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Labour Force Participation in the Euro Area: A Cohort Based Analysis

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Abstract

We use a cohort based model of labour force participation to analyse determinants of participation for disaggregated groups of workers in the euro area and the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands). Beyond observed structural determinants the model identifies significant age and cohort effects as indicators of (unobserved) structural determinants of participation behaviour. We use the age and cohort effects and observed determinants to construct trend measures and projections of labour supply. Our results suggest that a decomposition based on age and cohort effects can account for a substantial part of the recent increase in labour force participation rates in the euro area, although not the surge since the mid-1990s. Cohort effects appear particularly relevant for women, with those born in the 1920s and 1930s less likely and those born in the late 1960s and early 1970s more likely to participate in the labour market over the life-cycle. There is substantial variation in the estimated age-participation profiles and cohort effects across euro area countries. Looking forward, positive cohort effects for women are not large enough to compensate for the downward impact of population ageing on aggregate labour force participation rates in the euro area as a whole

Keywords: labour force participation, cohort analysis, labour market institutions

JEL codes: J11, J21

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Non-technical summary

The euro area labour force participation rate, defined as the ratio between the labour force and the working age population, has increased from below 65% in the early 1980s to 70.9% in 2007. The participation rate of females in the euro area has increased by more than 15 percentage points over this time period, to 63.3% in 2007, compared to the participation rate of 78.6% for males.

The large increase in the propensity of the euro area population to work or to search for and to be available for jobs has been one of the main drivers of the substantial increase in euro area labour supply that has accelerated since the mid-1990s. This has significantly reduced the gap in the use of labour input between the euro area and the United States, and has made a substantial positive contribution to output growth and welfare in the euro area. A number of factors could have contributed to this increase, including reforms in the labour market, changes in cultural attitudes towards work (particularly for women), as well as demographic factors. Looking forward, demographic factors will become less favourable with population ageing increasing the importance of positive participation trends within age and gender groups in sustaining potential growth in the euro area.

We use a cohort based model of labour force participation to analyse determinants of participation for disaggregated groups of workers in the euro area and the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands). The model is used to decompose the evolution of time-series of age-specific participation rates into the impact of the business cycle, observed structural determinants of participation and other unobserved determinants captured by age and birth year specific (cohort) effects.

We find that analysing participation behaviour both between (age and gender effects) and within (cohort effects) detailed age and gender groups is particularly useful for modelling trends in euro area aggregate participation rates and projecting them forward. Our results suggest that age and cohort effects explain a substantial part of the recent increase in labour force participation rates in the euro area, although not the surge since early 2000s. Cohort effects are particularly relevant for women, with those born in the 1920s and 1930s less likely and those born in the late 1960s and early 1970s more likely to participate in the labour market over the life-cycle. There is substantial variation in cohort effects across the five largest euro area countries that we analyse. Depending on the country, the estimated cohort profiles suggest an increase of 10 to 30 percentage points in female participation rates. We also find that a number of observed determinants, such as labour taxes, union density, unemployment benefits and the average number of children have had an impact on labour

force participation rates, although the specific impact varies across age and gender groups and countries. Looking forward, while they continue to provide some upward support to participation rates of women in the euro area, positive cohort effects are not large enough to compensate for the downward impact of population ageing on labour force participation rates in the euro area.

1. Introduction

The euro area labour force participation rate, defined as the ratio between the labour force and the working age population, has increased from below 65% in the early 1980s to 70.9% in 2007. The participation rate of females in the euro area has increased by more than 15 percentage points over this time period, to 63.3% in 2007, compared to the participation rate of 78.6% for males (see Figure 1). At the same time, the participation rate of the young working age population (15-24 years old) declined markedly until the mid-90s, to stabilise around 45% in the last decade. By contrast, the participation rate of the old working age population (55-64 years old), after being relatively stable for most of the period considered, has experienced an increase of around 10 percentage points between 2001 and 2007. While the overall increase in labour force participation rates is shared across most euro area countries, the extent of the increase as well as its composition across worker groups varies substantially. For example, the participation rate increased by around 20 percentage points in the Netherlands and by more than 15 percentage points in Spain, whereas it remained broadly unchanged in France. As regards worker groups, these differences reflect the stronger dynamism of female participation observed in the Netherlands and Spain relative to France, but also a small increase in male participation in the Netherlands and Spain against the decline observed in France. These differences are likely to reflect important heterogeneity in the factors determining individuals labour supply decisions across euro area countries.

The increase in the propensity of the euro area population to work or to search for and to be available for jobs has been the one of the main drivers of the substantial increase in euro area labour supply that has accelerated since the mid-1990s. The upward trend has reduced the gap in the use of labour input between the euro area and other economic areas, such as the United States, and has made a positive contribution to output growth and welfare in the euro area. A number of factors could have contributed to this increase: robust, employment intensive economic growth (in particular from the mid-1990s onwards), reforms in the labour market that have focused on increasing the supply of labour for groups with lower attachment to the labour market, changes in cultural attitudes towards work (particularly for women), as well as demographic factors, such as the larger share of the population in prime working age.[2]

We use harmonised data from the European Labour Force Survey (LFS) and a cohort-based model of labour force participation to analyse determinants of participation in the euro area and the

[2] For a detailed description of labour supply in the euro area countries and related policy issues, see Masuch et al. (2008)

five largest euro area countries (Germany, France, Italy, Spain and the Netherlands) over the last few decades. The model is used to decompose time-series of age-specific participation rates into the impact of the business cycle, observed structural determinants of participation (such as labour market institutions) and unobserved determinants captured by age and birth-year specific (i.e. cohort) effects.

The propensity to participate evolves substantially over the life-cycle, and as a result the age-participation profile traces an inverted u-shape profile that peaks at prime working age. In general terms, the participation rates of younger workers (those below 30) and older workers (those above 50) change from one age group to another, whereas the substantially higher participation rates for those in prime working age show a relatively flat profile between the ages of 30 and 50. The age-participation profile is captured by the age-specific effects. At the same time, the age-participation profile is continuously shifting. The cohort based model captures parallel shifts in the profile that are specific to a birth-year through the unobserved cohort effects. While cohort effects generally encompass any factor associated with a particular birth year, they are likely to reflect the impact of individual choices made early on in life (for example regarding fertility, maternity leave and/or education) and persisting throughout the life-cycle. In terms of underlying determinants, they may reflect crowding-out effects or slowly evolving preferences, social norms or institutions.[3] Finally, potential changes in the shape of the profile are captured through observed time-varying determinants, such as demographic trends and changing labour market institutions. We estimate the model separately for individual euro area countries and aggregate the results. The model therefore also fully incorporates the role of heterogeneity across countries.

We use the model to explain changes in trend participation rates over time and also to project them forward. Projections that take age and cohort effects and the changing population structure into account provide a useful benchmark scenario for future labour supply. In particular, a cohort based model takes into account the extent of the pass-through of participation behaviour from the young cohorts to the oldest cohorts. Looking forward, demographic factors will become less favourable with population ageing increasing the importance of positive participation trends within age and gender groups in sustaining potential growth in the euro area.

Our paper is related to two main strands of literature. First, our main focus is on accurately estimating trends in participation based on both observed determinants and the unobserved age and

[3] Fernandez (2007) builds a model of female participation that based on culture and learning, Based on the model she argues that culture can explain the increase (and the S-shaped pattern) found in data of female participation rates in the United States.

cohort effects. For this purpose we use a modified version of the cohort-based model presented in Fallick and Pingle (2007) and applied in Aaronson et al. (2006) to data for the United States. By simultaneously estimating participation equations for single ages for each gender and taking advantage of cross-equation restrictions the model provides a detailed account of the role of age and cohort effects on the aggregate participation rate. Fallick and Pingle (2007) find that these effects provide additional insights compared to time series based trend/cycle decompositions. For example, they find that the levelling off of the increase in the propensity to participate at cohorts born around 1950 suggests that increased labour market attachment is less likely to support an increase in the participation of females. Euwals *et al.* (2007) and Fitzenberger *et al.* (2004) estimate models with cohort effects for the Netherlands and Germany (respectively). Euwals *et al.* (2007) use a cohort based model and LFS microdata to evaluate female participation in the Netherlands. They find that unobserved cohort effects have played an important role in explaining the increase in female participation from 1992 to 2004. Fitzenberger *et al.* (2004) use an alternative age, cohort, and period accounting model that relies of functional form assumptions to separately identify the three effects to study participation and employment in Germany.[4]

Second, a number of studies have documented the impact of labour and product market institutions on unemployment and employment in European countries (for a recent contribution and review of the literature, see Bassanini and Duval, 2006). Participation decisions have received less attention in this context. For the OECD countries, Blöndal and Scarpetta (1999) and Duval (2006) focus on older workers and their retirement decisions and Jaumotte (2003) on females. Genre et al. (2005) and Genre et al. (2008) focus on group specific participation rates in European countries. Using annual data for a panel of European Union countries, they estimate participation equations for age and gender groups in order to identify the impact of institutions in participation decisions. They find that labour market institutions indeed matter for labour supply: higher union density, more employment protection and more generous unemployment benefits lower participation rates. Genre et al. (2008) also find, using lagged participation rate as a proxy, that a common (across countries) cohort effect is an important element for understanding participation rates of older women (those between 55-64) in European countries.

We find that analysing participation behaviour both between (age and gender effects) and within (cohort effects) detailed age and gender groups is particularly useful for modelling trends in

[4] Other studies that use closely related methods based on cohort effects to analyse participation include Beaudry and Lemieux (1999) for Canada and Fukuda (2006) for Japan. In addition, Carone (2005) and Burniaux *et al.* (2004) take advantage of cohort effects to project participation rates for EU and OECD countries (respectively).

euro area aggregate participation rates and projecting them forward. Our results suggest that age and cohort effects explain a substantial part of the recent increase in labour force participation rates in the euro area, although not the surge since early 2000s. Cohort effects are particularly relevant for women, with those born in the 1920s and 1930s less likely and those born in the late 1960s and early 1970s more likely to participate in the labour market over the life-cycle. There is substantial variation in cohort effects across the five largest euro area countries that we analyse. Depending on the country, the estimated cohort profiles suggest an increase of 10 to 30 percentage points in female participation rates. We also find that a number of observed determinants, such as labour taxes, union density, unemployment benefits and the average number of children have had an impact on labour force participation rates, although the specific impact varies across age and gender groups and countries. Looking forward, while they continue to provide some upward support to participation rates of women in the euro area, positive cohort effects are not large enough to compensate for the downward impact of population ageing on labour force participation rates in the euro area.

The rest of the paper is organized as follows. We describe recent changes in labour force participation by age and gender groups in Section 2. In Section 3 we describe the data used throughout the paper and the cohort based model of participation. In Section 4 we present results from the model in three parts. We first illustrate the role of age and cohort effects and the ability of trend participation rates derived from a basic model with only age, cohort and business cycle effects to follow actual participation rates. Second, we add a number of indicators of time-varying labour market institutions to control for the impact of observed labour market reforms on trend participation. Finally, we present projections for male and female participation rates up to 2030 based on the model. While the focus is on the euro area, we also estimate the model separately for a number of euro area countries. Finally, we summarise our results and conclude in Section 5.

2. Labour force participation by age and gender in the euro area

Participation behaviour and its determinants vary systematically by age and gender and changes in group-specific participation rates translate into the aggregate through an evolving population structure.[5] As a result, analysing participation behaviour of detailed age and gender groups is essential for understanding aggregate participation developments. We therefore, first

[5] Naturally, participation behavior varies also across other personal characteristics, such as education and skills, immigrant status etc. We focus on age and gender for reasons of data availability: in particular, LFS data by education categories is only available from the early 1990s onwards. That data shows that more educated workers tend to have higher participation rates and that an increase in overall educational attainment over time has coincided with an increase in participation rates, particularly for women.

describe recent developments in group–specific participation rates in more detail. We then assess the impact of the changing population structure on the aggregate participation rate.

Labour supply and participation rates evolve substantially over the life-cycle, tracing a well-known overall inverted u-shape profile of participation rates that peaks around the prime working age. Figure 2 illustrates these profiles for euro area males and females in 2007. The participation rates of younger workers (those below 25) and older workers (those above 50) change substantially from one age group to another, whereas the substantially higher participation rates for those in prime working age show a relatively flat profile between the ages of 30 and 50. The age participation profile for females is always below, peaking earlier, than the profile for men, and showing a smaller gap at younger than at older ages. These age participation profiles for males and females are continuously evolving as a result of changes both between and within age groups. Overall, since 1983 the female profile has been lifted up for those above 25 years old and has in particular tilted upwards for older women, with more women staying in the labour market after child-bearing. At the same time, the participation rates for the youngest women have declined. By contrast, a change in the age-participation profile of males is only visible for the youngest males, whose participation rate also declined somewhat.

Focussing on changes in group-specific participation rates helps paint a more precise picture of how the age-participation profiles in the euro area have evolved over time. Figure 2 plots the overall change in participation rates in two time periods, 1983-1995 and 1995-2007, for each single age. These two periods are comparable both in terms of length and in terms of economic developments (i.e. the business cycle). Starting with males, the change in trend observed in the mid-1990s is mostly accounted for by the youngest ages. The participation rates of those between 15-24 years old switched from declines between 5 and 25 percentage points in the pre-1995 period to a stabilisation and even small increases since then. At the same time, regarding the oldest ages, the participation rates of those between 60-64 years old switched from a decline of around 10 pp on average to an increase slightly below 10 pp on average (see the upper panel of Figure 3). This pattern is also shared by those between 55 and 59 years old. Moving to females, the ongoing increase in female participation over the two time periods considered appears to result mainly from the sustained increase recorded for those between 25 and 58 years old (see lower panel of Figure 3). This has been supported, since the mid-1990s by a much smaller decline in the participation rates of the youngest and by an increase for the oldest. For both males and females, the increases in participation rates for the youngest and oldest workers may be related to the impact of labour market reforms that have focused on groups with a weaker attachment to the labour market.

