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Does Retirement Make You Happy? A Simultaneous Equations Approach

Raquel Fonseca, Arie Kapteyn, Jinkook Lee, and Gema Zamarro

11.1 Introduction

Continued improvements in life expectancy and fiscal insolvency of public pensions have led to an increase in pension entitlement ages in several countries, but its consequences for subjective well-being are largely unknown.[1] As subjective well-being is known to influence health, if retirement has adverse effects on subjective well-being, it is plausible that the fiscal savings cre-

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1. An exception is Grip, Lindeboom, and Montizaan (2012), who found a strong and persistent negative effect on psychological well-being from a change in the Dutch civil servants' pension system that affected the pension age eligibility of some cohorts but not of others.

ated by delaying retirement may be at least partly offset by increased health expenditures driven by worsened subjective well-being.

Labor force participation may affect subjective well-being in a number of different ways. Specifically, there is solid evidence that unemployment can adversely affect subjective well-being (e.g., Lucas et al. 2004; Clark and Oswald 1994; Winkelmann and Winkelmann 1998), but some mixed evidence on how retirement might do so.[2] In the United States evidence is mixed, finding both positive (Charles 2004) and negative (Dave, Rashad, and Spasojevic 2008; Szinovacz and Davey 2004) retirement effects. In contrast, consistently positive effects are found in England (Johnston and Lee 2009; Mein et al. 2003) and Finland (Okasanen et al. 2011; Salokangas and Joukamaa 1991), while no effect is found in the Republic of Korea or continental Europe for depression measures (Lee and Smith 2009; Coe and Zamarro 2011), suggesting potential cross-country variations in retirement effects on subjective well-being.[3]

Two other branches of the literature relate retirement and well-being. Recently a number of papers have found that retirement could have positive or negative effects on well-being depending on how the transition to retirement happens. For example Clark and Fawaz (2009), using European and British data sets, find that the type of job in which retirees were employed before retirement affects well-being after retirement. Similarly, Calvo, Haverstick, and Sass (2007) and Bonsang and Klein (2011) find that well-being is affected by whether the individual perceives the transition to retirement as voluntary or not. A different literature relates well-being and aging. Several papers find a U-shaped relationship between life satisfaction and age (see Blanchflower and Oswald 2008; De Ree and Alessie 2011; van Landeghem 2012, among others). Although, De Ree and Alessie (2011) note that age effects cannot be identified without imposing cohort effect assumptions.

In Fonseca et al. (2014), we examined the effect of retirement on subjective well-being within twelve countries, using panel data from the US Health and Retirement Study (HRS) and the Survey of Health, Ageing, and Retirement in Europe (SHARE). In estimating retirement effects, we accounted for potential reverse causation of poor subjective well-being on retirement, using an instrumental variables approach by exploiting variations in public-

2. The same mixed results are found in the psychology literature where the debate on how the retirement affects the well-being started a bit earlier than in economics research (see Pinquart and Schindle [2007], and their citations).

3. Several of these studies have tried to circumvent endogeneity problems by using an instrumental variables approach. For example, Charles (2004), Johnson and Lee (2009), and Coe and Zamarro (2011) used pension entitlement age as an instrument; Dave, Rashad, and Spasojevic (2008) used spouse's retirement status; and Lee and Smith (2009) used mandatory retirement policies as instruments. However, up to this point there is no cross-country comparative study of the effect of retirement on an array of well-being measures, while addressing the potential endogeneity of retirement choices.

pension eligibility due to country and cohort-specific retirement ages (early and full entitlement ages). Here, we provide a more comprehensive analysis of the interplay of work/retirement, financial well-being, and subjective well-being.

Financial consequences of retirement complicate the estimation of effects of retirement on subjective well-being as financial circumstances, both in absolute and relative terms (i.e., one's financial means in comparison with others, or in comparison with one's own income before retirement), may influence subjective well-being and, therefore, the effect of retirement is likely to be confounded by the change in income. At the same time, unobservable determinants of income are probably related with unobservable determinants of subjective well-being, making income possibly endogenous if used as a control in subjective well-being regressions. To address these issues, we estimate a simultaneous model, explicitly modeling the interplay of retirement, income, and subjective well-being while still using our instrumental variables approach for retirement decisions based on public-pension eligibility. By estimating the complete system of equations, we are able to get a better understanding of the role of retirement induced through Social Security or pension eligibility in determining the subjective as well as financial well-being of the elderly.

The remainder of the chapter is structured as follows: In section 11.2 the data are described, while in section 11.3 we describe the model we are estimating. Section 11.4 presents and discusses estimation results. To gain further insights in the nature of the estimated relationships, we present some simulations in section 11.5. Section 11.6 considers an alternative specification for the effect of age on retirement as a robustness check. Section 11.7 concludes.

11.2 Data

This chapter makes use of data from HRS and SHARE for a common period of observation (2004–2010). For HRS there are currently eleven waves of data (1992–2012) available. The HRS was designed to cover a wide range of demographics, health, work and retirement, income and assets, as well as family and social networks. SHARE was developed using the HRS model to collect conceptually comparable data across different countries in these key domains. Lee (2007) provides a detailed discussion of the comparability of the surveys. Currently, three waves of SHARE (2004, 2006, and 2010) are available. The first wave of SHARE was collected in 2004 in eleven European countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Switzerland, and Sweden). The 2008 SHARE wave was devoted to life-history interviews and did not include subjective well-being measures.

All surveys contain several questions that can be used as indicators of sub-

Table 11.1 Data on subjective well-being in HRS and SHARE

Well-being measure	HRS	SHARE
Life satisfaction	Diener scale (2004–2010 Leave Behind Questionnaire, LBQ); a single-item overall life satisfaction (2008–2010 Core interview)	A single-item overall life satisfaction question (2006–2010 Core Interview)
Depressive symptoms	Eight items CESD (1994–2010 Core interview)	Twelve items EURO–D (2004–2010 Core); 8-item CESD questions to a random subsample (2006 Core)

jective and financial well-being. Table 11.1 summarizes the available information and comparability of subjective well-being questions. Although not all surveys include exactly identical questions on subjective well-being, they all include questions that cover comparable domains and harmonized versions of variables can be constructed for cross-country comparison. Comparable measures of total household income can also be constructed. In this respect, the project benefits from ongoing efforts to harmonize aging data sets around the world.[4]

The single-item overall life satisfaction question in SHARE reads as follows:

"On a scale from 0 to 10 where 0 means completely dissatisfied and 10 means completely satisfied, how satisfied are you with your life?"
0 . . . 10

As noted in table 11.1, this question is only available in two waves: 2006 and 2010. The single-item life satisfaction question included in HRS waves 2008 and 2010 reads:

"Please think about your life as a whole. How satisfied are you with it? Are you completely satisfied, very satisfied, somewhat satisfied, not very satisfied, or not at all satisfied?"

1. Completely satisfied
2. Very satisfied
3. Somewhat satisfied
4. Not very satisfied
5. Not at all satisfied
8. Don't know; not ascertained
9. Refused

Although the formulation of the life satisfaction questions in HRS and SHARE is similar, the response scales are not. We have first reverse-coded

4. See http://www.g2aging.org/.

the HRS scale so that it runs from "not at all satisfied" to "completely satisfied." Next we have recoded the SHARE responses as follows: 0, 1, 2 are recoded as 1; 3, 4 are recoded as 2; 5, 6 are recoded as 3; 7, 8 are recoded as 4; and 9, 10 are recoded as 5. After recoding we obtain the following distribution of self-reported life satisfaction by country: (see table 11.2)

The HRS has included an eight-item binary version of the Center for Epidemiologic Studies Depression Scale (CESD) (yes/no/DK/RF) in core interviews from 1994 to 2010. This eight-item measure with binary response categories constitutes a subset of the original twenty-item CESD scale, which uses a four-point Likert scale. Based on the advice of mental health practitioners who compared this modified version of the CESD scale with structured interviews evaluating major depression, a cutoff threshold of 3 (out of 8) is often taken as a clinically important level of psychological distress. Thus, based on this clinical threshold, we created a binary variable of depression. Similarly, for SHARE we created a binary variable based on the recommended clinical threshold for the Euro-D. Table 11.3 presents the prevalence of depression according to the constructed binary measures in the various countries in our sample.

We note that depression is substantially less prevalent in the United States than in the European countries, according to this measure. This suggests that the depression measures might not be strictly comparable. In the analyses that follow we will always include country dummies that hopefully will correct for the lack of comparability.

