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FROM INCOME TO CONSUMPTION: MEASURING HOUSEHOLDS PARTIAL INSURANCE

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Abstract

This paper computes the degree of consumption insurance with respect to transitory and permanent income shocks for different households. The lack of income-consumption data in the US surveys forces researchers to use an empirical strategy to impute consumption. We avoid this procedure by using the Spanish Continuous Family Expenditure Survey that contains good quality income and consumption information in the same survey. We find full insurance for transitory income shocks and partial insurance for permanent shocks for some sub-groups. For the full sample, a 10 percent permanent income shock induces a 7.8 percent permanent change in consumption, with higher insurance capacity for home-owners and more educated households.

Key words: Consumption, Income, Insurance.
JEL Classification: D52, D91, I30

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1 Introduction

Full consumption insurance requires the assumption of complete markets. Under this assumption, households and firms can sign contracts providing full insurance against idiosyncratic shocks to income. However, market imperfections, like moral hazard and asymmetric information, lead to the rejection of the null hypothesis of full consumption insurance [Attanasio and Davis, 1996]. This requires the construction and testing of market models under partial insurance [Deaton and Paxson, 1994].

In the traditional life cycle context [Hall, 1978], the agent attempts to keep the expected marginal utility of consumption stable over time to maximize the objective function (Permanent Income Hypothesis, PIH). In this context, where insurance markets are absent, permanent and transitory income shocks are smoothed through borrowing and saving. However, when the income shocks are very persistent over time, households cannot borrow to smooth out a permanent income decline without violating the budget constraint. The permanent shocks to income will be permanent shocks to consumption.

Empirically, we observe that consumption reacts too little to permanent income shocks. For that reason we could ask ourselves if there are any other ways for the agents to smooth consumption changes when incomes are shifted by permanent or transitory shocks. Partial insurance might provide a mechanism. In this paper partial insurance is defined as a smoothing devices -other than personal savings and borrowings- to smooth consumption changes, when incomes are shifted by permanent or transitory shocks. These mechanisms could help us understand the lower volatility of consumption in relation to the volatility of income, and introduce a method to measure the impact of different smoothing tools. Some examples in the literature to date are family networks or internal family income transfers [Kotlikoff and Spivank, 1981; Attanasio and Rios-Rull, 2000], the added worker effects [Stephens, 2002] , selection of time of expenditures [Browning and Crossley, 2003], progressive income taxation [Mankiw and Kimball, 1992 and Auerbach and Feenberg, 2000], food stamps [Blundell and Pistaferri, 2004] and unemployment schemes [Engen and Gruber, 2001,Browning and Crossley, 2001] .

The analysis of partial insurance requires the study of consumption volatility and its relationship to transitory and permanent income shocks. The relationship between income shocks and consumption depends on the degree of persistence of income and we expect to uncover less insurance for more persistent shocks. Blundell and Preston [1998] derive the conditions under which the growth of variance and covariance of income and consumption can be used to separately identify the growth in variance of permanent and transitory income shocks. Blundell, Pistaferri and Preston [2006] describe the transmission of income inequality into consumption inequality and derive the transitory and permanent partial insurance parameters.

This paper examines the degree of household partial insurance for transitory and permanent income shocks for different individual and households characteristics (time cohorts, employment status, education levels, city size and house owners sub-groups of households). After defining income and consumption processes, we derive the Euler equation that provides a mapping from the transitory and permanent income shocks to the optimal consumption growth. Finally, we estimate the moments required to compute the partial insurance parameters by diagonally weighted minimum distance (DWMD)[1].

A study like this requires good quality longitudinal consumption and income data. The lack of income-consumption data in the US and UK surveys forces the researcher to use an empirical strategy to impute consumption. Skinner (1987) proposes to impute total consumption in the PSID using the estimated coefficient of a regression of total consumption on a series of consumption items that are present in both surveys (food, vehicles, utilities, etc). Ziliak (1998) and Browning and Leth-Petersen (2003) propose an alternative of imputing consumption on the basis of income and the first difference of wealth. Finally, Blundell, Preston and Pistaferri (2006) follow the Skinner imputation but introduce prices, total non durable expenditure and demographic variables in the food demand equation.

One innovation in the current paper is to use true income and consumption data. Specifically, the Spanish Continuous Family Expenditure Survey (ECPF, from now on) contains good quality income and consumption information in the same survey. Therefore, we can use the income and consumption process without imputation methods and compute transitory and permanent partial insurance parameters using DWMD[2].

Results show partial insurance parameters to the permanent and transitory shocks to income for different subgroups of the population. For the full sample a 10 percent permanent income shock induces a 7.8 percent permanent change in consumption. Simultaneously, a 10 percent transitory income shocks induces an

[1] Appendix II give a full explanation of this method.

[2] In a previous work, Casado [2005] analyzes the insurance measurement bias incurred when imputed data are used for a short sample of the ECPF.

insignificant 0.5 percent transitory change in consumption. We find full insurance to transitory shocks for all different sub-groups and partial insurance for permanent shocks for some sub-groups. The insurance for the more educated group is statistically higher than for the less educated. More interesting are the results for the home property sub-group. While the insurance capacity to permanent shocks of the tenants is only the 10%, the home owner insurance capacity reaches the 30%. Finally, we have computed the insurance for urban-rural, employee-self employee and time cohort sub-groups not finding relevant differences in comparison with the whole sample.

The insurance capacity of the Spanish household is lower than in the US. Results from Blundell, Preston and Pistaferri (2004) show us a 10 percent permanent income shock induces a 6.1 percent permanent change in consumption. In Spain, as we saw above, permanent income shock induces a 7.8 percent permanent change in consumption.

Besides, our study remarks the importance that the education level has in the insurance capacity of the households. While in the US the insurance capacity for the college educated group is a 275 percent higher than for the non-college educated, in Spain this amount is lower but not less important. College educated Spanish households have a 85 percent higher capacity to smooth income shocks than non college educated households[3]. In this paper, we do not only learn the importance of the education to increase the insurance capacity of our citizens but also how owning a house increases the insurance level of the households. So, a country willing to increase the insurance capacity level of its citizens should invest

[3]US insurance capacity is 93% higher for more educated households compared to the Spanish high educated population.

resources to improve the educational level of the population and to make easier to citizens to own a home.

This work is related to others papers in the literature, particularly Deaton and Paxson (1994), Moffitt and Gottshalk (1994), Blundell and Preston (1998) and Blundell, Pistaferri and Preston (2006) that examine the role of asymmetric information, moral hazard, heterogeneity and ask how the complete markets model must be amended to include some forms of imperfect insurance. Skinner (1987), Ziliak (1998), Browning and Leth-Petersen (2003) and Blundell, Pistaferri and Preston (2005) propose to impute total consumption using a regression from a standard demand function for food (for a consumption item available in income and consumption survey) and they make this depends on price, total non-durable expenditure, and a set of socio-economics characteristics of the household.

In the Spanish literature, the study of partial insurance is new. However, previous works have researched the consumption volatility to analyze changes to permanent income. These papers are always linked with the study of inequality. Cutanda (2002) -following Blundell and Preston (1998)-, Cutanda, Labeaga and Mochón (2004) and Labeaga, López Salido and Mochón (2005) compute the variance of permanent and transitory income using the consumption and income microeconomics information of the ECPF. They concludes there is a large reduction in inequality in the 1985-1995 period, however they note a small increase in inequality at the beginning of the 90's and underline the quantitative importance of age, education and employment to smooth inequality.