Figure 2 also hints at possible birth year or cohort specific effects in participation behaviour. In particular, focussing on changes in female participation rates, the hump-shaped pattern of an increase in participation for those between 25 and 58 years old has shifted towards older age groups over time. For example, while the age group recording the highest increase in participation in 1983-95 was between 40 and 45 years old, for the next twelve year period (1995-2007) the highest increase took place for those between 52 and 56 years old. This pattern is reminiscent of cohort specific participation effects, i.e. female participation behaviour for a particular cohort persists over time. Cohort effects generally encompass any factor associated with a particular birth year. They are likely to reflect the impact of different cohorts of the population on labour market participation emerging as a result of individual choices made early on in life (for example regarding fertility, maternity leave and/or education) and persisting throughout the life-cycle. Beyond potential crowding-out effects stemming from the size of the cohort entering the labour market and differences in human capital investment over time, these cohort effects are likely to reflect evolving preferences, social norms or institutions. In terms of the age-participation profile, these cohort effects shift the whole profile up, as discussed in the previous section.

At the country level, we can observe somewhat different participation profiles in 2007, pointing to important heterogeneity in participation behaviour. For instance, the gap between males' and females' participation rates is more substantial in Italy and Spain than in France, Germany and the Netherlands, especially for those in prime age. At the same time, while the participation rates of the youngest age groups are comparable between countries (at levels of 10-30%), they turn out to be much higher in the Netherlands (at around 60%). Finally, for the oldest age groups (60-64 years old), differences are mostly concentrated in female participation, which varies from 10% in Italy to around 30% in Germany, while for males, participation rates are generally between 30-50%, with the only exception of France (below 20%).

In addition to changes in group-specific participation behaviour, the composition of the euro area population has changed over time. How relevant has the change in composition been for the overall participation rate? This can be measured by applying the change in the population composition between two periods of time to the participation rates of the first period, by age and gender groups. Table 1 shows that the positive effect of the population composition observed in 1983-1995, around 1.3 percentage point, significantly declined in 1995-2007. This recent fall in the contribution of the population effect results from the decline in the share of the prime age population in favour of older groups with lower participation rates. In particular, the contribution of those between 25-34 years old in 1983-1995 was 1.9 percentage point, i.e. very supportive to aggregate

participation, while it turned out to be negative (-2.4) in 1995-2007. At the same time, the table indicates that the increase in participation across age and gender groups was very significant between the two periods considered. Indeed, even though the population effect declined in 1995-2007, the overall participation rate increased much more (5.7 compared to 1.5 in 1983-1995). Looking forward, population ageing implies that the older age groups within the working age population gain more weight: those above 55 years old that are expected to be around 20% of the working age population in 2015, compared with 17.6% in 2007. In contrast, the weight of the youngest age groups, i.e. below 24 years, is expected to decline by 1 percentage point over the same period to 16.5%; and the weight of the group between 35 and 44 years old, i.e. those most attached to the labour market, will decline by more than 2 percentage points to 21.4%. The mechanical decomposition based on age specific participation rates and population shares therefore suggests a substantial decline (by 0.6 percentage point) in the aggregate participation rate, putting downward pressure on total labour supply and potential growth in the euro area. This downward pressure intensifies significantly (suggesting a decline of 2.4 percentage points in the aggregate participation rate) if the horizon is extended up to the year 2030, when the group of those between 55 to 64 years old is expected to be around one fourth of the working age population.

3. Data and methodology

The source for data on population, employment and unemployment for detailed age and gender groups for euro area countries is the European Community Labour Force Survey (LFS) compiled by Eurostat.[6] The same LFS data are used by Eurostat to calculate official statistics on participation and unemployment for EU countries. The LFS data are harmonised across countries and therefore particularly well-suited for cross-country comparative analysis. The annual data from 1983 to 2007 are based on the spring (second quarter) results. Data are available for ages from 15 to those over 70.[7]

Constructing consistent data over time requires some adjustments. In the case of Germany, data prior to 1991 have been extrapolated backwards on the basis of the developments in West Germany. We will refer to two euro area aggregates in the paper. The first consists of the euro area

[6] A detailed description of the sampling methods and adjustment procedures used in the LFS can be found in "The European Union Labour Force Survey – Methods and Definitions, 2001", the available variables are listed and described in the "EU Labour Force Survey database – User guide". The change from annual to quarterly periods by Eurostat has resulted in breaks in the LFS survey in many euro area countries. Therefore we rely on the more consistent spring (second quarter) data throughout the sample period, except for France and Austria (first quarter).

[7] Except for Spain where data are available for those above 16.

12 countries before Slovenia, and later Malta and Cyprus, entered the euro area. While there is no information available in the LFS for the euro area countries before they joined the European Union (i.e. for Spain and Portugal prior to 1986, for Austria and Finland prior to 1995), this has been taken into account in the calculation of the euro area 12 aggregate. In particular, data for the euro area 12 aggregate prior to 1996 have been obtained on the basis of the growth rate of the largest aggregate available (i.e. 12 countries in 1995 to 2006, 10 countries between 1986 and 1995 and 8 countries before 1986). The second aggregate (euro area 5) contains only the largest 5 countries of the euro area, namely Germany, France, Italy, Spain and the Netherlands. This aggregate is calculated from the actual and estimated participation rates of the single countries, weighted with their respective population shares.

We have explored alternative indicators of the business cycle (including unemployment, employment and output gap measures). As available unemployment and employment data are drawn from the same sources as the LFS and may suffer from endogeneity problems, we prefer to use the output gap. The output gap is calculated as a deviation of real GDP from an HP filtered trend. In line with Uhlig and Ravn (2002), the smoothing parameter in the HP-filter for annual data is set at lambda = 6.25. The real GDP data for both the euro area 12 and the single countries is taken from the AMECO database.

The full model specifications include a number of indicators for key time-varying institutions. We include OECD indicators for union density, labour taxes, implicit tax for older workers, the unemployment benefit replacement rate, the share of youth in education, average number of children and the marriage rate also used in Bassanini and Duval (2006) and a measure of life expectancy from Eurostat. Note that we rely on time-series variation within a single country only to identify the impact of institutions. Therefore, several important institutional determinants of labour supply that do not generally vary over time, such as the mandatory retirement age, are excluded from this analysis. The impact of these institutions is captured in the estimated age-participation profile.

Finally, in order to construct a scenario for future labour supply, we use population projections from the NewCronos database by Eurostat (EUROPOP2008). EUROPOP2008 contains statistical information on population projections with reference to projected 1st of January population by sex and single year of age, projected vital events (births and deaths) and assumptions concerning Total Fertility Rate (TFR), life expectancy at birth by sex and international migration. In the projections, we have made use of two variants: projections with and without migration.

The estimation strategy is based on the cohort-based model presented in Fallick and Pingle (2007). Specifically, we estimate a system of constrained least squares regressions for single ages 15 to 70 and over separately for men and women:

$$\ln\left(\frac{LFPR_{g,t}}{1-LFPR_{g,t}}\right) = \alpha_g + \sum_{b=1917}^{1992} C_{g,b,t}\beta_b + \lambda_g X_{g,t} + \varepsilon_{g,t}$$

The dependent variable is the logistic transformation of the participation rate for males or females. We use the logistic transformation to ensure that predicted participation rates remain bounded between 0 and 100 and undo the transformation after estimation. The coefficient α represents an age effect that is constant over time and measures the average propensity to participate in the labour market at a certain age. Alphas for all ages trace an underlying fixed age-participation profile.

The coefficients $C_{g,b,t}$ represent dummies for the different birth years and are equal to one if the birth cohort *b* appears in age *g* at time *t*. Within each gender group and country, the coefficient β is constrained to be the same across equations. This allows an identification of cohort effects separately from the age and business cycle effects. As a consequence, the coefficients β represent a cohort effects that are constant over time and may be interpreted as the average propensity to participate in the labour force when born in a particular year. The cohort effect shifts the underlying age participation profile up and down, depending on the propensity of the birth year cohort to participate in the labour market throughout their working lives. We include all cohorts in the estimation which results in considering persons born between the years 1917 and 1992. However, as the most recent birth cohorts are only observed when they are very young, we estimate the model without the last eight cohorts.[8] Later, we assign a cohort effect to these cohorts after estimation by setting it equal to the last estimated cohort effect (equal to the cohort effect for those born in 1984).

Finally, *X* contains other variables that have explanatory power for participation rates of particular age groups. In the baseline specification, this encompasses business cycle effects represented by the contemporaneous value and two preceding lags of the output gap. In addition, both the estimated age and cohort effects are potentially influenced by time-varying institutions. In the full model therefore *X* includes also a set of indicators of institutions. Note that the institutions do not vary across ages, although some institutions are included only in the equations for young, female

[8] We do this by replacing the values of the participation rate and the other explanatory variables of the ages affected with means from the rest of the sample. We also restrict the cohort effects of the last eight cohorts to equal the average of the remaining cohorts for the respective age.

or older workers. The coefficients of the institutions are allowed to vary freely across ages, and therefore allow the underlying age-participation profile to tilt.

The total system is estimated based on 1400 age-year observations, with 56 equations, resulting in 56 estimated age and 168 estimated business cycle parameters each and 72 (constrained) cohort parameters. The unconstrained model results in a regressor matrix that is of reduced rank. With the help of the restrictions on the cohort effects, the estimation is nevertheless possible as shown in Greene and Seaks (1991). Significance tests are based on robust (White-corrected) standard errors. The cross-equation constraints identify the cohort effects only up to a scale factor. As in Fallick and Pingle (2007), we therefore normalize the coefficient estimates by setting the parameter of one cohort (here 1969) to one.[9]

4. Results

We present results in three parts. We first illustrate the role of age and cohort effects using a basic decomposition of age and year participation rates into age, cohort and business cycle effects. Second, we add a number of indicators of time-varying observed determinants of participation behaviour, such as labour market institutions. Finally, we present projections for male and female participation rates up to 2030. While the focus is on the euro area, throughout the paper we use country results to illustrate cross-country heterogeneity in participation behaviour. In particular, , the full model with time-varying observed determinants is estimated separately for the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands) and the results, in terms of trends and projections, are then aggregated to form a euro area 5 aggregate.

Figures 3 to 6 show the results from the decomposition to age and cohort effects using the basic model for the euro area (EA12) and the five largest euro area countries. The results suggest substantial and highly statistically significant age effects that show the familiar hump-shaped pattern. For males, underlying euro area participation rates increase until age 30, remain stable until age 50, before gradually declining again (see Figure 4). The overall level of the underlying euro area age-

[9] Alternative models based on pure age, cohort and period accounting have a long tradition in sociological and demographic research and have been recently applied to analyse labour supply in Beaudry and Lemieux (1999) and Fitzenberger et al. (2004). Articles in Mason and Fienberg (1985) provide an early discussion of basic accounting models and applications that rely on functional form assumptions. Fitzenberger et al. (2004) use the basic age/period/cohort accounting model, including polynomial terms to evaluate participation and employment in Germany. They obtain identification by restricting the linear cohort effect to zero. However, from an economic perspective the pure age, cohort and period accounting approach seems rather ad hoc in nature. The current model is therefore an attempt to move beyond a pure statistical decomposition by including observable variables that capture underlying variables that determine participation rates. See also Euwals et al (2007) for a discussion and comparison of different modelling strategies.

participation profile is lower for females, while male participation rates are close to 100% in prime-age, female participation is highest at ages 40-50 at around 45%. In addition, for females the estimated age participation profile features a pronounced dip around early 30s. The dip suggests that a number of women leave the labour market temporarily to start a family, returning to work in their late 30s. The overall pattern of the age effects is similar across euro area countries. However, both the level and shape of the underlying female age-participation profiles differ substantially across countries (see Figure 5). While female participation rates peak at close to 70% in France, they do not exceed 40% in Spain and the Netherlands. The post child bearing age hump is most pronounced in Germany and Spain, and not visible in Italy. These differences point to significant underlying differences in the participation behaviour of European women that are likely to reflect a combination of time-invariant cultural and institutional factors. The results also point to the need to mode the female participation rate using a flexible functional form that varies across countries. While the male participation rate is well characterized by a second order polynomial of age, female participation profiles are more complex and cannot be adequately captured by simple polynomials of age.

The results from the basic model also confirm that cohort effects are statistically significant and robust to age and period effects as measured by an indicator of the business cycle. In line with the descriptive evidence, cohort effects appear more significant in size for females than males. The normalized cohort fixed effects for the euro area are plotted in Figure 6 for both males and females. The results show a broadly declining profile for males and an increasing profile for females. The overall pattern of declining cohort effects for men and decreasing cohort effects for women appears similar to that observed in the United States (see Figure 8 in Fallick and Pingle, 2007). This mix of a positive cohort effect for the middle female cohorts and a negative effect for the younger female cohorts has a large impact on overall labour supply and, as demographic change shifts the weight between birth cohorts, turns out to be a relevant factor for future euro area labour supply. Again country results broadly confirm the overall pattern of estimated cohort effects (see Figure 7). The relative decline in cohort effects for men varies most across countries, with a substantial decline in Italy contrasted with an increase throughout in the Netherlands.