The key outcome variables considered in this chapter are retirement status, household income, depression, and life satisfaction. Table 11.4 presents the correlations between these four variables by country. Although the correlations are often not very large in absolute value, the signs of the correla-

Table 11.2 **Distribution of life satisfaction by country (%)**

	Life satisfaction					
Country	1	2	3	4	5	Total
Austria	1.3	3.3	15.0	42.3	38.2	100
Belgium	0.4	1.4	10.7	61.0	26.5	100
Denmark	0.3	0.6	6.0	37.0	56.2	100
France	1.3	2.7	20.1	54.6	21.4	100
Germany	0.8	2.6	16.4	47.8	32.5	100
Greece	1.0	2.6	25.3	56.7	14.4	100
Italy	1.9	2.9	18.2	52.0	25.0	100
Netherlands	0.2	0.5	4.6	68.2	26.6	100
Spain	1.5	4.2	18.2	48.4	27.7	100
Sweden	0.5	0.9	7.4	42.3	49.0	100
Switzerland	0.1	1.1	7.2	41.2	50.4	100
United States	0.9	3.1	24.4	46.4	25.3	100
Total	0.8	2.4	17.6	49.2	29.9	100

Table 11.3 Depression by country

	Depressed		
Country	No	Yes	Total
Austria	81.1	18.9	100
Belgium	75.8	24.3	100
Denmark	84.8	15.2	100
France	68.4	31.6	100
Germany	81.3	18.7	100
Greece	81.5	18.5	100
Italy	69.3	30.7	100
Netherlands	83.0	17.0	100
Spain	68.1	31.9	100
Sweden	82.5	17.5	100
Switzerland	83.7	16.3	100
United States	87.4	12.6	100
Total	82.3	17.7	100

Table 11.4 Correlations between key outcome variables

	Retirement, Log-income	Retirement, depression	Retirement, life satisfaction	Log-income, depression	Log-income, life satisfaction	Depression, life satisfaction
Austria	–0.13	0.09	–0.05	–0.11	0.14	–0.41
Belgium	–0.11	0.04	–0.01	–0.07	0.11	–0.28
Denmark	–0.32	0.01	–0.04	–0.04	0.08	–0.29
France	–0.18	0.05	–0.08	–0.11	0.21	–0.30
Germany	–0.14	0.06	–0.07	–0.07	0.21	–0.32
Greece	–0.28	0.15	–0.15	–0.09	0.22	–0.26
Italy	–0.14	0.09	–0.09	–0.10	0.15	–0.35
Netherlands	–0.24	0.09	–0.04	–0.10	0.11	–0.26
Spain	–0.24	0.17	–0.07	–0.10	0.13	–0.38
Sweden	–0.22	0.08	–0.04	–0.08	0.04	–0.28
Switzerland	–0.16	0.07	–0.04	–0.11	0.13	–0.31
United States	–0.35	0.08	0.02	–0.16	0.13	–0.34
Total	–0.28	0.10	–0.03	–0.15	0.18	–0.31

tions are identical across all countries, with the exception of the correlation between retirement and life satisfaction in the United States, which is slightly positive, whereas in other countries it is negative. We see positive correlations between retirement and depression and between log-income and life satisfaction; we observe negative correlations between retirement and log-income; retirement and life satisfaction; log-income and life satisfaction; and depression and life satisfaction.

Table 11.5 presents descriptive statistics by country. We observe substantial differences in retirement rates across countries, with Italy and Austria

Table 11.5 **Descriptive statistics**

Country	Retired	Age	Female	Log-household income	Log-household wealth	At least one ADL	Major health condition	Less than high school	High school	Some college
Austria	0.82	66.1	0.56	10.08	11.08	0.07	0.14	0.18	0.61	0.21
Belgium	0.72	65.3	0.51	10.16	12.10	0.09	0.17	0.25	0.50	0.25
Denmark	0.59	64.9	0.54	11.78	13.43	0.06	0.17	0.15	0.49	0.37
France	0.70	65.4	0.55	10.23	12.03	0.09	0.20	0.39	0.40	0.21
Germany	0.67	64.9	0.52	10.20	11.35	0.07	0.19	0.01	0.71	0.28
Greece	0.66	63.9	0.47	9.62	11.66	0.06	0.16	0.48	0.35	0.17
Italy	0.80	65.8	0.49	9.85	11.94	0.08	0.16	0.52	0.41	0.07
Netherlands	0.68	64.3	0.52	10.33	11.51	0.05	0.16	0.14	0.63	0.23
Spain	0.75	66.8	0.49	9.54	11.94	0.10	0.16	0.64	0.28	0.08
Sweden	0.63	66.6	0.53	11.97	13.48	0.06	0.21	0.34	0.43	0.23
Switzerland	0.59	65.5	0.54	11.07	12.64	0.05	0.10	0.17	0.73	0.10
United States	0.62	68.5	0.56	10.62	12.02	0.15	0.43	0.23	0.54	0.23
Total	0.65	66.9	0.54	10.54	12.07	0.11	0.30	0.26	0.52	0.22

having the highest retirement rates and the United States, Switzerland, and Denmark the lowest. Log-income and log-wealth vary substantially across countries. To the extent that this reflects exchange-rate effects, these will be absorbed by additive country dummies in our model. Probably the most striking difference across countries is the high prevalence of major health conditions in the United States in comparison to the European countries, while also the number of ADLs is larger in the United States than in Europe. This may be partly explained by the somewhat higher ages of respondents in the HRS sample.

In the analysis we will use several institutional parameters that vary across countries. Table 11.6 shows replacement rates at full retirement age in the various countries. The replacement rates are net of taxes for a median earner with an uninterrupted career. Obviously individual replacement rates may vary substantially, but for the purpose of international comparison this information is probably about as good as it gets.

Another important institutional variable is the age at which one may be eligible for early or full retirement. Both full and early retirement ages are given in table 11.7. The ages for the United States refer to Social Security claiming ages rather than retirement; sixty-two is the earliest age at which one can claim Social Security. One can claim Social Security at any time between sixty-two and seventy and a half, with an actuarial adjustment for claiming earlier or later than the full retirement age. Receipt of Social Security benefits has no implications for one's ability to be gainfully employed. For comparison purposes we treat the US early claiming age and

Table 11.6 **Replacement rates at full retirement age**

Country	Male_2004	Female_2004	Male_2006	Female_2006	Male_2010	Female_2010
Austria	93.2	84.6	90.3	90.3	89.9	89.9
Belgium	63.1	63.1	63.7	63.7	63.8	63.8
Denmark	54.1	54.1	91.3	91.3	86.9	86.9
France	68.8	68.8	65.7	65.7	60.7	60.7
Germany	71.8	71.8	61.3	61.3	58.5	58.5
Greece	99.9	99.9	110.8	110.8	70.7	70.7
Italy	88.8	88.8	74.8	58.1	92.4	92.4
Netherlands	84.1	84.1	103.2	103.2	100.7	100.7
Spain	88.3	88.3	84.7	84.7	80.1	80.1
Sweden	68.2	68.2	64.1	64.1	53.6	53.6
Switzerland	67.3	68.0	64.5	65.3	65.4	64.4
United States	51	51	44.8	44.8	48.5	48.5

Source: Pensions at a Glance, 2005 (http://stats.oecd.org/Index.aspx?DataSetCode=ELSPENSIONS#).
Note: The replacement rates are net replacement rates (after tax) at the nations' full retirement age for a median earner who entered the labor force at the age of twenty and experienced an uninterrupted career.

Table 11.7 **Early and full retirement ages (full retirement ages in parentheses)**

	2002		2004		2006		2008		2010	
Country	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Austria	60 (65)	57 (60)	65 (65)	60 (60)	65 (65)	65 (65)	65 (65)	65 (65)	62 (65)	60 (65)
Belgium	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)
Denmark	65 (65)	65 (65)	65 (65)	65 (65)	65 (65)	65 (65)	65 (65)	65 (65)	67 (67)	67 (67)
France	57 (60)	57 (60)	60 (60)	60 (60)	60 (60)	60 (60)	61 (61)	61 (61)	56–60 (65)	56–60 (65)
Germany	63 (65)	63 (65)	63 (65)	63 (65)	63 (65)	63 (65)	63 (67)	63 (67)	63 (67)	63 (67)
Greece	60 (65)	55 (60)	57 (65)	57 (65)	55 (65)	55 (65)	55 (65)	55 (65)	55 (65)	55 (65)
Italy	57 (65)	57 (65)	60 (65)	60 (65)	60 (65)	60 (60)	60 (65)	60 (60)	61 (65)	60 (60)
Netherlands	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	65 (65)	65 (65)
Spain	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	60 (65)	61 (65)	61 (65)
Sweden	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)	61 (65)
Switzerland	63 (65)	62 (64)	63 (65)	62 (64)	63 (65)	62 (64)	63 (65)	62 (64)	63 (65)	62 (64)
United States[a]	62 (65)	62 (65)	62 (65+)	62 (65+)	62 (65+)	62 (65+)	62 (65+)	62 (65+)	62 (65+)	62 (65+)

Sources: OECD Pensions at a Glance for several years.

[a] Full retirement age depends on birth year.

full retirement age similarly to the treatment of early and full retirement ages in the European countries.

11.3 Model

We consider a system of four equations. The first equation explains retirement; the second equation models log-income. The third and fourth equations explain depression and life satisfaction. The specifications are as follows:

(1) **The Labor Supply Equation:** $R_{ict} = \rho_0 + \rho_1 X_{ict} + \rho_2 I^L_{ict} + \rho_{ci} + e_{ict}$

(2) **The Income Equation:** $\ln Y_{ict} = \gamma_1 X_{ict} + \gamma_2 R_{ict} + \gamma_3 I^Y_{ct} + \gamma_{ci} + \varepsilon_{ict}$

The Subjective Well-Being Equations: For both life satisfaction and depression, we specify linear models of the form:

(3) $$SW_{ict} = \alpha_1 \ln Y_{ict} + \alpha_2 X_{ict} + \alpha_3 R_{ict} + \alpha_4 I^{SW}_{ct} + \alpha_{ci} + \upsilon_{ict}$$

where Y_{ict} is the logarithm of current per capita household income of an individual i, who lives in country c, at time t, SW_{ict} denotes a given measure of subjective well-being (life satisfaction or depression), and R_{ict} takes the value 1 if the individual is retired at time t and zero otherwise; X_{ict} is the set of individual and household explanatory variables and includes: gender, ethnicity, age, time effects, education, marital status, and health and disability measures; I^Y_{ct} represents institutional variables that may affect the income process such as indices of welfare program generosity or average replacement rates in retirement and unemployment insurance programs; I^{SW}_{ct} denotes institutional variables that may affect subjective well-being directly (e.g., social safety nets), as opposed to indirectly through income $\ln Y_{ict}$; and I^L_{ict} contains a set of indicator variables denoting retirement incentives. In order for these institutional variables to be validly excluded from equations (1) and (2), they must not have a direct effect on well-being. Their effect on well-being is only through the influence on retirement. In particular, we will use dummy variables indicating whether or not an individual is above the full or early retirement age: $I^L_{ict} = 1(\text{age}_{it} \geq \text{Statutory\_retirement\_age}_{ct})$. The inclusion of individual specific constant terms (ρ_{ci}, γ_{ci}, and α_{ci}) is important because it allows us to control for individual unobserved heterogeneity, as well as for time-invariant measurement error in reporting household income or well-being.

