.45]	-9.19***	[-6.23]	10.61***	[7.12]	-8.40***	[-6.44]
	(0.93)		(1.00)		(0.69)		(0.66)	
Income squared/10e16	-54.20***	[-27.36]	29.23***	[20.74]	-39.98***	[-26.84]	28.29***	[21.43]
	(3.45)		(3.66)		(2.56)		(2.43)	
Risky financial assets/10e8	0.19	[0.03]	-0.02	[0.14]	0.33***	[0.23]	-0.06	[-0.08]
	(0.14)		(0.18)		(0.10)		(0.10)	
Net wealth/10e8	0.33***	[0.21]	-0.31***	[-0.28]	0.07	[0.05]	-0.14*	[-0.11]
	(0.11)		(0.12)		(0.08)		(0.08)	
Constant	0.06		0.28***		0.17		0.45***	
Observations	101161		101161		25290		25290	
Log likelihood	-165039		-165039		-26664		-26664	
Sigma	0.60***		0.62***		0.38***		0.36***	
Rho	0.84***		0.84***		-0.47***		-0.47***	

This table presents the empirical results of bivariate Tobit models using the 1999 cross-sectional sample. Coefficients and marginal effects (evaluated at the mean) of the relative shares of risky financial assets invested in directly owned stocks and in equity and mixed mutual funds are reported for the whole sample and for households with risky financial assets above the 75th percentile separately. Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in the Appendix are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, and *risky financial assets* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

Table A2: Shares of Risky Financial Assets Invested in Directly Owned Stocks and in Equity Mutual Funds, 2003

	All households				Risky financial assets > 75th percentile			
	Stocks		Mutual funds		Stocks		Mutual funds	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Owner (single-family home)	0.14***	[0.11]	-0.15***	[-0.12]	0.10***	[0.07]	-0.06***	[-0.05]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (cooperative apartment)	0.06***	[0.04]	-0.06***	[-0.05]	0.06***	[0.04]	-0.04***	[-0.03]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (summer house)	0.04***	[0.03]	-0.02***	[-0.02]	0.05***	[0.04]	-0.02***	[-0.02]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (agricultural property)	0.02***	[0.01]	-0.02**	[-0.01]	0.02***	[0.02]	-0.02**	[-0.01]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (multi-dwelling building)	0.11***	[0.07]	-0.10***	[-0.07]	0.09***	[0.07]	-0.07***	[-0.06]
	(0.03)		(0.03)		(0.02)		(0.02)	
Owner (industrial building)	0.07***	[0.05]	-0.08***	[-0.06]	0.04*	[0.03]	-0.06**	[-0.04]
	(0.02)		(0.02)		(0.02)		(0.02)	
Owner (property abroad)	0.05	[0.02]	-0.02	[-0.01]	0.07*	[0.05]	-0.02	[-0.01]
	(0.04)		(0.04)		(0.04)		(0.04)	
(Single-family home)/NW	-0.11***	[-0.11]	0.22***	[0.17]	-0.13***	[-0.09]	0.15***	[0.12]
	(0.01)		(0.01)		(0.01)		(0.01)	
(Cooperative apartment)/NW	-0.09***	[-0.07]	0.16***	[0.12]	-0.17***	[-0.12]	0.15***	[0.12]
	(0.01)		(0.01)		(0.03)		(0.03)	
(Summer house)/NW	0.01	[-0.01]	0.05***	[0.03]	-0.05**	[-0.03]	0.00	[-0.00]
	(0.02)		(0.02)		(0.02)		(0.02)	
(Agricultural property)/NW	0.09***	[0.05]	0.06***	[0.02]	0.00	[0.00]	0.08***	[0.07]
	(0.02)		(0.02)		(0.02)		(0.02)	
(Multi-dwelling building)/NW	0.11*	[0.06]	0.03	[0.01]	0.04	[0.03]	-0.04	[-0.03]
	(0.06)		(0.06)		(0.06)		(0.06)	
(Industrial building)/NW	-0.05	[-0.02]	0.10	[0.04]	-0.00	[0.00]	0.05	[0.04]
	(0.10)		(0.11)		(0.12)		(0.12)	
(Property abroad)/NW	0.18	[0.11]	0.09	[0.08]	0.54	[0.39]	-0.13	[-0.13]
	(0.22)		(0.23)		(0.33)		(0.35)	
(Other debt)/NW	0.00	[-0.00]	-0.00	[0.00]	0.00**	[0.00]	-0.00**	[-0.00]
	(0.00)		(0.00)		(0.00)		(0.00)	

Table A2 (cont.)

	All households				Risky financial assets > 75th percentile			
	Stocks		Mutual funds		Stocks		Mutual funds	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Mortgage (single-family home)/NW	0.10***	[0.10]	-0.20***	[-0.15]	0.13***	[0.09]	-0.15***	[-0.13]
	(0.01)		(0.01)		(0.01)		(0.01)	
Debt (cooperative apartment)/NW	0.08***	[0.07]	-0.15***	[-0.11]	0.17***	[0.12]	-0.15***	[-0.12]
	(0.01)		(0.01)		(0.03)		(0.03)	
Debt (summer house)/NW	-0.01	[0.01]	-0.04**	[-0.03]	0.06**	[0.05]	-0.00	[0.00]
	(0.02)		(0.02)		(0.03)		(0.03)	
Debt (agricultural property)/NW	-0.06***	[-0.03]	-0.07***	[-0.03]	0.05*	[0.03]	-0.10***	[-0.08]
	(0.02)		(0.02)		(0.03)		(0.03)	
Debt (multi-dwelling building)/NW	-0.10*	[-0.06]	-0.03	[-0.00]	-0.02	[-0.02]	0.03	[0.02]
	(0.06)		(0.06)		(0.06)		(0.06)	
Debt (industrial building)/NW	0.02	[-0.00]	-0.08	[-0.02]	0.07	[0.05]	-0.10	[-0.08]
	(0.11)		(0.12)		(0.15)		(0.16)	
Debt (property abroad)/NW	-0.14	[-0.09]	-0.10	[-0.06]	-0.49	[-0.34]	-0.63	[-0.55]
	(0.24)		(0.25)		(0.57)		(0.63)	
Income/10e8	4.94***	[3.55]	-2.60***	[-2.54]	1.98***	[1.28]	-1.98***	[-1.44]
	(0.71)		(0.75)		(0.54)		(0.55)	
Income squared/10e16	-9.90***	[-7.45]	5.51***	[5.60]	-3.54***	[-2.24]	3.53***	[2.54]
	(1.77)		(1.88)		(1.26)		(1.30)	
Risky financial assets/10e8	1.13***	[0.65]	-0.86***	[-0.52]	1.12***	[0.83]	-0.70***	[-0.60]
	(0.15)		(0.16)		(0.11)		(0.11)	
Net wealth/10e8	0.03	[0.02]	-0.06	[-0.07]	-0.01	[-0.01]	-0.06	[-0.05]
	(0.05)		(0.05)		(0.04)		(0.04)	
Constant	0.11**		0.60***		0.05		0.55***	
Observations	109861		109861		27465		27465	
Log likelihood	-158026		-158026		-21570		-21570	
Sigma	0.50***		0.53***		0.32***		0.33***	
Rho	0.92***		0.92***		-0.49***		-0.49***	

This table presents the empirical results of bivariate Tobit models using the 2003 cross-sectional sample. Coefficients and marginal effects (evaluated at the mean) of the relative shares of risky financial assets invested in directly owned stocks and in equity and mixed mutual funds are reported for the whole sample and for households with risky financial assets above the 75th percentile separately. Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in the Appendix are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, and *risky financial assets* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

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Table 1: International Stock Participation Rates

	France	Germany	Italy	Nether-lands	Sweden	U.K.	U.S.
Direct participation	0.15	0.17	0.07	0.14	0.27	0.27	0.19
Total participation	0.23	n/a	0.15	0.24	0.54	0.34	0.48

This table presents direct and total stock market participation rates in 1998 (Sweden, 1999). Source: Guiso, Haliassos and Jappelli (2003).

Table 2: Equity Shares

Year	All equity	Indirect	Direct
1989	0.33	0.26	0.17
1992	0.39	0.34	0.17
1995	0.49	0.38	0.20
1998	0.53	0.46	0.21
2001	0.57	0.48	0.18

This table presents median shares of equity relative to total financial assets conditional on owning. Based on SCF data from 1989–2001. Source: Polkovnichenko (2005).

Table 3: Aggregate Wealth

	1999	2000	2001	2002	2003
Real Estate	2,253	2,559	2,756	3,057	3,278
Single-family homes	*1,347*	*1,532*	*1,660*	*1,863*	*1,984*
Cooperative apartments	*247*	*356*	*378*	*388*	*446*
Other real estate	*659*	*671*	*718*	*806*	*848*
Financial Assets	1,530	1,515	1,422	1,166	1,397
Bank accounts	*365*	*357*	*401*	*402*	*458*
Mutual funds	*401*	*470*	*420*	*319*	*419*
Stocks	*517*	*472*	*394*	*260*	*328*
Other financial assets	*247*	*216*	*207*	*185*	*192*
Other Assets	222	146	151	102	89
Total Assets	4,005	4,220	4,330	4,325	4,765
Debt	1,056	1,166	1,252	1,323	1,477
Net Wealth	2,949	3,054	3,077	3,001	3,288

This table presents aggregate wealth in Sweden in billions of Swedish kronor (SEK) from 1999–2003. Source: Statistics Sweden.

Table 4: Tenure Choice

Type of building	Number of households (in 1,000s)	Home-owners	Coop owners	Renters	Others	N/a
All	3,830	41%	15%	40%	4%	1%
One- or two-dwelling building	1,861	82%	3%	11%	4%	0%
Three- or more dwelling building	1,969	2%	26%	67%	4%	2%

This table presents the shares of Swedish households by type of building and tenure in 1990. *Coop owners* refers to owners of cooperative apartments. Source: Bostads- och byggnadsstatistik årsbok 2006, Statistics Sweden, 2006.

Table 5: Summary Statistics

Average values	1999	2003	Longi-tudinal
Household size	3.27	3.26	3.66
Female	0.33	0.35	0.25
Married	0.62	0.58	0.72
Unemployed	0.08	0.07	0.00
Age	43.72	44.21	42.47
Age 26–30 years	0.08	0.06	0.03
Age 31–35 years	0.14	0.13	0.17
Age 36–40 years	0.16	0.19	0.24
Age 41–45 years	0.18	0.17	0.22
Age 46–50 years	0.17	0.16	0.15
Age 51–55 years	0.16	0.15	0.16
Age 56–60 years	0.11	0.14	0.03
Born in Sweden	0.94	0.94	0.95
Born in other Nordic countries	0.02	0.02	0.02
Born in EU15 + 6 OECD countries	0.01	0.01	0.01
Born in all other countries	0.03	0.03	0.02
Primary or lower secondary education	0.16	0.12	0.15
Upper secondary education	0.47	0.48	0.50
Post-secondary education	0.36	0.38	0.34
Postgraduate education	0.02	0.02	0.01
Education not known	0.00	0.00	0.00
Central government sector	0.12	0.10	0.13
Local government sector	0.24	0.23	0.20
Private sector	0.64	0.67	0.67

This table presents average values of individual characteristics for the 1999 and 2003 cross-sectional samples and for the longitudinal sample. The numbers of observations are 101,161 in 1999, 109,861 in 2003, and 14,037 in the longitudinal sample. Industries are not reported.

Table 6: Wealth Statistics

	1999			2003			Longitudinal		
	Mean	**StDev**	**Share**	**Mean**	**StDev**	**Share**	**Mean**	**StDev**	**Share**
Household disposable income	341	447	100%	393	404	100%	335	158	100%
Directly owned stocks	179	2,987	50%	94	1,105	58%	73	334	49%
+ Equity mutual funds	132	329	79%	127	368	88%	127	257	87%
= *Total stock holdings*	*311*	*3,062*	*91%*	*222*	*1,239*	*96%*	*201*	*450*	*97%*
+ Mixed mutual funds	19	104	30%	n/a	n/a	n/a	16	61	30%
+ Capital insurance products	33	206	23%	30	158	30%	24	250	21%
+ Other financial assets	15	73	23%	8	54	12%	12	53	20%
+ Interest-bearing instruments	24	150	24%	26	225	27%	16	79	22%
= *Risky financial assets*	*402*	*3,159*	*100%*	*286*	*1,348*	*100%*	*268*	*582*	*100%*
+ Bank account, imputed	122	365	100%	153	520	100%	96	159	100%
(Bank account, reported)	104	367	71%	131	523	73%	74	164	69%
= *Financial assets*	*524*	*3,264*	*100%*	*440*	*1,629*	*100%*	*364*	*647*	*100%*
+ Real estate holdings	1,062	2,020	89%	1,449	2,723	88%	988	568	100%
+ Other assets	87	1,394	12%	42	2,400	4%	35	257	8%
– Total debt	468	1,079	89%	626	1,048	91%	547	363	97%
= *Net wealth*	*1,205*	*4,339*	*100%*	*1,305*	*4,210*	*100%*	*840*	*1,044*	*100%*
Stocks/(Total stock holdings)	0.27	0.38		0.24	0.34		0.24	0.36	
Funds/(Total stock holdings)	0.65	0.42		0.71	0.37		0.76	0.36	
Δ(Single-family home/NW)							0.52	0.79	
Δ(Stocks/Total stock holdings)							0.00	0.25	
Δ(Funds/Total stock holdings)							0.00	0.25	

This table presents summary statistics on income and wealth variables for the 1999 and 2003 cross-sectional samples and for the longitudinal sample. Asset values are reported in thousands of Swedish kronor (SEK). *Stocks* refer to directly owned stocks and *funds* to equity mutual funds in 1999 and to equity and mixed mutual funds in 2003. *Share* is the percentage share of all households holding that specific asset. Δ is the change from 1999 to 2003.