Combining the age and cohort effects, and excluding the business cycle and the error term, provides a measure of trend participation rates for each age group. For both females and males the actual and trend participation rates show a decline in participation of the younger age groups (up to 20-24 for females and 25-29 for males). For those in prime age and for older workers the trends diverge somewhat. For females, actual and trend participation increase for those in prime working age, and post mid 1990s also for older workers. For males, actual and trend participation rates are

either stable or declining for those in prime age, whereas a more recent increase in participation rates for older workers results in a mild u-shaped pattern. Estimated trend participation rates from the simple decomposition capture actual developments reasonably well for most detailed age groups. The model does particularly well in explaining the increasing trend of female participation and the recent increase in the participation of older workers for both males and females (with different timing across genders). In comparison, the results for some age groups suggest that the simple model misses important determinants of participation. Aggregating results for both males and females shows that beyond the broad trends of increasing participation of females and decreasing participation of males, important medium term developments are not fully captured by the simple model. For both males and females this includes a mild slump in participation in the 1990s and the most recent increase beginning around 2004. For males, actual participation rates were also above trend rates as captured by the model in the early 1980s. Overall, while the simple decomposition does well in explaining broad trends in participation, in particular for females, for some groups, age and cohort effects alone are not sufficient to capture trend participation patterns in the euro area.

Going, beyond the basic model, it is likely that other factors, such as time-varying labour market institutions, may have influenced participation trends in the medium term. Therefore, in a second step, we estimate the cohort model for the five largest euro area countries with a number of indicators of observed determinants that may matter for participation decision. We include OECD indicators for union density, labour taxes, implicit tax on retirement for older workers, unemployment benefit replacement rate, the share of highly educated in the youth population, average number of children and the marriage rate also used in Bassanini and Duval (2006) and life expectancy from Eurostat. The list of indicators is suggested by previous empirical analysis on the impact of institutions on labour force participation (for a recent contribution and review of the literature, see Bassanini and Duval, 2006 and Genre et al. 2005 and 2008) and theoretical considerations. In addition, availability of comparable indicators with sufficient time variation limits the list of relevant institutional factors. As the model is estimated using variation over time, institutions with little or no time variation (such as available indicators of employment protection legislation or the retirement age) do not add information to the model and are therefore not included.

A number of hypotheses about the likely impact of these institutional factors can be put forward. First, we expect that declining union density in a number of euro area countries may have contributed to increase participation through its positive impact on expectations about the availability of jobs to those that have been previously inactive. As unions tend to compress the wage distribution,

the decline in unionisation may have more of an impact on those at the lower part of the wage distribution (more likely to be younger and older workers). Second, an increase in labour taxes (observed in a number of euro area countries) over time is also expected to result in lower labour participation by making leisure relatively less expensive. However, from a household labour supply perspective an increase in labour taxes for the head of the household may also result in an increased propensity to participate for other members of the household (more likely to be women). For older workers the implicit tax on continued work, a summary measure of retirement incentives, is likely to be more relevant than the overall labour tax. A higher implicit tax rate is expected to lower incentives to retire early (for the ages 55-64 considered here) and therefore to increase the participation rate of older workers. Third, observed declines in the generosity of the unemployment benefits system, as measured by the replacement rate, in a number of euro area countries is likely to lower the incentive to participate in the labour market by lowering alternative income when unemployed relative to inactivity. By contrast, unemployment benefits may also have a positive impact on participation via wage bargaining, with lower generosity leading to weakening of the insider's position in the labour market relative to the outsiders, or as a proxy for the overall generosity of the welfare system. Fourth, longer life expectancy is likely to lead to higher participation for older workers as they remain active and may also anticipate a longer period of retirement. Fifth, the higher share of young in education relative to older workers is expected to lower participation of young workers. Finally, both the number of children and marriage rates are expected to influence female participation rates. At the typical age for starting a family, both are likely to lower participation rates of women. More generally, both factors may also reflect more general changes in cultural attitudes about the role of women in the workplace. While union density, unemployment benefits and labour taxes are included in the equations for all age and gender groups (in working age), variables relating to education are included only for the youngest workers, life expectancy and the implicit tax on continued work for the oldest workers and, finally, the number of children and marriage rates for females only.

Tables 2 and 3 show the aggregated coefficient estimates and their t-statistics of the observed determinants of participation for three main age groups: young (15-24), prime-aged (25-54) and older (55-64), for all five countries. The coefficients have been aggregated using labour force weights in 2007. Note that the identification of the impact of institutions here relies only on available within-country time variation, which is often limited for the indicators of labour market institutions considered here. As a result, relatively few indicators turn out to be statistically significant. With this caveat in mind, a number of institutional indicators seem to matter, although the magnitude, and in

some cases the sign, varies across countries and age groups. When statistically significant and consistently signed for the age group, in all but one case (young people in Germany), higher labour taxes lower participation rates. This impact is estimated more consistently for males in all countries. Higher union density (in 11 out of 13 statistically significant coefficients) and more generous unemployment benefits (15 out of 20 statistically significant coefficients) also tend to lower participation rates. The positive impact of unemployment benefits is consistent with the interpretation that unemployment benefits impact participation rates negatively either via their impact on bargaining (with increased power for insiders leading to higher bargained wages and lower participation rates for outsiders) or via their role as a proxy of the overall generosity of the welfare state (more generous benefits tend to coincide with more generous welfare benefits for financing non-participation). An exception to this main result seems to be young people in France, whose participation rates are increased by both higher union density and unemployment benefits. The results also suggest that unemployment benefits increase participation of all males and young women in Germany. While not conclusive, these results are suggestive of negative incentive effects for the unemployed stemming from generous unemployment benefits that are also of relatively long duration. In this case, a decline in benefits over time would then lead some unemployed workers (who may have not been actively looking for jobs) to leave the labour force. Overall, the results for union density and unemployment benefits are in line with panel regression results in Genre et al. (2005) and Genre et al. (2008), who also find that higher union density and more generous unemployment benefits lower participation rates.

For females, although the impact is usually not statistically significant, higher number of children on average tends to lower participation whereas a higher marriage rate tends to increase participation rates. Declining fertility in most euro area countries is therefore associated with an increase in female participation rates. Altogether, changes over time in fertility and marriage rates are likely to be correlated with underlying changes in cultural attitudes towards female work. However, in the context of this model, these observed determinants of participation do not appear to capture the increase in female participation in this model.

Other variables appear to be estimated less consistently, with both the sign and statistically significance changing across age groups and countries. The implicit tax on retirement, in the few cases when it is statistically significant, has a positive impact on participation of older workers. With few counterintuitive exceptions (older males in France and females in Germany) increased life expectancy also increases participation of older workers. Both the sign and statistical significance of

the share of youth in education varies across countries, suggesting that investment in human capital may not be well captured in the model.[10]

As regards the business cycle, we find that the sum of the coefficients of current and two lags of the output gap for worker groups are often not statically significant or have a counter-intuitive negative sign (not shown) [11] For some groups of workers the negative sign could reflect "added worker" effects. For example, for individuals in families with a main bread-winner, in good times labour income from the rest of the family members may not be needed, whereas additional income from a second job is needed in bad times.[12] We tried other indicators of the business cycle (unemployment and employment gap measures) with similar results. We therefore conclude that the business cycle has little influence on participation decisions in these countries, in line with results that show that European unemployment and employment rates are mainly influenced by structural factors or interactions of structural factors and shocks (e.g. Bassanini and Duval, 2006 and Blanchard and Wolfers, 2000).

Both age and cohort effects remain jointly statistically significant in all models even after including business cycle indicators and other time-varying determinants of participation. These coefficients can be thought of as capturing the impact of other time-invariant cultural or institutional factors (for the age coefficients) or slowly changing impact of factors that are specific to birth years (for the cohort coefficients). The latter may include factors such as cultural attitudes towards labour market participation (for women in particular) or institutional factors and reforms that are not captured by the observed determinants. Cohort effects appear to be particularly important for women in all five countries. Figure 8 plots the estimated cohort profiles from the model, aggregated to the euro area five (EA5) level. Indeed, for males, the lines indicating participation rates for specific cohorts are mostly overlapping. There is some indication that most recent cohorts enter the labour market later, reflecting the substantial increase in the average number of years spent in education. The same impact is visible also for the youngest female cohort. However, in addition, the cohort profile suggests a substantial shifting up of the age participation profile over time. For prime-aged women, those in their mid 30s and 40s, the participation rate has increased by more than 20 percentage points. Furthermore, while the cohort profile for those born between 1953 and 1962 shows a pronounced dip at child bearing age, this dip is not visible for the next cohort (those born

[10] These effects could be capture better by changes in returns to education. However, we are not aware of comparable estimates that would provide a sufficiently long time-series for this variable to be included in the model.
[11] Detailed results are available upon request.
[12] Prieto-Rodriguez and Rodriguez-Gutierrez (2000) find these effects to be relevant for women in Spain, in line with our finding of negative business cycle effects for women of all ages.

between 1963 and 1973). The higher propensity to participate of females born in the late 1960s and early 1970s has therefore contributed to the increase in female participation in the euro area.

Country results show that participation behaviour differs across the largest five euro area countries and that again this is most evident for women. For women in their 30s and 40s, the estimated cohort profiles show that participation rates of most recent cohorts has increased most, by more than 30 percentage points, in the Netherlands and Spain and the least in France, with roughly 10 percentage points (see Figure 9 for women, results for men are available upon request). The disappearance of the dip at child bearing age is most pronounced in the Netherlands: while the participation rates of women in the late 20s and early 30s for those born in 1950s dropped by as much as 20 percentage points, the more recent cohorts appear to have stayed in the labour market through the child bearing years.

In a third step we plot the trend participation rates from the full model for the euro area five (EA5) and the five largest euro area countries. In addition, using Eurostat projections for the future population of the countries, we project forward participation rates until 2030. The results of both trend and projection for the euro area (EA5), shown in Figure 10, are obtained by aggregating the full model estimates for Germany, France, Italy, Spain and the Netherlands weighting the countries with their respective populations. We assume that age and cohort effects are fixed throughout the sample and keep observed determinants at their 2007 values. In addition, for the young cohorts, i.e. the last eight cohorts of our sample and those that enter the labour market after 2007, we fix their effects to the last cohort effect we estimate, namely those born at 1984. Figure 10 shows the trend from the estimation of the full model together with the actual participation rates. The results clearly show that the full model captures both trends and medium term developments well.

The projected participation rate decreases for males throughout the projection period, while those for females increases slightly for approximately the first ten years of the projection period, before beginning to decline. This pattern is in line with the waning impact of the positive cohort effects for females that continue to support participation rates in the first few years of the projection period. Thereafter, however, the negative impact of population ageing shifting the larger share of the population to older age groups with lower participation rates begins to dominate and dampen the overall participation rate. As a result, the overall participation rate is anticipated to increase slightly up to 2015, by 0.5 percentage point, and then start to decline relatively strongly, to reach a participation rate 2 percentage points below the current level in 2030.

The results of the model imply a more positive outlook for participation than what would result from keeping the participation rates by age and gender groups unchanged at their 2007 level, i.e. accounting only for population effects (see Figure 11 and Table 4). Indeed, in the latter case, the overall participation rate would have declined already in 2015, with a gap of more than 1 percentage point in 2020. There is, nevertheless, some convergence at the end of the projection horizon as the downward impact of ageing intensifies.

Figure 11 and Table 4 also show two alternative scenarios, one that accounts for the impact of the assumption on migration used by Eurostat in its population projections and another one derived from the participation rate projections at the country level published by the European Commission (EPC, 2006). We find that the impact of additional migration is positive. On average, migrants tend to be younger and therefore to have higher participation rates than the native population. The impact is relatively small, but its relevance grows over time – the gap in the participation rate between the migration and non-migration scenario is around 0.1 percentage point in 2015, but reaches 0.6 percentage point in 2030. There is a significant gap between the model based scenario and those that are obtained using EC projections. According to the latter, the overall participation is expected to increase by around 3 percentage points in 2015 and by around 3.5 percentage points in 2030. While it is not straightforward to decompose the difference in terms of underlying determinants, the EC projections clearly incorporate more inertia from past participation trends. A comparison of the scenarios by gender helps to shed some light on the results (see Table 4). It shows, for instance, that the impact of migration in the model estimates is only significant for the male participation rate, while the impact on the female participation rate is negligible. At the same time, the comparison shows that the discrepancy between the model estimates and those derived from the EC projections is more significant for males than for females – for females the gap in participation is 0.9 and 3.4 percentage points in 2015 and 2030 respectively, while for males is 3.4 and 7.1 percentage points.

Country results are shown in Figure 12. The results for all countries point to an ongoing increase in females' participation, with the exception of Spain and France, while males' participation declines in all of them, albeit to different degrees. This is consistent with the estimated cohort effects for females providing upward support to the aggregate participation rates, as detailed above. Note that we keep the effect of institutional variables unchanged in the projections. Therefore, to the extent that past increases are associated with changes in observed determinants instead of the cohort effects, the trend increases are not reflected in the scenario. This is the case for Spain, where

observed determinants appear to explain a significant part of the recent increases in females participation rates. The overall developments indicate an ongoing increase in Italy and, to a lesser extent, in the Netherlands. By contrast, the overall participation rate in Germany, France and Spain is expected to decline.

5. Conclusions

Disentangling structural and business cycle determinants of labour supply as measured by the labour force participation rate in real time poses a challenge for economic policy makers. We use a cohort based model of labour force participation to analyse determinants of participation for disaggregated groups of workers in European countries, with a focus on the euro area. Beyond observed structural determinants of participation the model identifies significant age and cohort effects for detailed worker groups as indicators of (unobserved) structural determinants. We use the observed structural determinants and age and cohort effects to construct trend measures of labour supply and to disentangle the impact of structural and business cycle factors on labour force participation rates.