Ideally, one would want to estimate dynamic versions of equation (1). Given that we have only two waves of the life satisfaction variable in either survey, estimation of a dynamic panel-data model with individual effects is out of the question. For depression, SHARE has three waves of data (and HRS has more) so a dynamic model can be estimated in principle, but iden-

tification would be tenuous. We limit ourselves therefore to static models until the 2012 wave of SHARE becomes available.

A Hausman specification test soundly rejects the random effects assumption of independence of the individual effects of the other right-hand-side variables in equations (1)–(3). So we adhere to a fixed effects assumption, which allows the individual effects to correlate with the explanatory variables in the equations. A straight fixed effects estimation procedure would wipe out all non-time-varying variables, such as country dummies. Due to a result by Mundlak (1978), the estimated coefficients of the time-varying explanatory variables are identical to what would be obtained in a random effects specification, while including the individual means of all time-varying explanatory variables on the right-hand side of the equations. It is easy to see that this also holds if one includes the non-time-varying explanatory variables on the right-hand side. The advantage of this procedure is that one then also obtains estimates of the effects of the non-time-varying variables, such as country dummies, education, and gender.

Several of the right-hand-side variables may not be strictly comparable due to institutional differences, such as education. The same might be true for other variables, such as ADLs and major health conditions, as noted above. We therefore include several interactions of such variables with a dummy for the United States. So the assumption is that these variables are reasonably comparable across European countries, but less so between the United States and Europe. We could, of course, include full interactions of such variables with all country dummies, but we abstain from that, mainly for reasons of parsimony.

11.4 Results

The system is estimated with 2SLS, taking into account random individual effects in a Mundlak-type specification (xtivreg in STATA). Table 11.8 contains the estimation results. Before discussing the estimates, it is worth noting the exclusion restrictions that were imposed to identify the model. The first equation (the retirement equation) is a reduced-form equation and hence no exclusion restrictions are needed. The equation for the logarithm of per capita household income has two endogenous explanatory variables on the right-hand side: retirement status (retired or not) and an interaction between being retired and the pension replacement rate. These two variables are instrumented by all exogenous variables in the model. The excluded variables are whether one is above full or early retirement age and an interaction of these variables with the pension replacement rate. So the assumption is that these variables do not exert a direct effect on household income, but only via the retirement variables.

The equations for being depressed (a binary variable, cf. table 11.3) and

life satisfaction (a variable taking on five possible values, cf. table 11.2) have identical structures. Two explanatory variables are endogenous: retirement status and the logarithm of per capita household income. The exclusion restrictions are the same as for the log-household income equation.

As noted, we estimate a Mundlak specification, so that we also have estimated coefficients for the individual means of all time-varying variables. For brevity's sake these coefficients are not reported.

The estimated effects of individual and institutional variables on retirement are largely according to expectation (first column of table 11.8). The probability of being retired decreases with education, but increases with age for most of the relevant age range (the quadratic age relation has a maximum at seventy-six years). Females are more likely to be retired. Major health conditions have a negative effect on the probability of being in the labor force, particularly in the United States. Note that for the interpretation of coefficients for the United States, these have to be added to the overall coefficient. So, for instance, the coefficient of "major health condition" in the retirement equation is 0.008, while the coefficient for "major health condition in the United States" is .040. This means that the effect of a major health condition in the United States is equal to .008 + .040 = .048. Difficulties with activities of daily living reduce the chances of being in the labor force in the United States, but not in Europe. Being eligible for early or full retirement has a strong positive effect on the probability of being retired. The pension-replacement rates appear to have only a limited effect, possibly reflecting the fact that these may be poor proxies of the actual replacement rates faced by individuals. Their effects may also be absorbed by the country dummies. The country dummies generally suggest a higher retirement probability in the European countries than in the regions of the United States. (The Northeast is the reference category). Residents outside the United States are more likely to be retired, presumably because many of these moved to a location outside the United States to spend their retirement years. The time dummies suggest an increase in retirement probability over time, which may reflect the effect of the evolving financial crisis during the observation period.

The income equation (second column in table 11.8) shows a negative effect of retirement on income, which may be compensated by a high pension-replacement rate. For instance, if the pension-replacement rate is 100 percent (as it is in the Netherlands) then the net effect of retirement on income is quite modest. A similar observation can be made with respect to the effect of unemployment. Being unemployed reduces income very substantially, but this can be compensated for by a high income-replacement rate. In this age range income is monotonically decreasing in age (the parabola has a minimum at 164). Since we control for individual effects, we are implicitly also controlling for cohort effects. The effects of health conditions are somewhat difficult to interpret. The ADLs have a negative effect in the United States, but not in Europe, while for the presence of a major health condition the

Table 11.8 **Estimation results**

Variables	Retired	Log HH-income	Depressed	Life satisfaction
Retired		–0.978***	–0.061*	0.179**
		(0.067)	(0.032)	(0.086)
Pension rr * (retired)		0.008***		
		(0.000)		
Unemployed		–0.881***	0.106	–0.596*
		(0.210)	(0.105)	(0.305)
Unemployed * unempl. rr		1.073***	–0.167	0.893*
		(0.350)	(0.175)	(0.511)
Log-household net wealth		0.151***	–0.003*	0.027***
		(0.002)	(0.002)	(0.005)
d2006	0.024***	0.198***	–0.001	–0.149***
	(0.006)	(0.014)	(0.007)	(0.040)
d2008	0.038***	0.349***	0.003	–0.034
	(0.010)	(0.025)	(0.013)	(0.023)
d2010	0.072***	0.420***	0.012	
	(0.016)	(0.039)	(0.020)	
Age	0.049***	–0.154***	–0.016***	–0.064***
	(0.004)	(0.010)	(0.005)	(0.017)
Age^2 divided by 100	–0.032***	0.047***	0.012***	0.029***
	(0.002)	(0.006)	(0.003)	(0.010)
Female	0.022***	–0.158***	0.083***	–0.012
	(0.005)	(0.010)	(0.006)	(0.017)
Married	0.014	0.257***	–0.081***	0.258***
	(0.010)	(0.024)	(0.013)	(0.039)
Married and female	0.011	0.182***	0.016	0.078
	(0.013)	(0.030)	(0.016)	(0.050)
College	–0.097***	0.363***	–0.088***	0.205***
	(0.005)	(0.012)	(0.010)	(0.023)
College in United States	–0.012	0.292***	–0.034***	–0.109***
	(0.008)	(0.016)	(0.011)	(0.027)
High school	–0.021***	0.147***	–0.056***	0.135***
	(0.004)	(0.008)	(0.005)	(0.013)
High school in United States	–0.019***	0.130***	–0.022***	–0.110***
	(0.007)	(0.013)	(0.008)	(0.020)
ADL	–0.142***	0.291***	0.014	0.115***
	(0.011)	(0.024)	(0.015)	(0.042)
ADL in United States	0.175***	–0.249***	0.057***	–0.225***
	(0.010)	(0.021)	(0.013)	(0.036)
Major health condition	0.008	–0.073***	0.079***	–0.071***
	(0.006)	(0.015)	(0.007)	(0.020)
Major health condition in United States	0.040***	0.207***	–0.058***	–0.058*
	(0.008)	(0.020)	(0.011)	(0.033)
Austria	0.185***	–0.547***	0.091***	0.086*
	(0.013)	(0.030)	(0.016)	(0.048)
Belgium	0.204***	–0.519***	0.160***	0.022
	(0.010)	(0.024)	(0.016)	(0.045)
Denmark	0.099***	0.864***	–0.018	0.531***
	(0.011)	(0.023)	(0.023)	(0.053)

(*continued*)

Table 11.8 (continued)

