DISCUSSION PAPER SERIES

Female Labor Force Participation in Turkey: A Synthetic Cohort (Panel) Analysis, 1988-2013

İnsan Tunalı
Murat Güray Kırdar
Meltem Dayıoğlu

Female Labor Force Participation in Turkey: A Synthetic Cohort (Panel) Analysis, 1988-2013

İnsan Tunalı
Boğaziçi University, Koc University and Economic Research Forum

Meltem Dayıoğlu
Middle East Technical University and Economic Research Forum,

Murat Güray Kırdar
Boğaziçi University, American University of Beirut, IZA and Economic Research Forum

ABSTRACT

Female Labor Force Participation in Turkey: A Synthetic Cohort (Panel) Analysis, 1988-2013*

We study the aggregate labor force participation behavior of women over a 25-year period in Turkey using a synthetic panel approach. In our decomposition of age, year, and cohort effects, we use three APC models that have received close scrutiny of the demography community. We rely on predictions from just-identified models that render different methods comparable. The exercise is carried out by rural/urban status and by education to tease out some key differences in behavior, and to test hypotheses about the course of participation. Our comparative methodology yields remarkably consistent profiles for most subsamples, but not all. Notably all methods reveal an M-shaped age profile attributable to child-bearing related interruptions in rural areas and for low-educated women in urban areas. We also find that younger cohorts among the least-educated women are more likely to participate, contrary to the belief that culture stands in the way. This implies that the recent rise in the aggregate participation rates is not only due to a composition effect arising from increasing education levels. We also show that Turkey has reached the turning point of the U-shaped pattern in female participation. In addition, we dwell on methodological issues and offer explanations for the fragility of the methods. We establish that evolution of the linear trend present in the crosssection age profiles is responsible for the apparent differences in the findings.

JEL Classification:	J21, C18
Keywords:	female labor force participation, U-hypothesis, synthetic birth cohort analysis, age-participation profiles, cohort effects, M-shaped profile, culture

Corresponding author:
Murat Güray Kırdar
Boğaziçi University
Bebek
Istanbul 34342
Turkey
E-mail: murat.kirdar@boun.edu.tr

1. Introduction

Among the OECD countries, Turkey has the lowest female labor force participation rate (35 percent in 2015 – trailing behind Mexico by a margin of almost 12 percentage points) and the largest gender participation gap (of almost 42 percentage points). Moreover, despite significant gains in education and falling fertility rate over time, the aggregate labor force participation rate for Turkish women declined well into the 21st century. This fall has been accompanied by migration from rural to urban areas, where female participation rate has only recently risen above 20 percent, and exacerbated by a falling participation rate in rural areas. At the same time, aggregate data show signs of a reversal since 2008.

Our paper constitutes an effort to understand the developments from a prospective perspective, by constructing a synthetic panel. The age-cohort-period (APC) methodology we rely on allows us to estimate the age-participation profile of a representative woman and account for period-specific labor market shocks, so that participation orientation of different birth cohorts can be studied. The main objective of our paper is to establish whether intra-cohort differences can be compiled to yield a consistent explanation for the changes that took place over the 25-year window we study. Towards that end we put the changes in the participation rate within the context of the dramatic changes in education and fertility and exploit the differences by location (rural vs. urban) and education to conclude that women in Turkey are marching down the beaten path that their brethren in the Western world took.

A stylized fact that emerges from a handful of long term investigations is a period of falling female participation rates followed by a sustained rise, a "U-shaped" pattern (Goldin, 1995; Mammen and Paxson, 2000). Examination of the aggregate female labor force participation rate over time suggests that Turkey has reached the turning point sometime between 2006 and 2008. The U-shape is a manifestation of changes in the manner women contribute to economic activities over the course of development.[1] The fall is the result of a decline in the role of