Our results suggest that age and cohort effects explain a substantial part of the recent increase in labour force participation rates in the euro area, although not the surge since early 2000s. Cohort effects are particularly relevant for women, with those born in the 1920s and 1930s less likely and those born in the late 1960s and early 1970s more likely to participate in the labour market over the life-cycle. There is substantial variation in cohort effects across the five largest euro area countries that we analyse. While cohort effects generally encompass any factor associated with a particular birth year, we speculate that the cohort effects that we observe reflect evolving preferences, social norms or institutions that may well vary across countries. Depending on the country, the estimated cohort profiles suggest an increase of 10 to 30 percentage points in female participation rates. We also find that a number of observed determinants, such as labour taxes, union density, unemployment benefits and the average number of children have had an impact on labour force participation rates, although the specific impact varies across age and gender groups and countries. Looking forward, while they continue to provide some upward support to participation rates of women in the euro area, positive cohort effects are not large enough to compensate for the downward impact of population ageing on labour force participation rates in the euro area.

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Table 1. The contribution of population composition to changes in participation rates
(in percentage points)

	1983-1995	1995-2007	2007-2015	2007-2030
15-19	-1.4	-0.2	-0.1	0.0
20-24	-0.4	-0.8	-0.3	-0.1
25-34	1.9	-2.4	-1.4	-1.9
35-44	1.1	1.9	-1.9	-3.5
45-54	-0.3	1.7	2.2	0.4
55-64	0.4	0.2	1.0	2.8
Total	1.3	0.4	-0.6	-2.4
Change in PR	1.5	5.7	--	--

Sources: EU-Labour Force Survey (Eurostat) and own calculations.

Table 2. Impact of observed determinants: males

	LT	UD	UB	TR	LE	YE
Germany:						
Young	0.00	-0.01	0.10			0.05
	(-0.22)	(-0.33)	(5.07)			(3.68)
Prime-aged	-0.07	-0.03	0.03			
	(-7.03)	(-1.43)	(1.97)			
Older	-0.12	-0.04	0.07	0.03	0.40	
	(-7.89)	(-1.02)	(3.34)	(0.54)	(7.29)	
France:						
Young	-0.16	0.46	0.05			-0.27
	(-4.86)	(5.14)	(2.54)			(-5.00)
Prime-aged	-0.07	-0.04	-0.02			
	(-5.10)	(-2.10)	(-2.28)			
Older	0.02	-0.09	-0.06	0.02	-0.09	
	(0.86)	(-2.06)	(-5.49)	(1.44)	(-2.47)	
Italy:						
Young	-0.14	-0.07	-0.32			0.20
	(-6.10)	(-2.000	(-9.00)			(2.95)
Prime-aged	-0.11	0.00	-0.10			
	(-4.83)	(-0.15)	(-3.85)			
Older	0.00	-0.15	0.06	0.04	0.21	
	(0.08)	(-4.43)	(1.54)	(3.12)	(3.06)	
Spain:						
Young	-0.03	-0.04	-0.12			0.05
	(-3.18)	(-2.24)	(-4.27)			(0.85)
Prime-aged	-0.08	-0.01	-0.11			
	(-6.52)	(-0.50)	(-7.65)			
Older	-0.03	0.01	-0.07	-0.03	0.05	
	(-1.78)	(0.62)	(-2.33)	(-0.59)	(1.49)	
Netherlands:						
Young	-0.08	-0.34	-0.08			-0.02
	(-1.91)	(-5.21)	(-2.97)			(-0.25)
Prime-aged	-0.03	-0.18	-0.08			
	(-1.37)	(-4.42)	(-4.21)			
Older	-0.11	0.05	0.04	0.42	0.14	
	(-2.66)	(0.71)	(1.30)	(4.49)	(2.20)	

Note. T-statistics in parenthesis. LT is labour taxes, UD is union density, UB is unemployment benefits, TR is tax on retirement, LE is life expectancy, YE is youth education.

Table 3. Impact of observed determinants: females

	LT	UD	UB	TR	LE	YE	NC	MR
Germany:								
Young	0.04	0.04	0.05			0.00	-0.10	0.21
	(3.66)	(1.35)	(2.85)			(-0.32)	(-9.22)	(2.95)
Prime-aged	-0.04	0.01	0.01				-0.01	0.04
	(-6.01)	(1.06)	(1.00)				(-1.78)	(0.85)
Older	-0.03	0.04	-0.05	0.09	-0.11		-0.03	-0.08
	(-3.25)	(1.37)	(-3.81)	(2.45)	(-2.12)		(-1.87)	(-1.01)
France:								
Young	-0.08	0.28	0.06			-0.03	-0.43	0.37
	(-2.34)	(2.32)	(2.35)			(-0.32)	(-2.56)	(2.06)
Prime-aged	0.02	-0.10	0.00				0.23	-0.34
	(1.61)	(-4.13)	(-0.77)				(4.39)	(-4.06)
Older	0.02	-0.20	-0.02	-0.03	-0.05		0.02	0.04
	(0.57)	(-3.35)	(-1.44)	(-1.21)	(-1.13)		(0.17)	(0.36)
Italy:								
Young	0.04	0.05	-0.15			0.18	-0.03	0.59
	(1.44)	(1.19)	(-4.05)			(2.24)	(-1.81)	(7.26)
Prime-aged	-0.04	0.02	-0.10				-0.03	0.14
	(-4.07)	(1.51)	(-8.66)				(-4.34)	(4.52)
Older	0.04	-0.02	-0.04	0.02	0.04		0.00	0.12
	(0.77)	(-0.74)	(-0.95)	(1.29)	(0.51)		(0.10)	(1.81)
Spain:								
Young	0.03	0.02	-0.12			-0.11	0.03	-0.17
	(1.74)	(0.68)	(-3.70)			(-0.36)	(0.21)	(-1.57)
Prime-aged	0.00	0.02	-0.08				-0.13	-0.21
	(0.16)	(1.25)	(-4.61)				(-1.45)	(-2.98)
Older	-0.01	-0.03	-0.07	-0.07	0.02		0.09	-0.18
	(-0.34)	(-0.88)	(-1.80)	(-0.58)	(0.59)		(0.37)	(-1.58)
Netherlands:								
Young	-0.08	-0.29	-0.04			0.00	0.08	0.12
	(-1.47)	(-4.26)	(-1.34)			(0.06)	(1.91)	(0.46)
Prime-aged	0.00	-0.06	-0.04				-0.04	-0.09
	(0.03)	(-2.44)	(-2.22)				(-1.87)	(-0.27)
Older	0.04	-0.10	0.05	0.19	0.01		0.06	-0.08
	(0.69)	(-1.52)	(0.70)	(1.31)	(0.16)		(0.61)	(-0.22)

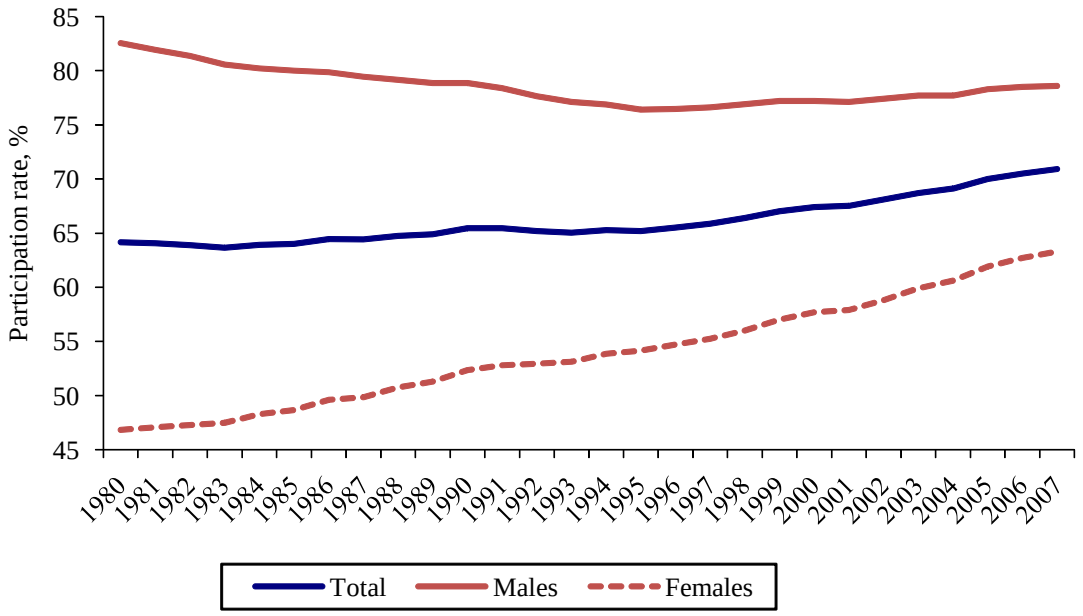
Note. T-statistics in parenthesis. LT is labour taxes, UD is union density, UB is unemployment benefits, TR is tax on retirement, LE is life expectancy, YE is youth education, NC is number of children and MR is the marriage rate.

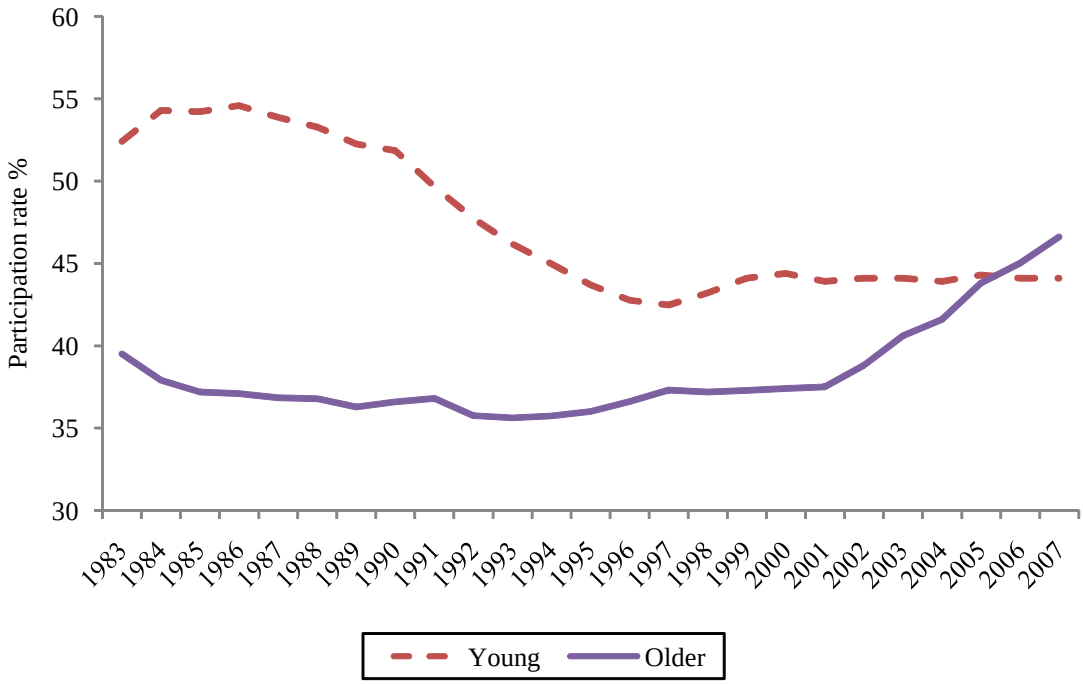
Table 4. Alternative scenarios for future participation rates

	2007	2015	2020	2025	2030
Overall participation rate					
PR (model)	70.9	71.5	70.8	69.7	69.1
PR (model - no migration)	70.9	71.4	70.5	69.2	68.5
PR (2007 level)	70.9	70.5	69.7	68.9	68.8
PR (EC)	70.9	73.8	74.2	74.2	74.5
Females participation rate					
PR (model)	63.3	65.7	65.7	65.2	64.8
PR (model - no migration)	63.3	65.7	65.7	65.1	64.6
PR (2007 level)	63.3	62.5	61.7	61.0	60.9
PR (EC)	63.3	66.6	67.4	67.6	68.2
Males participation rate					
PR (model)	78.6	77.5	76.0	74.4	73.6
PR (model - no migration)	78.6	77.3	75.5	73.6	72.6
PR (2007 level)	78.6	78.3	77.5	76.7	76.6
PR (EC)	78.6	80.9	80.9	80.6	80.7

Note: Euro area obtained as the aggregation of Germany, Italy, France, Spain and the Netherlands. PR (2007 level) refers to a scenario based on unchanged participation rates at the 2007 level. PR (EC) refers to a scenario derived from EPC (2006). Sources: EU-Labour Force Survey (Eurostat) and own calculations.