Table 7: Stock Market Participation Rates

	Stocks		Funds		Stocks *or* funds		Stocks *and* funds	
	1999	2003	1999	2003	1999	2003	1999	2003
All households	0.50	0.58	0.85	0.88	0.95	0.96	0.40	0.51
Households with risky financial assets below the 75th percentile	0.41	0.49	0.83	0.87	0.94	0.95	0.31	0.41
Households with risky financial assets above the 75th percentile	0.77	0.84	0.91	0.94	0.99	0.99	0.70	0.79

This table presents stock market participation rates in the 1999 and 2003 cross-sectional samples. *Stocks* refer to directly owned stocks and *funds* to equity mutual funds in 1999 and to equity and mixed mutual funds in 2003. *Risky financial assets* include directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets.

Table 8: Values of Real Estate and Debt

	1999			2003			Longitudinal		
	Mean	**StdDev**	**Share**	**Mean**	**StdDev**	**Share**	**Mean**	**StdDev**	**Share**
Single-family homes	714	729	73%	1,017	1,885	72%	988	568	100%
+ Cooperative apartments	49	230	13%	94	343	15%			
+ Summer houses	82	255	21%	125	628	20%			
+ Agricultural properties	159	902	14%	162	1,024	13%			
+ Multi family houses	42	1,411	1%	43	1,270	1%			
+ Industrial buildings	7	252	1%	6	261	1%			
+ Properties abroad	1	35	0%	2	99	0%			
+ Sites	6	58	4%						
= *Real estate holdings*	*1,062*	*2,020*	*89%*	*1,449*	*2,723*	*88%*	*988*	*568*	*100%*
Debt (single-family home)	338	406	69%	470	579	69%	541	357	97%
+ Debt (cooperative apartment)	17	93	10%	36	157	13%			
+ Debt (summer house)	30	116	19%	43	174	18%			
+ Debt (agricultural property)	40	298	13%	43	370	11%			
+ Debt (multi-dwelling building)	19	780	1%	18	612	1%			
+ Debt (industrial building)	3	154	1%	2	162	1%			
+ Debt (property abroad)	0	22	0%	1	25	0%			
+ Debt (site)	2	23	4%	n/a	n/a	n/a			
+ Other debt	17	207	23%	12	99	21%	6	47	7%
= *Total debt*	*468*	*1,079*	*89%*	*626*	*1,048*	*91%*	*547*	*363*	*97%*

This table presents summary statistics on real estate and debt variables in thousands of Swedish kronor (SEK) for the 1999 and 2003 cross-sectional samples and for the longitudinal sample. The numbers of observations are 101,161 in 1999, 109,861 in 2003, and 14,037 in the longitudinal sample. *Mean* is the average value of all observations in the sample, *StdDev* is the standard deviation, and *Share* is the percentage share of all households holding that specific category of asset/debt.

Table 9: Real Estate and Debt Variables as Shares of Net Wealth

	1999			2003			Longitudinal		
	Obs.	**Mean**	**StDev**	**Obs.**	**Mean**	**StDev**	**Obs.**	**Mean**	**StDev**
(Total value of real estate)/NW	89,702	1.91	2.31	97,013	2.09	2.33	14,037	2.30	2.46
(Single-family home)/NW	73,528	1.86	2.36	79,398	2.01	2.36	14,037	2.30	2.46
(Cooperative apartment)/NW	12,923	1.00	1.62	16,127	1.22	1.82			
(Summer house)/NW	20,762	0.55	1.11	21,688	0.62	1.14			
(Agricultural property)/NW	14,129	0.56	0.70	13,771	0.56	0.74			
(Multi-dwelling building)/NW	1,249	0.99	1.54	1,228	1.15	1.64			
(Industrial building)/NW	906	0.38	0.64	884	0.38	0.70			
(Property abroad)/NW	244	0.26	0.54	267	0.26	0.66			
Site/NW	3,917	0.22	0.59	n/a	n/a	n/a			
(Total debt)/NW	90,224	1.61	3.34	100,116	1.66	3.49	13,573	1.86	2.73
Debt (single-family home)/NW	69,836	1.45	2.45	76,277	1.52	2.45	13,573	1.81	2.57
Debt (cooperative apartment)/NW	10,466	0.83	1.78	14,157	0.91	1.93			
Debt (summer house)/NW	18,958	0.38	1.12	20,271	0.41	1.14			
Debt (agricultural property)/NW	12,878	0.26	0.66	12,634	0.27	0.71			
Debt (multi-dwelling building)/NW	1,202	0.69	1.53	1,188	0.81	1.62			
Debt (industrial building)/NW	846	0.23	0.60	817	0.25	0.67			
Debt (property abroad)/NW	227	0.18	0.52	248	0.18	0.64			
Debt (site)/NW	3,584	0.16	0.60						
(Other debt)/NW	23,343	0.99	4.24	23,262	1.05	5.04	988	0.68	0.98

This table presents summary statistics of real estate and debt variables as shares of net wealth (NW) for the 1999 and 2003 cross-sectional samples and for the longitudinal sample. *Obs* is the number of observations holding that specific category of asset/debt, *Mean* is the average value conditional on holding that specific asset/debt, and *StDev* is the standard deviation.

Table 10: Ownership Probabilities of Directly Owned Stocks and of Equity Mutual Funds

	1999				2003			
	OWNER (STOCKS)		OWNER (FUNDS)		OWNER (STOCKS)		OWNER (FUNDS)	
	ALL	>75th perc.	ALL	>75th perc.	ALL	>75th perc.	ALL	>75th perc.
Owner (single-family home)	0.31***	0.15***	0.16***	0.03***	0.37***	0.12***	0.10***	0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Owner (cooperative apartment)	0.05***	0.01	0.04***	-0.00	0.10***	0.04***	0.03***	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Owner (summer house)	0.09***	0.06***	0.02***	0.00	0.07***	0.03***	0.02***	0.01
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
Owner (agricultural property)	0.06***	0.05***	0.03***	-0.00	0.04***	0.02**	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Owner (multi-dwelling building)	0.11***	0.07***	0.02	0.00	0.06***	0.03	-0.01	0.00
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Owner (industrial building)	0.05**	0.05*	-0.02	-0.05**	0.08***	0.04	-0.03**	-0.01
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)
Owner (property abroad)	0.04	0.06	-0.05	-0.08**	0.00	0.04	-0.03	-0.05*
	(0.04)	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Owner (site)	0.06***	0.05***	-0.01	-0.01				
	(0.01)	(0.01)	(0.01)	(0.01)				
(Single-family home)/NW	-0.41***	-0.24***	-0.23***	0.03*	-0.42***	-0.09***	-0.12***	0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
(Cooperative apartment)/NW	-0.24***	-0.10**	-0.12***	0.01	-0.26***	-0.11***	-0.09***	0.03*
	(0.01)	(0.05)	(0.01)	(0.04)	(0.01)	(0.03)	(0.01)	(0.02)
(Summer house)/NW	-0.25***	-0.14***	-0.14***	-0.00	-0.14***	0.02	-0.08***	-0.01
	(0.02)	(0.04)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)	(0.02)
(Agricultural property)/NW	-0.01	0.03	-0.31***	-0.02	-0.08***	0.06**	-0.13***	0.02
	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
(Multi-dwelling building)/NW	-0.21***	-0.11	-0.21***	-0.08	0.02	0.03	-0.13***	-0.06
	(0.05)	(0.08)	(0.05)	(0.06)	(0.05)	(0.06)	(0.04)	(0.04)
(Industrial building)/NW	-0.12	-0.04	-0.26***	0.08	-0.19**	0.04	-0.07	0.06
	(0.09)	(0.16)	(0.08)	(0.13)	(0.09)	(0.13)	(0.07)	(0.09)
(Property abroad)/NW	-0.12	-0.51	0.06	0.08	-0.06	0.28	0.05	0.71***
	(0.22)	(0.50)	(0.20)	(0.38)	(0.21)	(0.38)	(0.15)	(0.25)
Site/NW	-0.36***	-0.15	-0.15**	-0.17				
	(0.07)	(0.19)	(0.06)	(0.15)				
(Other debt)/NW	-0.00	0.00	-0.00**	-0.00	-0.00**	0.00**	-0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table 10 (cont.)

	1999				2003			
	OWNER(STOCKS)		OWNER(FUNDS)		OWNER(STOCKS)		OWNER(FUNDS)	
	ALL	>75th perc.	ALL	>75th perc.	ALL	>75th perc.	ALL	>75th perc.
Mortgage (single-family home)/NW	0.37***	0.19***	0.22***	-0.05***	0.37***	0.08***	0.11***	-0.02*
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Debt (cooperative apartment)/NW	0.21***	0.07	0.11***	-0.05	0.24***	0.12***	0.08***	-0.03*
	(0.01)	(0.05)	(0.01)	(0.04)	(0.01)	(0.03)	(0.01)	(0.02)
Debt (summer house)/NW	0.23***	0.13***	0.13***	-0.01	0.12***	-0.02	0.08***	0.02
	(0.02)	(0.04)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)	(0.02)
Debt (agricultural property)/NW	0.01	-0.04	0.27***	0.01	0.07***	-0.03	0.10***	-0.03
	(0.02)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)
Debt (multi-dwelling building)/NW	0.22***	0.13	0.20***	0.09	-0.03	-0.01	0.13***	0.05
	(0.05)	(0.08)	(0.05)	(0.06)	(0.05)	(0.07)	(0.04)	(0.04)
Debt (industrial building)/NW	0.07	-0.03	0.26***	-0.18	0.12	-0.11	0.06	-0.17
	(0.10)	(0.20)	(0.08)	(0.16)	(0.10)	(0.17)	(0.07)	(0.11)
Debt (property abroad)/NW	0.20	0.50	-0.09	-0.06	0.08	-0.49	-0.02	-1.47***
	(0.24)	(0.52)	(0.21)	(0.40)	(0.22)	(0.65)	(0.16)	(0.42)
Debt (site)/NW	0.36***	0.14	0.13**	0.19				
	(0.07)	(0.19)	(0.06)	(0.15)				
Income/10e8	10.82***	4.59***	-1.07*	-2.70***	7.62***	1.28**	0.32	-0.45
	(0.70)	(0.73)	(0.61)	(0.57)	(0.65)	(0.60)	(0.46)	(0.39)
Income squared/10e16	-42.09***	-18.04***	-0.16	7.82***	-17.82***	-2.86**	-1.03	0.97
	(2.59)	(2.69)	(2.27)	(2.08)	(1.63)	(1.42)	(1.16)	(0.92)
Risky financial assets/10e8	-0.38***	0.06	0.10	-0.08	0.93***	0.46***	0.41***	-0.05
	(0.11)	(0.11)	(0.09)	(0.08)	(0.14)	(0.12)	(0.10)	(0.08)
Net wealth/10e8	0.64***	0.05	-0.05	0.03	0.04	-0.06	-0.04	-0.01
	(0.08)	(0.08)	(0.07)	(0.07)	(0.05)	(0.04)	(0.03)	(0.03)
Constant	0.00	0.57***	0.00	0.00	0.24***	0.00	0.00	0.87***
Observations	101161	25290	101161	25290	109861	27465	109861	27465
Adjusted R-squared	0.154	0.075	0.047	0.040	0.140	0.056	0.048	0.029
Individual characteristics	YES	YES	YES	YES	YES	YES	YES	YES

This table presents the empirical results of SUR linear probability models using the 1999 and 2003 cross-sectional samples. Owner of stocks equals one if directly owned stocks > SEK 1,000 and zero otherwise, and owner of funds equals one if equity mutual funds (equity and mixed mutual funds in 2003) > SEK 1,000 and zero otherwise. Results for the whole sample and for households with risky financial assets above the 75th percentile are reported separately. Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in Appendix 1 are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, and *risky financial assets* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

Table 11: Shares of Total Stock Holdings Invested in Directly Owned Stocks and in Equity Mutual Funds

	1999				2003			
	All households		RFA > 75th perc.		All households		RFA > 75th perc.	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Owner (single-family home)	0.14***	[0.11]	0.14***	[0.11]	0.15***	[0.13]	0.11***	[0.08]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (cooperative apartment)	0.05***	[0.02]	0.04**	[0.02]	0.06***	[0.05]	0.07***	[0.05]
	(0.01)		(0.02)		(0.01)		(0.01)	
Owner (summer house)	0.05***	[0.05]	0.06***	[0.05]	0.03***	[0.03]	0.05***	[0.04]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (agricultural property)	0.00	[0.02]	0.02	[0.02]	0.02*	[0.02]	0.02**	[0.02]
	(0.01)		(0.01)		(0.01)		(0.01)	
Owner (multi-dwelling building)	0.09**	[0.07]	0.13***	[0.10]	0.12***	[0.08]	0.10***	[0.08]
	(0.04)		(0.03)		(0.03)		(0.03)	
Owner (industrial building)	0.06	[0.05]	0.09**	[0.09]	0.08***	[0.07]	0.07**	[0.05]
	(0.04)		(0.04)		(0.03)		(0.03)	
Owner (property abroad)	0.06	[0.06]	0.09	[0.09]	0.05	[0.03]	0.10**	[0.07]
	(0.06)		(0.06)		(0.05)		(0.04)	
Owner (site)	0.05***	[0.05]	0.06***	[0.05]				
	(0.02)		(0.02)					
(Single-family home)/NW	-0.22***	[-0.13]	-0.34***	[-0.26]	-0.15***	[-0.14]	-0.15***	[-0.11]
	(0.01)		(0.02)		(0.01)		(0.02)	
(Cooperative apartment)/NW	-0.19***	[-0.10]	-0.20***	[-0.15]	-0.12***	[-0.10]	-0.21***	[-0.15]
	(0.03)		(0.06)		(0.02)		(0.03)	
(Summer house)/NW	-0.13***	[-0.08]	-0.20***	[-0.15]	0.01	[-0.01]	-0.01	[-0.01]
	(0.03)		(0.05)		(0.02)		(0.03)	
(Agricultural property)/NW	0.06**	[0.16]	-0.04	[-0.01]	0.04*	[0.04]	-0.00	[-0.00]
	(0.03)		(0.04)		(0.02)		(0.03)	
(Multi-dwelling building)/NW	-0.09	[-0.02]	-0.20**	[-0.13]	0.05	[0.07]	0.10	[0.07]
	(0.09)		(0.10)		(0.07)		(0.07)	
(Industrial building)/NW	-0.02	[0.08]	-0.16	[-0.15]	-0.08	[-0.05]	-0.02	[-0.01]
	(0.15)		(0.21)		(0.12)		(0.14)	
(Property abroad)/NW	-0.10	[-0.08]	-0.34	[-0.39]	0.16	[0.07]	0.27	[0.23]
	(0.37)		(0.64)		(0.26)		(0.40)	
Site/NW	-0.15	[-0.16]	-0.12	[-0.07]				
	(0.12)		(0.24)					
(Other debt)/NW	0.00	[0.00]	0.00	[0.00]	0.00	[-0.00]	0.00**	[0.00]
	(0.00)		(0.00)		(0.00)		(0.00)	

Table 11 (cont.)