---

[1] Boserup's (1970) sweeping account of the experiences of developing economies dominated by agriculture aptly describes the changes in the declining segment of the U. Although no detailed discussion on the rising segment of the U is given, it is hinted at the very end of the book in the context of European industrialization. The evidence on the U-shape mainly comes from cross-country studies, where GDP per capita is generally used as the measure of economic development. Papers that allude to the U, or seek and find favorable empirical evidence include Psacharopoulos and Tzannatos (1989), Goldin (1995), Mammen and Paxson (2000), Tansel (2002), Luci

agriculture in national output and employment – where women account for a significant share of the workforce – and lack of employment opportunities for low educated women elsewhere. The increase reflects women's gradual return to the labor market as their educational attainment increases and their fertility declines, developments that make it possible for them to hold jobs outside of agriculture. Inherent in the discussion of the U-shape is the fact that changes that occur may not all be positive for women.[2]

Broadly speaking, this description matches Turkey's record. According to available census data, between 1955 and 2000 the female labor force participation rate (for individuals aged 12 and over) declined from 72 percent to 40 percent. Turkey had an agriculture oriented economy until 1950, and agriculture remained important throughout the twentieth century. The slow pace of decline of the share of agriculture in total employment from 85 percent in 1950, to 36 percent in 2000, provides a credible summary statistic. The sustained decline in the female labor force participation rate observed in Turkey is a byproduct of this slow transformation. When we turn to the more recent evidence from the Household Labor Force Survey – arguably a more appropriate data source – we find that the participation rate (for individuals aged 15 and above), which fell under 25 percent between 2004-2008, has risen since 2008. Notably it crossed the 30 percent mark in 2013, and reached 34.2 in 2018.[3]

A second objective of our paper is to reconcile the results of the decomposition exercise with the U-hypothesis. Towards that end, we first engage in descriptive data analysis designed to assess the role of various forces that have been shown to have an impact the observed

---

(2009) and Tam (2011). There are also studies that either find no or weak evidence for the U, such as Gaddis and Klasen (2014), Verick (2014), Verme (2014).

[2] See Boserup (1970). The "feminization of labor" literature highlights how structural changes since 1970s such as the re-orientation of the economy towards exports, adoption of flexible production systems, outsourcing and subcontracting lead to higher female employment. Since the process is accompanied by increased informality and proliferation of irregular jobs with low-pay, there has not been much progress in terms of altering the economic status of women (Standing, 1989, 1999; Seguino, 2000a, 2000b; Elson, 1999). Similar trends have been observed in manufacturing in Turkey, following the adoption of export-led growth strategy in the post-1980 period (Çağatay and Berik, 1991; Çağatay and Özler, 1995; Başlevent and Onaran, 2004).

[3] Closer examination reveals that the rise since 2008 has been accompanied by several years of increases in agricultural employment early on, followed by some controversial changes in the measurement of employment. Employment subsidies introduced in 2009 appear to have had a temporary effect as well (Uysal, 2013; Balkan *et al*., 2014; Dildar, 2014).

participation outcomes. We then exploit the results of the APC decomposition to isolate the roles that different factors played in the outcome. In doing so we also get to evaluate the role of the "culture" factor that has been implicated as the impediment to increased labor market orientation, and offer some convincing evidence that its influence is eroding.

The value and shortcomings of the age-period-cohort (APC) accounting system for keeping track of life course events are well-established. In executing the APC decomposition methodology, we work with three methods: (i) constrained least squares estimator proposed independently by Hanoch and Honig (1985), and Deaton and Paxson (1994), which we abbreviate as HHDP, (ii) Intrinsic Estimator (IE) due to Fu (2000) and Yang, Fu, Land (2004), (iii) Maximum Entropy (ME) due to Browning, Crawford and Knoef (2012). Despite the apparently arbitrary restriction it imposes to achieve identification, HHDP remains the most commonly used decomposition technique in economics, arguably thanks to the pioneering and influential work on savings by Deaton and colleagues. We also employ IE and ME methods that do not seem to place arbitrary restrictions to achieve identification. IE, like HHDP, is based on the least squares principle. Although ME uses a different estimation criterion, it shares the data driven approach present in IE to get around the perfect collinearity between age, period, and cohort indicators. By using all three methods in our empirical work, we get to evaluate the robustness of the results obtained from three popular methods.