The paper continues defining the income and consumption dynamic and deriving the Euler equation that provides a mapping from the transitory and permanent income shocks to the optimal consumption growth. Section 3 discusses data issues. Section 4 presents the partial insurance results and finally section 5 concludes.

2 Model and Empirical Specification

2.1 Income Process

We know that the main source of uncertainty faced by the consumer is the labor income, defined as the sum of earned income, self employment income, pensions and unemployment benefits. We assume separability in preferences between consumption and leisure and inelastically labour supply. Consequently, all new insurances provided will be reflected in disposable income variability. It is possible that the worker has insurance agreements of the salary linked to his productivity but this will be reflected in the variability of income. Taking this assumption into account we define the income process for each household i :

$$y_{i,t} = Z'_{i,t}\vartheta_t + P_{i,t} + v_{i,t} \tag{1}$$

where t is the time index, Z is a set of observable income characteristics that include demographic, education, calendar time and cohort effects variables. $P_{i,t}$ and $v_{i,,t}$ are the permanent and transitory income components respectively.

Following Moffitt and Gottschalk (1994) and Meghir and Pistaferri (2004) we assume that $P_{i,a,t}$ follows a martingale process:

$$P_{i,t} = P_{i,t-1} + \zeta_{i,t} \tag{2}$$

where $\zeta_{i,t}$ is serially uncorrelated and orthogonal to $v_{i,t}$.

The income transitory component follows a $MA(q)$ process, where q is empirically computed:

$$v_{i,t} = \sum_{j=0}^{q} \theta_j \varepsilon_{i,t-j} \quad \text{with} \quad \theta_j = 0 \text{ when } j = 0 \tag{3}$$

Finally, taking different in (1) the income growth is:

$$\Delta y_{i,t} = \Delta Z'_{i,t}\vartheta + \zeta_{i,t} + \Delta v_{i,t} \tag{4}$$

or rearranging

$$\Delta y^*_{i,t} = \zeta_{i,t} + \Delta v_{i,t} \tag{5}$$

where $\Delta y^*_{i,t} = \Delta y_{i,t} - \Delta Z'_{i,t}\vartheta$

2.2 Insurance and Consumption Growth

2.2.1 Consumption Growth

The typical optimization problem of the household i is to maximize

$$\underset{C}{Max} E_t \sum_{j=0}^{T-t} \frac{1}{(1+\delta)^j} \frac{C^{\beta}_{i,t+j} - 1}{\beta} e^{Z'_{i,t+j}\varphi_{t+j}} \tag{6}$$

subject to the intertemporal budget constraint

$$A_{i,t+j+1} = (1 + r_{t+j})(A_{i,t+j} + Y_{i,t+j} - C_{i,t+j}) \tag{7}$$

where $A_{i,t}$ is given and $A_{i,T} = 0$

$Z'_{i,t+j}\varphi_{t+j}$ is a vector of taste shifters and discount rate heterogeneity. $C_{i,t}$ is the consumption of non-durable goods $A_{i,t}$ is the household assets i in the time period t. The end of the life-cycle is T and we assume that there is no interest rate uncertainty.

Assuming constant relative risk adverse preferences (CRRA $u(c) = \frac{C^{\beta}-1}{\beta}$) and perfect credit markets, we obtain the following Euler equation expression:

$$C_{i,t-1}^{\beta-1} = \frac{1 + r_{t-1}}{(1+\delta)} e^{\Delta Z'_{i,t}\varphi_t} E_{t-1} C_{i,t}^{\beta-1} \tag{8}$$

Computing the mapping from the income shocks $\zeta_{i,t}$ and $\varepsilon_{i,t}$ to the optimal consumption growth following Appendix 1, we obtain:

$$\Delta \log C_{i,t} \approxeq \Gamma_{i,t} + \xi_{i,t} + \Delta Z'_{i,t}\varphi_t + \pi_{i,t}\zeta_{i,t} + \gamma_{t,L}\pi_{i,t}\varepsilon_{i,t} \tag{9}$$

where $\Delta \log C_{i,a,t}$ is the logarithm of the non durable consumption, $\Gamma_{b,t}$ is the slope of the consumption path for individual i and reflects interest rate, impatience or precautionary savings. $\xi_{i,a,t}$ is the is the innovation to higher moments of the income process.

Rearranging (9) we get the following expression

$$\Delta c_{i,t} \approxeq \pi_{i,t}\zeta_{i,t} + \pi_{i,t}\gamma_{t,L}\varepsilon_{i,t} + \xi_{i,t} \tag{10}$$

Where $\Delta c_{i,a,t} = \Delta \log C_{i,a,t} - \Gamma_{b,t} - \Delta Z'_{i,a,t}\varphi_t$.is the log of real stochastic consumption component. This Euler equation provides a mapping from the permanent and transitory labor income shocks to the optimal consumption growth. $\gamma_{t,L} = \sum_{j=0}^{q} \alpha_{t+j,L}^{\Delta Z\varphi - r}\theta_j$ is a weight that increases with age and it will be empirically considered as a known parameter rather than an estimated coefficient. But the most important coefficient is $\pi_{i,t} = \frac{\sum_{k=0}^{L-t} Q_{t+k}Y_{i,t-k}}{\sum_{k=0}^{L-t} Q_{t+k}Y_{i,t-k}+A_{i,t}}$ that can be interpreted like the share of future labour income in the present value of lifetime wealth or most easily the share of current financial assets relative to remaining future labour income.

$\pi_{i,a,t}$ can be interpreted like a first measurement of insurance, the precautionary saving. When the current financial assets of the household are small relative to remaining future labour income $\pi_{i,a,t} \approxeq 1$ permanent shocks are translated to consumption, and saving smooth the transitory shocks. In addition, saving can provide insurance against permanent shocks if the stock of assets built up is large relative to future labour income $\pi_{i,a,t} < 1$. Finally we conclude precautionary saving can provide insurance against permanent shocks if the stock of assets built up is large relative to future labour income.

2.2.2 Partial Insurance and Euler Equation

Besides personal or precautionary saving to smooth permanent shocks we can think that the agents have other smoothing devices to insure consumption against transitory or permanent income shocks like family networks, added worker effects, timing of durable purchases, progressive income taxation, mortgage refinancing or the social security public policy programs. This mechanism was defined in the introduction as partial insurance devices.