	1999				2003			
	All households		RFA > 75th perc.		All households		RFA > 75th perc.	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Mortgage (single-family home)/NW	0.19***	[0.12]	0.31***	[0.24]	0.13***	[0.12]	0.16***	[0.12]
	(0.01)		(0.02)		(0.01)		(0.01)	
Debt (cooperative apartment)/NW	0.17***	[0.09]	0.23***	[0.15]	0.12***	[0.09]	0.21***	[0.15]
	(0.03)		(0.06)		(0.02)		(0.03)	
Debt (summer house)/NW	0.12***	[0.07]	0.21***	[0.17]	-0.00	[0.01]	0.03	[0.02]
	(0.03)		(0.06)		(0.02)		(0.03)	
Debt (agricultural property)/NW	-0.03	[-0.13]	0.07	[0.03]	-0.02	[-0.03]	0.05*	[0.04]
	(0.03)		(0.05)		(0.02)		(0.03)	
Debt (multi-dwelling building)/NW	0.11	[0.03]	0.20**	[0.14]	-0.05	[-0.08]	-0.09	[-0.06]
	(0.09)		(0.10)		(0.07)		(0.07)	
Debt (industrial building)/NW	-0.06	[-0.11]	0.10	[0.12]	0.06	[0.01]	0.07	[0.05]
	(0.17)		(0.26)		(0.13)		(0.18)	
Debt (property abroad)/NW	0.10	[0.13]	0.30	[0.36]	-0.13	[-0.06]	0.22	[0.12]
	(0.39)		(0.66)		(0.27)		(0.71)	
Debt (site)/NW	0.15	[0.17]	0.09	[0.04]				
	(0.12)		(0.24)					
Income/10e8	11.60***	[8.70]	10.25***	[8.20]	3.89***	[3.91]	2.16***	[1.57]
	(1.24)		(0.97)		(0.85)		(0.64)	
Income squared/10e16	-36.70***	[-29.77]	-34.95***	[-28.62]	-7.46***	[-8.26]	-3.91***	[-2.81]
	(4.71)		(3.56)		(2.20)		(1.49)	
Risky financial assets/10e8	0.32	[-0.03]	0.34**	[0.24]	0.97***	[0.62]	1.11***	[0.81]
	(0.24)		(0.17)		(0.19)		(0.13)	
Net wealth/10e8	0.08	[0.26]	0.04	[0.06]	0.02	[0.04]	0.01	[0.00]
	(0.16)		(0.11)		(0.06)		(0.05)	
Constant	0.29**		0.11		0.26***		0.17*	
Observations	91275		24684		104418		27084	
Log likelihood	-138815		-36835		-151420		-30689	
Sigma	0.96***		0.52***		0.64***		0.38***	
Rho	3.85***		0.69***		1.78***		-0.13***	

This table presents the empirical results of bivariate Tobit models using the 1999 and 2003 cross-sectional samples. Coefficients and marginal effects (evaluated at the mean) of the relative share of total stock holdings invested in directly owned stocks are reported for the whole sample and for households with risky financial assets above the 75th percentile separately. The results for the share of total stock holdings invested in equity mutual funds (equity and mixed mutual funds in 2003) are of opposite signs but of the same magnitude (results not reported). Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in Appendix 1 are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, *total stock holdings* is directly owned stocks and equity mutual funds (equity and mixed mutual funds in 2003), and *risky financial assets (RFA)* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

Table 12: Shares of Total Stock Holdings Invested in Directly Owned Stocks and in Equity Mutual Funds in Stockholm/Rest of the Country

	1999				2003			
	Stockholm		Rest of the country		Stockholm		Rest of the country	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Owner (single-family home)	0.17***	[0.14]	0.13***	[0.10]	0.13***	[0.14]	0.15***	[0.12]
	(0.03)		(0.01)		(0.02)		(0.01)	
Owner (cooperative apartment)	0.10***	[0.08]	0.04***	[0.01]	0.09***	[0.09]	0.05***	[0.04]
	(0.03)		(0.01)		(0.02)		(0.01)	
Owner (summer house)	0.06***	[0.06]	0.05***	[0.04]	0.02	[0.03]	0.04***	[0.03]
	(0.02)		(0.01)		(0.01)		(0.01)	
Owner (agricultural property)	0.03	[0.03]	-0.00	[0.02]	0.04	[0.02]	0.01	[0.02]
	(0.04)		(0.01)		(0.03)		(0.01)	
Owner (multi-dwelling building)	0.10	[0.07]	0.09**	[0.06]	0.12	[0.04]	0.12***	[0.08]
	(0.10)		(0.04)		(0.08)		(0.03)	
Owner (industrial building)	0.04	[-0.04]	0.04	[0.04]	0.09	[0.08]	0.08***	[0.06]
	(0.15)		(0.04)		(0.11)		(0.03)	
Owner (property abroad)	0.04	[0.01]	0.07	[0.08]	0.02	[0.00]	0.06	[0.04]
	(0.12)		(0.07)		(0.08)		(0.06)	
Owner (site)	0.04	[0.04]	0.05**	[0.05]				
	(0.04)		(0.02)					
(Single-family home)/NW	-0.28***	[-0.19]	-0.19***	[-0.11]	-0.12***	[-0.11]	-0.15***	[-0.14]
	(0.03)		(0.01)		(0.03)		(0.01)	
(Cooperative apartment)/NW	-0.23***	[-0.17]	-0.23***	[-0.12]	-0.13***	[-0.12]	-0.13***	[-0.10]
	(0.04)		(0.04)		(0.03)		(0.02)	
(Summer house)/NW	-0.20***	[-0.12]	-0.09**	[-0.05]	0.03	[0.02]	-0.00	[-0.02]
	(0.05)		(0.03)		(0.03)		(0.02)	
(Agricultural property)/NW	-0.22	[0.01]	0.06**	[0.15]	0.00	[0.02]	0.04*	[0.03]
	(0.14)		(0.03)		(0.11)		(0.02)	
(Multi-dwelling building)/NW	0.01	[0.07]	-0.12	[-0.03]	0.13	[0.24]	0.03	[0.04]
	(0.24)		(0.10)		(0.17)		(0.07)	
(Industrial building)/NW	0.08	[0.46]	0.01	[0.07]	-0.42	[-0.36]	-0.04	[-0.01]
	(0.54)		(0.15)		(0.47)		(0.12)	
(Property abroad)/NW	0.08	[0.19]	-0.26	[-0.33]	0.34	[0.27]	0.19	[0.05]
	(0.62)		(0.48)		(0.46)		(0.33)	
Site/NW	-0.30	[-0.26]	-0.08	[-0.12]				
	(0.23)		(0.14)					
(Other debt)/NW	-0.00	[-0.00]	0.00	[0.00]	-0.00	[-0.00]	0.00	[0.00]
	(0.00)		(0.00)		(0.00)		(0.00)	

Table 12 (cont.)

	1999				2003			
	Stockholm		Rest of the country		Stockholm		Rest of the country	
	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]	Coeff.	[Marg.]
Mortgage (single-family home)/NW	0.26***	[0.16]	0.17***	[0.10]	0.11***	[0.10]	0.14***	[0.12]
	(0.03)		(0.01)		(0.03)		(0.01)	
Debt (cooperative apartment)/NW	0.20***	[0.14]	0.21***	[0.11]	0.13***	[0.12]	0.12***	[0.09]
	(0.04)		(0.04)		(0.03)		(0.02)	
Debt (summer house)/NW	0.17***	[0.10]	0.08**	[0.05]	-0.02	[-0.02]	0.01	[0.02]
	(0.05)		(0.03)		(0.03)		(0.02)	
Debt (agricultural property)/NW	0.20	[-0.03]	-0.03	[-0.12]	-0.00	[-0.02]	-0.01	[-0.02]
	(0.16)		(0.03)		(0.13)		(0.02)	
Debt (multi-dwelling building)/NW	-0.03	[-0.15]	0.14	[0.04]	-0.11	[-0.21]	-0.03	[-0.04]
	(0.32)		(0.10)		(0.18)		(0.07)	
Debt (industrial building)/NW	-0.23	[-0.57]	-0.06	[-0.09]	-0.01	[0.18]	0.02	[-0.03]
	(0.64)		(0.17)		(0.73)		(0.14)	
Debt (property abroad)/NW	-0.02	[0.20]	0.26	[0.38]	-0.52	[-0.40]	-0.13	[0.01]
	(1.01)		(0.50)		(0.53)		(0.34)	
Debt (site)/NW	0.38	[0.32]	0.08	[0.12]				
	(0.25)		(0.14)					
Income/10e8	9.95***	[8.05]	12.67***	[8.98]	1.35	[2.48]	6.51***	[5.45]
	(2.13)		(1.57)		(1.42)		(1.10)	
Income squared/10e16	-40.62***	[-34.68]	-37.18***	[-28.67]	-1.48	[-4.81]	-12.12***	[-11.02]
	(9.31)		(5.87)		(4.51)		(2.60)	
Risky financial assets/10e8	0.46	[0.15]	0.01	[-0.25]	1.05***	[0.67]	0.92***	[0.60]
	(0.29)		(0.37)		(0.36)		(0.22)	
Net wealth/10e8	-0.12	[0.06]	0.66**	[0.74]	-0.05	[-0.04]	0.16*	[0.18]
	(0.22)		(0.26)		(0.10)		(0.09)	
Constant	0.38***		0.36***		0.17		0.30***	
Observations	17926		73349		20949		83469	
Log likelihood	-28697		-109863		-32631		-118555	
Sigma	1.01***		0.94***		0.68***		0.63***	
Rho	3.97***		3.82***		1.85***		1.74***	

This table presents the empirical results of bivariate Tobit models using the 1999 and 2003 cross-sectional samples. Coefficients and marginal effects (evaluated at the mean) of the relative share of total stock holdings invested in directly owned stocks are reported for households in the Stockholm metropolitan area and for households in the rest of the country separately. The results for the share of total stock holdings invested in equity mutual funds (equity and mixed mutual funds in 2003) are of opposite signs but of the same magnitude (results not reported). Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in Appendix 1 are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, *total stock holdings* is directly owned stocks and equity mutual funds (equity and mixed mutual funds in 2003), and *risky financial assets (RFA)* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

Table 13: Heckman's Sample Selection Model

Households > 75th risky financial asset percentile	1999		2003	
	Selection	Share stocks	Selection	Share stocks
Owner (single-family home)	0.40***	0.08***	0.40***	0.06***
	(0.03)	(0.01)	(0.04)	(0.01)
Owner (cooperative apartment)	-0.01	0.04***	0.10**	0.05***
	(0.04)	(0.01)	(0.04)	(0.01)
Owner (summer house)	0.15***	0.04***	0.13***	0.04***
	(0.03)	(0.01)	(0.03)	(0.01)
Owner (agricultural property)	0.12***	-0.01	0.06	0.01
	(0.03)	(0.01)	(0.04)	(0.01)
Owner (multi-dwelling building)	0.21**	0.11***	0.14	0.10***
	(0.09)	(0.02)	(0.11)	(0.02)
Owner (industrial building)	0.04	0.06**	0.13	0.03
	(0.10)	(0.03)	(0.11)	(0.02)
Owner (property abroad)	-0.09	0.03	-0.11	0.04
	(0.15)	(0.04)	(0.18)	(0.04)
Owner (site)	0.08*	0.04***		
	(0.05)	(0.01)		
(Single-family home)/NW	-0.59***	-0.23***	-0.28***	-0.11***
	(0.06)	(0.02)	(0.06)	(0.01)
(Cooperative apartment)/NW	-0.28*	-0.17***	-0.30***	-0.11***
	(0.15)	(0.05)	(0.11)	(0.03)
(Summer house)/NW	-0.40***	-0.15***	0.02	-0.04*
	(0.14)	(0.04)	(0.11)	(0.02)
(Agricultural property)/NW	-0.03	-0.06**	0.18*	-0.04
	(0.11)	(0.03)	(0.11)	(0.02)
(Multi-dwelling building)/NW	-0.84***	-0.19***	-0.29	0.02
	(0.26)	(0.07)	(0.27)	(0.06)
(Industrial building)/NW	-0.42	-0.14	0.16	0.02
	(0.55)	(0.15)	(0.56)	(0.12)
(Property abroad)/NW	-1.27	-0.02	3.60*	0.63*
	(1.56)	(0.54)	(2.10)	(0.33)
Site/NW	-0.78	-0.15		
	(0.63)	(0.18)		
(Other debt)/NW	-0.00	0.00	0.00	0.00
	(0.01)	(0.00)	(0.01)	(0.00)
Mortgage (single-family home)/NW	0.46***	0.22***	0.24***	0.11***
	(0.06)	(0.02)	(0.06)	(0.01)
Debt (cooperative apartment)/NW	0.23	0.21***	0.31***	0.11***
	(0.15)	(0.05)	(0.11)	(0.03)
Debt (summer house)/NW	0.33**	0.17***	-0.00	0.06**
	(0.14)	(0.04)	(0.12)	(0.03)

Table 13 (cont.)