A key message from our empirical investigation is that use of a single APC decomposition can be misleading. As we document below, when linear trends in the cross-section age profiles evolve over time, the three methods attribute the changing trend to different components of the APC model. Although this results in an apparent inconsistency, closer inspection reveals that the three models we use are consistent in recovering the turning points of the age, period and cohort profiles. We believe this finding is as an important methodological contribution that goes beyond the substance matter.

The paper is organized as follows. Section 2 presents background information on the labor market in Turkey. It starts with a subsection that offers the motivation for choosing the APC model as our analytical tool. Two other subsections use a variety of data sources and institutional information to identify changes that help us weave our storyline and generate hypotheses about behavioral patterns that can be teased out in the APC decomposition. Section 3 describes our main data source and the APC methodology. It highlights recent methodological contributions that justify our empirical strategy. It also includes an assessment of the closed-population assumption and the threats to the identification of the "true" age profile when the

3

time window provided by the cross-section data is shorter than the relevant age span. Section 4 contains the results of the APC decomposition. This section is divided into two main parts. The first part focuses on the rural/urban contrast, which proves to be important given the historically dominant role of agriculture in rural areas. The second engages in a deeper examination of the behavior of women located in urban areas by stratifying the data by educational attainment. The evidence is used to test the hypotheses formulated in Sections 2 and 3. Section 5 reports the results from our robustness exercises. The next section (6) is devoted to a synthesis effort. Section 7 concludes. The arguments in the text are supported by five appendices. Appendix A collects the tables and figures relevant for Sections 2.1 and 2.2 in the background section. Appendix B contains information on the social security system and provides the basis for some additional hypotheses formulated in Section 3.3. Appendix C contains graphs of the cross-section age profiles as well as additional graphs that provide the backing for the methodological assessments we offer in Sections 3.4, 4 and 6. Appendix D contains the APC decomposition results from our robustness tests. Finally, Appendix E reports the results from the APC decomposition of male labor force participation rates, which are used to support some of the arguments in the text.

2. Background

To provide a first impression of the dramatic changes that have been occurring, consider the age profiles of the participation rate in urban areas shown in Figure 1. To arrive at these profiles, we constructed synthetic birth cohorts from five rounds of the HLFS that are five years apart.[4] Eight of the birth cohorts are identified on the graph. The profiles of two older cohorts (1938-42, 1943-47) are also shown. However, their birth cohorts are not marked because of lack of differentiation in participation behavior. In the case of profiles that span the full 25-year observation window, the first of five data points shown comes from the 1992 cross-section, and the last comes from 2012.

<Insert Figure 1>

---

[4] Here is a brief explanation of the mechanics: The youngest cohort that contributes five data points (1973-77) shows up for the first time in the 1992 cross-section, at ages 15-19. To determine their LFPR at ages 20-24, we rely on the data for individuals in this age group in the 1997 cross-section; to determine their LFPR at ages 30-34 we use the data for individuals in this age group in the 2002 cross-section; etc.

The steep positive slopes of the participation profiles of the two youngest cohorts provide a striking contrast with the others. The dramatic rises in the profiles for the 1973-77 and 1968-72 cohorts in the final year (2012) are also remarkable. In fact, the profiles for the 1963-67 and 1958-62 cohorts also display a similar tail behavior, but the magnitudes of the increases are smaller. Finally, compared to older cohorts, the 1953-57 and 1948-52 cohorts also display higher participation rates, in particular in year 2012.

Based on the fanning out pattern observed in Figure 1, it is tempting to conclude that younger cohorts are more participation oriented than older cohorts. However, since different cohorts reach a given age in different years, the observed differences could also be attributable to period effects. In fact, 2012 appears to be a special year, in the sense that all but the oldest birth cohorts in the graph experienced a boost in participation rates in that year, when compared to the previous cohort.

In Figure 2, age profiles of the participation rate in rural areas are shown. The differences between these and those in Figure 1 are striking. If we were to exclude the fifth observation, between-cohort differences at a given point in the life cycle suggest that women residing in rural areas (population under 20,000) have been withdrawing from the labor force over time. Evidently 2012 was a special year, when the earlier trend was reversed. Recall that 2012 emerged as a special year in Figure 1 as well. This finding forcefully supports the first point we want to make: Since apparent differences in cohort effects may be attributable to period effects, APC decomposition emerges as a natural modelling choice.