We can differentiate two partial insurance forms. Firstly those mechanisms that smooth a fraction $(1-\phi_{i,t})$ of permanent income shocks and secondly the mechanisms that smooth a share $(1-\psi_{i,t})$ of transitory income shocks. The most popular mechanisms is personal saving. If that is the only one available, then $\phi_{i,t}=\gamma_{t,L}^{-1}\psi_{i,t}=\pi_{i,t}$ and the consumption growth equation (10) can be written as:

$$\Delta c_{i,t} \approxeq \phi_{i,t}\zeta_{i,t}+\psi_{i,t}\varepsilon_{i,t}+\xi_{i,t} \tag{11}$$

We can interpreted that there is full consumption insurance against permanent and transitory income shocks when $\phi_{i,t}=0$ and $\psi_{i,t}=0$ respectively and no insurance when $\phi_{i,t}=\psi_{i,t}=1$.Following the precautionary saving literature we hope that $\phi_{i,t}$ will be close to one and $\psi_{i,t}$ close to zero

Computing $\phi_{i,t}$ and $\psi_{i,t}$ we measure general insurance parameters. This general insurance includes self-insurance (precautionary saving), partial insurance and other insurance devices. We cannot identify each insurance component by itself but we know the degree of transmission of income shocks into consumption which is the immediate goal of the paper.

2.3 Partial Insurance, Measurement Error and Moments Conditions

We prefer to use actual data instead of imputed data in our approach. For that reason, in this paper we estimate the partial insurance parameters using a sample that contains income and consumption information in the same survey. In a first approach, we consider no measurement error, serially uncorrelated transitory component, stationarity and i.i.d. transitory shock to income.

$$\Delta c_{i,t} \approxeq \phi \zeta_{i,t} + \psi \varepsilon_{i,t} + \xi_{i,t} \tag{12}$$

$$\Delta y_{i,t} = \zeta_{i,t} + \Delta \varepsilon_{i,t} \tag{13}$$

Following Meghir and Pistaferri (2004) we identify the parameters of interest $\phi, \psi, \sigma^2_\varepsilon, \sigma^2_\zeta$ and σ^2_ξ

$$E\left(\Delta y_t \left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right) = \sigma^2_\varsigma \tag{14}$$

$$E\left(\Delta y_t \Delta y_{t-1}\right) = E(\Delta y_{t+1} \Delta y_t) = -\sigma^2_\varepsilon \tag{15}$$

and

$$\phi = \frac{E\left(\Delta c_t \left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right)}{E\left(\Delta y_t \left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right)} \tag{16}$$

$$\psi = \frac{E\left(\Delta c_t \Delta y_{t+1}\right)}{E\left(\Delta y_t \Delta y_{t+1}\right)} \tag{17}$$

$$\sigma_{\xi}^2 = E\left(\Delta c_t\left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right) - \frac{\left[E\left(\Delta c_t\left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right)\right]^2}{E\left(\Delta y_t\left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right)} + \frac{\left[E\left(\Delta c_t \Delta y_{t+1}\right)\right]^2}{E\left(\Delta y_t \Delta y_{t+1}\right)} \tag{18}$$

Where transitory insurance parameter (ψ) is computed measuring the relation between income and lagged consumption, that must be correlated through the transitory component ($E\left(\Delta c_t \Delta y_{t+1}\right) = \sigma_{\varepsilon}^2 \psi$). Similary, we compute the covariance between current consumption and current income growth $E\left(\Delta c_t \Delta y_t\right)$ removing the contribution of the transitory component to compute the permanent income shock effect $E\left(\Delta c_t\left(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}\right)\right) = \sigma_{\varsigma}^2 \phi$. Finally, the variance of the component σ_{ξ}^2 is computed like the variance of consumption growth, removing the contribution of permanent and transitory income shocks.

Following this simplest approach, ϕ and ψ could be understood like the instrumental variable estimation of Δc on Δy_t using $\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}$ and $E\left(\Delta c_t \Delta y_{t+1}\right)$ as instruments respectively.

However, as usual in microeconometric literature, we assume that income and consumption data are measured with multiplicative independent error due to the data collected process of the survey. Income ($y_{i,t}^*$) and consumption ($c_{i,t}^*$) data are composed by income and consumption real data plus the income and consumption error component.

$$y^*_{i,t} = y_{i,t} + u^y_{i,t} \tag{19}$$

$$c^*_{i,t} = c_{i,t} + u^c_{i,t} \tag{20}$$

Where $y^*_{i,t}$ and $c^*_{i,t}$ denote measured income and consumption, $y_{i,t}$and $c_{i,t}$ are the true income and consumption and $u^y_{i,t}$ and $u^c_{i,t}$ the measurement errors.

Measurement error in consumption induces serial correlation. Like consumption is a martingale with drift the variance of measurement error is

$$E(\Delta c^*_t \Delta c^*_{t-1}) = E\left(\Delta c^*_t \Delta c^*_{t+1}\right) = -\sigma^2_{u^c} \tag{21}$$

ϕ is still idenfied by (16). However, ψ and σ^2_ξ are unidentified. We put a lower bound assuming in our estimation a downward bias due to measurement error in income[4]

$$\psi \geqslant \frac{E\left(\Delta c_t \Delta y_{t+1}\right)}{E\left(\Delta y_t \Delta y_{t+1}\right)} \tag{22}$$

Finally, our results in tables V and VI take into account the existence of non-stationarity changing the equation (14) to

$$E\left(\Delta y^*_t \left(\Delta y^*_{t-1} + \Delta y^*_t + \Delta y^*_{t+1}\right)\right) = \sigma^2_{\varsigma,t} \tag{23}$$

for t=3,4,...,T-1. The variance of transitory shock becomes

[4] An extension of the downward bias measurement could be found in Meghir and Pistaferri (2004)

$$-E(\Delta y_t^* \Delta y_{t-1}^*) = \sigma_{\varepsilon,t}^2 \tag{24}$$

for t=2,3,...,T-1. With an MA(1) process for the transitory component, that is the one considered in the results section, $\sigma_{\varsigma,t}^2$ and $\sigma_{\varepsilon,t}^2$ will be:

$$E\left(\Delta y_t^* \left(\Delta y_{t-2}^* + \Delta y_{t-1}^* + \Delta y_t^* + \Delta y_{t+1}^* + \Delta y_{t+2}^*\right)\right) = \sigma_{\varsigma,t}^2 \tag{25}$$

for t=4,5,...,T-2 and assuming θ is identified:

$$-E(\Delta y_t^* \Delta y_{t-1}^*) = \theta\sigma_{\varepsilon,t}^2 \tag{26}$$

for t=2,3,...,T-2. In our case t=1 corresponds to 1985 and t=T corresponds to 1995.

The main parameters of interest can be identified using:

$$-E(\Delta c_t^* \Delta c_{t+1}^*) = \sigma_{u^c}^2 \tag{27}$$

$$\psi = \frac{E\left(\Delta c_t^* \Delta y_{t+1}^*\right)}{E\left(\Delta y_t^* \Delta y_{t+1}^*\right)} \tag{28}$$

$$\phi = \frac{E\left(\Delta c_t^* \left(\Delta y_{t-1}^* + \Delta y_t^* + \Delta y_{t+1}^*\right)\right)}{E\left(\Delta y_t^* \left(\Delta y_{t-1}^* + \Delta y_t^* + \Delta y_{t+1}^*\right)\right)} \tag{29}$$

$$\sigma_{\xi}^{2}=E\left(\Delta c_{t}^{*}\left(\Delta y_{t-1}^{*}+\Delta y_{t}^{*}+\Delta y_{t+1}^{*}\right)\right)-\frac{\left[E\left(\Delta c_{t}^{*}\left(\Delta y_{t-1}^{*}+\Delta y_{t}^{*}+\Delta y_{t+1}^{*}\right)\right)\right]^{2}}{E\left(\Delta y_{t}^{*}\left(\Delta y_{t-1}^{*}+\Delta y_{t}^{*}+\Delta y_{t+1}^{*}\right)\right)}+\frac{\left[E\left(\Delta c_{t}^{*}\Delta y_{t+1}^{*}\right)\right]^{2}}{E\left(\Delta y_{t}^{*}\Delta y_{t+1}^{*}\right)} \tag{30}$$

All these moments and their standard deviations can be estimated using generalized method of moments. We use diagonally weighted minimum distance explained in the appendix section.