	1999		2003	
	Selection	**Share stocks**	**Selection**	**Share stocks**
Debt (agricultural property)/NW	-0.02	0.11***	-0.09	0.06**
	(0.12)	(0.03)	(0.13)	(0.03)
Debt (multi-dwelling building)/NW	0.86***	0.19**	0.29	-0.02
	(0.27)	(0.07)	(0.29)	(0.06)
Debt (industrial building)/NW	0.35	0.06	-0.83	0.06
	(0.69)	(0.19)	(0.71)	(0.17)
Debt (property abroad)/NW	1.27	-0.00	-6.08*	-0.50
	(1.64)	(0.54)	(3.33)	(0.66)
Debt (site)/NW	0.75	0.14		
	(0.63)	(0.18)		
Income/10e8	6.30**	7.51***	3.65	1.25**
	(2.67)	(0.69)	(2.78)	(0.55)
Income squared/10e16	-34.32***	-24.51***	-7.67	-1.80
	(8.99)	(2.51)	(6.17)	(1.22)
Risky financial assets/10e8	-1.83***	0.34***	1.95**	0.82***
	(0.55)	(0.11)	(0.81)	(0.10)
Net wealth/10e8	1.98***	0.01	0.45	0.02
	(0.52)	(0.07)	(0.45)	(0.04)
Constant	-0.44	0.37***	-0.07	0.38***
Observations	24,684		27,084	
Observations censored	7,845		5,622	
Log likelihood	-19,105		-17,218	
Lambda, coefficient	-0.0533		-0.0365	
Lambda, standard error	0.0237		0.0148	

This table presents the empirical results of a full maximum likelihood Heckman's sample selection model, using the 1999 and 2003 cross-sectional samples restricted to households with risky financial assets above the 75th percentiles. Under *Selection* are the empirical results of the first-stage regression on the probability of owning more than SEK 1,000 of directly owned stocks *and* more than SEK 1,000 of equity mutual funds (equity and mixed mutual funds in 2003) reported. Under S*hare stocks* are the empirical results of the second-step regression on the relative share of total stock holdings invested in directly owned stocks reported. The empirical results on the share of total stock holdings invested in equity mutual funds (equity and mixed mutual funds in 2003) are of the opposite signs but of the same magnitude (not reported). Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The variables described in Appendix 1 are included in all regressions but not reported here. *NW* is net wealth, *income* is household disposable income, *total stock holdings* is directly owned stocks and equity mutual funds (equity and mixed mutual funds in 2003), and *risky financial assets* are directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets. All amounts are in Swedish kronor (SEK).

Table 14: Longitudinal Results

	Δs
Δ(single-family home/NW)	0.01***
	(0.00)
Δ(single-family home/NW)*Dummy(2)	0.03
	(0.03)
Δ(single-family home/NW)*Dummy(3)	-0.00
	(0.01)
Δ(single-family home/NW)*Dummy(4)	-0.11***
	(0.04)
Risky financial assets/10e8	1.96***
	(0.73)
Net wealth/10e8	-0.78*
	(0.42)
Stocks/(Total stock holdings)	-0.41***
	(0.01)
Income/10e8	12.54***
	(2.24)
Income squared/10e16	-145.28***
	(45.79)
Constant	0.12
Observations	14,037
Adjusted R^2	0.287

This table presents the empirical results of OLS regressions using the longitudinal sample. The sample is described in section 3.5.1, and summary statistics are provided in Tables 5–6 and in Tables 7–8. The dependent variable is the change in the relative shares of total shock holdings invested in directly owned stocks from 1999 to 2003 (Δs). The empirical results for the change in the relative shares of total stock holdings invested in equity and mixed mutual funds are of opposite signs but of the same magnitude (not reported). Δ*(single-family home/NW)* is the relative change in the values of owner-occupied single-family homes over net wealth from 1999 to 2003. *Dummy(2)* = 1 if the holding of risky financial assets is above the 75th percentile and home value is below the 75th percentile and zero otherwise, *Dummy(3)* = 1 if the level of risky financial assets is below the 75th percentile and home value is above the 75th percentile and zero otherwise, and *Dummy(4)* = 1 if the levels of risky financial assets and home value are above the 75th percentiles and zero otherwise. Standard errors in parentheses. * denotes significant at 10%, ** at 5%, and *** at 1%. The 1999 values of the variables described in Appendix 1 are included in all regressions but not reported here. *NW* is net wealth in 1999, *stocks* is the value of directly owned stocks in 1999, *total stock holdings* is the value of directly owned stocks and equity and mixed mutual funds in 1999, *income* is household disposable income in 1999, and *risky financial assets* consists of directly owned stocks, equity and mixed mutual funds, capital insurance products, interest-bearing instruments, and other financial assets in 1999. All amounts are in Swedish kronor (SEK).

Chapter 4

Hedging Labor Income Risk

Joint work with Sebastien Betermier, Christine A. Parlour, and Johan Walden

Abstract

We investigate the relationship between workers' labor income and capital market investment. Using a detailed Swedish dataset on employment and portfolio holdings, we estimate wage volatility and labor productivity for Swedish industries and, motivated by theory, demonstrate that highly labor productive industries are more likely to pay workers variable wages. We also find that both levels and changes of wage volatility are significant in explaining changes in household investment portfolios. A household going from an industry with low wage volatility to one with high volatility will, all else being equal, reduce its portfolio share of risky assets by 25%, i.e., USD 7,750. Similarly, a household that switches from a low- to a high-labor-productivity industry reduces its risky asset share by 20%. Our results suggest that human capital risk is an important determinant of household portfolio holdings.

4.1 Introduction

Labor income accounts for about two thirds of national income and, since the seminal work of Mayers (1973), it has been known to play an important role in theoretical asset pricing. Studies such as Bodie, Merton, and Samuelson (1992), Danthine and Donaldson (2002), Qin (2002), Santos and Veronesi (2006), and Parlour and Walden (2008) have demonstrated that risky labor income affects the portfolio decisions made by investors, which in turn has general equilibrium asset pricing implications. However, the empirical evidence is mixed as to whether an aggregate labor factor can explain stock returns. Fama and Schwert (1977) find that adding a labor factor does not improve the performance of the unconditional capital asset pricing model (CAPM). In contrast, Jagannathan and Wang (1996) find that an aggregate labor factor significantly improves the performance of a conditional CAPM in explaining the cross section of expected returns (see also Palacios-Huerta, 2003).

Given a potentially incomplete market and noisy measurements, using aggregate labor income data to show the importance of human capital risk in investors' investment decisions is a daunting task. We therefore take a different approach. Since the effects of risky human capital on asset prices are driven by investors' portfolio decisions, we directly study their portfolio holdings. If there is no discernable relationship between agents' labor income and their investment decisions, then it is difficult to posit a plausible link between a labor factor and asset prices. We use panel data on employment and portfolio holdings for a large subset of the Swedish population, and examine whether there is a relationship between employees' labor productivity, wage structure (measured by wage level and volatility), and portfolio holdings.

We find that although there is only a weak link between the *levels* of employee labor productivity, wage structure, and portfolio holdings, there is a strong link between *changes* in these variables. For example, households adjust their portfolios in response to job changes. In particular, for households in which both adults switch industries in the same year, an increase in wage volatility of 1% will lead to a decrease in the share of risky assets of 1.07%. This effect is statistically significant at the 5% level. This means that a household going from the industry with the least variable wage (recycling metal waste) to the industry with the most variable wage (fund management) will, all else being equal, reduce its share of risky assets by more than 25%, or USD 7,750. Similarly, a household that switches from a low- to a high-labor-productivity industry reduces its risky asset share by 20%. We also provide evidence on the link between wage volatility and labor productivity in particular industries. We find that industries that require high levels of labor productivity also have wages that are (*i*) volatile and (*ii*) high on average.

Our results are consistent with a world in which households consider hu-

man capital when making investment decisions, but in which other, offsetting, factors are also important, for example, heterogeneity in risk-preferences, a familiarity bias, or heterogeneous information. If any of these other factors varies with the business cycle, then our results are consistent with a world in which a human capital factor is of little help in an unconditional CAPM (as argued in Fama and Schwert, 1977), but significantly improves the performance of a conditional CAPM (as argued in Jagannathan and Wang, 1996).

Our tests are based on the predictions presented in Parlour and Walden (2008). Briefly stated, the paper develops a general equilibrium model with multiple industry sectors in which workers accept employment contracts offered by firms and their effort is used as a production input. Firms face a moral hazard problem in that they cannot observe the effort level of employees, so optimal wage contracts include risky compensation. The theory explicitly links the level of labor productivity in a sector to (i) both the level and volatility of wages offered to employees and (ii) the portfolios that these employees hold in equilibrium. Firms that require high labor productivity choose a highly variable wage structure that is linked to performance in order to induce effort from their employees. As a result, employees of high-productivity firms choose to reduce their exposure to risky assets in their investment portfolios.

We use the LINDA database, which provides detailed income and wealth information on a large representative sample of approximately 3% of the Swedish population from 1999 to 2003. While we do not have information on individuals' security holdings, we do know the share of household wealth invested in directly held stocks, mutual funds, and other financial assets, such as derivatives and capital insurance products. This information provides us with a measure of the hedging of systematic risk. By definition, most firms are exposed to a positive level of market risk. If we assume that wages are on average positively correlated with the market, then employees can hedge their labor income risk by holding a smaller share of risky assets and mutual funds.

In addition to investigating the relationship between agents' portfolio composition and labor income, we also investigate individuals who change industries over the years. For these individuals, we look at their portfolio holdings one year before and one year after their industry switch, and ask the following questions: Given these individuals' initial portfolio holdings, how does the industry switch affect the change in their portfolio holdings? In particular, do individuals who switch to sectors that are more productive and offer riskier income streams reduce their share of risky assets? Our measure of industry risk and volatility is estimated across all agents who work in the industry and therefore captures the ex ante uncertainty in an agent's human capital.

Our paper is related to a series of other empirical papers that use micro data to investigate the relationship between non-financial income risk and

portfolio decisions. Malloy, Moskowitz, and Vissing-Jørgensen (2005) find evidence that labor income risk, through a firing decision, can explain the value effect. Their focus is different from ours, however, since we are interested in the relationship between a firm's productivity, the wages it pays, its expected stock returns, and the portfolio holdings of investors.

Massa and Simonov (2006) also present a detailed study of the Swedish population. They look at individual stock holdings and find that households tend to hold stocks that are closely related to their labor income, which goes against the hedging hypothesis. They argue this is because of a preference for familiar stocks, due to heterogeneous information. This is in line with our finding that the hedging motive does not appear in stock holding levels, but rather in their changes after a shock to human capital. In fact, this is consistent with one of Massa and Simonov's findings, namely, that investors' hedging demand is greater (or not as negative) for households who switch professions/locations or experience an unemployment shock. They interpret this as a familiarity shock that prevents the investor from biasing his portfolio away from hedging. Our analysis thus differs from theirs in that we explicitly consider changes in employment but are agnostic about the determinants of portfolio composition.

Our paper is also related to another series of papers looking at the relationship between wage volatility and labor productivity. Our results indicate that industries with high coefficients of labor elasticity also provide more volatile wages, which is consistent with our theory and with the results of other studies. Abowd, Kramarz, and Margolis (1999) use a French longitudinal sample and find that firms with higher (total) wages are more productive. Furthermore, the proportion of executive compensation in high-productivity firms is found to be higher than in low-productivity firms (see, e.g., Gaver and Gaver, 1993, 1995; Bizjak, Brickley, and Coles, 1993; Smith and Watts, 1992). The workers sampled in the LINDA database, however, are not necessarily executives.

The rest of the paper is organized as follows. The next section briefly reviews the model presented in Parlour and Walden (2008) and describes the predictions regarding the relationship between firm productivity, wages, and portfolio decisions. Section 4.3 describes the data and the methodology, while section 4.4 presents the empirical results. In section 4.5, we offer some concluding remarks.

4.2 Theoretical Framework and Empirical Strategy

Our discussion in this section provides an overview of, and intuition regarding, the predictions presented in Parlour and Walden (2008), to which the reader

is referred for further detail. The model is static and uses a CARA-normal framework. The economy is composed of N sectors, which, for expositional purposes, we will take to be two, each having a different level of labor productivity: sector 1 has high labor productivity and sector 2 has low labor productivity. Each sector comprises many firms and each firm employs many workers. Workers need to exert effort to be productive, and since their effort level is not observable, firms face a moral hazard problem. As a result, firms choose to offer incentive contracts, which optimally comprise a fixed and a variable part. The variable part depends on the performance of the firm, e.g., its profits. For simplicity, firms are assumed to have unlimited liability.

The central intuition of the paper is that an agent's stock portfolio does not accurately reflect his or her total exposure to systematic risk. Alternatively, in general equilibrium, a firm's equity also does not reflect all the systematic risk that it generates: firms pay out risk through wages. Firms with high labor productivity find it optimal to pay most of their wage compensation as incentive wages, since it is relatively important for them to provide incentives to their workers. Thus, compensation in the high-productivity sector 1, $\tilde{w}_1$, is risky. Low-productivity firms, in sector 2, pay most of their wage compensation through the fixed part, so their compensation, w_2, is essentially risk free.