Variables	Retired	Log HH-income	Depressed	Life satisfaction
France	0.126***	–0.387***	0.207***	–0.141***
	(0.010)	(0.022)	(0.014)	(0.041)
Germany	0.151***	–0.463***	0.097***	–0.003
	(0.011)	(0.023)	(0.015)	(0.044)
Greece	0.107***	–1.264***	0.137***	–0.297***
	(0.012)	(0.028)	(0.023)	(0.065)
Italy	0.169***	–0.840***	0.234***	–0.198***
	(0.011)	(0.025)	(0.019)	(0.053)
Netherlands	0.181***	–0.490***	0.079***	0.122***
	(0.011)	(0.026)	(0.014)	(0.041)
Spain	0.134***	–1.124***	0.252***	–0.197***
	(0.011)	(0.025)	(0.023)	(0.062)
Sweden	0.058***	1.135***	–0.017	0.472***
	(0.010)	(0.020)	(0.026)	(0.057)
Switzerland	0.065***	0.363***	0.032**	0.393***
	(0.012)	(0.023)	(0.015)	(0.038)
Midwest	0.034	–0.057	0.000	0.105
	(0.027)	(0.064)	(0.033)	(0.115)
South	0.049**	–0.065	–0.005	0.085
	(0.021)	(0.050)	(0.026)	(0.090)
West	–0.001	–0.177***	0.032	0.123
	(0.025)	(0.060)	(0.031)	(0.098)
Residing outside United States	0.346***	–0.008	0.102	–0.243
	(0.107)	(0.256)	(0.150)	(0.784)
Above full ret. age	0.103***			
	(0.014)			
Above early ret. age	0.154***			
	(0.014)			
Pension rr * (above full ret. age)	0.000			
	(0.000)			
Pension rr * (above early ret. age)	–0.001***			
	(0.000)			
Log-household income			0.011	–0.016
			(0.008)	(0.016)
Constant	–3.726***	10.777***	–0.379	5.371***
	(0.101)	(0.354)	(0.295)	(0.727)
Observations	120,775	120,775	116,254	63,661
Number of groups	52,028	52,028	51,006	40,429

Note: Standard errors in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

pattern is reversed. Caution needs to be exercised when interpreting country dummies as these are affected by exchange rates (except for the comparison of countries within the euro zone: Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, and Spain).

For the purpose of this chapter, the final two columns in table 11.8 are of the most interest. It appears that being retired both reduces the likelihood of depression (though only significantly so at the 10 percent level) and improves life satisfaction. This is in contrast with the findings in table 11.4, where we found that in the raw data retirement was negatively related to life satisfaction in all countries (with the sole exception of the United States), while retirement was positively related to depression in all countries. Generally the coefficients in the last two columns of table 11.8 have opposite signs. For instance, unemployment increases the likelihood of depression, while it reduces life satisfaction. Note, however, that these effects are mitigated very substantially in the case of a high unemployment-replacement rate. Being married, having a higher education, and having more wealth all increase life satisfaction and reduce the likelihood of depression. On the other hand, having a major health condition or experiencing difficulties with activities of daily living reduce life satisfaction and increase the likelihood of depression.

Notably, household income does not appear to have an appreciable effect on either depression or life satisfaction, once we control for all the other explanatory variables. This is also in marked contrast with the raw correlations relations reported in table 11.4.

11.5 Simulations

To obtain a better understanding of the quantitative importance of the estimation results we use the estimated system to simulate the effects of some counterfactual policies. To have a valid benchmark to compare the simulations with we first simulate outcomes for the dependent variables within sample and compare with the values observed in the data. The results of this exercise are presented in table 11.9.

The second simulation investigates the effect of setting pension-replacement rates to 100 percent in all countries. The results of this simulation are presented in table 11.10.

In contrast, the third simulation investigates the effect of setting pension-replacement rates to 40 percent in all countries. The results of this simulation are presented in table 11.11.

The fourth and final simulation considers the effect of raising early retirement age to sixty-seven and full retirement age to seventy. Results are given in table 11.12.

Table 11.9 shows that the model does a reasonable job of reproducing sample statistics, with the exception of log-income, which seems to be systematically overpredicted.

Table 11.9 **Predicted and observed outcome variables**

Country	Retirement predicted	Retirement observed	Log-income predicted	Log-income, observed	Depression predicted	Depression observed	Life satisfaction predicted	Life satisfaction observed
Austria	0.82	0.82	10.48	10.08	0.19	0.19	4.11	4.13
Observations	3,365	3,365	3,365	3,365	3,337	3,337	1,839	1,839
Belgium	0.72	0.72	10.65	10.16	0.25	0.24	4.11	4.12
Observations	8,066	8,066	8,066	8,066	8,046	8,046	4,838	4,838
Denmark	0.59	0.59	11.05	11.78	0.14	0.15	4.50	4.48
Observations	5,257	5,257	5,257	5,257	5,225	5,225	3,857	3,857
France	0.70	0.70	10.64	10.23	0.32	0.32	3.91	3.92
Observations	7,010	7,010	7,010	7,010	6,908	6,908	4,244	4,244
Germany	0.66	0.67	10.59	10.2	0.19	0.19	4.08	4.09
Observations	6,170	6,170	6,170	6,170	6,149	6,149	3,529	3,529
Greece	0.66	0.66	10.89	9.62	0.20	0.19	3.79	3.81
Observations	4,395	4,395	4,395	4,395	4,395	4,395	2,400	2,400
Italy	0.80	0.80	10.72	9.85	0.32	0.31	3.93	3.96
Observations	6,088	6,088	6,088	6,088	6,055	6,055	4,161	4,161
Netherlands	0.68	0.68	10.88	10.33	0.18	0.17	4.20	4.20
Observations	6,522	6,522	6,522	6,522	6,501	6,501	4,007	4,007
Spain	0.75	0.75	10.63	9.54	0.33	0.32	3.94	3.97
Observations	4,587	4,587	4,587	4,587	4,537	4,537	2,940	2,940
Sweden	0.63	0.63	10.78	11.97	0.16	0.17	4.40	4.38
Observations	6,784	6,784	6,784	6,784	6,762	6,762	4,080	4,080
Switzerland	0.59	0.59	10.8	11.07	0.16	0.16	4.41	4.41
Observations	3,108	3,108	3,108	3,108	3,102	3,102	2,257	2,257
United States	0.62	0.62	10.33	10.62	0.13	0.13	3.92	3.92
Observations	59,423	59,423	59,423	59,423	55,237	55,237	25,509	25,509
Total	0.66	0.65	10.54	10.54	0.18	0.18	4.05	4.05
Observations	120,775	120,775	120,775	120,775	116,254	116,254	63,661	63,661

Table 11.10 **Simulated outcomes with 100 percent replacement rates**

Country	Retirement simulated	Retirement predicted	Log-income simulated	Log-income, predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.81	0.82	10.56	10.48	0.20	0.19	4.11	4.11
Belgium	0.71	0.72	10.87	10.65	0.25	0.25	4.11	4.11
Denmark	0.58	0.59	11.15	11.05	0.15	0.14	4.49	4.50
France	0.68	0.70	10.85	10.64	0.33	0.32	3.9	3.91
Germany	0.65	0.66	10.79	10.59	0.19	0.19	4.07	4.08
Greece	0.67	0.66	10.86	10.89	0.20	0.20	3.79	3.79
Italy	0.79	0.80	10.84	10.72	0.32	0.32	3.92	3.93
Netherlands	0.68	0.68	10.91	10.88	0.18	0.18	4.20	4.20
Spain	0.75	0.75	10.74	10.63	0.33	0.33	3.94	3.94
Sweden	0.62	0.63	10.98	10.78	0.16	0.16	4.39	4.40
Switzerland	0.58	0.59	10.97	10.8	0.16	0.16	4.40	4.41
United States	0.60	0.62	10.60	10.33	0.13	0.13	3.91	3.92
Total	0.64	0.66	10.74	10.54	0.18	0.18	4.04	4.05

Table 11.11 **Simulated outcomes with 40 percent replacement rates**

Country	Retirement simulated	Retirement predicted	log–income simulated	log–income predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.84	0.82	10.13	10.48	0.19	0.19	4.12	4.11
Belgium	0.73	0.72	10.50	10.65	0.25	0.25	4.12	4.11
Denmark	0.60	0.59	10.84	11.05	0.14	0.14	4.50	4.50
France	0.71	0.70	10.48	10.64	0.32	0.32	3.91	3.91
Germany	0.67	0.66	10.45	10.59	0.18	0.19	4.08	4.08
Greece	0.69	0.66	10.51	10.89	0.19	0.20	3.80	3.79
Italy	0.82	0.80	10.43	10.72	0.31	0.32	3.93	3.93
Netherlands	0.69	0.68	10.56	10.88	0.17	0.18	4.20	4.20
Spain	0.77	0.75	10.34	10.63	0.33	0.33	3.95	3.94
Sweden	0.64	0.63	10.66	10.78	0.16	0.16	4.40	4.40
Switzerland	0.60	0.59	10.67	10.80	0.16	0.16	4.41	4.41
United States	0.62	0.62	10.28	10.33	0.12	0.13	3.92	3.92
Total	0.66	0.66	10.4	10.54	0.18	0.18	4.05	4.05

Table 11.12 **Simulated outcomes: Full retirement age is seventy; early retirement age is sixty-seven**

Country	Retirement simulated	Retirement predicted	Log-income simulated	Log-income predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.75	0.82	10.50	10.48	0.20	0.19	4.10	4.11
Belgium	0.68	0.72	10.66	10.65	0.25	0.25	4.10	4.11
Denmark	0.56	0.59	11.06	11.05	0.15	0.14	4.49	4.50
France	0.62	0.70	10.67	10.64	0.33	0.32	3.89	3.91
Germany	0.62	0.66	10.61	10.59	0.19	0.19	4.07	4.08
Greece	0.62	0.66	10.90	10.89	0.20	0.20	3.78	3.79
Italy	0.73	0.80	10.74	10.72	0.32	0.32	3.91	3.93
Netherlands	0.66	0.68	10.89	10.88	0.18	0.18	4.19	4.20
Spain	0.71	0.75	10.65	10.63	0.33	0.33	3.93	3.94
Sweden	0.58	0.63	10.8	10.78	0.17	0.16	4.39	4.40
Switzerland	0.56	0.59	10.82	10.8	0.16	0.16	4.40	4.41
United States	0.58	0.62	10.35	10.33	0.13	0.13	3.92	3.92
Total	0.61	0.66	10.56	10.54	0.18	0.18	4.04	4.05

The simulations in tables 11.10 and 11.11 show only small effects of changes in replacement rates. In view of the small estimates of the coefficient estimates of the replacement variables, this is not surprising. Incomes, which are directly affected by replacement rates, show most sensitivity to the level of replacement rates: high replacement rates lead to high incomes and low replacement rates lead to low incomes.