3 The Data

3.1 The Spanish Continuous Family Expenditure Survey

The ECPF is a rotating panel based on a survey conducted by the Spanish National Statistics Office (Instituto Nacional de Estadística, INE) and it is used primarily to revise the consumption price index (IPC, Indice de precios al consumo). The ECPF reports a continuous flow of data on the buying habits of Spanish consumers and collects information on socio-demographic variables, including income and a wide range of good expenditures from the first quarter of 1985 to the last one of 1995. The ECPF interviews about 3,200 households every quarter and 12.5 percent of the households are replaced every quarter by a new randomly drawn group. Thus, each household can stay far a maximum of eight quarters.

The definition of total non durable consumption used in this paper is the same as in Attanasio and Weber (1995). It is the sum of food, alcohol, tobacco and expenditures on other nondurable goods, such as services, heating fuel, public and private transport, personal care and semi-durable, clothing and footwear.

The food consumption necessary to implement the imputation procedure includes all food at home and non-alcoholic beverage categories. Finally, labor income is the aggregation of wage income, pensions, unemployment wages, other regular transfers and other monetary and non-monetary incomes.

We select a ECPF sample with the objective to focus on stable families because usually they have higher income and assets and they could be more successful in securing access to credit, family networks and other informal insurance devices (partial insurance). The step-by-step selection of our ECPF sample is illustrated in Table I. Our initial 1985-1995 ECPF sample includes 125,394 quarterly observations, corresponding to 27,755 households. Firstly, we eliminate households where the head is a single, widower, widow or those aged under 30 or over 65. Secondly, we eliminate households headed by a female and drop those born before 1925 or after 1965. We drop some graphically detected income outliers. Finally, we exclude households whose income and consumption are below or above percentile 1%.

As stated before, we would like to emphasize the advantages of ECPF over previous studies which have used a combination of PSID and CEX datasets. Firstly, in the ECPF we can find income, food and a wide range of non-durable consumption information for the same household. Nevertheless, PSID-CEX requires an indirect procedure to impute a measure of non durable consumption from a standard demand function for food. Blundell, Pistaferri and Preston (2004) review the conditions that make this procedure reliable and show that it is able to reproduce the trends in the consumption distribution. In spite of this, we think that it is necessary to compute the impact of the imputation using a dataset that contains all the required information to investigate the degree of insurance against income shock and calculate the error incurred with the imputation process. Additionally ECPF not only has better consumption and income information but also this information is available over a longer period of time. ECPF follows a household for a maximum of eight consecutive quarters but in the CEX, each household is only interviewed every five quarters[5]. Our survey also has time advantages over FES where households are interviewed only once.

The availability of good panel data presents many others advantages over a repeated cross-sections analysis. With a panel dataset the variance and covariances of differences in income and consumption can be observed. However, previous studies [Blundell and Preston, 1998] have made assumptions under which the variance and covariance of differences in income and consumption can be computed[6]. On the other hand, with panel data, the identification of the variances of shocks does not require making assumptions and it is only necessary panel data of income and not of consumption. Finally, panel data provide more over-identifying restrictions compared with repeated cross-section data and it can afford more flexibility to model specification and testing.

4 The Results

In this section two different results are presented: first, the variance-covariance structure of income and consumption in the ECPF and second, the estimation

[5] Although only four of these quarters are useful (see Bureau of Labor Statistics, Handbook of Methods, for additional details)

[6] Under the assumption that shocks are cross-sectionally orthogonal to past consumption and income and that transitory shocks are serially uncorrelated.

of the degree of insurance to the permanent and transitory shocks to income for different sub-groups of population.

4.1 Autocovariance Estimates of Consumption and Income

In this section we analyze the income and consumption variance-covariance results. We use non-durable consumption as a measure of expenditure and labor income as a unit of earning. Both units are deflated by the Stone Price Index and divided by the equivalent adult index[7].We remove the deterministic effect of logarithmic income and logarithmic real consumption by regressing this on year, quarter, year of birth dummies and a set of household composition dummy variables. Then, we work with the residuals of this regression. Finally, we aggregate the quarterly data to create an annual income and consumption sample.

Table II reports unrestricted minimum distance estimations of several moments of the income process for the whole sample. We compute the variance of income growth $var\left(\Delta y_t\right)$, the first-order autocovariance $cov\left(\Delta y_{t+1}, \Delta y_t\right)$ and the second-order autocovariance, $cov\left(\Delta y_{t+2}, \Delta y_t\right)$ .Table III repeats these computations for consumption and finally, table IV reports minimum distance estimations of contemporaneous and lagged consumption-income covariance. Bootstrap Standard Deviations have been computed using 1000 replications following the income and consumption data generation process defined above and preserving the panel data characteristics of our dataset.

Table II shows a diminishing variance of income growth from 1985-1992, show-

[7] We consider 1 for the head of household, 0.7 for the wife and other household adults and 0.5 for each child.

ing a little increase in the last three years of the sample. The absolute value of the first-order autocovariances also decreases through 1985-1992 and there is a small blip from 1993-1995. Second order autocovariance, informative of serial correlation in the transitory income component, is small and not always significant.

Table III informs about shifts in the consumption distribution. Consumption variance decreases from 1985 to 1992 and increases from then on. Although the absolute value of the first-order autocovariance of consumption growth should be a good estimation of the variance of the imputed error; since we are working with true consumption data this is small and insignificant. Second-order consumption growth autocovariances are also insignificant.

Table IV looks at the relation of income and consumption growth at various lags. The contemporaneous covariance should be informative of the effects of income shocks on consumption growth. This covariance decreases from 1985 to 1992 and increases since then. The covariance between current consumption growth and future income growth $cov\left(\Delta y_{t+1}, \Delta c_t\right)$ represents the consumption insurance against transitory income shocks. In our case as $cov\left(\Delta y_{t+1}, \Delta c_t\right) = 0$ we have full consumption insurance against transitory income shocks. Finally, the covariance between current consumption growth and past income growth $cov\left(\Delta c_{t+1}, \Delta y_t\right)$ must highlight the need to consider models where liquidity constraints are present. The estimations of this covariance are close to zero in our results.

To conclude, there is no evidence that transitory shocks impact consumption growth or that liquidity constraints are important in this sample. Income and consumption variances decrease between 1985 and 1992 and increase since then. The first-order autocovariance of consumption growth, proxy for the variance of imputation error is not significant, showing the importance of working with true data.

4.2 Partial Insurance and the DWMD Moment Estimation

In this section we estimate the parameters (23)-(30) by diagonally weighted minimum distance (DWMD) and get the insurance parameters to the permanent and transitory shocks to income for different sub-groups of population. In all cases, we let the variance of the permanent and the transitory shock σ^2_ζ and σ^2_ε vary with calendar time. However, we present the results of a simple model in which the insurance parameters are constant over time.