The model also has implications for the cross section of expected returns. For example, it is natural to obtain a size effect (and, under other additional assumptions, a value effect). In equilibrium, although the total size of the high-productivity sector is larger than that of the low-productivity sector, high-productivity firms are on average *smaller* than low-productivity firms, because of the higher level of competition. Furthermore, since the high-productivity firms pay out a *larger* fraction of their asset risk through wage compensation, their true risk is underestimated if one uses the stock market portfolio as a proxy for the true market portfolio. In other words, econometricians who use the stock market portfolio in their CAPM regressions should find that firms in sector 1 earn positive abnormal returns, $\tilde{\mu}_1$ in the stock market, whereas firms in sector 2 earn negative abnormal returns, $\tilde{\mu}_2$. The model is summarized in Figure 1.

While this framework generates several predictions about the relationship between type of compensation (fixed versus variable) offered, expected returns, and type of firm, in line with existing empirical literature, we focus on novel implications that relate to firm productivity, the riskiness of the wage contract, and workers' portfolio holdings.

In particular, two sorts of predictions arise. First, there are predictions regarding *levels*:

H1: The higher the labor productivity of the industry, the higher the wage volatility.

H2: Workers with more variable wages have lower exposure to the market through financial assets.

H3: Workers in higher labor productivity industries have lower exposure to the market through financial assets.

Second, there are predictions regarding *changes*. While there might be agent-specific heterogeneity outside the model that affects portfolio holdings, if an employee moves to an industry that offers a different wage contract, then he should rebalance his portfolio. For example, consider a worker who changes jobs, moving from a low- to a high-productivity sector. Through the labor market, he has effectively increased his exposure to the market and should therefore reduce his exposure to risky assets in his investment portfolio.

H4: Workers who switch to a sector with higher wage volatility reduce their exposure to the market through financial assets.

H5: Workers who switch to higher labor-productive sectors reduce their exposure to the market through financial assets.

4.2.1 Data

To construct measures of portfolio holdings, we use a unique Swedish annual panel database, Longitudinal INdividual DAta for Sweden (LINDA), a joint project between Uppsala University, the National Social Insurance Board,[1] Statistics Sweden, and the Swedish Ministry of Finance. LINDA contains an annual cross-sectional sample of approximately 300,000 individuals, approximately 3% of the entire Swedish population, who are tracked over the years. Family members of sampled individuals are also included, allowing us to examine household labor and investment decisions. The sampling procedure ensures that the panel is representative of the population as a whole, and each annual cohort is cross-sectionally representative.

The data are primarily based on filed tax reports (available annually from 1968) and include various measures of income, government transfers, and taxes in addition to individual characteristics such as sex, marital status, education, municipality of residence, and country of birth. From 1999 onward, the market values of financial and real assets (e.g., stocks, bonds, mutual funds, and owner-occupied homes) are estimated by Statistics Sweden and included in LINDA.

For data on labor income and working conditions, we rely on two more datasets from Statistics Sweden. The first provides information on industry

[1]Försäkringskassan (The Swedish Social Insurance Agency) manages the Swedish social security system; see http://www.fk.se/sprak/eng.

characteristics, and we use it to compute a measure of labor productivity for each industry. Every year, Statistics Sweden collects firm data, such as total sales, number of employees, and value added. Data are collected from the 558 largest companies through surveys. Information about the remaining companies is provided by the Swedish Tax Authorities. The coverage rate in 2006 was approximately 85%. However, the percentage of missing companies as share of total number of employees or of net income was only approximately 3%. The data are reported by industrial sector, classified according to five-digit SNI codes. These are equivalent to the NAICS/SIC codes in the U.S. We have access to industries at the three-digit SNI level from 1997 to 2005.

In LINDA, all working individuals are assigned a five-digit SNI code each year, depending on their industry of employment.[2] Using the SNI codes, we can therefore merge the industry-level data with the household-level data from LINDA. We do this at the three-digit SNI code level, which provides sufficient granularity. In total, there are 223 three-digit codes; however, we only use a subset of these because the classification changed in 2002, and the mapping between the old (1992 classification) and the new codes (2002 classification) is not one-to-one. This classification change matters for our study, because it occurs in the period we are studying. To avoid any potential bias, we only use the subset of SNI codes that remain the same. In addition to other filters, we still end up with 104 SNI codes.

Finally, to control for agent heterogeneity, we use a Statistics Sweden demographic dataset. Since LINDA provides information on the region where individuals live, we can also merge this with the LINDA database and use population density as a control in our regressions on portfolio holdings. This dataset groups regions into six different categories, based on the population composition at the end of 2002.

We exclude observations lacking information on wage volatility or level of labor productivity, and households (defined below) whose financial wealth, net wealth, and/or family income are extremely low (i.e., less than SEK 3,000, SEK 1,000, and SEK 1,000, respectively) and those with negative net holdings of risky assets. As we are interested in labor market participation, we also exclude households in which the largest income goes to someone younger than 18 years or older than 65 years, and households whose family income in 2000 lies in the top 0.1% of the remaining sample.

4.2.2 Constructing Variables

Our tests require a measure of portfolio holdings in addition to agents' employment (the source of their returns to human capital). To understand the

[2]In the event individuals have had two jobs during the course of a year, the reported SNI code corresponds to the sector in which most income was generated during that year.

relationship between returns to human capital and portfolio returns, we also require a measure of wage volatility. Finally, to relate wage characteristics to industry characteristics, we need to estimate an aggregate industry production function.

Portfolios

Since portfolio decisions are typically made at the household level, we use the household as our unit of observation. However, we also keep track of the individuals within each household as each may work in a different industry. While aggregating household financial holdings is straightforward, imputing wage volatility or labor productivity to a household is less so. Our sample includes information on wealth from 1999 to 2003; we take 2001 as the base year to maximize the sample size. In 2001, we select the two adults in each household who generate the greatest levels of income. We then sort these two individuals by income, and adopt the convention that individual #1 (Ind1) generates the highest income in 2001 and individual #2 (Ind2) is the other adult.[3] We then retain and keep track of these two individuals over the years.

We define a "switcher" as a household in which at least one of these two adults changed sectors between 1999 and 2002. More precisely, to take into account of the fact that investors may not adjust their portfolios immediately before or after a job change, we only look at the adults who switched industries between 2000 and 2001.[4] A change in industries is recorded as a three-digit SNI code change. We eliminate "switcher households" that undergo a major change in their civil status, such as marriage or divorce, and those that have increased or reduced their portfolio holdings of risky assets, mutual funds, or stocks by more than 100% between 1999 and 2002.[5] Summary statistics for the overall population and for the switchers are displayed in Table 1 for the reference year 2001. A first glance at the table indicates that the sample of switchers is fairly representative of the overall population, though switchers tend to be slightly wealthier. In addition, more of them are homeowners and they are more likely to be married and have a college degree.

For each household (h), we look at its non-retirement portfolio[6] of risky as-

[3] If the two individuals have the same income, we adopt the convention that individual #1 is the oldest individual.

[4] In other words, who did not switch industries between 1999 and 2000 and between 2001 and 2002.

[5] These are absolute values.

[6] Retirement portfolios are not available in LINDA. Until 1998, Sweden had a low-risk defined benefit system, Allmän Tjänste Pension (ATP), which was then replaced by a defined contribution system (see Sunden, 2006). Since no changes were made retroactively, a large part of Swedish pension capital was therefore low-risk in our studied period.

sets (ra), which contains directly held stocks and risky mutual funds. We do not consider other risky financial assets, such as capital insurance products, as we do not have any information on the composition of the investments. Calvet, Campbell, and Sodini (2007) find that including capital insurance products does not change the results concerning the level of diversification of a households' portfolios. Risky mutual funds include pure equity funds and funds that invest only a positive fraction of their assets in stocks. Ideally, we would like to distinguish between these two types of mutual funds; unfortunately, however, this information is not available after 1999 in LINDA. From the 1999 data, however, it seems that the vast majority of these funds is pure equity. We also decompose the portfolio of risky assets and study in detail the portfolios of directly held stocks (s) and risky mutual funds (mf). At the end of each year t, we define $w^i_{h,t}$ as the share of household h's holdings of portfolio i over its financial wealth, which is the sum of cash (checking and savings accounts, money-market funds), bond-only mutual funds, stocks, and risky mutual funds. Therefore, $w^s_{12,2003}$ refers to household #12's share of directly held stocks in its financial wealth at the end of 2003.

We report summary statistics on the portfolio shares of the overall population and of switchers in 2001 in Panel A of Table 6. Again, the switchers are fairly representative of the population, although they are slightly more likely to invest in the stock market. To benchmark, we compare Swedes' participation rates in risky assets and their portfolio shares with those from the U.S., using data from the 2001 Survey of Consumer Finances (SCF). Since the information on household wealth is more precise in SCF, we present two tables. In Panel B of Table 6, we adjust the SCF portfolios so that they are comparable to those computed from LINDA. In particular, we exclude retirement assets and we total the holdings of pure equity and mixed mutual funds. Panel C of Table 6 more accurately reflects the true risky portfolio shares in the U.S., The holdings of mixed mutual funds are halved to reflect the fact that they are not fully invested in stocks, and the retirement assets are included.

Comparing panels A and B of Table 6 reveals that the participation rate in risky assets is much higher in Sweden than in the U.S. Part of this is technical: Bank accounts on which the annual interest earned is under SEK 100 do not have to be recorded in LINDA. Since we impose a minimum wealth threshold of SEK 3,000, we eliminate all households that do not make the threshold because of missing bank accounts and that do not participate in the stock market. The SCF, which is a survey and not a tax authority report, does not exclude such observations. However, these missing bank accounts do not completely explain the difference in participation rates. Indeed, if we relax the minimum financial wealth threshold, participation rates in stocks and mutual funds are still approximately 75% and 69%, respectively, which is still considerably higher than in the U.S. This result indicates that the selection

bias in stock market participation in Sweden is not as important as in the U.S. The widespread stock market participation of the Swedish population is well known, and one explanation cites the high degree of trust and sociability in Swedish society (see Georgarakos and Pasini, 2009). Second, Swedish households tend to invest much more of their risky assets in mutual funds than do American households. This may be due to the introduction in the early 1980s of highly accessible mutual funds (so-called Allemansfonder) that offered high tax incentives. The tendency toward well-diversified investments is consistent with our empirical analysis, since our measure of hedging is the share of financial assets invested in risky assets. As we do not know how Swedish households compile their portfolios of direct stock holdings, observing a large share of the portfolio in mutual funds indicates that these households are likely mostly invested in the overall stock market. As a result, if these households hedge their labor income risk, they are likely to do so by levering their mutual fund holdings up or down.

Wage Volatility and Labor Productivity

Given that our focus is on households who have switched jobs, computing a measure of annual wage volatility that comes directly from these households' total income is difficult, because we only have data for two years after the employment switch in 2001. We proceed as follows. We begin by computing industry averages of wage volatility, given the large LINDA sample from 1993 to 2003, and then attribute these values to all individuals according to the industry they work in each year.[7] Finally, we aggregate by household each year.

We proceed similarly for our measure of labor productivity, using the industry characteristics data from Statistics Sweden. While using industry averages may not necessarily reflect an agent's exact wage volatility or labor productivity, it is not unreasonable to view them as ex ante measures of both productivity and wage volatility, given that agents are unaware of how their particular careers will evolve.

In the large LINDA sample from 1993 to 2003, we select all individuals who worked in the same industry for at least five consecutive years.[8] (Data on

[7] In some cases, individuals have worked in two or more industries during the same year; we unfortunately have no access to this information. The reported SNI code refers to the industry in which individuals earned most of their annual combined salary.

[8] These individuals must have kept the same five-digit SNI code, to ensure that they did not switch jobs. We also exclude individuals receiving student aid and new job training (if unemployed), in order to exclude part-time workers. Finally, we exclude individuals who are either self-employed or who are owners (or who are closely related to owners) of closely held companies, for example, "3:12" firms, because these individuals are more likely to report their income unconventionally. We choose a period of five consecutive years in order to

wages are also available from Statistics Sweden output files, but we only have access to the aggregate wage per industry, which provides less information than do the micro data from LINDA.) We calculate the wage growth volatility of each individual, which we then aggregate by industry sector. Then, we compute the volatility of the annual growth rate of real disposable income over these years,[9] and average this volatility across all households in the same three-digit sector. We only select industries for which we have more than 30 observations, and in doing so we have a measure of wage volatility for 191 industries. This measure takes unemployment risk into account. Workers let go during the course of a year will retain their former SNI codes as long as they are employed for part of the year.

Table 2 reports the top and bottom ten industries ranked by wage volatility. It is not surprising to find that industries such as "fund management," "legal representation activities," and "motion picture and video production" have high wage volatility, whereas industries such as "recycling of metal waste and scrap" and "mining of iron and ores" have low wage volatility.

Parlour and Walden (2008) find that agents from highly productive industries who receive volatile wages also receive higher wages on average, to be compensated for the high level of labor income risk. It is easy to test this relationship using data from LINDA. We select the same individuals as those from our measure of wage volatility and compute the average annual level of real disposable income for each three-digit SNI code.

Once we have computed these measures of the volatility and level of wages for each three-digit industry, we assign them to each individual-year given their SNI code. Finally, we aggregate these measures by household, weighting each individual by the amount of disposable income earned during the year. In other words, if the household comprises two working individuals, then the measure of household labor income volatility is a weighted average of the individuals' volatility. In reality, household labor volatility should also include the covariance between both individuals' labor income. However, given that we are working with industry-level estimates of their labor income, it is difficult to estimate this covariance precisely. In our regression, we try to correct for this by creating a dummy to capture whether both individuals share the same three-digit SNI code.

According to Parlour and Walden (2008), the volatility of wages should reflect the level of labor productivity of each industry sector. As a robustness check, we construct a measure of labor productivity from the Statistics Swe-

maximize the sample size, but the results are robust to different specifications.