Table 11.12 shows the effects of increasing full and early retirement ages. The effects of changing eligibility ages on retirement is considerably larger than the effects of changing replacement rates, although it should be observed that the change in retirement ages simulated here is quite dramatic. As one would expect, the effects are largest in the countries where currently eligibility ages are low, such as Austria, France, and Italy. To obtain more insight in the incidence of the effects, we break down the results by age in tables 13–16. For each country, the first row presents the simulated counterfactuals, while the second row presents the predicted in-sample values. The effects on retirement are large in the age range fifty-five to sixty-nine in

Table 11.13 Simulated retirement by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	0.27	0.49	0.65	0.78	1.03	1.08	0.75
	Predicted	0.27	0.54	0.8	0.95	1.03	1.08	0.82
Belgium	Simulated	0.27	0.43	0.57	0.75	1.01	1.07	0.68
	Predicted	0.27	0.43	0.67	0.92	1.01	1.07	0.72
Denmark	Simulated	0.14	0.30	0.46	0.65	0.92	0.98	0.56
	Predicted	0.14	0.30	0.46	0.82	0.92	0.98	0.59
France	Simulated	0.19	0.36	0.51	0.69	0.94	1.01	0.62
	Predicted	0.19	0.44	0.74	0.86	0.94	1.01	0.70
Germany	Simulated	0.22	0.37	0.52	0.70	0.95	1.01	0.62
	Predicted	0.22	0.37	0.56	0.87	0.95	1.01	0.66
Greece	Simulated	0.17	0.38	0.59	0.76	1.00	1.06	0.62
	Predicted	0.17	0.40	0.70	0.92	1.00	1.06	0.66
Italy	Simulated	0.25	0.45	0.63	0.77	1.02	1.07	0.73
	Predicted	0.25	0.49	0.78	0.94	1.02	1.07	0.80
Netherlands	Simulated	0.25	0.40	0.56	0.77	1.04	1.09	0.66
	Predicted	0.25	0.40	0.56	0.94	1.04	1.09	0.68
Spain	Simulated	0.21	0.39	0.60	0.75	0.99	1.05	0.71
	Predicted	0.21	0.39	0.69	0.92	0.99	1.05	0.75
Sweden	Simulated	0.13	0.29	0.43	0.61	0.87	0.93	0.58
	Predicted	0.13	0.29	0.51	0.78	0.87	0.93	0.63
Switzerland	Simulated	0.13	0.29	0.44	0.62	0.87	0.93	0.56
	Predicted	0.13	0.29	0.50	0.79	0.87	0.93	0.59
United States	Simulated	0.08	0.23	0.37	0.55	0.81	0.89	0.58
	Predicted	0.08	0.23	0.44	0.7	0.81	0.89	0.62
Total	Simulated	0.16	0.31	0.46	0.63	0.88	0.94	0.61
	Predicted	0.16	0.32	0.55	0.79	0.88	0.94	0.66

Table 11.14 Simulated log-income by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	11.95	11.44	10.93	10.43	9.88	9.04	10.50
	Predicted	11.95	11.43	10.89	10.39	9.88	9.04	10.48
Belgium	Simulated	12.08	11.57	11.06	10.45	9.87	9.09	10.66
	Predicted	12.08	11.57	11.01	10.38	9.87	9.09	10.65
Denmark	Simulated	12.48	11.91	11.41	10.85	10.22	9.38	11.06
	Predicted	12.48	11.91	11.41	10.8	10.22	9.38	11.05
France	Simulated	12.09	11.60	11.08	10.49	9.91	9.11	10.67
	Predicted	12.09	11.56	10.99	10.42	9.91	9.11	10.64
Germany	Simulated	11.93	11.52	10.94	10.37	9.86	9.02	10.61
	Predicted	11.93	11.52	10.93	10.30	9.86	9.02	10.59
Greece	Simulated	12.13	11.64	11.09	10.52	10.06	9.28	10.9
	Predicted	12.13	11.64	11.08	10.50	10.06	9.28	10.89
Italy	Simulated	12.15	11.64	11.12	10.60	10.08	9.38	10.74
	Predicted	12.15	11.62	11.07	10.55	10.08	9.38	10.72
Netherlands	Simulated	12.14	11.67	11.17	10.61	10.05	9.26	10.89
	Predicted	12.14	11.67	11.17	10.58	10.05	9.26	10.88
Spain	Simulated	12.13	11.67	11.11	10.61	10.07	9.35	10.65
	Predicted	12.13	11.67	11.08	10.57	10.07	9.35	10.63
Sweden	Simulated	12.37	11.86	11.36	10.78	10.15	9.27	10.80
	Predicted	12.37	11.86	11.32	10.71	10.15	9.27	10.78
Switzerland	Simulated	12.22	11.75	11.24	10.67	10.06	9.24	10.82
	Predicted	12.22	11.75	11.22	10.6	10.06	9.24	10.80
United States	Simulated	12.05	11.59	11.05	10.47	9.91	9.10	10.35
	Predicted	12.05	11.59	11.01	10.39	9.91	9.10	10.33
Total	Simulated	12.12	11.63	11.10	10.52	9.96	9.15	10.56
	Predicted	12.12	11.63	11.07	10.45	9.96	9.15	10.54

countries like Austria, Belgium, and France. In the remaining countries the effects show up at somewhat later ages. As one would expect, the effects on income are most noticeable in these same age ranges, but now the size of the effect also depends on replacement rates. For instance, in the Netherlands, the effect is quite modest.

The effect on depression is generally modest. We note a slight uptick in France and Italy in the age group sixty to sixty-four. Similarly, the effect on life satisfaction is most visible in the sixty to sixty-nine age range in France and Italy. The effects are most visible in the United States in the age range sixty-five to sixty-nine.

11.6 An Alternative Age Specification

Our specification for the effect of age on the four outcomes of interest has been quadratic in all four equations. To investigate if this rather sparse parameterization of the age effects drives some of our results, the appendix

Table 11.15 Simulated depression rates by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	0.18	0.19	0.19	0.19	0.19	0.24	0.20
	Predicted	0.18	0.19	0.18	0.18	0.19	0.24	0.19
Belgium	Simulated	0.24	0.24	0.24	0.25	0.25	0.28	0.25
	Predicted	0.24	0.24	0.24	0.24	0.25	0.28	0.25
Denmark	Simulated	0.14	0.14	0.14	0.13	0.14	0.18	0.15
	Predicted	0.14	0.14	0.14	0.12	0.14	0.18	0.14
France	Simulated	0.31	0.30	0.32	0.33	0.32	0.37	0.33
	Predicted	0.31	0.30	0.30	0.32	0.32	0.37	0.32
Germany	Simulated	0.19	0.18	0.18	0.18	0.17	0.22	0.19
	Predicted	0.19	0.18	0.18	0.17	0.17	0.22	0.19
Greece	Simulated	0.19	0.18	0.19	0.20	0.21	0.25	0.20
	Predicted	0.19	0.18	0.18	0.19	0.21	0.25	0.20
Italy	Simulated	0.31	0.31	0.32	0.32	0.33	0.36	0.32
	Predicted	0.31	0.30	0.30	0.30	0.33	0.36	0.32
Netherlands	Simulated	0.18	0.17	0.17	0.17	0.18	0.2	0.18
	Predicted	0.18	0.17	0.17	0.16	0.18	0.2	0.18
Spain	Simulated	0.34	0.32	0.33	0.33	0.32	0.36	0.33
	Predicted	0.34	0.32	0.32	0.32	0.32	0.36	0.33
Sweden	Simulated	0.16	0.15	0.15	0.16	0.16	0.21	0.17
	Predicted	0.16	0.15	0.14	0.15	0.16	0.21	0.16
Switzerland	Simulated	0.17	0.16	0.15	0.16	0.16	0.18	0.16
	Predicted	0.17	0.16	0.15	0.15	0.16	0.18	0.16
United States	Simulated	0.14	0.13	0.13	0.12	0.11	0.14	0.13
	Predicted	0.14	0.13	0.12	0.11	0.11	0.14	0.13
Total	Simulated	0.20	0.18	0.18	0.17	0.17	0.19	0.18
	Predicted	0.20	0.18	0.17	0.16	0.17	0.19	0.18

presents estimation and simulation results for a specification in which the quadratic age function is replaced by forty age dummies (for ages fifty-one through ninety). Figure 11A.1 plots the estimated age dummies, while table 11A.1 presents the estimates of the remaining parameters. The graphs confirm that the likelihood of being retired increases with age, while income falls with age (this may partly be a cohort effect). Life satisfaction shows a slight increase with age. The graph with depression suggests that depression also increases somewhat with age, but inspection of the estimated coefficients reveals that these effects are not significant.