Tables V present the results of three different specifications: one for the whole sample, one where parameters are estimated separately for college, non-college graduates and one where parameters are estimated by cohort 1955-1945 and 1945-1935. Table VI repeats the exercise using data of three different specifications: one when parameters are estimated separately by urban (cities with more than 500,000 inhabitants) and rural (cities with less than 10,000 inhabitants) other by employee and self-employee and the last one for tenant and home-owner. Both tables show the variances of the permanent σ^2_ς and transitory shock σ^2_ϵ from 1985 to 1995 and the partial insurance coefficient for the permanent shock ϕ and transitory shock ψ.

The first column of Table V shows the results for the whole sample. The estimated variance of the permanent shock and the estimated variance of the transitory shock decrease from 1985 to 1992 and increase in the last three years (especially for the permanent shocks). This result is consistent with previous works - Cutanda (2002) and Cutanda, Labeaga and Mochón (2004)- which conclude that there is a large reduction in inequality in the 1985-1995 period, however they note a small increase in inequality at the beginning of the 90's. The estimation of ϕ, the partial insurance coefficient for the permanent shock, has a value of 0.7810 predicting the existence of partial insurance. This value could be interpreted as follows, a 10 percent permanent income shock induces a 7.8 percent permanent change in consumption. The estimation of ψ,the insurance coefficient for the transitory shock, has a value of 0.0541 but it is not significant. We can conclude that $\psi = 0$ and there is full insurance for transitory income shocks for the whole sample.

Table V also reports the results of the model for two education groups (with and without high education level), and for the two middle cohorts of the sample (born between 1935 and 1945 and between 1945 and 1955). As before, both the variance of the permanent and the variance of the transitory shocks are decreasing from 1985 to 1992 and increasing from 1993 to 1995. The partial insurance parameter indicates higher insurance in response to permanent shocks among the college educated group and full insurance with respect to transitory shocks $\psi = 0$ for both education groups. Comparing the insurance parameter to permanent shocks for educated and non-educated we can conclude that there are statistically significant differences. Then, we can say that the insurance for the more educated group is higher than for the less educated. However, comparing the college and non college results with the ones obtained for the whole sample, we do not find important significant differences.

When the sample is divided by year of birth, we apparently find that to the older cohorts, permanent shocks are smoothed in a bigger share than to the younger. The presence of a higher precautionary asset accumulation among older cohorts could provide an explanation to this result. However this difference is not statistically significant. Comparing the time-cohorts with the full sample, non remarkable differences are found.

Table VI reports the results of the model for the following groups: urban, rural, employee, self-employee, tenant and home-owner. The partial insurance parameters in response to permanent shocks of urban and rural subgroups do not show significant differences with the full sample.

More interesting are the results for the home property sub-group. Firstly, there is a big and significant difference between the insurance capacity to permanent shocks of the tenants and the home-owners. While the first ones can only insure 10% of permanent shocks, home owners' insurance capacity reaches 30%. This result underlines the importance of home property in the Spanish culture. While in Europe 30% of the households rent their houses in Spain this percentage is only the 11%. Besides, each household owns 1.5 houses in Spain and this magnitude decreases to 1.1 in Europe. Moreover, 68% of low income households rent their properties whereas only 0.11% of the richest households rent. Finally, not significant differences are found in comparison with the whole sample. There is little evidence against full insurance for transitory income shocks.

When we divide the sample between employee and self-employee not important different are found for the permanent and transitory insurance parameters. These differences are also not significant related to the whole sample.

Summarizing, we find full insurance to transitory shocks for all different sub-groups and partial insurance for permanent shocks for some sub-groups. However, we only find significant differences in the partial insurance parameter between college and non college and tenant and home-owners. Remarkable differences between the behaviour of the full sample and the tenant and home-owner sub-group is underlined.

5 Conclusions

The main objective of this paper is to compute the degree of consumption partial insurance with respect to transitory and permanent income shocks for different sub-groups. Partial insurance is defined as a smoothing device -other than personal savings and borrowings- to smooth consumption changes when incomes are shifted by permanent or transitory shocks. These mechanisms could help us understand the lower volatility of consumption in relation to the volatility of income, and to introduce a method to measure the impact of different smoothing tools. After defining income and consumption processes, we derive the Euler equation that provides a mapping from the transitory and permanent income shocks to the optimal consumption growth. We estimate the moments required to compute the partial insurance parameters by diagonally weighted minimum distance (DWMD).

Results show partial insurance of permanent income shocks and full insurance of transitory shocks. For the full sample, a 10 percent permanent income shock induces a 7.8 percent permanent change in consumption. Dividing the sample by groups of interest (time-cohort, college-non college, urban-rural, employee-self employee, tenant-home owners) not significant differences are found with the full sample. However, the more educated sample has 85% higher insurance capacity than the less educated. Another remarkable and significant result is that households owning a residence have 160% higher insurance capacity to permanent shocks than tenants.

The comparison of our results with previous study using US data[8] shows that the insurance capacity of Spanish households is lower. The Spanish insurance level to permanent shocks is 43% lower than in the US. Distinguishing by level of education, US insurance capacity is 93% higher for more educated households compared to the Spanish high educated population. The difference in insuring permanent shocks for educated and non educated households is significant in both countries. [9]

[8] Blundell, Preston and Pistaferri [2006]

[9] It is not possible to compare our results to every US sub-groups because these are not available.

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Appendix I. The Euler Equation

CRRA functional form of preferences are used here. The Euler equation can be linearized to describe the behaviour of consumption growth. However, in this appendix we are focusing in the approximation of the mapping between the expectation error of the Euler equation and the income shock.

Firstly, we know that the sum of an arbitrary series $X_t, X_{t+1}...X_s$ can be approximated by

$$\ln \sum_{k=1}^{S-t} X_{t+k} = \ln X_t + \ln \left[1 + \sum_{k=1}^{S-t} \exp \left(\ln X_{t+k} - \ln X_t \right) \right]$$

Taylor expansion around $\ln X_{t+k} = \ln X_t + \sum_{i=0}^{k} \delta_{t+i}$, we can substitute $\ln X_{t+k} - \ln X_t$ in the above expression

$$\begin{aligned} \ln \sum_{k=1}^{S-t} X_{t+k} &\approxeq \ln X_t + \ln \left[1 + \sum_{k=1}^{S-t} \exp \left(\sum_{i=0}^{k} \delta_{t+i} \right) \right] \\ &\quad + \sum_{k=1}^{S-t} \frac{\exp \left(\sum_{i=0}^{k} \delta_{t+i} \right)}{\left[1 + \sum_{k=1}^{S-t} \exp \left(\sum_{i=0}^{k} \delta_{t+i} \right) \right]} \left(\ln X_{t+k} - \ln X_t - \sum_{i=0}^{k} \delta_{t+i} \right) \\ &\approxeq \sum_{k=1}^{S-t} \alpha^{\delta}_{t+k,S} \left[\ln X_{t+k} - \ln \alpha^{\delta}_{t+k,S} \right] \end{aligned}$$

where $\alpha^{\delta}_{t+k,S} = \frac{\exp \left(\sum_{i=0}^{k} \delta_{t+i} \right)}{\left[1 + \sum_{k=1}^{S-t} \exp \left(\sum_{i=0}^{k} \delta_{t+i} \right) \right]}$.