Figure 1. Participation rates by worker groups in the euro area (EA12)
(percentage points)

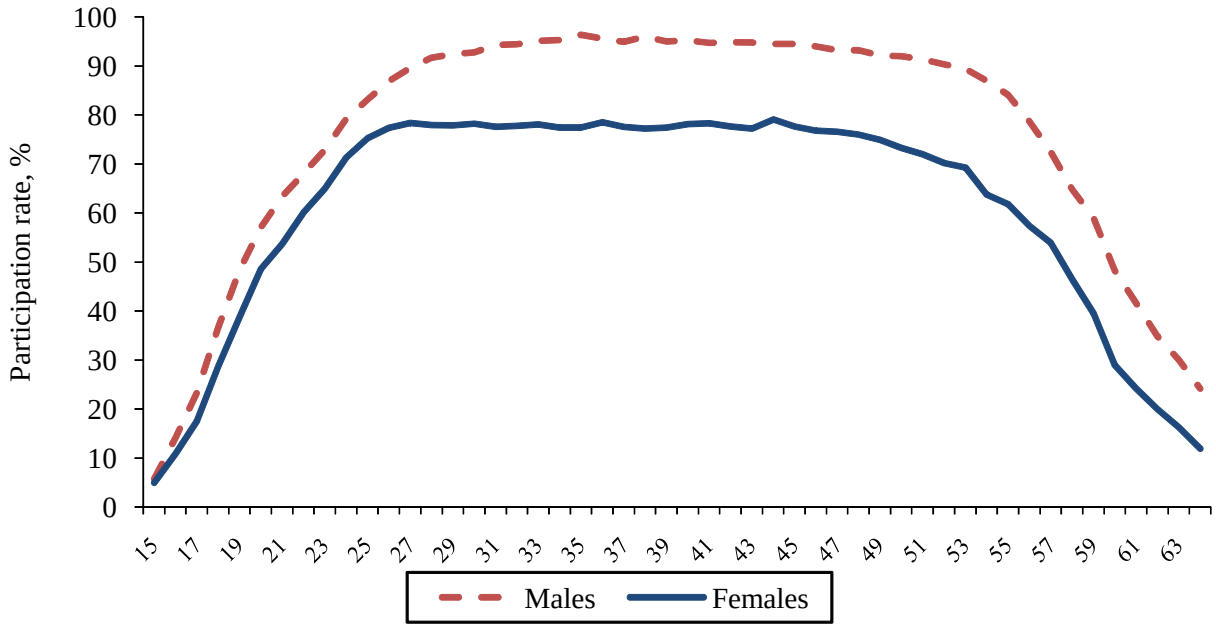




Sources: EU-Labour Force Survey (Eurostat), OECD and own calculations.

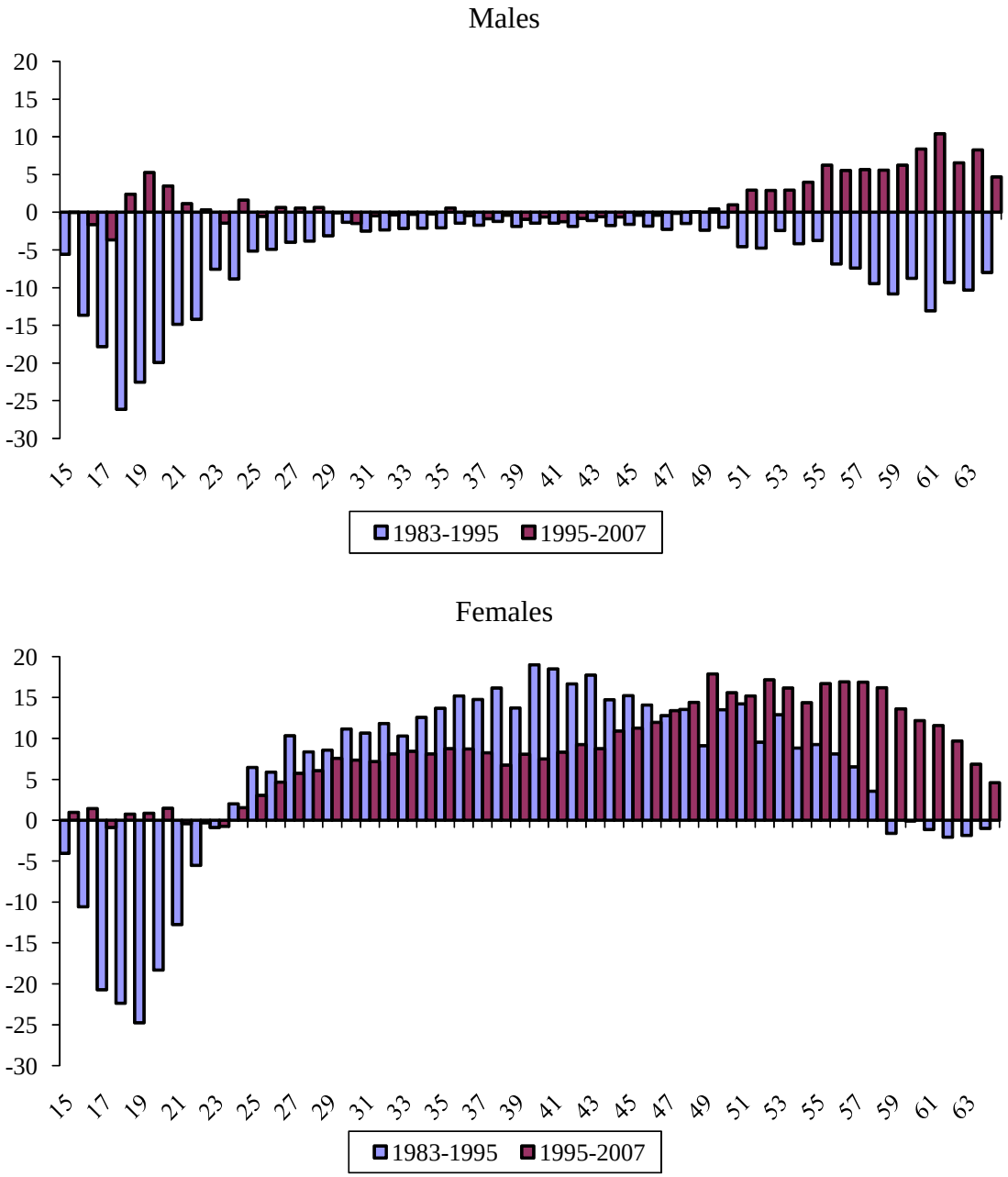
Figure 2. Age participation profiles by gender in the euro area (EA12), 2007

(as % of the population in each group)



Sources: EU-Labour Force Survey (Eurostat) and own calculations.

Figure 3. Changes in participation rates by age and gender in the euro area (EA12)
(percentage points)



Sources: EU-Labour Force Survey (Eurostat) and own calculations.

Figure 4: Estimated age-participation profile (EA12)

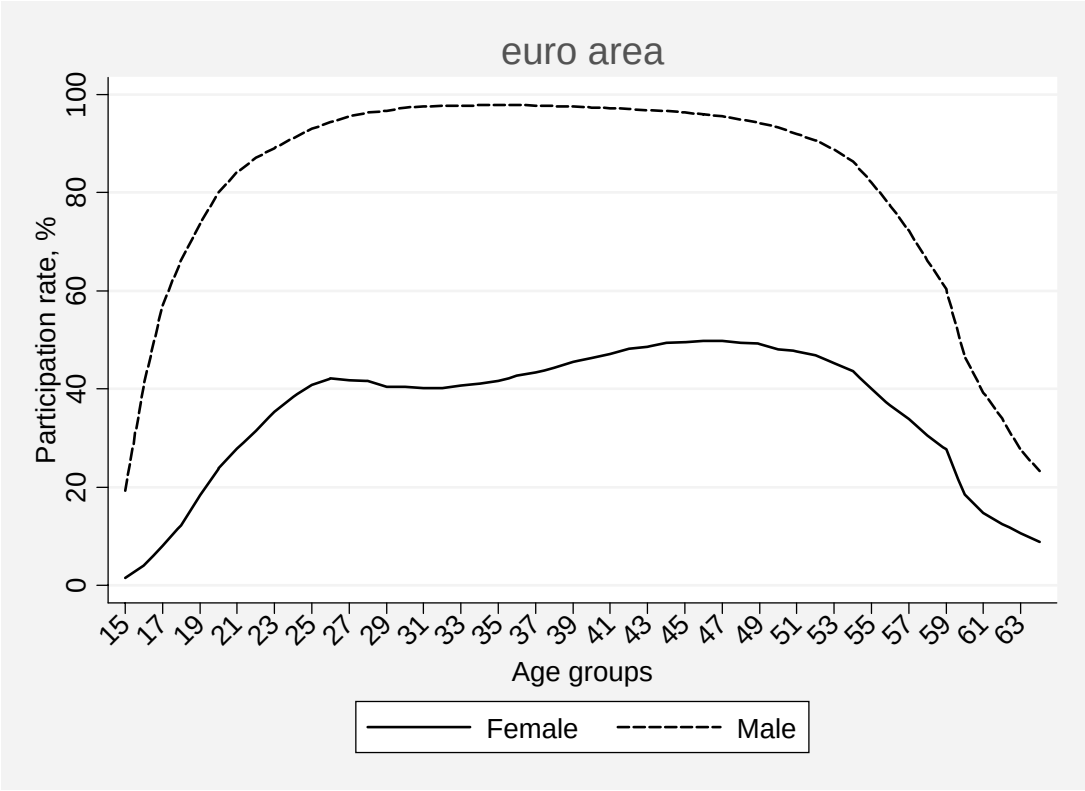


Figure 5: Estimated age-participation profiles

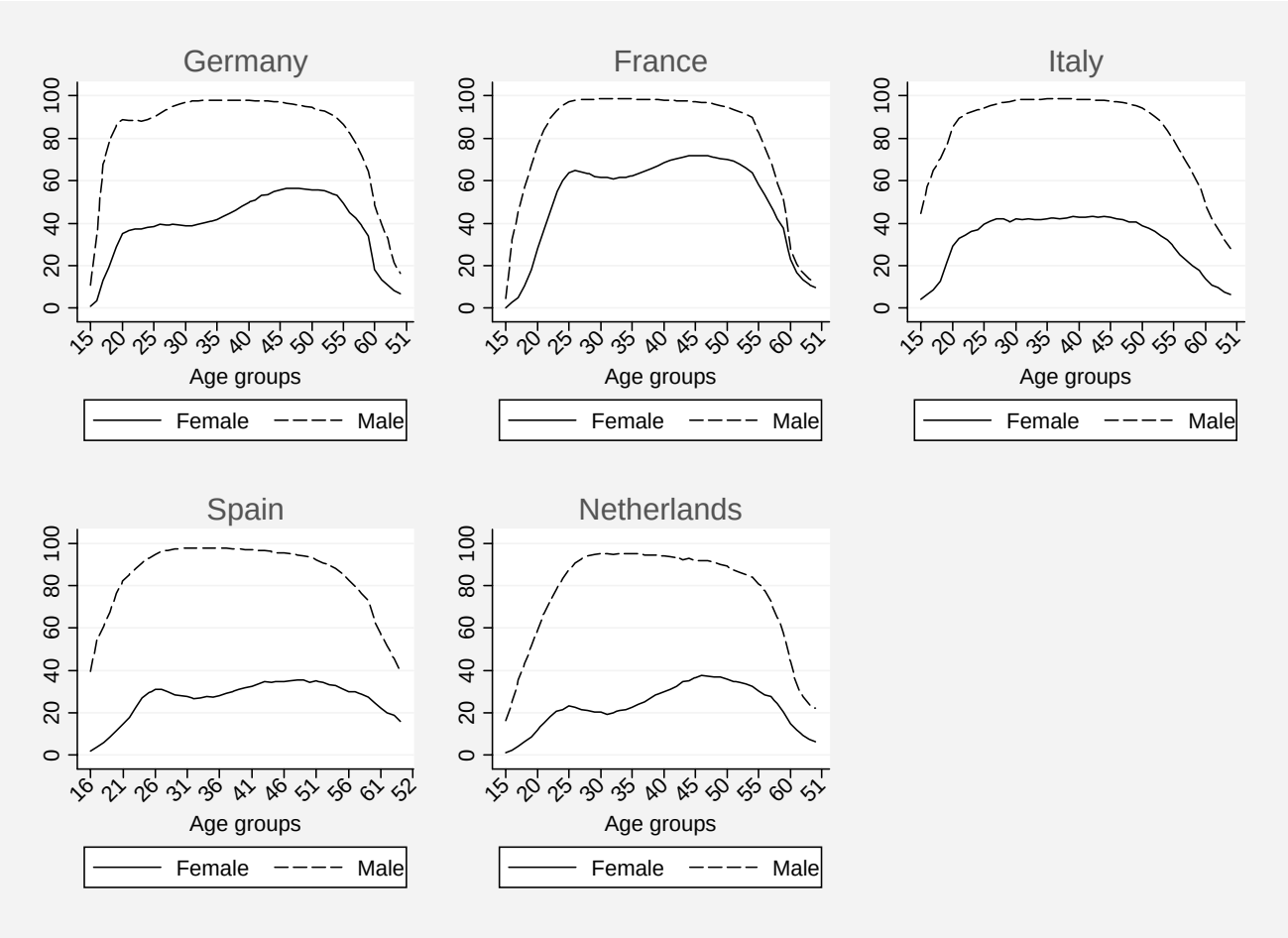


Figure 6: Estimated cohort effects (EA12)