Comparing table 11A.1 with table 11.8 shows that the sizes of the estimated coefficients are affected by the more flexible age specification, but qualitatively conclusions don't change. Virtually all estimates have the same sign in table 11.8 and in table 11A.1. The most noteworthy change is that, whereas in table 11.9 retirement has a marginally significant (at the 10 percent level) negative effect on the prevalence of depression and a significant (at the 5 percent level) positive on life satisfaction, these effects are insignificant in table 11A.1, although the signs remain the same.

Table 11.16 **Simulated life satisfaction by age**

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	4.14	4.11	4.10	4.11	4.13	4.05	4.10
	Predicted	4.14	4.12	4.13	4.14	4.13	4.05	4.11
Belgium	Simulated	4.10	4.10	4.10	4.09	4.13	4.10	4.10
	Predicted	4.10	4.10	4.12	4.12	4.13	4.10	4.11
Denmark	Simulated	4.50	4.49	4.49	4.50	4.51	4.48	4.49
	Predicted	4.50	4.49	4.49	4.53	4.51	4.48	4.50
France	Simulated	3.91	3.91	3.89	3.88	3.92	3.87	3.89
	Predicted	3.91	3.93	3.93	3.91	3.92	3.87	3.91
Germany	Simulated	4.06	4.06	4.06	4.07	4.13	4.06	4.07
	Predicted	4.06	4.06	4.07	4.10	4.13	4.06	4.08
Greece	Simulated	3.81	3.80	3.79	3.75	3.77	3.73	3.78
	Predicted	3.81	3.80	3.81	3.78	3.77	3.73	3.79
Italy	Simulated	3.96	3.94	3.91	3.91	3.91	3.89	3.91
	Predicted	3.96	3.95	3.94	3.94	3.91	3.89	3.93
Netherlands	Simulated	4.18	4.19	4.19	4.20	4.20	4.18	4.19
	Predicted	4.18	4.19	4.19	4.23	4.20	4.18	4.2
Spain	Simulated	3.92	3.92	3.92	3.93	3.95	3.95	3.93
	Predicted	3.92	3.92	3.93	3.96	3.95	3.95	3.94
Sweden	Simulated	4.41	4.41	4.40	4.40	4.39	4.35	4.39
	Predicted	4.41	4.41	4.42	4.43	4.39	4.35	4.40
Switzerland	Simulated	4.39	4.40	4.40	4.40	4.42	4.40	4.40
	Predicted	4.39	4.40	4.41	4.43	4.42	4.40	4.41
United States	Simulated	3.84	3.85	3.88	3.91	3.95	3.95	3.92
	Predicted	3.84	3.85	3.89	3.94	3.95	3.95	3.92
Total	Simulated	4.07	4.03	4.04	4.04	4.04	4.03	4.04
	Predicted	4.07	4.03	4.06	4.06	4.04	4.03	4.05

Tables 11A.2–11A.9 repeat the simulation exercise of tables 11.9–11.16. Comparing table 11.9 with table 11A.2 shows that the model with forty age dummies provides a somewhat better fit than the model with a quadratic age specification, as one would expect. The simulation results presented in tables 11A.3–11A.9 are qualitatively very similar to the results presented in tables 11.10–11.16. Also, in the specification with age dummies effects are generally small. The exercise with a substantial increase in early and full retirement ages shows the biggest effect in both cases, in particular for the age bracket sixty to sixty-nine.

11.7 Concluding Remarks

We have estimated a simultaneous system of equations explaining the joint determination of retirement, income, depression, and life satisfaction. The system accounts for unobserved individual heterogeneity, by including fixed effects. Statistical tests show that omitting these would lead to serious misspecification. To identify causal effects we have used variation in institu-

tions across countries that influence retirement decisions and household incomes.

In the raw data, being retired is positively correlated with the risk of depression and negatively correlated with life satisfaction. Once we account for endogeneity of retirement these relations change sign. In the most flexible specification with forty age dummies, the effect of retirement on either depression or life satisfaction is insignificant. Interestingly, income does not appear to play much of a role in the determination of depression or life satisfaction, once other factors are accounted for. This also contrasts with the correlations in the raw data, which suggested that a higher income leads to higher life satisfaction and to fewer depressive symptoms.

As one would expect, household wealth, being married, and educational attainment are all positively related to life satisfaction and reduce the probability of depression. Health conditions and difficulties with activities of daily living increase the probability of depression and reduce life satisfaction.

The fairly weak effects of retirement on life satisfaction and depression suggest that, at least as far as these variables are concerned, gradual increases in retirement ages will have only moderate effects. We should note, however, that the effects estimated here are average effects. Plausibly, the effects of retirement will vary across subgroups, so to inform policy an analysis of the heterogeneity of effects across different socioeconomic strata is called for.

Appendix

Specification with Age Dummies

Table 11A.1 Estimation results

Variables	Retired	Log HH-income	Depressed	Life satisfaction
Retired		–2.448***	–0.013	0.230
		(0.153)	(0.064)	(0.147)
Pension rr * (retired)		0.007***		
		(0.001)		
Unemployed		–1.342***	0.123	–0.576*
		(0.261)	(0.107)	(0.299)
Unemployed * unempl. rr		0.836*	–0.165	0.889*
		(0.430)	(0.175)	(0.499)
Log-household net wealth		0.150***	–0.003*	0.027***
		(0.003)	(0.002)	(0.004)
d2006	0.026***	0.247***	–0.004	–0.150***
	(0.006)	(0.018)	(0.007)	(0.039)
d2008	0.041***	0.433***	–0.002	–0.034
	(0.010)	(0.032)	(0.014)	(0.022)
d2010	0.073***	0.567***	0.005	
	(0.016)	(0.049)	(0.021)	
Female	0.023***	–0.162***	0.086***	–0.006
	(0.005)	(0.010)	(0.007)	(0.017)
Married	0.011	0.272***	–0.082***	0.246***
	(0.010)	(0.030)	(0.013)	(0.039)
Married and female	0.013	0.206***	0.015	0.078
	(0.013)	(0.037)	(0.016)	(0.049)
College	–0.098***	0.360***	–0.095***	0.191***
	(0.005)	(0.013)	(0.010)	(0.024)
College in United States	–0.010	0.288***	–0.038***	–0.108***
	(0.008)	(0.015)	(0.011)	(0.028)
High school	–0.021***	0.144***	–0.058***	0.132***
	(0.004)	(0.009)	(0.005)	(0.014)
High school in United States	–0.019***	0.127***	–0.025***	–0.112***
	(0.007)	(0.013)	(0.008)	(0.020)
ADL	–0.138***	0.349***	0.001	0.086*
	(0.011)	(0.028)	(0.016)	(0.044)
ADL in United States	0.172***	–0.251***	0.069***	–0.196***
	(0.010)	(0.023)	(0.015)	(0.038)
Major health condition	0.008	–0.064***	0.079***	–0.069***
	(0.006)	(0.018)	(0.007)	(0.020)
Major health condition in United States	0.040***	0.270***	–0.060***	–0.056*
	(0.008)	(0.026)	(0.011)	(0.033)
Austria	0.182***	–0.575***	0.105***	0.132**
	(0.013)	(0.031)	(0.018)	(0.053)
Belgium	0.210***	–0.533***	0.173***	0.064
	(0.010)	(0.026)	(0.018)	(0.049)
Denmark	0.082***	0.828***	–0.024	0.553***
	(0.011)	(0.024)	(0.024)	(0.054)

(*continued*)

Table 11A.1 (continued)

Variables	Retired	Log HH-income	Depressed	Life satisfaction
France	0.137***	–0.403***	0.217***	–0.106**
	(0.010)	(0.024)	(0.015)	(0.044)
Germany	0.142***	–0.476***	0.106***	0.029
	(0.011)	(0.024)	(0.016)	(0.047)
Greece	0.100***	–1.288***	0.154***	–0.260***
	(0.012)	(0.029)	(0.025)	(0.068)
Italy	0.169***	–0.866***	0.250***	–0.157***
	(0.011)	(0.027)	(0.021)	(0.057)
Netherlands	0.162***	–0.515***	0.089***	0.158***
	(0.011)	(0.027)	(0.015)	(0.044)
Spain	0.132***	–1.148***	0.269***	–0.161**
	(0.011)	(0.026)	(0.024)	(0.065)
Sweden	0.058***	1.104***	–0.027	0.489***
	(0.010)	(0.020)	(0.026)	(0.058)
Switzerland	0.058***	0.349***	0.030*	0.412***
	(0.012)	(0.023)	(0.015)	(0.039)
Midwest	0.038	0.000	–0.001	0.115
	(0.027)	(0.079)	(0.033)	(0.113)
South	0.048**	0.003	–0.006	0.090
	(0.021)	(0.061)	(0.026)	(0.088)
West	–0.003	–0.180**	0.033	0.131
	(0.025)	(0.074)	(0.031)	(0.097)
Residing outside United States	0.367***	0.558*	0.078	–0.323
	(0.106)	(0.319)	(0.152)	(0.813)
Above full ret. age	0.176***			
	(0.016)			
Above early ret. age	0.003			
	(0.017)			
Pension rr * (above full ret. age)	–0.001***			
	(0.000)			
Pension rr * (above early ret. age)	0.001**			
	(0.000)			
Log-household income			0.013	–0.017
			(0.008)	(0.015)
Constant	0.052***	9.103***	–0.467**	4.808***
	(0.015)	(0.036)	(0.182)	(0.442)
Observations	120,775	120,775	116,254	63,661
R-squared				
Number of groups	52,028	52,028	51,006	40,429
Individual effects	RE	RE	RE	RE