[9]We work with disposable income because it is more reliable than pre-tax income. One weakness of using disposable income is that we may pick up tax effects unrelated to individual labor income situations. On the other hand, it allows us to capture all tax effects related to the labor income situation. Disposable income is available at the individual level, because in Sweden individuals do not file their taxes jointly.

den output tables that does not refer directly to wages. This specification allows us to test hypotheses (1), (3), and (5). We look at the elasticity of labor under the assumption that an industry's production is a Cobb–Douglas function:

$$log(Y_{j,t}) = log(A_j) + a_j * log(L_{j,t}) + b_j * log(K_{j,t}) + \epsilon_{j,t}, \tag{4.1}$$

where indices j and t refer to the three-digit SNI code j and year t, and where Y is the aggregate value added in real terms, L is the number of employees, and K is the real value of the industry's assets. We filter out a few SNI codes where data were missing or that represented very few firms.[10]

We estimate the elasticity of labor, a_j via a random coefficient panel regression, where a_j, b_j, and $log(A_j)$ are treated as random effects. We also add year fixed effects, and impose an AR(1) structure on the errors within each industry j to allow for potential serial correlation over time. The results conform to standard intuition. Summary statistics of a include a mean of 0.21, a standard deviation of 0.09, a minimum of 0.02, and a maximum of 0.35. In Table 2, we also report the top and bottom ten industries ranked by their level of labor productivity. Industries such as "manufacturing of construction products" and "recycling of metal waste and scrap" have low labor productivity, whereas industries such as "legal representation activities," "architecture," and "publishing of software" have high labor productivity. We have data on labor elasticity for 104 industries. As with our measures of labor income risk, once we have computed a measure of productivity for each industry, we assign it to each individual-year and aggregate these values by household.

4.3 Empirical Tests and Results

We are now in a position to test hypotheses H1–H5 from section 4.2. For convenience, we repeat the hypotheses below.

H1: The higher the labor productivity of the industry, the higher the wage volatility.

One of the first conclusions of the optimal contracting approach is that in industries in which labor productivity is high, employers have a stronger incentive to elicit high effort and so expose workers to more risk in order to motivate them. Furthermore, if agents are risk averse, then to induce them to accept more volatile wages, they must be paid a higher wage. Therefore, there should be a positive correlation between wage levels and wage volatility. We report the correlations between average wages, wage volatility, and labor

[10]Details are available on request.

elasticity in Table 3. The data suggest that the higher the labor elasticity (or productivity), the higher the mean level of wages. This is consistent with a payment that compensates a risk-averse agent for wage volatility. In addition, there is a positive correlation between elasticity and wage growth volatility, which is consistent with an optimal contracting framework.

Having established the positive correlation between labor productivity and wage volatility, we address the effect of both on portfolio levels and then on portfolio changes. Here are the hypotheses regarding the levels:

H2: Workers with more variable wages have lower exposure to the market through financial assets.

H3: Workers in higher labor productivity industries have lower exposure to the market through financial assets.

First, consider H2. If human capital is an asset that generates a cash flow stream, then those working in high-productivity sectors, which, all else being equal, have riskier income streams, should have a smaller share of risky assets and mutual funds. Of course, both employment and human capital are potentially endogenous variables.

As in Vissing-Jørgensen (2003) and Massa and Simonov (2006), we assume that the investment decision is made in two steps: the investor first decides whether to enter the stock market, and then selects the desired portfolio holdings. To account for the first-stage participation decision, we use a two-step estimation procedure following Heckman (1979). We model the decision to enter the stock market by estimating $p^{ra}_{h,t}$, the observed probability of participation in the portfolio of risky assets, using the probit regression,

$$p^{ra}_{h,t} = \alpha^{ra}_{1,t} + \beta^{ra\prime}_{1,t} \cdot \Phi_{h,t} + \gamma^{ra\prime}_{1,t} \cdot X_{h,t} + \epsilon^{ra}_{1,h,t}, \tag{4.2}$$

where $X_{h,t}$ is a vector of explanatory variables for household h in year t, and $\Phi_{h,t}$ includes either wage volatility or labor productivity along with interaction variables for households in which both individuals work in the same industry.

In this and subsequent regressions, the choice of control variables in the vector $X_{h,t}$ is critical because of potential endogeneity issues. We control for each household's composition, location, sources and composition of household wealth, and financial sophistication.

To control for differences in household composition, we include the age (and age squared) of the household head, dummies for the civil status of the head (married, partnered but not married, single parent, or single household), the number of minors in the household, a dummy for whether at least one of the adults was born in a Nordic country, and dummies for the number of individuals who used to be part of the household but who are deceased or have emigrated.

Location may affect portfolio decisions, so we use dummies for the population density of the area in which the household lives (high, medium, or low). A high-density region indicates one of the three metropolitan areas in Sweden: the Stockholm region, the Gothenburg region, or the Malmo/Lund/Trelleborg region. A medium-density region is one in which the household lives in another (less) urban area, which consists of municipalities with (*i*) more than 27,000 inhabitants, (*ii*) less than 90,000 inhabitants within 30 km (19 miles) of the municipal center, and (*iii*) more than 300,000 inhabitants within 100 km (62 miles) of the municipal center. Finally, a low-density region represents all other regions of Sweden.

Measures of labor income and employment include the logarithm of family disposable income, a dummy for whether at least one of the adults is receiving unemployment insurance, a dummy for whether at least one of the adults is receiving a retirement pension, and the ratio of debts to family income. Measures of real estate include a dummy for whether the household owns real estate and the ratio of house value to net worth.

Measures of education include dummy variables for whether at least one of the adults has a college degree and studied business after high school. We also add a dummy variable for whether at least one of the adults is receiving student aid. We avoid controlling for portfolio shares in previous years, because as we will see in the next section, portfolio shares are extremely predictable over time, which means that including them would capture most of the information from the other variables, including $\Phi_{h,t}$. We also avoid net wealth and financial wealth for the same reasons.

Then, in the second stage, we regress the portfolio shares $w^i_{h,t}$ on $\Phi_{h,t}$, our vector of proxies for either wage volatility (for H2) or labor productivity (for H3). Our focus is on the portfolio share of risky assets ($i = ra$), but we also repeat the exercise for the portfolio shares of stocks and mutual funds. We also include the same vector, $X_{h,t}$, of control variables and Heckman's lambda variable ($\lambda_{h,t}$), which controls for possible selection in the first stage. The equation is as follows:

$$w^i_{h,t} = \alpha^i_{2,t} + {\beta^i_{2,t}}' \cdot \Phi_{h,t} + {\gamma^i_{2,t}}' \cdot X_{h,t} + \theta^i_{2,t} \cdot \lambda_{2,h,t} + \epsilon^i_{2,h,t}, \tag{4.3}$$

where i refers to the asset class (risky assets, stocks, and mutual funds). Households hedge their labor income risk if $\beta^i_{2,t} < 0$.

The results of the second-stage regressions are reported in Table 4 for wage volatility and Table 5 for labor productivity. We only report the results for 2002, but the results are almost identical across the years. The coefficients of the control variables are similar across Tables 4 and 5. The table reporting wage volatility is based on 102,049 observations; however, the table reporting labor productivity is based on only 38,403 observations, as there are fewer industries for which we could compute a measure of labor productiv-

ity. These cross-sectional regressions include both switcher and non-switcher households.

Multiple variables are strong predictors of portfolio shares. This is not surprising, and it is consistent with the results presented in Vissing-Jørgensen (2003), Massa and Simonov (2006), and Calvet, Campbell, and Sodini (2007). The richer and more educated households tend to tilt their portfolios toward stocks. This is especially the case for the households in which at least one adult has a business degree.

In terms of real estate and location, we find that conditional on owning real estate, a high ratio of house value to net worth does crowd out participation in the stock market, in line with the findings of Cocco (2005). Our empirical results also indicate that households that are highly exposed to the housing market reduce their exposure to directly owned stocks and increase their exposure to mutual funds, in line with the findings of Jansson (2009). Furthermore, while living in a small urban area does lead to an increase in the share of risky assets and mutual funds, relative to living in a rural area, living in one of Sweden's three metropolitan areas leads to a decrease in the share of risky assets. This may be due to the crowding-out effect of the higher home prices in these areas.

In terms of other household characteristics, households from Nordic countries tend to invest more in mutual funds, which suggests a cultural effect that is consistent with the summary statistics presented earlier. Married, partnered, and single parent households tend to be more invested in risky assets than are single households, but less invested in stocks. The coefficient for the number of children is similar, which suggests risk aversion.

The coefficient for λ_t confirms the selectivity of market participants, despite the high overall participation rate for risky assets. We report the bootstrapped standard errors of the estimates, and for the shares of both risky assets and mutual funds, θ_t is significantly different from 0.

It is clear from Table 4 that, controlling for selection bias, the effect of the wage volatility variable is weakly consistent with H2. An increase in wage volatility does lead to a decrease in the portfolio share of risky assets that is significant at the 5% level. However, it is not necessarily significant from an economic perspective. A 1% increase in wage volatility only leads to a 0.08% decrease in share of risky assets. Furthermore, Table 5 indicates that an increase in the labor productivity variable actually leads to an increase, though not a significant one, in the share of risky assets.

The decomposition of risky assets into directly held stocks and mutual funds provides some extra insight. For one, there is a clear substitution effect between stocks and risky mutual funds. While an increase in wage volatility leads to a significant increase in the share of stocks, it also leads to a similar decrease in the share of mutual funds. This result is consistent with the findings of Massa and Simonov (2006), who look at the levels of individual

stock holdings and find that household investment in stocks is also determined by factors other than hedging, such as a preference for familiar stocks, for information reasons. Indeed, they argue that less-informed agents choose to invest more in stocks closely related to their labor income because they are more familiar with them, due to either location or professional proximity.

One can conjecture other sources of heterogeneity correlated with labor income that affect portfolio selection. For example, households in high-productivity industries could be more financially educated and choose to invest more in individual stocks and less in mutual funds. They might also be of a different type with distinct investment policies. For example, it may be that the less risk-averse agents choose to work in riskier industries and invest more in the stock market. Since our cross-sectional analysis cannot control for these issues, we turn to our main estimation strategy and look instead at changes in the portfolio shares of the switchers, conditional on their initial portfolio shares. This analysis allows us to abstract from the potential heterogeneity in the levels of portfolio shares, and to test H4 and H5 and consider how household investment behavior changes with employment.

H4: Workers who switch to a sector with higher wage volatility reduce their exposure to the market through financial assets.

H5: Workers who switch to higher labor-productive sectors reduce their exposure to the market through financial assets.

As with the levels analysis, we implement a two-stage analysis in which we begin by controlling for the possibility of a selection bias among market participants, using 1999 as the base year. Equation (4.4) is similar to equation (4.2), except that t now refers to 1999. Then, in the second stage, we retain the switchers who participated in the stock market in 1999 and study the effect of a change in $\Phi_{h,t}$ between 1999 and 2002 on their portfolio holdings (recall that $\Phi_{h,t}$ captures either wage volatility or labor productivity along with interaction variables for households in which both individuals work in the same industry). The equations take the following form:

$$p^{ra}_{h,t} = \alpha^{ra}_{3,t} + \beta^{ra\prime}_{4,t} \cdot \Phi_{h,t} + \gamma^{ra\prime}_{3,t} \cdot X_{h,t} + \epsilon^{ra}_{3,h,t}, \tag{4.4}$$

$$\Delta w^{i}_{h,t} = \left[\begin{array}{c} \alpha^{i}_{4,t} + \beta^{i\ \prime}_{4,t} \cdot \Delta\Phi_{h,t} + \gamma^{i\ \prime}_{4,t} \cdot X_{h,t} + \varphi^{i\prime}_{t} \cdot Y_{h,t} + \\ \kappa^{i\prime}_{t} \cdot Z_{h,t} + \theta^{i}_{4,t} \cdot \lambda_{4,h,t} + \epsilon^{i}_{4,h,t}. \end{array} \right] \tag{4.5}$$

where t refers to 1999, h indexes switchers, $X_{h,t}$, $Y_{h,t}$, and $Z_{h,t}$ are vectors of control variables, and $\Delta X_{h,t}$ refers to a change in X_h from year t (1999) to year $t+3$ (2002). As in the previous section, we expect households to hedge their labor income risk if $\beta^{ra}_{4,t} < 0$.

To control for different possible explanations, we decompose switchers into three groups: first, a group in which individual #1 switches industries, a

second group in which individual #2 switches industries, and a third in which both individuals switch industries. For each group of households, we also add an interaction variable that captures change in either wage volatility or labor productivity. These groups are not mutually exclusive. For example, the first group includes individuals #2 who are also switching. The idea behind this decomposition is to see whether (*i*) the hedging effect is strongest in the third group, in which both individuals switch during the same year, and whether (*ii*) the hedging effect is stronger when (the affluent) individual #1 switches than when (the less affluent) individual #2 switches. We also add two interaction variables for households who switch in such a way that they either (*i*) end up in the same industry in 2002 or (*ii*) are no longer in the same industry in 2002.

In the second stage, we include the vector of controls, $X_{h,t}$ (described for the previous hypotheses) and two other sets of control variables, which we denote $Y_{h,t}$ and $Z_{h,t}$. These include key variables, such as the initial level of net worth and the initial portfolio shares of stocks and risky mutual funds, which capture all the information on the individuals' types, assuming that types do not vary over time; $Y_{h,t}$ is defined as the vector of these extra controls.

In addition to employment, other household characteristics may have changed from 1999 to 2002, and $Z_{h,t}$ is defined as the vector of these changes. These variables include a dummy for whether the household moved from a rural to a metropolitan area, a dummy for whether at least one member of the household has died or emigrated, and a variable that computes the change in the number of children. We also look at change in family disposable income and in the debt-to-income ratio, and create dummies for whether at least one of the adults found a job, lost a job, or retired from the job market in the period. In terms of real estate, we include two dummies for whether households started or stopped owning real estate as well as a variable that captures the change in the ratio of house value to net worth. In terms of education, we include a dummy for whether at least one of the household members has graduated.[11] We avoid controlling for changes in wealth in the period, since some of it comes from the proceeds of the household's portfolio.