The common consumption income model of (6) with CRRA give us the knowledged Euler equation

$$C^{B-1}_{i,t-1} = \frac{(1 + r_{t-1})}{1 + \delta} e^{\Delta Z'_{i,a,t} \vartheta_t} E_{t-1} C^{B-1}_{i,t}$$

and this is approximately:

$$\Delta \log C_{i,t} \approxeq \Delta Z'_{i,t}\vartheta_t + \eta_{i,t} + \Omega_{i,t}$$

where $\eta_{i,t}$ are the consumption shocks and $\Omega_{i,t}$ represent the slope in the consumption path due to precautionary savings, interest rates and impatience.

When the idiosyncratic component to this gradient to the consumption path can be divided by a cohort/time-specific component $\Gamma_{b,t}$ and individual component $\xi_{i,a,t}$, we can write $\Delta \log C_{i,a,t}$ as:

$$\Delta \log C_{i,t} - \Gamma_{b,t} - \Delta Z'_{i,t}\vartheta_t \approxeq \Delta c_{i,t} \approxeq \eta_{i,t} + \xi_{i,t}$$

From the income process defined above (5)

$$\Delta y_{i,t+k} = \zeta_{i,t+k} + \sum_{j=0}^{q} \theta_j \epsilon_{i,t+k-j}$$

and the budget constraint

$$\sum_{k=0}^{T-t} Q_{t+k} C_{t+k} = \sum_{k=0}^{L-t} Q_{t+k} Y_{i,t+k} + A_{i,t}$$

where T is the end of the life, L is the retirement and Q_{t+k} is the appropriate discount factor $\Pi_{i=i}^{k}(1 + r_{t+i})$, $k = 1, ..., T - t$.

Using the approximation method described at the beginning of this section we have:

$$\begin{aligned}
&\sum_{k=0}^{T-t} \alpha_{t+k,T}^{\Omega+\Delta Z\vartheta-r} \left[\ln C_{i,t+k} - \ln Q_{t+k} - \ln \alpha_{t+k,T}^{w-r}\right] \\
\approxeq\ & \pi_{i,a,t} \sum_{k=0}^{L-t} \alpha_{t+k,L}^{\Delta Z\varphi-r} \left[\ln Y_{i,t+k} - \ln Q_{t+k} - \ln \alpha_{t+k,L}^{\Delta Z\varphi-r}\right] \\
&+ (1 - \pi_{i,t}) \ln A_{i,t} - \left[(1 - \pi_{i,t}) \ln (1 - \pi_{i,t}) + \pi_{i,t} \ln \pi_{i,t}\right]
\end{aligned}$$

where $\pi_{i,t} = \frac{\sum_{k=0}^{L-t} Q_{t+k} Y_{i,t-k}}{\sum_{k=0}^{L-t} Q_{t+k} Y_{i,t-k} + A_{t,t}}$ that can be interpreted like a first measurement of insurance (precautionary saving). When the current financial assets of the household are small relative to remaining future labour income $\pi_{i,t} \approxeq 1$ permanent shocks are translated to consumption (no insurance). Otherwise, when the assets go to infinite $\pi_{i,t} \approxeq 0$, permanent shocks are not translated to consumption (full insurance).

Taking differences in expectation gives

$$\eta_{i,t} \approxeq \pi_{i,t} \left[\varsigma_{i,t} + \gamma_{t,L} \varepsilon_{i,t} \right]$$

where $\gamma_{t,L} = \left(\sum_{j=0}^{q} \alpha_{t+j,L}^{\Delta Z \varphi - r} \theta_j \right)$.

Finally as $\Delta c_{i,t} \approxeq \eta_{i,t} + \xi_{i,t}$

$$\Delta c_{i,t} \approxeq \xi_{i,t} + \pi_{i,t} \varsigma_{i,t} + \pi_{i,t} \gamma_{t,L} \varepsilon_{i,t}$$

Appendix II. Diagonally-Weighted Minimum Distance Method

Firstly, we compile observations on income Δy and consumption Δc for each individual obtaining the vector:

$$x_{i,t} = \begin{pmatrix} \Delta c_i \\ \Delta y_i \end{pmatrix}$$

and derive:

$$m = vech \left\{ \sum_{i=1}^{N} (x_i x_i') \oslash d_i' d_i \right\}$$

where $d_i = \begin{pmatrix} d_i^c \\ d_i^y \end{pmatrix}$ $d_{i,t}^c = 1 \{\text{if } \Delta c_{i,t} \text{ is not missing}\}$ and

$d_{i,t}^y = 1 \{\text{if } \Delta y_{i,t} \text{ is not missing}\}$.$\oslash$ denote an elementwise division. This notation allows us to handle in a simple way the problems of unbalanced panel. In our case the vector m contains the estimation of $cov(\Delta y_t, \Delta y_{t+s}), cov(\Delta y_t, \Delta c_{t+s})$ and $cov(\Delta c_t, \Delta y_{t+s})$ a total of $T(2T+1)$ moments.

The variance-covariance matrix of m that can be used for inference is:

$$V = \left[\sum_{i=1}^{N} \left((m_i - m) (m_i - m)' \right) \circledast D_i \right] \oslash \left(\sum_{i=1}^{N} D_i \right)$$

Where $D_i = vech \left\{ d_i d_i' \right\}$. The square roots of V provide the standard error of the corresponding elements in m.

In the empirical analysis we estimate models for m

$$m = f(\Lambda) + \Upsilon$$

where Λ is the vector of parameters of interest. In our case the variances of the permanent shock, the variances of transitory shock, the partial insurance parameters, etc.. Υ capture sampling variability. Following equations (15)-(23) are:

$$\begin{pmatrix} var(\Delta c_1) \\ cov(\Delta c_1, \Delta c_2) \\ \ldots \\ cov(\Delta c_1, \Delta c_T) \\ \ldots \end{pmatrix} = \begin{pmatrix} \phi^2 var(\zeta_1) + \psi^2 var(\varepsilon_1) + var(\xi_1) + 2\sigma^2_{u^c} \\ -\sigma^2_{u^c} \\ \ldots \\ 0 \\ \ldots \end{pmatrix} + \Upsilon$$

We estimate Λ by minimizing:

$$\min_{\Lambda} \left(m - f\left(\Lambda \right) \right)' W \left(m - f\left(\Lambda \right) \right)$$

where W is a weighting matrix. Equally weighted minimum distance imposes $W = I$ and diagonally weighted minimum distance (DWMD) requires that W is a diagonal matrix with the elements in the main diagonal given by the diagonal of the variance-covariance matrix. $W = diag(V^{-1})$.

$$V = \left[\sum_{i=1}^{N} (m_i - m)(m_i - m)' \circledast (d_i d_i') \right] \oslash DD'$$

Following Chamberlain [1984], the standard errors for the parameters can be obtained as

$$\widehat{var\left(\widehat{\Lambda}\right)} = (G'AG)^{-1}G'AVAG(G'AG)^{-1}$$

where $G = \frac{\partial f(\Lambda)}{\partial \Lambda} \mid_{\Lambda=\widehat{\Lambda}}$ is the Jacobain matrix evaluated at the estimated parameters $\widehat{\Lambda}$.