<Insert Figure 2>

The second point we want to make is that with the possible exception of the shared experience in 2012, it is obvious that different forces are operating in urban and rural areas. As we argue below, another important driver of differences in the outcome is education. Since the LFPR is a weighted average of the location or education specific rates, the aggregate picture will be sensitive to labor force weights of the subgroups. With these observations in mind, we stratify the pooled cross-section data by location and by education.

In the remainder of this section, we engage in some data analysis designed to identify the forces behind the patterns we highlighted and extract some testable hypotheses. We start by describing the long term labor market trends in Turkey and pay attention to the links between changes in the female participation rate, and changes in the form of female employment, as measured in labor force surveys. This discussion is followed by a summary of developments in

female education and fertility over time, broken down by location. By tracking the changes in education and fertility outcomes together, we aim to provide a useful backdrop for the discussion of our empirical findings. We end this section with a brief examination of the role of culture.

2.1. Labor Market Trends

Reliable micro data on participation based on a nationally representative sample was not available before 1988. Annual estimates provided by Bulutay (1995) using model based predictions suggest that a secular decline in the labor force participation began in the 1950s when Turkey began its transition from an agrarian economy to an industrial one. This transition was accompanied by massive rural-urban migration. [5] To provide some perspective, the share of individuals residing in towns and villages decreased from 75 percent to 35 percent between 1950 and 2000 (Turkish Statistical Institute, 2011).

Figure 3 shows the participation trends as reflected in our main data set, the Household Labor Force Survey (HLFS), compiled by the Turkish Statistical Institute (TurkStat). The data are for the non-institutional population, aged 15 and over. Up until 2014 locations with 20,000 or fewer residents were designated as rural, while the rest were termed urban. Four patterns are worth underscoring: First, male participation rates top the chart. Second, the rates are higher in rural areas. Third, the lowest rate is observed for females residing in urban areas. Fourth, the urban female labor force participation rate (LFPR), which remained in the 16-18 percent range until 2001, started creeping up. It reached the 20 percent mark in 2007 and registered a sustained climb in later years. The slope of the total female LFPR line also shows a sustained rise after 2007 and beyond 2013, the last year included in our APC decomposition window.

<Insert Figure 3>

The sizes of both the rural-urban and the gender participation gap are remarkably large. High rural participation rate is attributable to the primacy of family-farm based agricultural production in rural areas. Since it is difficult to separate market oriented production from consumption oriented production (Singh, Squire, and Strauss, 1986), almost every member of the agricultural household member passes the statistical test for being counted as employed

---

[5] The contours of internal migration flows during the 20th century are documented in Tunalı (1996), Gedik (2003) and Berker (2011).

(Anker, 1990). By contrast the majority of employment opportunities in urban areas are outside the home domain. As a result, wage and salary employment becomes highly selective on sex, and skills that the women have (İlkkaracan and Tunalı, 2010). The gender gap that is magnified in urban areas also reflects the traditional division of labor, whereby the male household head is the designated main breadwinner, and females shoulder the burden of home production.

To substantiate this explanation, we examine the trends since 1988 in terms of sector of economic activity and status in employment, given in Figures A1 and A2 in Appendix A. We observe a decline in the share of agriculture, complemented by a fast paced increase in services and a milder one in manufacturing. In 1988, agriculture accounted for 46 percent of all employment. Its share dropped to 18 percent by 2018. The steeper decline observed for a few years after 2001 is attributable to reform attempts of the agricultural sector.[6] The pace of decline slowed in 2005 and was followed by a period of increase in the share of agricultural employment from 2008 to 2011. The break in the trend coincides with the global financial crisis that hit Turkey in the last quarter of 2008. Although the crisis had a severe initial adverse effect on the unemployment rate and curbed employment growth, the economy rebounded in 2010.[7]

When we track the changes in terms of type of employment by sex (given in Figure A2), we see that unpaid family work, which accounted for more than half of female employment until 2002, has been on a course of long term decline. Notably wage work has been on the rise for both men and women, and has become the dominant form of employment for women starting with 2005. The period of recovery of agricultural employment (2008-11) coincides with a slowdown in the decline of unpaid family work, followed by a small increase. Evidently the arrest of the long term structural transformation was a temporary phenomenon, and the secular trends of decline in unpaid family work complemented by a rise in wage work were restored in 2011.