Note: Standard errors in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 11A.2 **Predicted and observed outcome variables**

Country	Retirement predicted	Retirement observed	Log-income predicted	Log-income observed	Depression predicted	Depression observed	Life satisfaction predicted	Life satisfaction observed
Austria	0.82	0.82	10.15	10.08	0.19	0.19	4.12	4.13
Observations	3,365	3,365	3,365	3,365	3,337	3,337	1,839	1,839
Belgium	0.72	0.72	10.44	10.16	0.25	0.24	4.11	4.12
Observations	8,066	8,066	8,066	8,066	8,046	8,046	4,838	4,838
Denmark	0.59	0.59	11.05	11.78	0.14	0.15	4.5	4.48
Observations	5,257	5,257	5,257	5,257	5,225	5,225	3,857	3,857
France	0.7	0.7	10.49	10.23	0.32	0.32	3.91	3.92
Observations	7,010	7,010	7,010	7,010	6,908	6,908	4,244	4,244
Germany	0.66	0.67	10.49	10.2	0.19	0.19	4.08	4.09
Observations	6,170	6,170	6,170	6,170	6,149	6,149	3,529	3,529
Greece	0.66	0.66	10.73	9.62	0.2	0.19	3.79	3.81
Observations	4,395	4,395	4,395	4,395	4,395	4,395	2,400	2,400
Italy	0.8	0.8	10.45	9.85	0.31	0.31	3.93	3.96
Observations	6,088	6,088	6,088	6,088	6,055	6,055	4,161	4,161
Netherlands	0.68	0.68	10.73	10.33	0.17	0.17	4.2	4.2
Observations	6,522	6,522	6,522	6,522	6,501	6,501	4,007	4,007
Spain	0.75	0.75	10.42	9.54	0.33	0.32	3.94	3.97
Observations	4,587	4,587	4,587	4,587	4,537	4,537	2,940	2,940
Sweden	0.63	0.63	10.77	11.97	0.16	0.17	4.4	4.38
Observations	6,784	6,784	6,784	6,784	6,762	6,762	4,080	4,080
Switzerland	0.59	0.59	10.83	11.07	0.16	0.16	4.41	4.41
Observations	3,108	3,108	3,108	3,108	3,102	3,102	2,257	2,257
United States	0.62	0.62	10.47	10.62	0.13	0.13	3.92	3.92
Observations	59,423	59,423	59,423	59,423	55,237	55,237	25,509	25,509
Total	0.66	0.65	10.53	10.54	0.18	0.18	4.05	4.05
Observations	120,775	120,775	120,775	120,775	116,254	116,254	63,661	63,661

Table 11A.3 **Simulated outcomes with 100 percent replacement rates**

Country	Retirement simulated	Retirement predicted	Log-income simulated	Log-income predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.82	0.82	10.22	10.15	0.19	0.19	4.12	4.12
Belgium	0.72	0.72	10.64	10.44	0.25	0.25	4.11	4.11
Denmark	0.59	0.59	11.14	11.05	0.14	0.14	4.5	4.5
France	0.69	0.7	10.68	10.49	0.32	0.32	3.9	3.91
Germany	0.66	0.66	10.67	10.49	0.19	0.19	4.07	4.08
Greece	0.66	0.66	10.7	10.73	0.2	0.2	3.79	3.79
Italy	0.8	0.8	10.56	10.45	0.32	0.31	3.93	3.93
Netherlands	0.68	0.68	10.75	10.73	0.18	0.17	4.2	4.2
Spain	0.75	0.75	10.51	10.42	0.33	0.33	3.94	3.94
Sweden	0.63	0.63	10.95	10.77	0.16	0.16	4.4	4.4
Switzerland	0.59	0.59	10.99	10.83	0.16	0.16	4.4	4.41
United States	0.61	0.62	10.72	10.47	0.13	0.13	3.91	3.92
Total	0.65	0.66	10.72	10.53	0.18	0.18	4.04	4.05

Table 11A.4 **Simulated outcomes with 40 percent replacement rates**

Country	Retirement simulated	Retirement predicted	Log-income simulated	Log-income predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.83	0.82	9.84	10.15	0.19	0.19	4.12	4.12
Belgium	0.72	0.72	10.31	10.44	0.25	0.25	4.12	4.11
Denmark	0.6	0.59	10.86	11.05	0.14	0.14	4.5	4.5
France	0.7	0.7	10.36	10.49	0.32	0.32	3.91	3.91
Germany	0.67	0.66	10.37	10.49	0.18	0.19	4.08	4.08
Greece	0.67	0.66	10.38	10.73	0.2	0.2	3.8	3.79
Italy	0.8	0.8	10.2	10.45	0.31	0.31	3.93	3.93
Netherlands	0.69	0.68	10.43	10.73	0.17	0.17	4.21	4.2
Spain	0.76	0.75	10.17	10.42	0.33	0.33	3.95	3.94
Sweden	0.63	0.63	10.66	10.77	0.16	0.16	4.4	4.4
Switzerland	0.6	0.59	10.71	10.83	0.16	0.16	4.41	4.41
United States	0.62	0.62	10.43	10.47	0.13	0.13	3.92	3.92
Total	0.66	0.66	10.41	10.53	0.18	0.18	4.05	4.05

Table 11A.5 **Simulated outcomes: Full retirement age is seventy and early retirement age is sixty-seven**

Country	Retirement simulated	Retirement predicted	Log-income simulated	Log-income predicted	Depression simulated	Depression predicted	Life satisfaction simulated	Life satisfaction predicted
Austria	0.77	0.82	10.24	10.15	0.19	0.19	4.1	4.12
Belgium	0.7	0.72	10.49	10.44	0.25	0.25	4.11	4.11
Denmark	0.57	0.59	11.09	11.05	0.14	0.14	4.49	4.5
France	0.65	0.7	10.59	10.49	0.32	0.32	3.9	3.91
Germany	0.64	0.66	10.55	10.49	0.19	0.19	4.07	4.08
Greece	0.63	0.66	10.78	10.73	0.2	0.2	3.78	3.79
Italy	0.75	0.8	10.54	10.45	0.32	0.31	3.92	3.93
Netherlands	0.66	0.68	10.76	10.73	0.18	0.17	4.19	4.2
Spain	0.73	0.75	10.47	10.42	0.33	0.33	3.93	3.94
Sweden	0.6	0.63	10.83	10.77	0.16	0.16	4.39	4.4
Switzerland	0.57	0.59	10.89	10.83	0.16	0.16	4.4	4.41
United States	0.59	0.62	10.53	10.47	0.13	0.13	3.91	3.92
Total	0.63	0.66	10.59	10.53	0.18	0.18	4.04	4.05

Table 11A.6 Simulated retirement by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	0.27	0.45	0.74	0.85	1.02	1.07	0.77
	Predicted	0.27	0.48	0.84	0.97	1.02	1.07	0.82
Belgium	Simulated	0.28	0.4	0.64	0.8	1	1.06	0.7
	Predicted	0.28	0.4	0.67	0.94	1	1.06	0.72
Denmark	Simulated	0.14	0.26	0.54	0.71	0.9	0.95	0.57
	Predicted	0.14	0.26	0.54	0.83	0.9	0.95	0.59
France	Simulated	0.2	0.33	0.62	0.76	0.95	1.01	0.65
	Predicted	0.2	0.36	0.78	0.89	0.95	1.01	0.7
Germany	Simulated	0.22	0.33	0.6	0.74	0.93	0.99	0.64
	Predicted	0.22	0.33	0.61	0.88	0.93	0.99	0.66
Greece	Simulated	0.17	0.34	0.68	0.83	0.98	1.05	0.63
	Predicted	0.17	0.36	0.76	0.94	0.98	1.05	0.66
Italy	Simulated	0.27	0.42	0.72	0.84	1.01	1.06	0.75
	Predicted	0.27	0.44	0.82	0.96	1.01	1.06	0.8
Netherlands	Simulated	0.24	0.36	0.63	0.83	1.01	1.06	0.66
	Predicted	0.24	0.36	0.63	0.94	1.01	1.06	0.68
Spain	Simulated	0.22	0.36	0.67	0.81	0.98	1.03	0.73
	Predicted	0.22	0.36	0.72	0.93	0.98	1.03	0.75
Sweden	Simulated	0.14	0.26	0.5	0.66	0.86	0.93	0.6
	Predicted	0.14	0.26	0.53	0.8	0.86	0.93	0.63
Switzerland	Simulated	0.14	0.26	0.52	0.67	0.86	0.91	0.57
	Predicted	0.14	0.26	0.55	0.8	0.86	0.91	0.59
United States	Simulated	0.09	0.2	0.44	0.58	0.8	0.88	0.59
	Predicted	0.09	0.2	0.46	0.71	0.8	0.88	0.62
Total	Simulated	0.17	0.28	0.54	0.67	0.87	0.94	0.63
	Predicted	0.17	0.29	0.58	0.8	0.87	0.94	0.66