This estimation method is a simple generalization of equally minimum distance (EWMD). Main difference is that DWMD allows for heteroskedasticity. Moreover, it avoids the pitfalls of optimal minimum distance (OMD) which are primarily related to the terms outside the main diagonal of the optimal weighting matrix.

Table I
Sample selection in the ECPF

	#Dropped	#Remain
Initial Sample (1985-1995)	0	125394
Single, widower and widow	12495	112899
Age less than 30 or more than 65	31026	81873
Female Head	7068	74805
Born before 1925 or after 1965	2228	72577
Income outliers and incomplete income response	18962	53615
Poor income subsample (below percentile 1%)	537	53078
Rich income subsample (above percentile 1%)	536	52542
Low Consumer (above percentile 1%)	506	52036
Massive Consumer (above percentile 1%)	465	51571

Table II

The Autocovariance matrix of income growth

$Year$	$var\,(\Delta y_t)$	$cov\,(\Delta y_{t+1}, \Delta y_t)$	$cov\,(\Delta y_{t+2}, \Delta y_t)$
1985	0.1291 (0.0078)	−0.0534 (0.0049)	0.0044 (0.0031)
1986	0.1231 (0.0089)	−0.0534 (0.0071)	0.0107 (0.0044)
1987	0.1099 (0.0062)	−0.0479 (0.0041)	0.0015 (0.0038)
1988	0.1202 (0.0069)	−0.0446 (0.0036)	0.0044 (0.0031)
1989	0.1093 (0.0060)	−0.0456 (0.0037)	0.0138 (0.0033)
1990	0.1178 (0.0082)	−0.0516 (0.0043)	0.0066 (0.0038)
1991	0.1145 (0.0072)	−0.0479 (0.0051)	0.0100 (0.0036)
1992	0.1181 (0.0072)	−0.0511 (0.0050)	0.0093 (0.0027)
1993	0.1298 (0.0079)	−0.0604 (0.0051)	0.0127 (0.0038)
1994	0.1322 (0.0083)	−0.0571 (0.0044)	0.0101 (0.0041)
1995	0.1350 (0.0090)	−0.0611 (0.0060)	−0.0038 (0.0089)

1. Bootstrap Std. Err in parenthesis.

2. c_t and y_t stochastic log consumption and log income

Table III

The Autocovariance matrix of consumption growth

$Year$	$var\,(\Delta c_t)$	$cov\,(\Delta c_{t+1}, \Delta c_t)$	$cov\,(\Delta c_{t+2}, \Delta c_t)$
1985	0.0583 (0.0053)	−0.0071 (0.0039)	0.0005 (0.0041)
1986	0.0532 (0.0048)	−0.0069 (0.0047)	−0.0043 (0.0053)
1987	0.0522 (0.0045)	−0.0071 (0.0040)	-0.0035 (0.0035)
1988	0.0632 (0.0055)	−0.0075 (0.0042)	0.0029 (0.0041)
1989	0.0564 (0.0050)	−0.0066 (0.0337)	−0.0040 (0.0033)
1990	0.0546 (0.0046)	−0.0075 (0.0038)	0.0079 (0.0037)
1991	0.0563 (0.0050)	−0.0068 (0.0035)	−0.0066 (0.0038)
1992	0.0519 (0.0047)	−0.0066 (0.0037)	−0.0001 (0.0037)
1993	0.0616 (0.0052)	−0.0073 (0.0042)	0.0013 (0.0040)
1994	0.0601 (0.0060)	−0.0071 (0.0040)	−0.0014 (0.0044)
1995	0.0678 (0.0060)	−0.0081 (0.0049)	−0.0007 (0.0057)

1. Bootstrap Std. Err in parenthesis.

2. c_t and y_t stochastic log consumption and log income

Table IV

The consumption-income growth covariance matrix

$Year$	$cov\,(\Delta y_t, \Delta c_t)$	$cov\,(\Delta y_{t+1}, \Delta c_t)$	$cov\,(\Delta y_t, \Delta c_{t+1})$
1985	0.0105 (0.0026)	−0.0033 (0.0029)	0.0004 (0.0030)
1986	0.0108 (0.0025)	−0.0010 (0.0022)	−0.0049 (0.0034)
1987	0.0052 (0.0021)	0.0054 (0.0024)	0.0029 (0.0023)
1988	0.0057 (0.0027)	0.0024 (0.0027)	0.0053 (0.0029)
1989	0.0092 (0.0025)	−0.0021 (0.0028)	0.0021 (0.0024)
1990	0.0075 (0.0023)	−0.0021 (0.0024)	0.0010 (0.0025)
1991	0.0058 (0.0025)	0.0000 (0.0024)	0.0025 (0.0028)
1992	0.0014 (0.0026)	0.0059 (0.0026)	0.0048 (0.0029)
1993	0.0074 (0.0024)	−0.0017 (0.0030)	0.0008 (0.0027)
1994	0.0069 (0.0029)	−0.0004 (0.0032)	−0.0027 (0.0027)
1995	0.0103 (0.0026)	−0.0016 (0.0032)	−0.0050 (0.0028)