The upshot of this analysis is that the latter part of the sustained rise in female participation observed in Figure 3, starting with year 2004, is marked by increased market orientation. In fact, in 2018, 65.3 percent of women worked as wage earners (in manufacturing and services),

---

[6] A comprehensive account of the Agricultural Reform Implementation Project (ARIP) may be found in Karapınar *et al.* (2010). Its impact on the rural labor market and course of employment growth is the subject of İlkkaracan and Tunalı (2010).

[7] Arguably a better explanation for the surprising rise of the share of agricultural employment is the rise in global food prices (Şengül and Üngör, 2011; Gürsel and İmamoğlu, 2013).

23.7 percent as unpaid family workers (mostly in agriculture) and the rest (11 percent) on their own-account. This suggests that female LPR in Turkey is likely to have reached the bottom of the U-pattern by year 2006 or so and is no longer an "interesting exception" in cross-country comparisons of trends in female labor force participation.[8]

Improvements in education and reduction in fertility emerge as favorable factors that provide the pre-conditions for wage and salary work oriented participation to register an increase. If the U-pattern is driven by these changes, the APC decomposition conducted conditional on location and education should yield profiles that are consistent with the story. Before we tease out a testable hypothesis, it makes sense to review the evidence on changes in education and fertility, and their interaction.

2.2. Education and Fertility

Cross-section data reveal that education is an important determinant of the labor force participation rate (LFPR). Holding other important characteristics such as age constant, LFPR goes up in larger and larger increments as educational attainment increases (Dayıoğlu, 2000; Tunalı, 1997). Furthermore, labor market attachment also increases with education (Özkan and Tunalı, 2014). These effects operate through own wages (Tunalı and Başlevent, 2006) but also via the fertility-education link. When we contrast the educational composition of the female labor force with that of the female population, we observe that participation is highly selective on education (Figures A3 and A4 in Appendix A). In the female population, those with 5-years of primary education constitute the largest group. The school reform in 1997 extended compulsory primary school from five to eight years. This policy change affected new generations favorably and ushered in spillovers to higher levels (Kırdar *et al.*, 2016). Throughout the second half of our time window it had a small, but favorable effect on the educational composition of the population. In the case of the labor force, the changes were much more remarkable, underscoring the leverage of high school diploma and higher levels of schooling in bringing women closer to the labor market.

Next, we examine the changing educational compositions of the labor force in urban and rural areas over the time period under study (Figures A5 and A6 in Appendix A). Both figures

---

[8] The "interesting exception" designation is in Borjas' (2016) popular textbook, where the decline in the female LFPR for Turkey between 1990 and 2010 is contrasted with opposite trends elsewhere in the OECD.

underscore the importance of studying the urban and rural areas separately. That the urban female labor force has considerably better educational attainment than the rural female labor force is worth noting. In our examination of the age-period-cohort effects, we combine some of the adjacent levels and study four subgroups: university, high school (including technical high school), middle school (extended primary plus secondary school), and primary school and below. In urban areas, share of university educated women has been expanding throughout the time period, while the share of the lowest group shrank. Middle school constitutes the smallest category, with a stable share over time. The share of high school expanded until the mid-90s and decreased a bit subsequently. In rural areas, in 1988 almost half the women in the labor force had less than 5 years of primary education, and nearly 80 percent of these were illiterate. Those who had more than primary education were a tiny minority. Things evolved very slowly until the reform in 1997. Spillover to higher levels was less in rural areas compared to urban areas. Since only 25 percent of the participant women in rural areas had education above 5-year primary school as of 2013, we did not see any need to break down the rural subsample further.