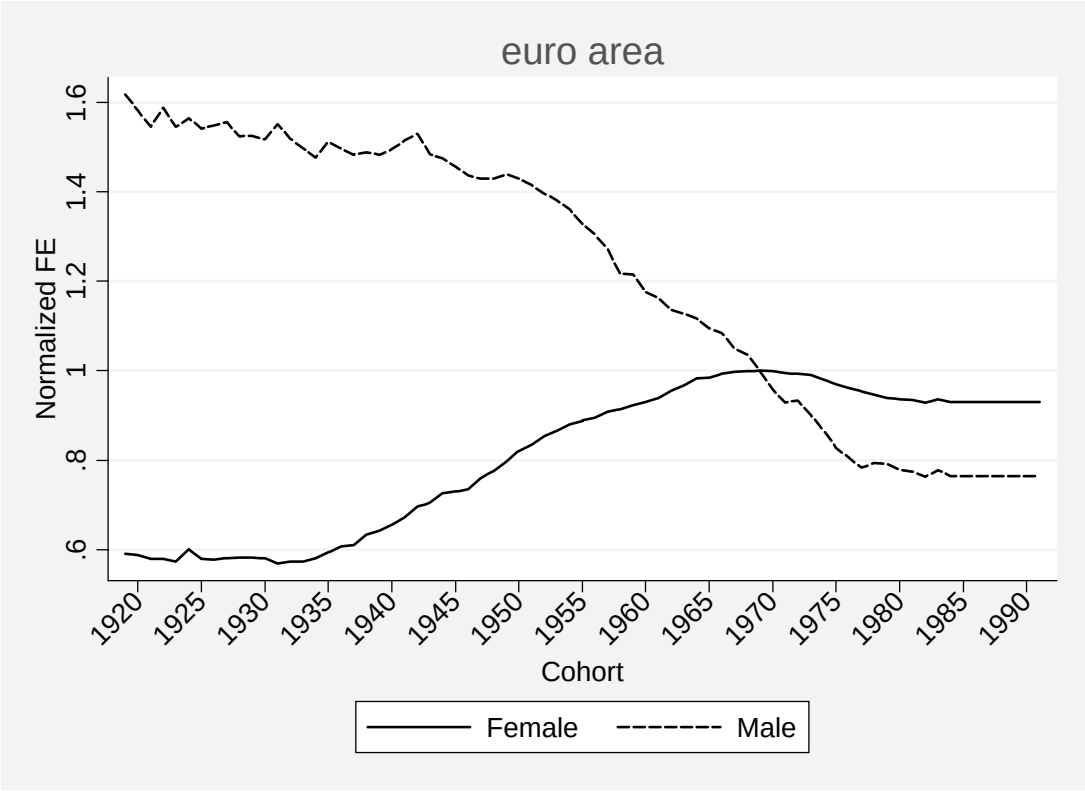
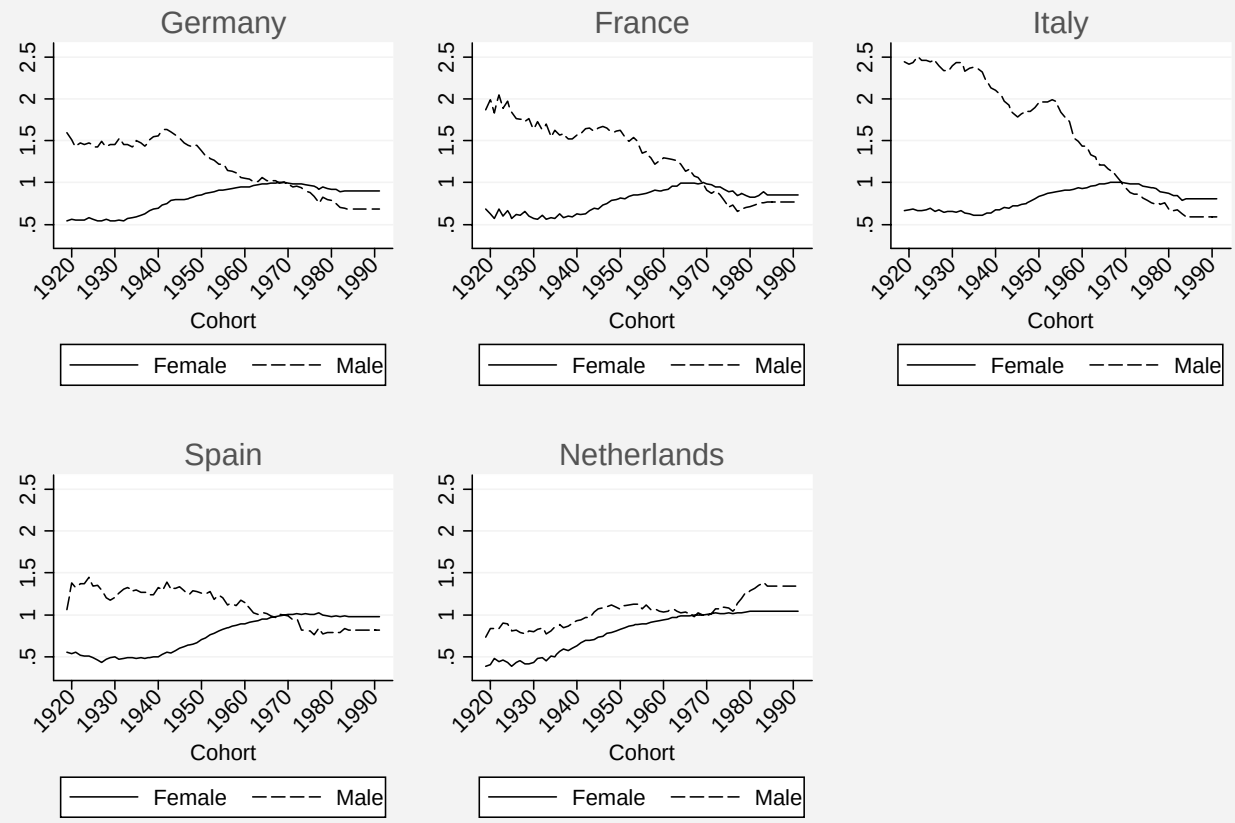