The results of equation (4.5) are reported in Table 7 for wage volatility and Table 8 for labor productivity. For parsimony, we do not report the coefficients of the $X_{h,t}$ control variables in 1999. The tables on wage volatility and labor productivity report on 6,428 and 1,580 switchers, respectively. As expected, the effects of the 1999 portfolio share levels are extremely significant, which confirms the high degree of predictability of portfolio shares.

Here we find strong evidence that switchers are hedging their labor income risk. Beginning with Table 7, the effect of a change in the level of wage volatility is significant for the switchers, both economically and statistically. In particular, for the double-switchers, an increase in wage volatility of 1%

[11] We define graduation as a stop in the individual's student aid.

will lead on average to a decrease in the share of risky assets of 1.07%, in absolute terms. This effect is statistically significant at the 5% level.[12] We stress that this percentage is of financial wealth, which in 2002 was approximately SEK 310,000 (approximately USD 31,000). This means that a household going from the industry with the least variable wage (recycling metal waste) to the industry with the most variable wage (fund management) will, all else being equal, reduce its share of risky assets by almost 25%, or USD 7,750. The decomposition of risky assets into stocks and mutual funds indicates that the decrease in risky assets is fairly balanced among the two asset classes.

The hedging effect is still evident, though not as strong, for households in which individuals #1 switched. For example, an increase in wage volatility of 1% leads the individual #1 switchers to reduce their share of risky assets by almost 0.12%.

Table 8 presents results similar to those for labor productivity. An increase in the coefficient of labor elasticity of 1% leads switchers to reduce their share of risky assets by 0.32–0.61%. Again, from an economic perspective, this means that households going from the least to the most productive industry would re-balance their share of risky assets by up to almost 20%. These effects are statistically significant at the 10% and 5% levels, respectively (one-tailed t-tests). We note, however, that the change in labor productivity has little effect on the portfolios of double-switchers. This is not surprising, since the sample is much smaller for labor productivity. There are only 45 double-switchers, instead of 208 in Table 7. There is also little effect evident for households in which the individuals switch either to or from the same industry in both tables.

One alternative explanation of the fact that the coefficients of the changes in wage volatility and labor productivity are negative is that wage volatility may be correlated with wealth. If so, a change in wage volatility could be associated with a change in wealth, which could be the real reason for the portfolio changes. We control for this potential factor by looking at the change in household income between 1999 and 2002. Supposedly, households who switch to an industry in which they obtain a wage increase have become wealthier. The addition of this variable acts not only as a control but also indicates the effect of an increase in wealth on the portfolio share of risky assets. In both Tables 7 and 8, we find that an increase in household income leads to a significant decrease in the share of risky assets. This result suggests that this other potential explanation works in the other direction, hence strengthening our results.

[12] Although the p-value reported for this coefficient in Table 7 is approximately 6%, our test of hedging is a one-tail test, and so the relevant p-value is approximately 3%.

4.4 Conclusions

The literature on labor income risk and levels of portfolio holdings presents a mixed picture. On one hand, there is evidence that agents hedge human capital risk (e.g., Guiso, Jappelli, and Terlizzese, 1996; Vissing-Jørgensen, 2003). On the other hand, at the individual stock holding level, households tend to own stocks that are closely related to their labor income (Massa and Simonov, 2006).

In the present paper, we take advantage of a unique Swedish panel dataset and take a new approach to this issue by focusing on households who switched industries between 1999 and 2002. We study the effect of this industry change—in particular, the effect of changes in wage volatility and labor productivity—on their portfolio holdings of risky assets. Focusing on changes in portfolio holdings for households who switch industries, we find that households do hedge their labor income risk, although the effects are now apparent in the cross section of levels of portfolio holdings. The effect is economically significant: a household that moves from the lowest to the highest productivity industry reduces its exposure to risky assets by approximately 25%.

Our results are therefore in line with the findings of Guiso, Jappelli, and Terlizzese (1996), Vissing-Jørgensen (2003), and Massa and Simonov (2006), and suggest that both hedging and other offsetting effects are important in households' portfolio decisions. If the strength of these two offsetting effects vary with the business cycle, it is not surprising that the unconditional CAPM with human capital fails (as documented by Fama and Schwert, 1977) while the conditional CAPM with human capital successfully explains the cross section of stock returns (as documented by Jagannathan and Wang, 1996).

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Table 1: Summary Statistics

	All Households				Switchers	
Variable	Mean	Std Dev	Min	Max	Mean	Std Dev
Demograhics						
Age	44.9	10.14	18	65	44.62	9.11
Nordic	.97	.17	0	1	.98	.13
Number of children	1.1	1.14	0	13	1.35	1.16
Civil Status						
Married	.57	.49	0	1	.69	.46
Partnered	.15	.36	0	1	.16	.37
Single	.19	.4	0	1	.11	.31
Education						
Student	.06	.23	0	1	.06	.23
College education	.47	.5	0	1	.53	.50
Business studies	.15	.35	0	1	.21	.40
Population Density						
High	.35	.48	0	1	.40	.49
Medium	.54	.50	0	1	.51	.50
Low	.11	.32	0	1	.09	.29
Labor income						
Family income	366	161	1	1243	409	158
Unemployed	.13	.34	0	1	.17	.37
Retired	.13	.34	0	1	.13	.34
Housing and Wealth						
Homeowner	.88	.33	0	1	.93	.25
Net wealth	1.09	1.81	0	154.18	1.3	1.71

Table 1 presents summary statistics from the 2001 wave of the LINDA dataset. There are 102,049 observations and 6,428 switchers. Reported are the age of the household head, the number of children, household disposable income (in thousands of SEK), and household net wealth in millions of SEK (which does not include the value of real assets such as yachts unless the household is subject to wealth tax; net wealth does not include any retirement—i.e., tax-deductible—assets, human capital, and the values of private businesses and bank accounts from which less than SEK 100 is earned annually; all debt is included). We also report the following dummy variables, which are 1 if at least one adult satisfies the criterion: unemployed, born in a Nordic country (Sweden, Finland, Denmark, Norway, and Iceland), college education, business studies, married, partnered, single, student, lives in a high-population-density area (Stockholm, Gothenburg, or Malmo/Lund/Trelleborg), medium-population-density area (more than 27,000 inhabitants and more than 300,000 within 100 km), low-population-density area, retired, and homeowner. All montetary values are defined in Swedish kronor (SEK). The average SEK/USD exchange rate on December 28, 2001 was 10.67.

Table 2: Rankings of Industries by Levels of Wage Volatility and Labor Productivity

SNI Code	Description	Wage Volatility	SNI Code	Description	Labor Productivity
Bottom 10			**Bottom 10**		
371	Recycling of metal waste and scrap	.07	552	Youth hostels, camping sites	.02
271	Manufacturing of iron and steel	.08	519	Other wholesale	.02
131	Mining of iron and ores	.08	504	Sales and maintenance of motorcycles	.03
173	Finishing of textile	.09	371	Recycling of metal waste and scrap	.04
272	Manufacturing and casting of iron tubes	.09	202	Manufacturing of fibreboard, plywood etc	.04
172	Weaving of cotton	.09	364	Manufacturing of sports goods	.05
365	Manufacturing of games and toys	.09	911	Activities of business organizations	.05
274	Production of precious metals, copper	.10	263	Manufacturing of construction products	.06
403	Steam and hot water supply	.10	205	Manufacturing of other products of wood	.06
175	Manufacturing of ribbons, curtains	.10	245	Manufacturing of perfumes and toilet preparations	.06
Top 10			**Top 10**		
21	Renting of household goods	.21	453	Installation wiring, insulation, plumbing	.32
13	Mixed farming	.21	741	Legal representation activities	.32
722	Publishing of software	.22	742	Architecture activities	.32
741	Legal representation activities	.23	211	Manufacturing of pulp and newsprint	.32
672	Other finance activities	.24	601	Urban transport via railways	.33
744	Advertising	.24	341	Manufacturing of motor vehicles	.33
924	Other Entertainment	.25	452	General construction	.33
553	Restaurants	.26	244	Pharmaceutical operations	.34
921	Motion picture and video production	.26	722	Post activities	.35
671	Finance administration, fund management	.30	401	Publishing of software	.35

Table 2 presents rankings of industries by levels of wage volatility and labor productivity. "Wage Volatility" is defined as the average volatility of annual returns to real disposable income across all individuals covered by a given three-digit SNI code who have retained the same five-digit SNI code for at least five consecutive years between 1993 and 2003. "Labor Productivity" is defined as the elasticity of output with respect to labor and is estimated via a random coefficient panel regression on the output tables from Statistics Sweden. Rankings of the wage volatility and labor productivity measures are based on 191 and 104 observations, respectively.

Table 3: Correlations between Labor Elasticity and Wage Measures

Variable	Labor Elasticity	Wage Level Mean	Wage Growth Volatility
Labor Elasticity	1		
Wage Level Mean	.26***	1	
Wage Growth Volatility	.20**	.189*	1

Table 3 presents Pearson correlations between labor elasticity and wage measures. There are 104 observations. "Labor Elasticity" is computed from the Statistics Sweden output tables. "Wage Level Mean" is the average level of log real wages per industry, and "Wage Growth Volatility" is the average volatility of annual growth rate of real wages per industry. Both measures are computed from the LINDA dataset for individuals working in a given sector for at least five consecutive years. Test statistics indicate the probability of observing the empirical correlation under the null hypothesis that the correlation is zero. Statistical significance is indicated by *** for 1%, ** for 5%, and * for 10%.

Table 4: Second-Stage Estimates of Portfolio Shares in Risky Assets, Stocks, and Mutual Funds on Wage Volatility

Variable	Risky Assets	Stocks	Mutual Funds
Intercept	.912**	-.614***	1.53***
	(8.98)	(.157)	(.232)
Wage volatility	-.081**	.536***	-.616***
	(.041)	(.034)	(.048)
Wage volatility Same industry	.046*	.083***	-.036
	(.026)	(.022)	(.027)
Age	-.007***	-.003***	-.004**
	(.001)	(.001)	(.002)
Age^2	.06***	.034***	.03*
	(.01)	(.001)	(.001)
Nordic	.077***	-.009	.086***
	(.014)	(.019)	(.028)
Has deceased	-.14***	-.003	-.137***
	(.041)	(.031)	(.035)
Has emigrated	-.037***	.001	-.037***
	(.014)	(.019)	(.014)
Number of children	.032***	-.006***	.038***
	(.001)	(.001)	(.002)
Single parent	.039***	-.032***	.071***
	(.006)	(.006)	(.013)
Partnered	.008	-.027***	.035**
	(.007)	(.008)	(.016)
Married	-.002	-.038***	.036***
	(.006)	(.006)	(.011)
Student	.024***	.016***	.009
	(.006)	(.005)	(.008)
College degree	.023**	.029***	-.007
	(.004)	(.004)	(.008)
Business major	.01***	.025***	-.014***
	(.003)	(.003)	(.004)
High pop. density	-.031***	.025***	-.056***
	(.005)	(.006)	(.007)
Medium pop. density	.023***	.005*	.019***
	(.004)	(.005)	(.003)
Family income	-.029***	.054***	-.082***
	(.007)	(.053)	(.016)
Unemployed	-.003	-.003	-.001
	(.004)	(.003)	(.004)
Retired	-.002	.004	-.007*
	(.003)	(.003)	(.004)
Homeowner	.033***	.046***	-.013
	(.006)	(.006)	(.09)
House value/net worth	.022***	-.017***	.038***
	(.003)	(.006)	(.008)
Debt/income	-.001	.001	-.001
	(.001)	(.003)	(.004)

Variable	Risky Assets	Stocks	Mutual Funds
Lambda	.269***	.206**	.063
	(.056)	(.086)	(.136)
No. Obs	102,049	102,049	102,049
F	3,209***	4,495***	17,291***

Table 4 presents second-stage estimates of portfolio holdings as a percentage of financial assets in 2002. The sample is restricted to households with positive holdings only. Three separate OLS regressions are run. The dependent variables are the shares of risky assets (stocks and mutual funds) over financial wealth (column 1), the share of directly held stocks over financial wealth (column 2), and the share of risky mutual funds (equity and mixed) over financial wealth (column 3). Financial wealth is defined as the sum of cash (checking and savings accounts, money-market funds), bond-only mutual funds, stocks, and risky mutual funds. λ is the inverse mills ratio from the first-stage estimate of equation (4.2). We report the bootstrapped standard errors. The superscripts ***, **, and * refer to coefficients statistically distinct from 0 at the 1, 5, and 10% levels, respectively. F refers to the Wald goodness-of-fit test. In addition to the explanatory variables of Table 1, "age^2" is the squared value of age (scaled by 1,000), "house value/net worth" is the ratio of housing wealth over net worth, and "debt-to-income" corresponds to the ratio of debts to household disposable income. Both family income and net worth are expressed in log terms. "Wage Volatility" is defined as the average volatility of annual returns to real disposable income across all individuals covered by a given three-digit SNI code who have retained the same five-digit SNI code for at least five consecutive years between 1993 and 2003. "Wage Volatility Same Industry" is an interaction variable that is equal to wage volatility if the two adults in the household share the same one-digit SNI code.