There is broad consensus that women with higher education exercise better control over fertility, which is manifested in terms of delay of the birth of the first born child, and reduction in the total number of children they have. In fact, all measures show that fertility in Turkey declines as education increases. In particular, the total fertility rate (TFR) for ever married women between the ages of 15 and 49 and the number of children ever born (CEB) for 40-49-year-old women, who are likely to have stopped child bearing, have declined over time (Table A1 in Appendix A).[9]

We draw two main conclusions on fertility changes over time. First, women who belong to older cohorts have higher fertility levels. This can be seen by comparing TFR with CEB for a given year, or following the same measure over time. Second, a steep fertility-education gradient can be seen in each cross-section. In 1983, TFR for mothers with an educational level below primary school was 4.42 children, more than two times than the average for mothers with a high school or higher degree, 2.15 children. The highest-to-lowest (H/L) TFR ratio by education groups provides a glimpse of the changes over time. We see that TFR gap by

---

[9] In Table A1, the birth cohorts that the data averages pertain to are shown under the survey years. Since our primary data source allows us to draw reasonable conclusions for the 1946-1986 birth cohorts, the trends captured in Table A1 are relevant.

education widened between 1983 and 2003, but narrowed down considerably in the subsequent decade. The H/L ratios for CEB are typically higher, except in 2003.

The two measures viewed together suggest changes in the tempo as well as the number of births. This is documented in Figure A7 in Appendix A, where the evolution of age-specific rates is shown for the period 1978-2013, as captured by DHS-Turkey. Between 1978 and 2003, TFR came down at every age range, but the profiles for the subsequent surveys indicate that some of this reduction was due to postponed births. In fact, in 2008 and 2013, TFR for women in the 30-34 and 35-39 age groups exceeded the 1993 levels and came close to the 1988 levels. The main take for our empirical work is that the pattern of an early peak at ages 20-24 followed by a decline has been replaced by a pattern of a fairly steady fertility rate between ages 20-34. This has implications for the timing of child-bearing related withdrawals from the labor market, and the likelihood of return. As Turkey evolves to a near replacement TFR regime, it is likely to follow countries that made the transition earlier, so that women who enter the labor market will delay child bearing, and will be more likely to return after an interruption.

When TFR differences are examined by location (rural < 10,000, vs. urban ≥ 10,000), women in rural areas exhibit higher average values of TFR (Table A2 in Appendix A). The sharp decline observed between 1983-93 slowed down in the next decade, and was replaced by a mild recovery in the final decade. The rural/urban TFR ratio which was 1.6 in 1983 declined to about 1.3 and remained stable in the following survey rounds. Given the physical demands of agricultural employment, child-bearing related interruptions are likely to have a more marked effect on participation behavior in rural areas.

Can the roles we attributed to education and fertility in our review of the recent developments be tested in the context of our APC exercise? We believe that they can be. If education and fertility serve as proximate determinants of labor market orientation, we should be able to detect their influence by comparing the patterns by location, and/or education. For example, in the age profile we could look for evidence of childbearing related interruptions, and see if they occur in locations/education groups known to have higher fertility. Obviously better education may offer other advantages, such as the ability to pay for child care. The first hypothesis, then, is a correspondence between education level, and dips in participation during child bearing years (H1: M-shape in age profile weakens with education).

The second hypothesis concerns the U-shape. If the U-shape is driven by increased market orientation aided by favorable developments in education and fertility, their impact should be

visible in profiles obtained from the APC decomposition. It is well-known that the public sector in particular provided educated women with well-protected salaried employment opportunities since the founding of the Republic. This being the case, the changes that are responsible for the turnaround can come from two sources. The first is the change in the education composition of the female population. As long as the link between education and participation is preserved, compositional changes can drive the aggregate LFPR up. The second source is one that operates from within. Year and cohort profiles obtained conditional on location and education should provide clues about changes that are taking place over time. If the shapes obtained from a given subsample are consistent with the U-shape, we may conclude that forces that operate within that subsample favor increased participation (H2: U-shape is driven by favorable within changes, as well compositional changes).