Figure 7: Estimated cohort effects



Note: X-Axis denotes fixed effects normalized to equal 1 in 1969

Figure 8: Estimated cohort profiles in the EA5

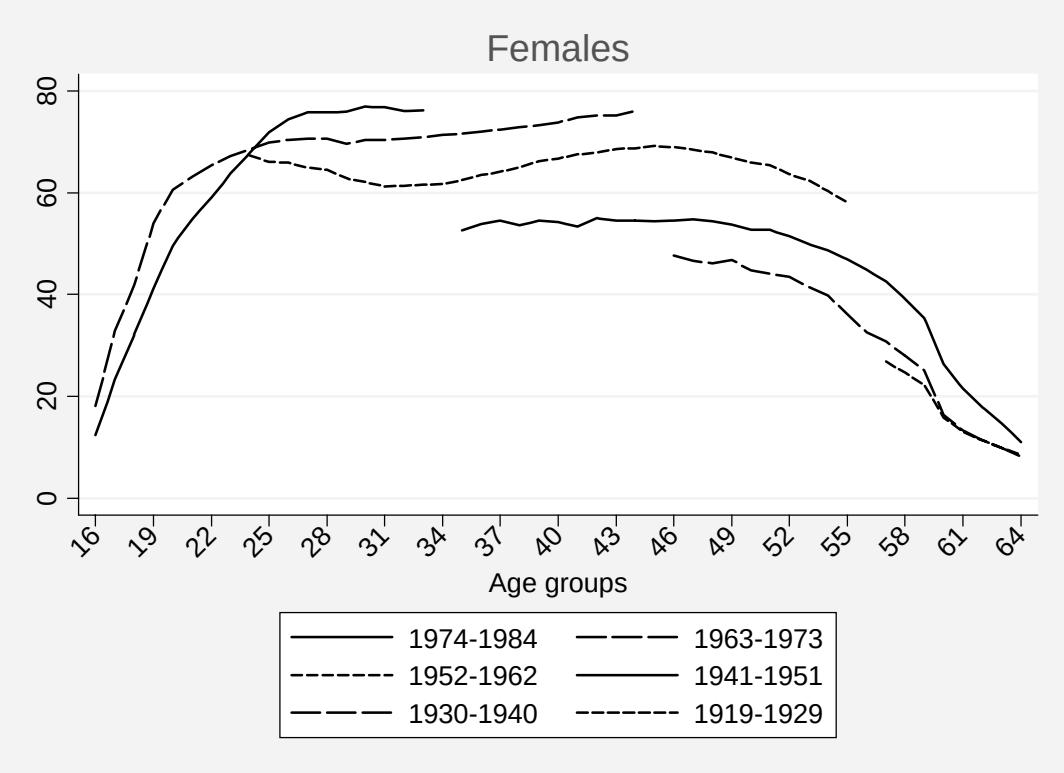


Figure 9. Cohort profiles by country, females

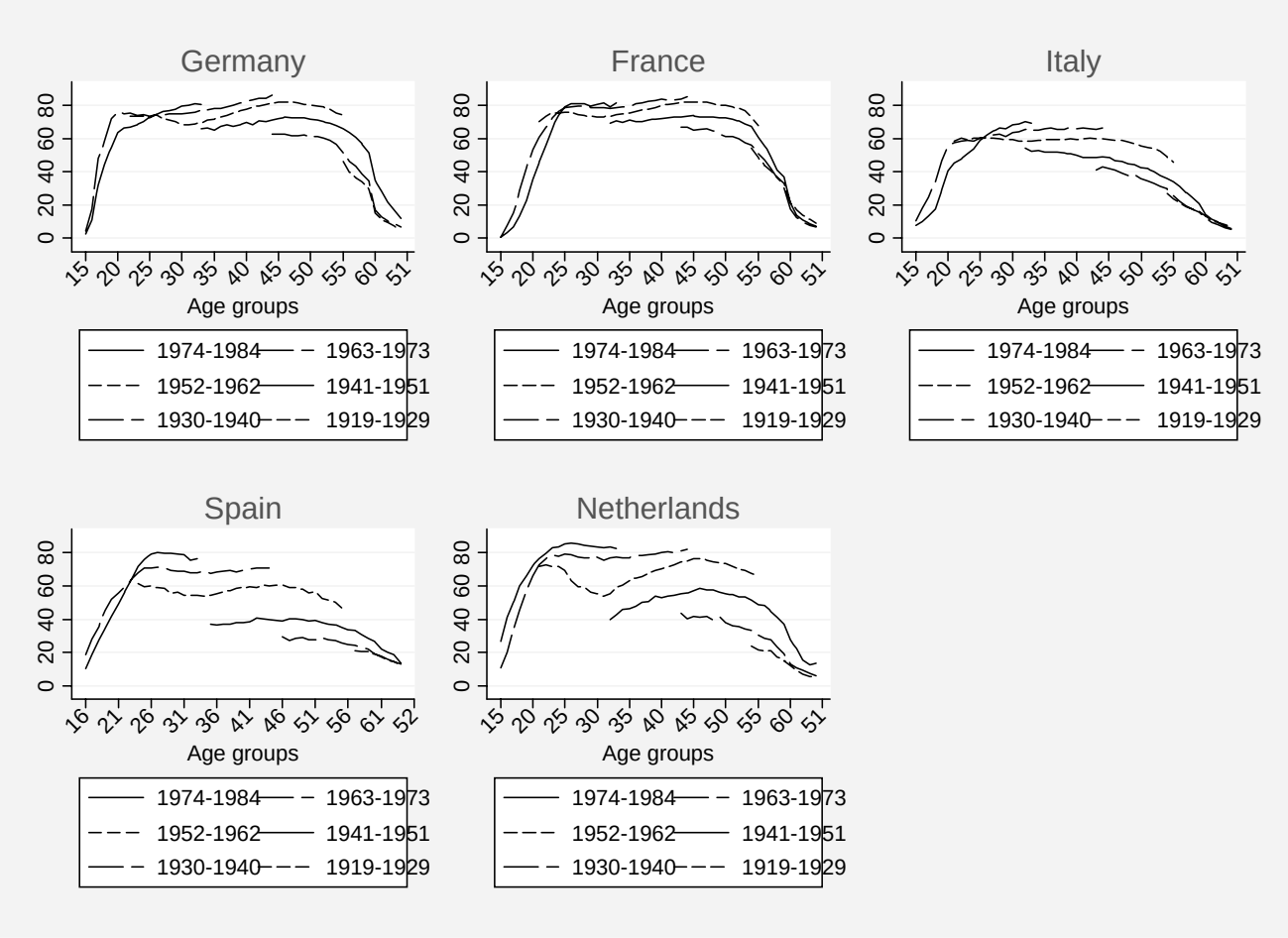


Figure 10. Trend participation and projections in the EA5, by gender,1986-2030

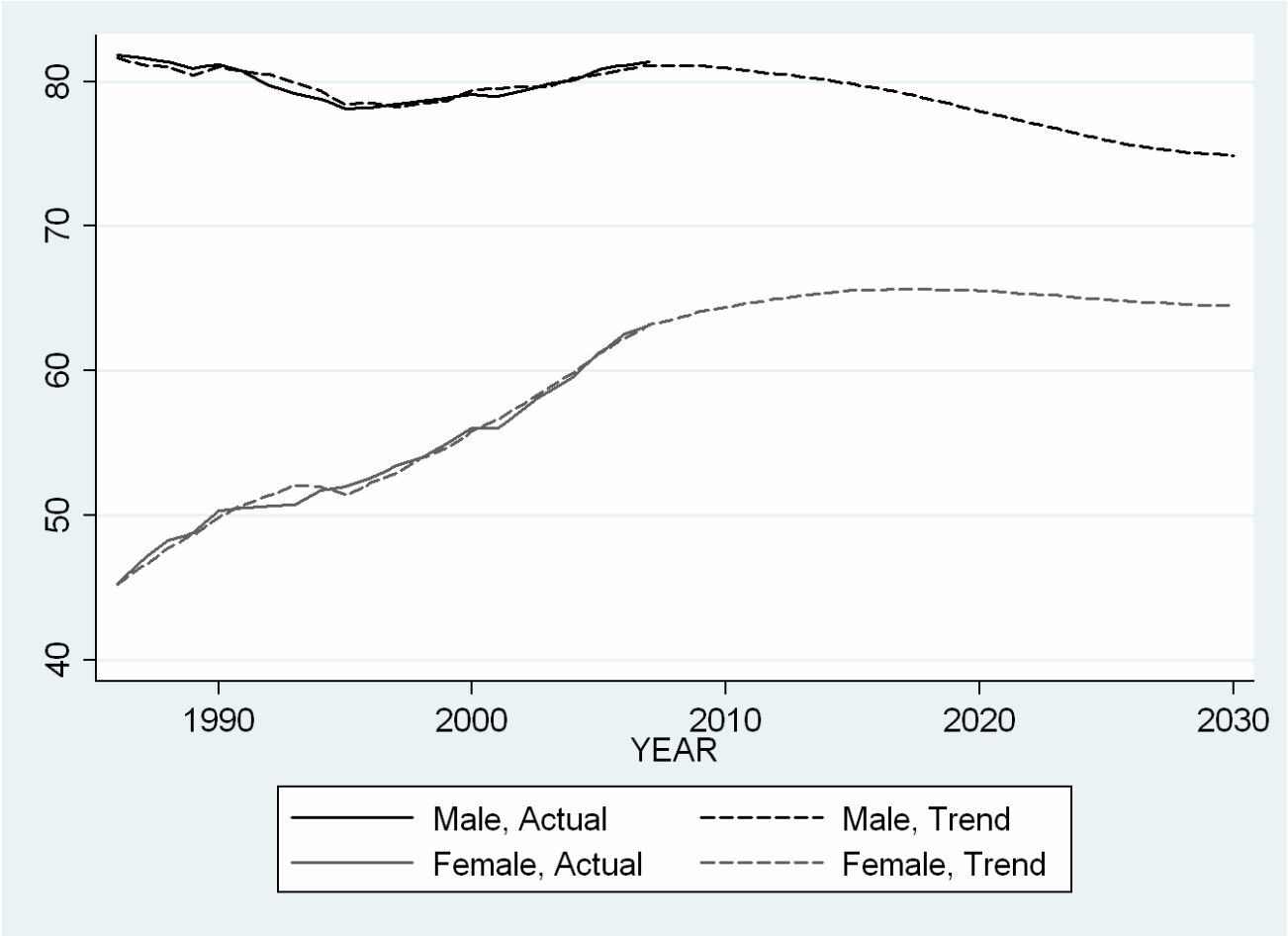


Figure 11. Participation rate projections in the EA5, 2008-2030

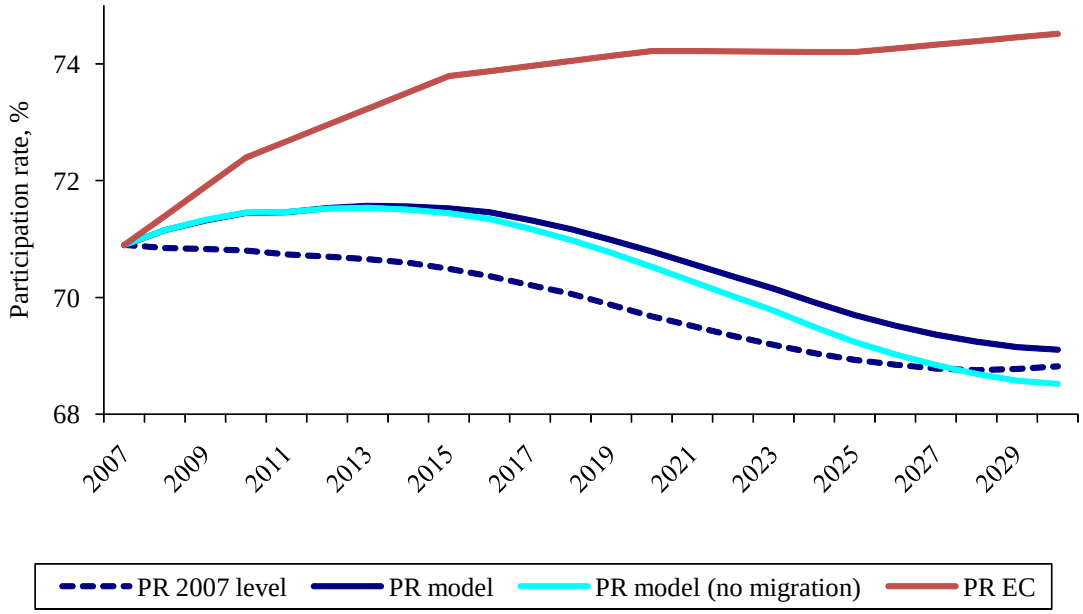
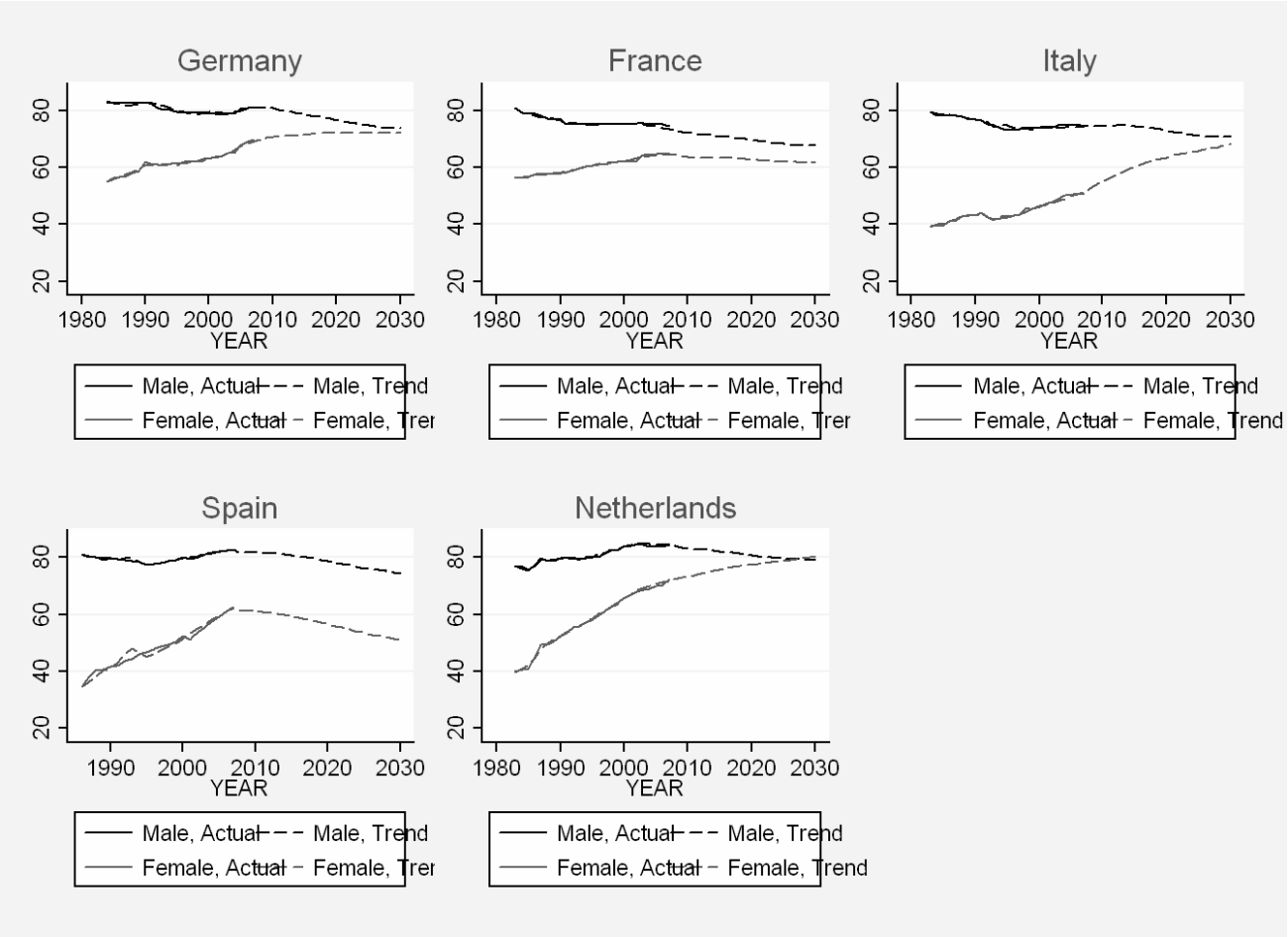