Table 11A.7 Simulated log-income by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	12.13	11.34	10.65	10.24	9.48	8.47	10.24
	Predicted	12.13	11.29	10.46	10.03	9.48	8.47	10.15
Belgium	Simulated	12.24	11.55	10.91	10.37	9.53	8.58	10.49
	Predicted	12.24	11.55	10.84	10.1	9.53	8.58	10.44
Denmark	Simulated	12.89	12.11	11.46	10.92	10.04	9.02	11.09
	Predicted	12.89	12.11	11.46	10.69	10.04	9.02	11.05
France	Simulated	12.4	11.7	10.98	10.46	9.64	8.67	10.59
	Predicted	12.4	11.64	10.67	10.2	9.64	8.67	10.49
Germany	Simulated	12.17	11.62	10.86	10.37	9.64	8.63	10.55
	Predicted	12.17	11.62	10.83	10.11	9.64	8.63	10.49
Greece	Simulated	12.49	11.71	10.87	10.33	9.66	8.71	10.78
	Predicted	12.49	11.68	10.74	10.16	9.66	8.71	10.73
Italy	Simulated	12.37	11.63	10.89	10.46	9.71	8.88	10.54
	Predicted	12.37	11.59	10.7	10.23	9.71	8.88	10.45
Netherlands	Simulated	12.39	11.73	11.06	10.47	9.67	8.72	10.76
	Predicted	12.39	11.73	11.06	10.27	9.67	8.72	10.73
Spain	Simulated	12.39	11.73	10.91	10.52	9.75	8.87	10.47
	Predicted	12.39	11.73	10.82	10.3	9.75	8.87	10.42
Sweden	Simulated	12.76	12.09	11.44	10.92	10.04	8.96	10.83
	Predicted	12.76	12.09	11.38	10.65	10.04	8.96	10.77
Switzerland	Simulated	12.65	12.01	11.31	10.82	9.96	8.95	10.89
	Predicted	12.65	12.01	11.26	10.55	9.96	8.95	10.83
United States	Simulated	12.59	12	11.32	10.82	9.98	8.96	10.53
	Predicted	12.59	12	11.28	10.56	9.98	8.96	10.47
Total	Simulated	12.49	11.85	11.17	10.69	9.87	8.88	10.59
	Predicted	12.49	11.84	11.09	10.43	9.87	8.88	10.53

Table 11A.8 Simulated depression rates by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	0.19	0.19	0.16	0.17	0.19	0.25	0.19
	Predicted	0.19	0.19	0.16	0.17	0.19	0.25	0.19
Belgium	Simulated	0.26	0.24	0.22	0.24	0.24	0.29	0.25
	Predicted	0.26	0.24	0.22	0.23	0.24	0.29	0.25
Denmark	Simulated	0.16	0.15	0.13	0.12	0.12	0.17	0.14
	Predicted	0.16	0.15	0.13	0.11	0.12	0.17	0.14
France	Simulated	0.32	0.31	0.3	0.31	0.32	0.37	0.32
	Predicted	0.32	0.31	0.29	0.3	0.32	0.37	0.32
Germany	Simulated	0.21	0.2	0.17	0.17	0.17	0.22	0.19
	Predicted	0.21	0.2	0.17	0.16	0.17	0.22	0.19
Greece	Simulated	0.2	0.18	0.17	0.19	0.2	0.25	0.2
	Predicted	0.2	0.18	0.17	0.19	0.2	0.25	0.2
Italy	Simulated	0.32	0.3	0.29	0.3	0.33	0.36	0.32
	Predicted	0.32	0.3	0.29	0.3	0.33	0.36	0.31
Netherlands	Simulated	0.2	0.17	0.15	0.16	0.17	0.2	0.18
	Predicted	0.2	0.17	0.15	0.15	0.17	0.2	0.17
Spain	Simulated	0.34	0.33	0.31	0.32	0.32	0.36	0.33
	Predicted	0.34	0.33	0.31	0.31	0.32	0.36	0.33
Sweden	Simulated	0.17	0.16	0.14	0.14	0.15	0.2	0.16
	Predicted	0.17	0.16	0.14	0.14	0.15	0.2	0.16
Switzerland	Simulated	0.18	0.17	0.15	0.15	0.15	0.18	0.16
	Predicted	0.18	0.17	0.15	0.15	0.15	0.18	0.16
United States	Simulated	0.15	0.14	0.13	0.12	0.11	0.13	0.13
	Predicted	0.15	0.14	0.12	0.12	0.11	0.13	0.13
Total	Simulated	0.21	0.19	0.17	0.16	0.16	0.19	0.18
	Predicted	0.21	0.19	0.17	0.16	0.16	0.19	0.18

Table 11A.9 Simulated life satisfaction by age

Country		< = 54	55–59	60–64	65–69	70–74	> = 75	Total
Austria	Simulated	4.15	4.08	4.1	4.12	4.14	4.07	4.1
	Predicted	4.15	4.09	4.13	4.15	4.14	4.07	4.12
Belgium	Simulated	4.12	4.09	4.1	4.09	4.14	4.12	4.11
	Predicted	4.12	4.09	4.11	4.13	4.14	4.12	4.11
Denmark	Simulated	4.51	4.49	4.51	4.5	4.49	4.47	4.49
	Predicted	4.51	4.49	4.51	4.53	4.49	4.47	4.5
France	Simulated	3.93	3.9	3.89	3.87	3.91	3.88	3.9
	Predicted	3.93	3.91	3.93	3.91	3.91	3.88	3.91
Germany	Simulated	4.07	4.06	4.08	4.06	4.11	4.05	4.07
	Predicted	4.07	4.06	4.08	4.1	4.11	4.05	4.08
Greece	Simulated	3.8	3.76	3.82	3.78	3.78	3.74	3.78
	Predicted	3.8	3.77	3.85	3.8	3.78	3.74	3.79
Italy	Simulated	3.97	3.91	3.91	3.91	3.92	3.9	3.92
	Predicted	3.97	3.92	3.94	3.94	3.92	3.9	3.93
Netherlands	Simulated	4.2	4.17	4.2	4.2	4.2	4.19	4.19
	Predicted	4.2	4.17	4.2	4.23	4.2	4.19	4.2
Spain	Simulated	3.91	3.9	3.93	3.94	3.96	3.95	3.93
	Predicted	3.91	3.9	3.95	3.97	3.96	3.95	3.94
Sweden	Simulated	4.43	4.42	4.44	4.39	4.37	4.34	4.39
	Predicted	4.43	4.42	4.44	4.42	4.37	4.34	4.4
Switzerland	Simulated	4.39	4.4	4.43	4.4	4.4	4.38	4.4
	Predicted	4.39	4.4	4.44	4.43	4.4	4.38	4.41
United States	Simulated	3.83	3.81	3.89	3.92	3.97	3.94	3.91
	Predicted	3.83	3.81	3.89	3.96	3.97	3.94	3.92
Total	Simulated	4.07	4.01	4.05	4.04	4.05	4.03	4.04
	Predicted	4.07	4.01	4.07	4.07	4.05	4.03	4.05

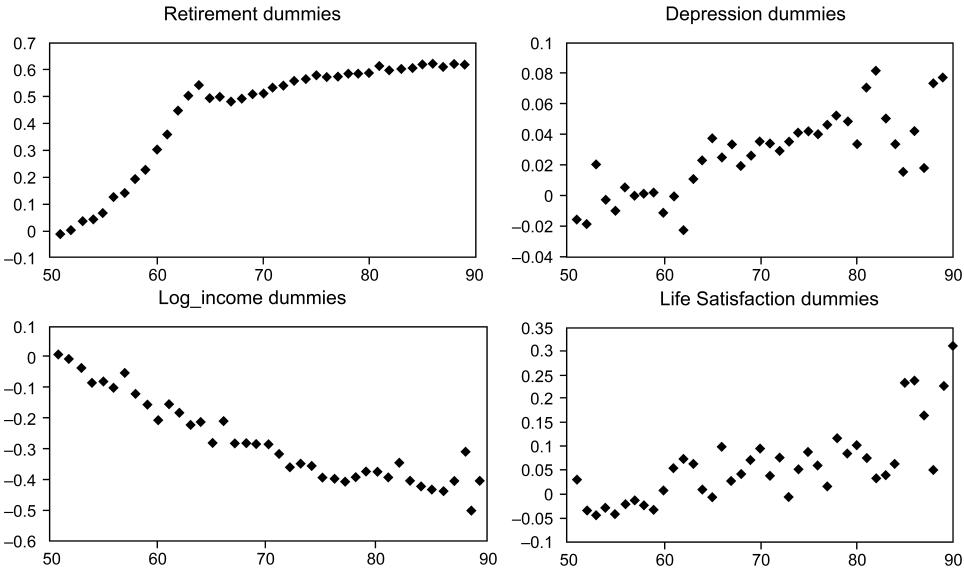

Fig. 11A.1 Estimated age dummies

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Comment Anne Case

This is an interesting chapter on an important topic. At a fundamental level, the question of whether retirement makes people happy (or, more specifically here, increases their reported life satisfaction) would appear to be unanswerable with observational data, and is much like trying to quantify whether having children makes one happy. If people who want children have children, and those who do not choose away from parenthood, then in expectation people in both groups are happier than they would be in the alternative state. And so it should be with respect to retirement.

Anne Case is the Alexander Stewart 1886 Professor of Economics and Public Affairs and professor of economics and public affairs at the Woodrow Wilson School of Public and International Affairs and the Economics Department at Princeton University and a research associate of the National Bureau of Economic Research.

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