1. Bootstrap Std. Err in parenthesis.

2. c_t and y_t stochastic log consumption and log income

Table V
Optimal Minimum Distance Partial Insurance and Variance Estimates

	Year	*Cohort*				
σ_{ς}^2		Whole Sample	1955-1945	1945-1935	No College	College
	1985	0.0323	0.0364	0.0314	0.0505	0.0391
		(0.0042)	(0.0017)	(0.0031)	(0.0091)	(0.0091)
	1986	0.0299	0.0351	0.0296	0.0495	0.0383
		(0.0071)	(0.0028)	(0.0034)	(0.0085)	(0.0094)
	1987	0.0286	0.0337	0.0278	0.0422	0.0376
		(0.0056)	(0.0051)	(0.0026)	(0.0074)	(0.0071)
	1988	0.0264	0.0324	0.0258	0.0409	0.0374
		(0.0058)	(0.0053)	(0.0024)	(0.0061)	(0.0048)
	1989	0.0253	0.0416	0.0236	0.0396	0.0366
		(0.0054)	(0.0051)	(0.0026)	(0.0091)	(0.0061)
	1990	0.0247	0.0378	0.0234	0.0385	0.0361
		(0.0047)	(0.0063)	(0.0024)	(0.0082)	(0.0045)
	1991	0.0222	0.0397	0.0229	0.0376	0.0309
		(0.0056)	(0.0057)	(0.0019)	(0.0095)	(0.0049)
	1992	0.0230	0.0356	0.0264	0.0388	0.0299
		(0.0061)	(0.0030)	(0.0059)	(0.0013)	(0.0051)
	1993	0.0361	0.0412	0.0322	0.0510	0.0384
		(0.0078)	(0.0029)	(0.0047)	(0.0015)	(0.0080)
	1994	0.0342	0.0383	0.0341	0.0451	0.0377
		(0.0071)	(0.0023)	(0.0035)	(0.0016)	(0.0034)
	1995	0.0320	0.0374	0.0344	0.0449	0.0371
		(0.0069)	(0.0021)	(0.0032)	(0.0018)	(0.0039)
σ_{ε}^2	1985	0.0491	0.0514	0.0488	0.0527	0.0501
		(0.0047)	(0.0046)	(0.0030)	(0.0091)	(0.0032)
	1986	0.0434	0.0508	0.0481	0.0511	0.0488
		(0.0050)	(0.0057)	(0.0029)	(0.0070)	(0.0030)
	1987	0.0402	0.0501	0.0476	0.0503	0.0474
		(0.0051)	(0.0059)	(0.0071)	(0.0048)	(0.0031)
	1988	0.0399	0.0473	0.0369	0.0466	0.0378
		(0.0059)	(0.0062)	(0.0087)	(0.0042)	(0.0036)
	1989	0.0384	0.0458	0.0355	0.0467	0.0356
		(0.0073)	(0.0068)	(0.0083)	(0.0057)	(0.0030)
	1990	0.0374	0.0402	0.0341	0.0395	0.0325
		(0.0048)	(0.0064)	(0.0032)	(0.0071)	(0.0021)
	1991	0.0386	0.0400	0.0306	0.0396	0.0315
		(0.0076)	(0.0054)	(0.0056)	(0.0066)	(0.0053)
	1992	0.0352	0.0396	0.0288	0.0375	0.0310
		(0.0048)	(0.0059)	(0.0050)	(0.0092)	(0.0058)
	1993	0.0441	0.0499	0.0396	0.0389	0.0345
		(0.0053)	(0.0048)	(0.0081)	(0.0082)	(0.0045)
	1994	0.0426	0.0436	0.0355	0.0335	0.0349
		(0.0074)	(0.0046)	(0.0019)	(0.0059)	(0.0013)
	1995	0.0411	0.0421	0.0341	0.0386	0.0393
		(0.0077)	(0.0079)	(0.0061)	(0.0048)	(0.0037)
ϕ		0.7810	0.8310	0.6714	0.8111	0.6512
		(0.0221)	(0.1144)	(0.0913)	(0.0249)	(0.0471)
ψ		0.0541	0.0887	0.0432	0.0753	0.0381
		(0.0719)	(0.0831)	(0.0807)	(0.1116)	(0.0531)

1. Standard error in parenthesis.

Table VI
Optimal Minimum Distance Imputed Partial Insurance and Variance Estimates

	Year	***Cohort***					
σ^2_{ς}		Urban	Rural	Employee	Self-Employee	Tenant	Home-Owner
	1985	0.0487	0.0327	0.0473	0.0291	0.0594	0.0236
		(0.0083)	(0.0055)	(0.0112)	(0.0061)	(0.0094)	(0.0106)
	1986	0.0444	0.0299	0.0466	0.0288	0.0583	0.0216
		(0.0089)	(0.0063)	(0.0113)	(0.0063)	(0.0104)	(0.0105)
	1987	0.0422	0.0281	0.0422	0.0262	0.0568	0.0204
		(0.0061)	(0.0078)	(0.0089)	(0.0101)	(0.0127)	(0.0093)
	1988	0.0408	0.0226	0.0395	0.0247	0.0547	0.0186
		(0.0070)	(0.0071)	(0.0091)	(0.0083)	(0.0156)	(0.0067)
	1989	0.0388	0.0214	0.0374	0.0226	0.0495	0.0177
		(0.0068)	(0.0068)	(0.0083)	(0.0084)	(0.0093)	(0.0076)
	1990	0.0382	0.0202	0.0339	0.0205	0.0482	0.0145
		(0.0092)	(0.0055)	(0.0097)	(0.0074)	(0.0099)	(0.0099)
	1991	0.0365	0.0198	0.0311	0.0199	0.0467	0.0149
		(0.0051)	(0.0052)	(0.0085)	(0.0069)	(0.0105)	(0.0105)
	1992	0.0370	0.0189	0.0310	0.0191	0.0433	0.0131
		(0.0049)	(0.0082)	(0.0090)	(0.0071)	(0.0079)	(0.0156)
	1993	0.0475	0.0352	0.0399	0.0302	0.0507	0.0286
		(0.0034)	(0.0061)	(0.0072)	(0.0073)	(0.0089)	(0.0128)
	1994	0.0460	0.0316	0.0413	0.0288	0.0489	0.0275
		(0.0060)	(0.0063)	(0.0089)	(0.0104)	(0.0091)	(0.0113)
	1995	0.0463	0.0328	0.0377	0.0275	0.0477	0.0299
		(0.0077)	(0.0069)	(0.0093)	(0.0101)	(0.0092)	(0.0099)
σ^2_{ε}	1985	0.0536	0.0462	0.0588	0.0428	0.0666	0.0333
		(0.0076)	(0.0109)	(0.0074)	(0.0102)	(0.0105)	(0.0099)
	1986	0.0524	0.0428	0.0560	0.0419	0.0647	0.0320
		(0.0083)	(0.0113)	(0.0089)	(0.0098)	(0.0107)	(0.0113)
	1987	0.0497	0.0430	0.0551	0.0407	0.0631	0.0306
		(0.0072)	(0.0099)	(0.0064)	(0.0097)	(0.0174)	(0.0139)
	1988	0.0488	0.0406	0.0512	0.0386	0.0605	0.0291
		(0.0068)	(0.0091)	(0.0066)	(0.0076)	(0.0132)	(0.0120)
	1989	0.0453	0.0394	0.0497	0.0363	0.0586	0.0284
		(0.0086)	(0.0100)	(0.0057)	(0.0073)	(0.0117)	(0.0111)
	1990	0.0444	0.0364	0.0485	0.0341	0.0571	0.0277
		(0.0043)	(0.0098)	(0.0086)	(0.0083)	(0.0125)	(0.0136)
	1991	0.0439	0.0355	0.0432	0.0329	0.0554	0.0232
		(0.0077)	(0.0118)	(0.0077)	(0.0093)	(0.0126)	(0.0069)
	1992	0.0420	0.0347	0.0422	0.0321	0.0526	0.0245
		(0.0070)	(0.0116)	(0.0074)	(0.0052)	(0.0107)	(0.0091)
	1993	0.0478	0.0387	0.0514	0.0396	0.0678	0.0333
		(0.0080)	(0.0089)	(0.0086)	(0.0049)	(0.0107)	(0.0085)
	1994	0.0547	0.0377	0.0505	0.0385	0.0666	0.0355
		(0.0088)	(0.0098)	(0.0093)	(0.0031)	(0.0132)	(0.0065)
	1995	0.0514	0.0400	0.0499	0.0397	0.0599	0.0317
		(0.0108)	(0.0077)	(0.0105)	(0.0077)	(0.0114)	(0.0046)
ϕ		0.8233	0.7140	0.8077	0.7684	0.8851	0.7001
		(0.0735)	(0.0242)	(0.1224)	(0.1124)	(0.0505)	(0.0224)
ψ		0.0701	0.0428	0.0593	0.0436	0.0333	0.0738
		(0.0814)	(0.0536)	(0.0485)	(0.0622)	(0.0211)	(0.0213)