Table 5: Second-Stage Estimates of Portfolio Shares in Risky Assets, Stocks, and Mutual Funds on Labor Productivity

Variable	Risky Assets	Stocks	Mutual Funds
Intercept	1.325***	-.555***	1.88***
	(.138)	(.203)	(.318)
Labor productivity	.064	.111***	-.048
	(.047)	(.034)	(.042)
Labor productivity Same industry	.038**	.07***	-.032
	(.017)	(.017)	(.021)
Age	-.004***	-.001	-.002
	(.018)	(.001)	(.002)
Age^2	.03*	.01	.02
	(.02)	(.01)	(.02)
Nordic	.04*	-.007	.046
	(.021)	(.026)	(.555)
Has deceased	-.094*	-.036	-.057
	(.056)	(.048)	(.068)
Has emigrated	-.02	-.003	-.017
	(.023)	(.014)	(.022)
Number of children	.031***	-.011*	.042***
	(.003)	(.003)	(.003)
Single parent	.033***	-.018*	.051***
	(.01)	(.003)	(.016)
Partnered	-.007	-.018	.011
	(.012)	(.013)	(.02)
Married	-.004	-.03***	.026*
	(.009)	(.009)	(.013)
Student	.02**	.018**	.001
	(.008)	(.007)	(.01)
College degree	.012**	.037***	-.024**
	(.006)	(.007)	(.012)
Business major	.001	.027***	-.026***
	(.009)	(.004)	(.007)
High pop. density	-.007	.039***	-.046***
	(.006)	(.005)	(.009)
Medium pop. density	.035***	.012***	.023***
	(.004)	(.004)	(.007)
Family income	-.063***	.048***	-.111***
	(.009)	(.013)	(.02)
Unemployed	-.003	-.004	-.001
	(.005)	(.004)	(.006)
Retired	-.005	.006	-.012*
	(.005)	(.004)	(.006)
Homeowner	.14	.044***	-.03**
	(.009)	(.008)	(.014)
House value/net worth	.033**	-.017***	.05***
	(.005)	(.007)	(.01)
Debt/income	-.001	.002	-.003
	(.001)	(.002)	(.003)

Variable	Risky Assets	Stocks	Mutual Funds
Lambda	.111	.256**	-.145
	(.08)	(.111)	(.173)
No. Obs	38,403	38,403	38,403
F	2,059***	1,571***	3,485***

Table 5 presents second-stage estimates of portfolio holdings as a percentage of financial assets in 2002. The sample is restricted to households with positive holdings only. Three separate OLS regressions are run. The dependent variables are the shares of risky assets (stocks and mutual funds) over financial wealth (column 1), the share of directly held stocks over financial wealth (column 2), and the share of risky mutual funds (equity and mixed) over financial wealth (column 3). Financial wealth is defined as the sum of cash (checking and savings accounts, money-market funds), bond-only mutual funds, stocks, and risky mutual funds. λ is the inverse mills ratio from the first-stage estimate of equation (4.2). We report the bootstrapped standard errors. The superscripts ***, **, and * refer to coefficients statistically distinct from 0 at the 1, 5, and 10% levels, respectively. F refers to the Wald goodness-of-fit test. In addition to the explanatory variables of Table 1, "age^2" is the squared value of age (scaled by 1,000), "house value/net worth" is the ratio of housing wealth over net worth, and "debt-to-income" corresponds to the ratio of debts to household disposable income. Both family income and net worth are expressed in log terms. "Labor Productivity" is defined as the elasticity of output with respect to labor and is estimated via a random coefficient panel regression on the output tables from Statistics Sweden. "Labor Productivity Same Industry" is an interaction variable that is equal to labor productivity if the two adults in the household share the same one-digit SNI code.

Table 6: Participation Rates and Portfolio Shares

	All Households			Switchers		
Variable	Mean	Std Dev	Participation	Mean	Std Dev	Participation
Panel A: LINDA						
Risky assets	.58	.33	.91	.57	.31	.95
Stocks	.22	.26	.56	.22	.24	.63
Mutual funds	.48	.32	.84	.46	.3	.88
Panel B: SCF I						
Stocks	.40	.31	.41			
Mutual funds	.30	.26	.30			
Panel C: SCF II						
Stocks	.29	.26	.41			
Mutual funds	.19	.19	.30			

Table 6 presents participation rates and portfolio shares for participants in 2001. Panel A refers to observations from the LINDA dataset. The dataset has 102,049 observations overall and 6,428 observations for the switchers. Panels B and C refer to observations from the Survey of Consumer Finances (SCF). In Panel B, we adjust the SCF portfolios so that they are comparable to the ones computed from LINDA. In particular, we exclude retirement assets and we total the holdings of pure equity and mixed mutual funds. Panel C more accurately reflects the true risky portfolio shares in the United States. The holdings of mixed mutual funds are halved to reflect the fact that they are not fully invested in stocks and the retirement assets are included.

Table 7: Regression of Changes in the Shares of Portfolio Holdings between 1999 and 2002 on Changes in Wage Volatility for Switcher Households

Variable	Δ Risky Assets	Δ Stocks	Δ Mutual Funds
Intercept	-.44	-.97***	.527**
	(.39)	(.221)	(.29)
Ind #1 switchers	-.126	-.01	-.115
	(.157)	(.094)	(.149)
Ind#2 switchers	.346	.305	.041
	(.292)	(.194)	(.249)
Double-switchers	-.1.073*	-.322	-.751*
	(.569)	(.38)	(.409)
To the same industry	.218	-.177	.395
	(.536)	(.297)	(.495)
From the same industry	-.09	.021	-.111
	(.497)	(.257)	(.409)
Δ household size	.022***	-.006	.028***
	(.008)	(.004)	(.007)
Has graduated	-.017	-.009	-.008
	(.023)	(.014)	(.02)
Low to high pop. density	-.029	.015	-.044*
	(.031)	(.021)	(.023)
Δ family income	-.154***	-.013	-.141***
	(.018)	(.01)	(.013)
Found a job	-.028*	-.01	-.018
	(.016)	(.009)	(.015)
Lost a job	.012	-.001	.012
	(.014)	(.007)	(.012)
Has retired	.008	.0158	-.007
	(.016)	(.01)	(.012)
Δ debt/income	-.017***	-.001	-.016***
	(.003)	(.002)	(.003)
Bought a house	.019	.014	.005
	(.035)	(.016)	(.023)
Sold a house	-.086**	-.01	-.075**
	(.038)	(.02)	(.031)
Δ house value/net worth	.054***	-.001	.054***
	(.007)	(.005)	(.007)
Net worth	.006*	.006**	.001
	(.004)	(.003)	(.003)
Stocks	-.51***	-.464***	-.042***
	(.017)	(.014)	(.013)
Mutual funds	-.512***	-.01***	-.502***
	(.012)	(.007)	(.013)
Lambda	.634***	.37***	.257**
	(.164)	(.101)	(.153)
No. Obs	6,428	6,428	6,428
F	8,907***	2,813***	5,096***

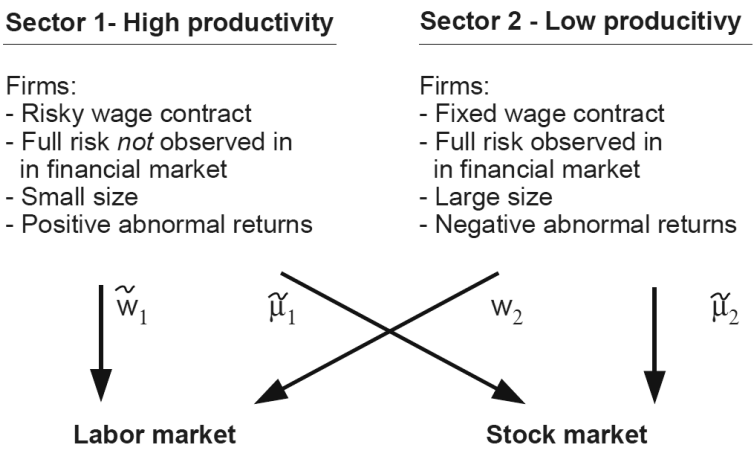
Table 7 presents second-stage estimates of changes in the shares of portfolio holdings between 1999 and 2002. Three separate OLS regressions are run. The sample is restricted to households with positive holdings of risky assets in 1999. The dependent variables are the change in the share of risky assets (stocks and mutual funds) over financial wealth (column 1), the change in the share of directly owned stocks over financial wealth (column 2), and the change in the share of mutual funds (equity and mixed) over financial wealth (column 3). Financial wealth is defined as the sum of cash (checking and savings accounts, money-market funds), bond-only mutual funds, stocks, and risky mutual funds. λ is the inverse mills ratio from the first-stage estimate of equation (4.4). We report the bootstrapped standard errors. The superscripts ***, **, and * refer to coefficients statistically distinct from 0 at the 1, 5, and 10% levels, respectively. F refers to the Wald goodness-of-fit test. Explanatory variables are changes in family disposable income expressed in log terms (Δ family income), changes in house-to-net-wealth ratio (Δ house value/net worth), changes in the debt-to-income ratio (Δ debt/income), and changes in wage volatility for various groups: "individual#1 (#2)" switcher consists of households in which individual #1 (#2) has switched industries between 2000 and 2001 and stayed in the same industry between 2001 and 2002, and "double-switchers" consists of households in which both individuals #1 and #2 switched industries. We include the following interaction variables: "to (from) the same industry" consists of households in which individuals switched industries in a way that they are both (no longer) covered by the same one-digit SNI code in 2002. Furthermore, we include dummy variables that equal 1 if at least one in the household satisfies the criteria: moved from a low- to a high-population-density area (low to high pop. density), stopped receiving student aid between 1999 and 2002 (has graduated), retired between 1999 and 2002 (has retired), unemployed in 1999 but not in 2002 (found a job), employed in 1999 but not in 2002 (lost a job), no real estate in 1999 but owns real estate in 2002 (bought a house), and owned real estate in 1999 but not in 2002 (sold a house). We also control for 1999 levels of net worth (logs) and shares of stocks and mutual funds.

Table 8: Regression of Changes in the Shares of Portfolio Holdings between 1999 and 2002 on Changes in the Level of Labor Productivity for Switcher Households

Variable	Δ Risky Assets	Δ Stocks	Δ Mutual Funds
Intercept	.001	-.88**	.889*
	(.845)	(.414)	(.507)
Ind #1 switchers	-.32	-.227**	-.092
	(.205)	(.105)	(.192)
Ind#2 switchers	-.616**	-.221	-.395
	(.278)	(.165)	(.284)
Double-switchers	-.037	-.159	.121
	(.559)	(.43)	(.548)
To the same industry	.661	.306	.355
	(.488)	(.291)	(.624)
From the same industry	.35	-.019	.369
	(.532)	(.326)	(.402)
Δ household size	.053***	.003	.05***
	(.015)	(.009)	(.017)
Has graduated	-.018	.038	-.056
	(.061)	(.034)	(.056)
Low to high pop. density	-.05	.037	-.087*
	(.061)	(.04)	(.052)
Δ family income	-.193***	.017	-.209***
	(.038)	(.02)	(.02)
Found a job	-.006	.025	-.032
	(.031)	(.017)	(.027)
Lost a job	.05*	.025*	.026
	(.026)	(.014)	(.031)
Has retired	.006	.01	-.004
	(.03)	(.018)	(.022)
Δ debt/income	-.018***	.001	-.018***
	(.005)	(.003)	(.004)
Bought a house	-.004	.01	-.014
	(.061)	(.023)	(.049)
Sold a house	.0126	.032	-.0196
	(.078)	(.037)	(.075)
Δ house value/net worth	.05***	-.013	.063***
	(.015)	(.011)	(.013)
Net worth	.007	.001	.006
	(.009)	(.005)	(.009)
Stocks	-.513***	-.44**	-.073***
	(.034)	(.029)	(.028)
Mutual funds	-.52***	-.002	-.518***
	(.023)	(.012)	(.024)
Lambda	.51	.178	.33
	(.42)	(.228)	(.251)
No. Obs	1,580	1,580	1,580
F	2,280***	1,345***	1,357***

Table 8 presents second-stage estimates of changes in the shares of portfolio holdings between 1999 and 2002. Three separate OLS regressions are run. The sample is restricted to households with positive holdings of risky assets in 1999. The dependent variables are the change in the share of risky assets (stocks and mutual funds) over financial wealth (column 1), the change in the share of directly owned stocks over financial wealth (column 2), and the change in the share of mutual funds (equity and mixed) over financial wealth (column 3). Financial wealth is defined as the sum of cash (checking and savings accounts, money-market funds), bond-only mutual funds, stocks, and risky mutual funds. λ is the inverse mills ratio from the first-stage estimate of equation (4.4). We report the bootstrapped standard errors. The superscripts ***, **, and * refer to coefficients statistically distinct from 0 at the 1, 5, and 10% levels, respectively. F refers to the Wald goodness-of-fit test. Explanatory variables are changes in family disposable income expressed in log terms (Δ family income), changes in house-to-net-wealth ratio (Δ house value/net worth), changes in the debt-to-income ratio (Δ debt/income), and changes in labor productivity for various groups: "individual#1 (#2)" switcher consists of households in which individual #1 (#2) has switched industries between 2000 and 2001 and stayed in the same industry between 2001 and 2002, and "double-switchers" consists of households in which both individuals #1 and #2 switched industries. We include the following interaction variables: "to (from) the same industry" consists of households in which individuals switched industries in a way that they are both (no longer) covered by the same one-digit SNI code in 2002. Furthermore, we include dummy variables that equal 1 if at least one in the household satisfies the criteria: moved from a low- to a high-population-density area (low to high pop. density), stopped receiving student aid between 1999 and 2002 (has graduated), retired between 1999 and 2002 (has retired), unemployed in 1999 but not in 2002 (found a job), employed in 1999 but not in 2002 (lost a job), no real estate in 1999 but owns real estate in 2002 (bought a house), and owned real estate in 1999 but not in 2002 (sold a house). We also control for 1999 levels of net worth (logs) and shares of stocks and mutual funds.

Figure 1: Summary of Model — Two Sector Example



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