Figure 12. Trend participation and projections in the EA5, 1986-2030



Appendix A: Trend participation rates in the EA5 by age

Figure A1. Young females

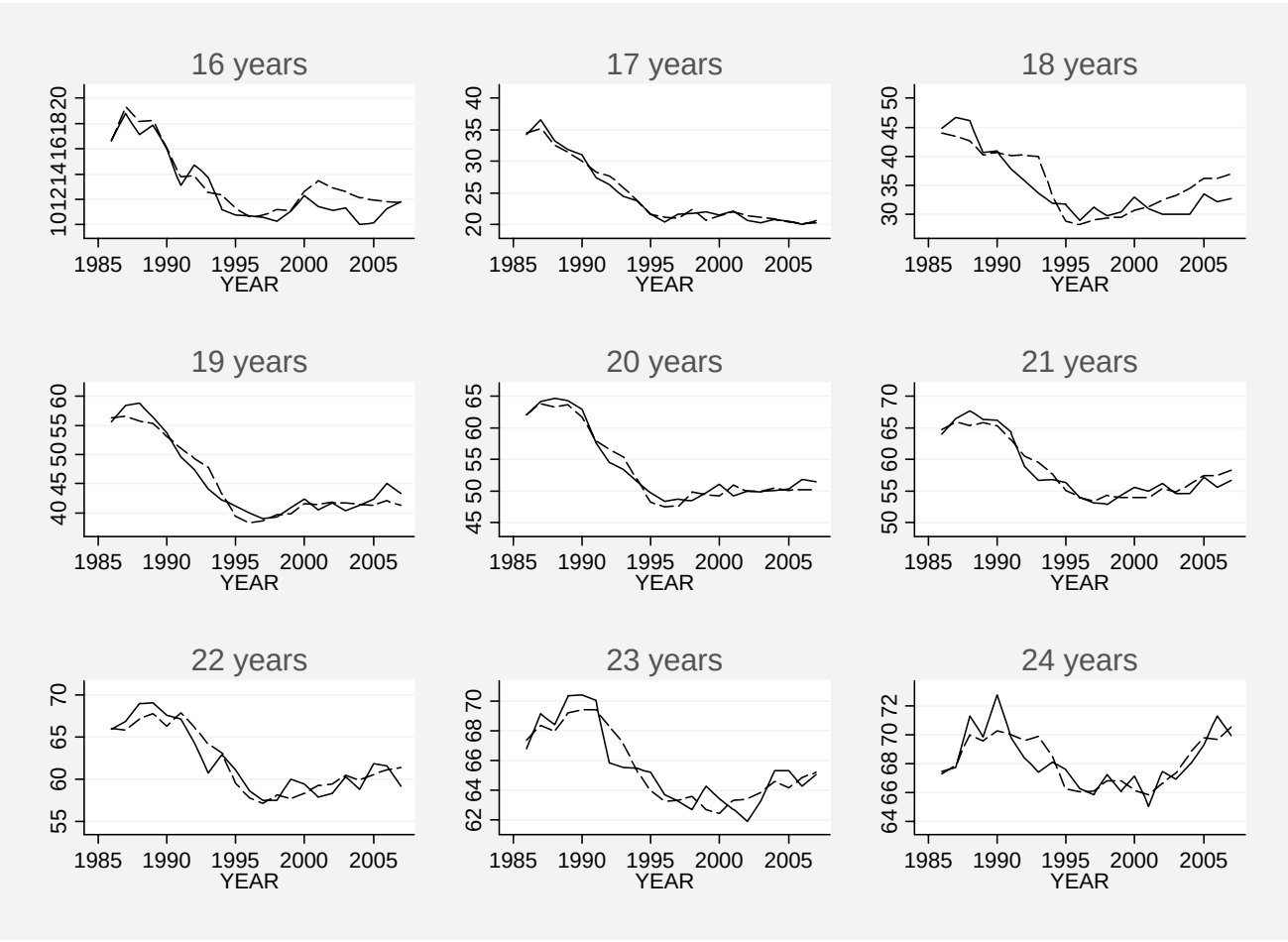


Figure A2. Prime-aged females

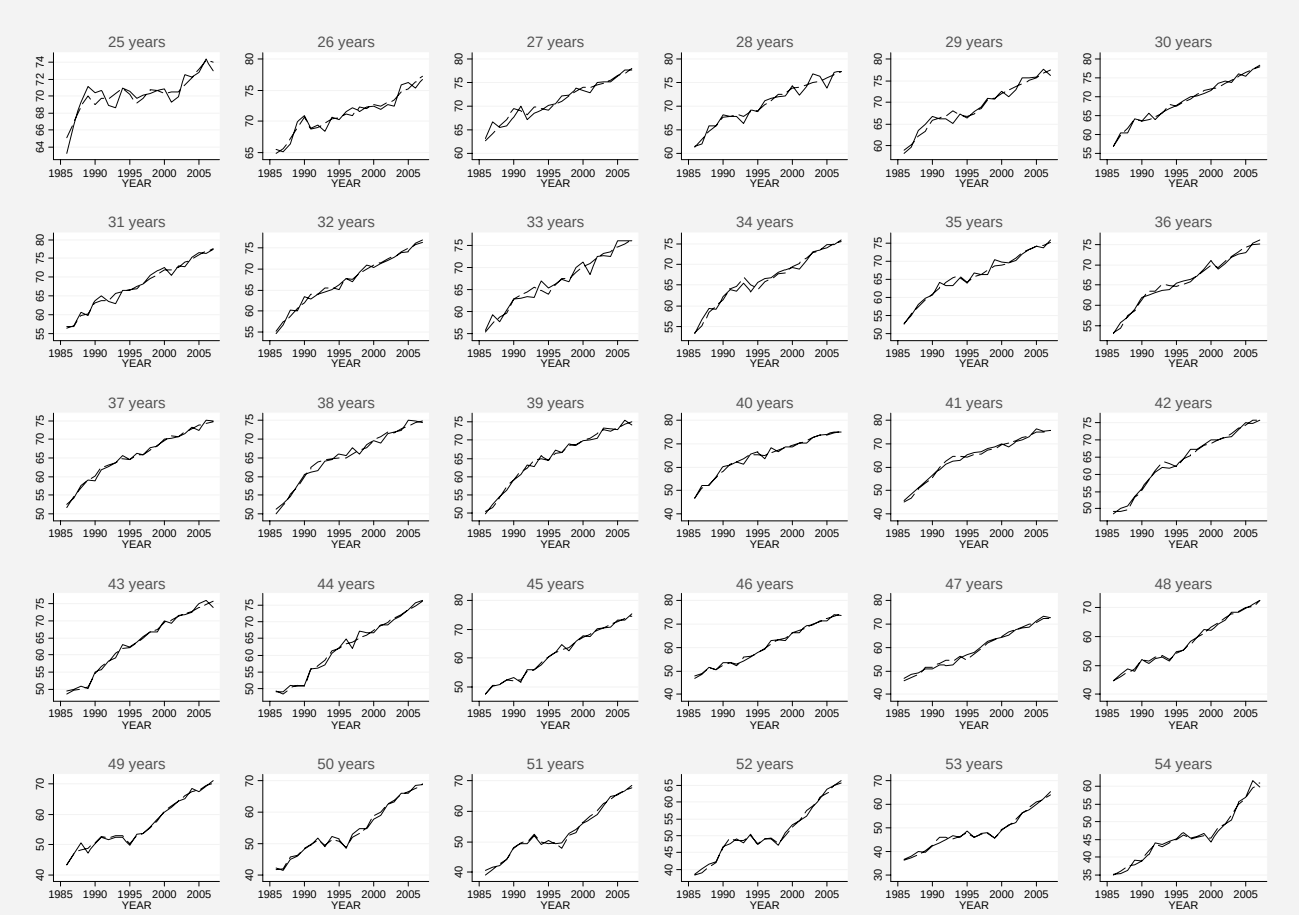


Figure A3. Older females

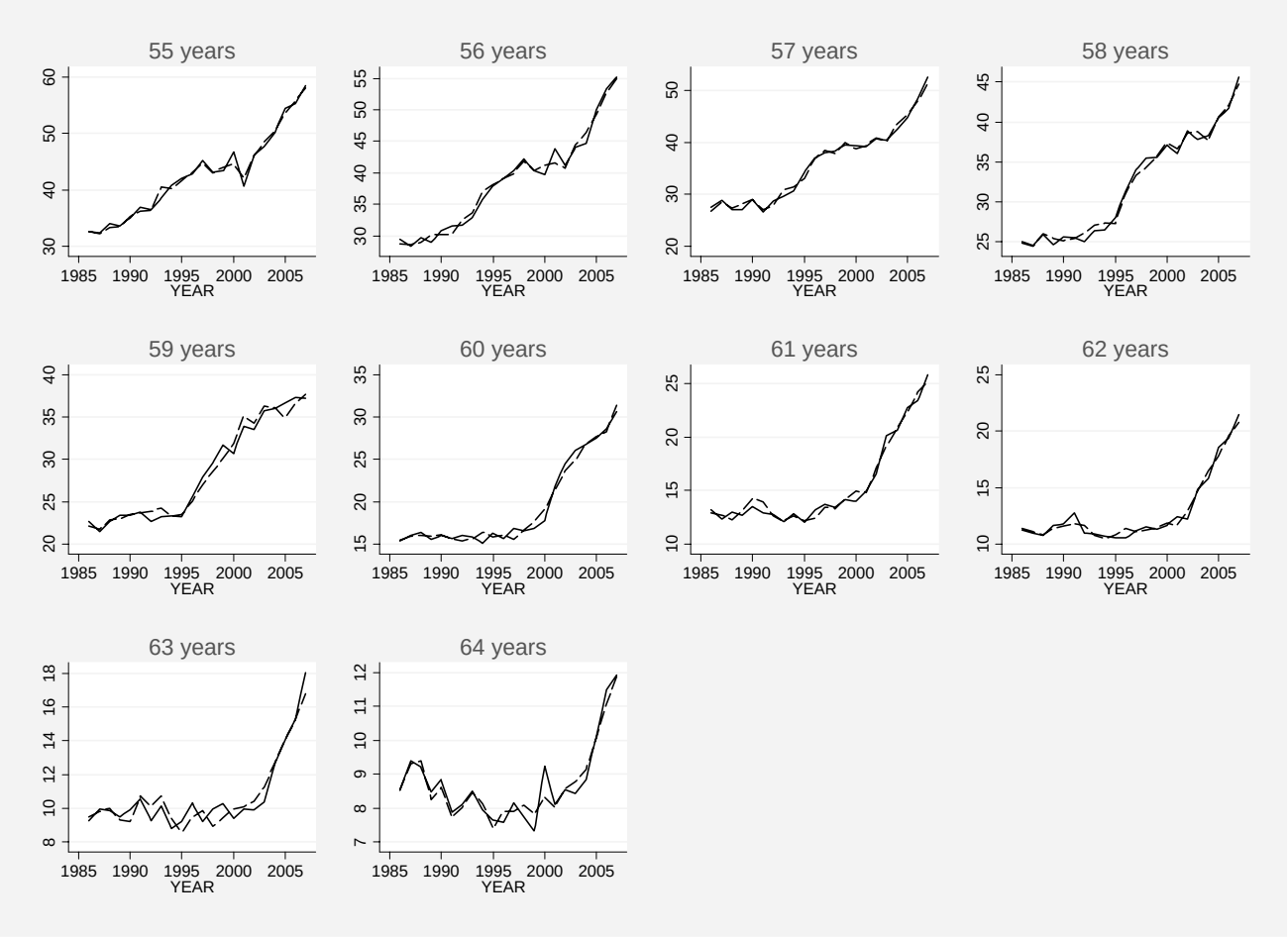


Figure A4. Young males

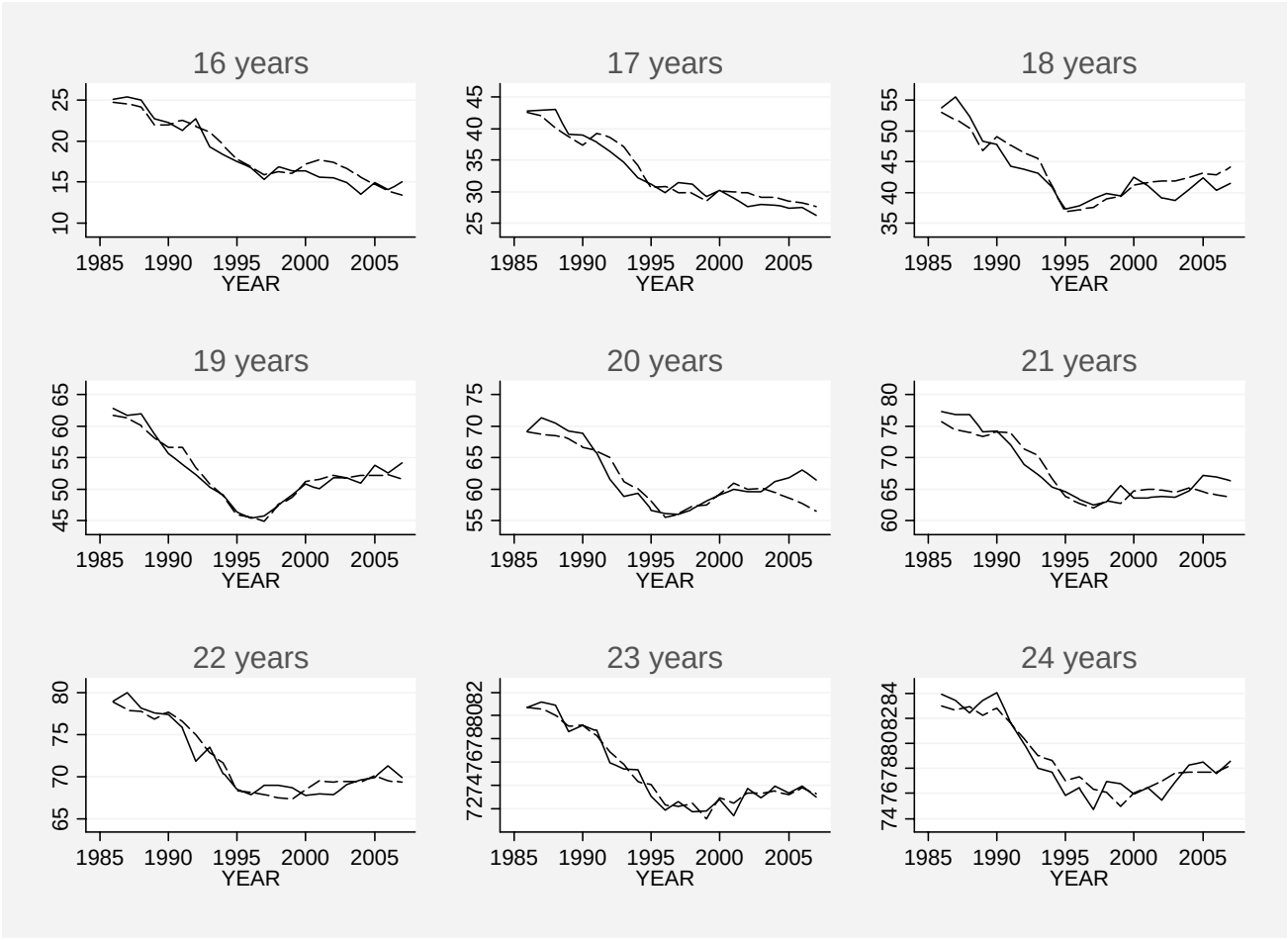


Figure A5. Prime-aged males

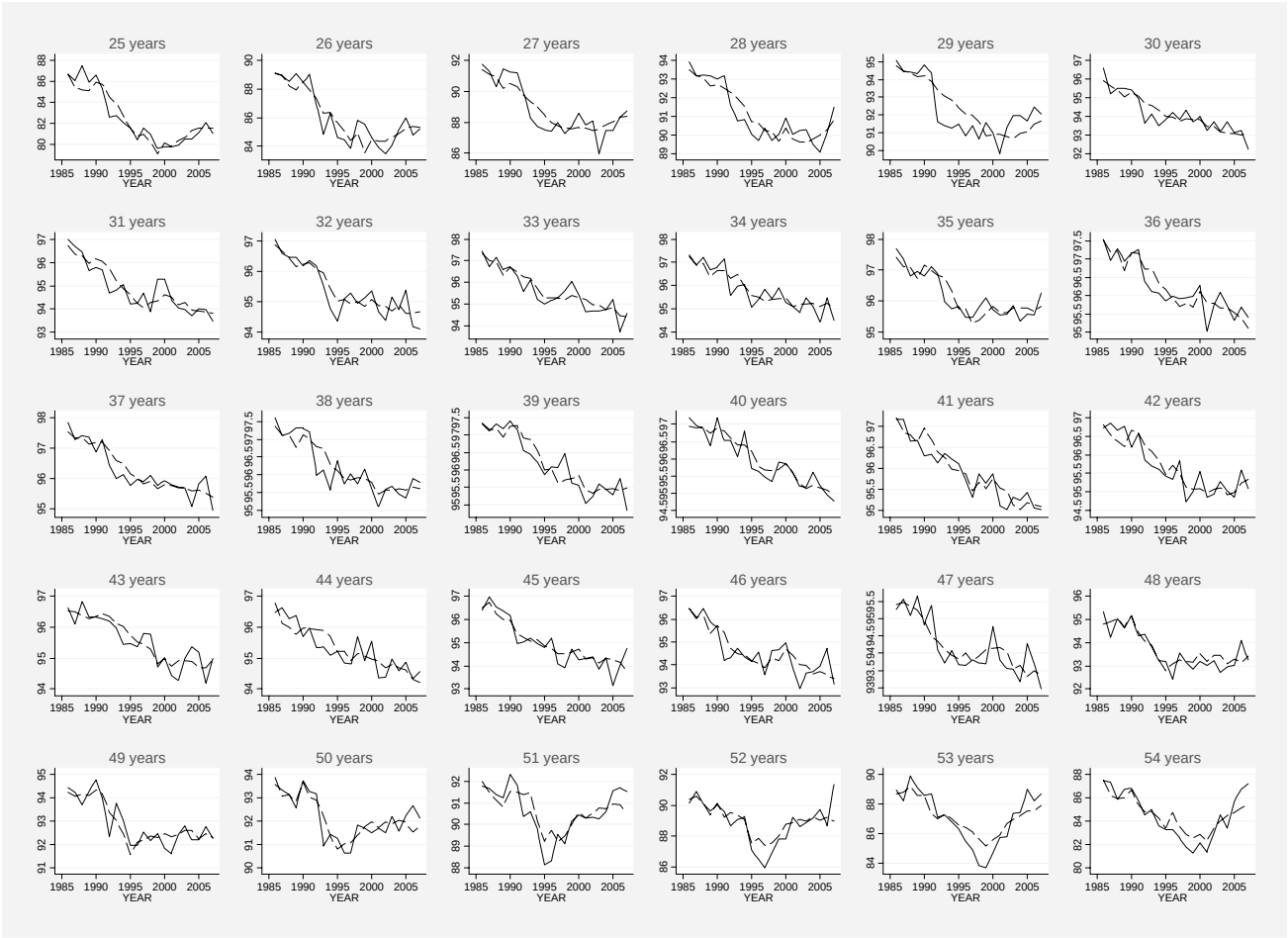


Figure A6. Older males