2.3. Role of Culture

The "culture" factor is often brought up to explain the low participation rate of women in the Middle East (Moghadam, 2005; Diwan and Vartanova, 2017; Solati, 2017). More specifically, the fact that women are assigned the role of home makers while men are the designated bread-winners, constrains the choices open to women outside of home. Indeed, in explaining the forces that operate over the falling portion of the U, Goldin (1995) underscores the "stigma" attached to women holding certain jobs such as paid manual jobs outside home. Another strand of the literature discusses how rising cultural conservatism and neo-liberal policies reinforce each other, and slow down market orientation. In the Turkish context, Buğra (2014) documents how policies that reflect the conservative outlook of governments have continued to double-burden working women by failing to introduce the institutional changes needed for reconciling their work and family responsibilities.

The literature that teases out the effect of culture by proxying it by inherited behavior from ancestors of immigrant women establishes that female labor force participation is influenced by culture (Reimers, 1985; Fernandez at al., 2004; Fernandez, 2007; Fernandez and Fogli, 2009). This line of work is able to convincingly distinguish between the influences of personal human capital characteristics, institutions and culture. In this section, we seek for clues on the effect of culture within the confines of our data set, the HLFS.

When we examine changes over time in the share of women who never worked by age group, we find that in 2004, two out of three women (68.5%) in the 55-64 age group indicated

that they had never worked (Figure A8, Appendix). Ten years later, the fraction without any labor market experience was down to less than one out of three women (31.1%). This sharp decline attests to the remarkable transformation that has been taking place. The fact that steadily higher fraction of younger cohorts are drawn into the labor market provides strong evidence that economic and demographic forces operate as expected, despite the grip of the culture factor.

We also note that the slower declines in the fraction never worked observed for the youngest age groups (15-19 and 20-24, Figure A8, Appendix) compared to others are attributable to increasing enrollment rates in tertiary education in response to the skill premium and accommodating expansion of university capacities (Bakış and Polat, 2015; Polat, 2016), and lengthening of the school to work transition (World Bank, 2008; İlhan, 2012). The steady decline in the fraction never worked during high marital risk ages suggests that participation-hindering influences of marriage and childbearing have become less important over time.[10] Given the low aggregate rate of participation, the steady decline in the fraction never worked by age suggests that women do not have trouble entering the labor market in later ages despite the lack of experience. In our view, none of these patterns can be reconciled with a pervasive cultural bias against female participation. Nonetheless we look for support for the role of culture when we stratify on education. If culture is operational as a barrier to participation, women with the lowest level of education are expected not to have benefitted from the positive developments underscored in Section 2.1 (H3: Culture impedes participation of low educated women). Note that this hypothesis is intimately connected with H2 which seeks support for within changes consistent with the U-shape in any one of the subsamples. Evidence in favor of H3 would be evidence against H2 in the subsample of low educated urban women.

3. Data and Methodology

The labor force participation data we use come from the annual Household Labor Force Surveys (HLFS) of the Turkish Statistical Institute (TurkStat).[11] We use the annual rounds of

---

[10] Data on nuptuality by age indicate that 46.1 percent of the women surveyed in 2013 were married by age 25, while 78.1 percent were married by age 30 (TDHS, 2013: 106). Twenty years earlier these fractions were respectively 58.5 and 83.4 (TDHS, 1993: 66).

[11] HLFS was launched for the first time in October 1988. The survey targets the civilian non-institutional population. It was conducted biannually (in April and October) with a sample size of 11,160 households between 1988 and 1993 and 15,000 households between 1994 and 1999. Starting in 2000, the survey was fielded every

HLFS over the 1988-2013 period and obtain a pooled cross-section dataset for individuals aged 15-64.[12] Throughout this period, HLFS provided a breakdown of the data by location, allowing for separate analysis by urban (20,000 or more inhabitants) and rural (less than 20,000) residence. This designation was suspended in 2014. Therefore, our analysis ends in 2013.

Our pooled dataset does not follow the same people over time. As described in detail below, we construct synthetic cohorts by categorizing individuals by their age-period identifiers and follow them for as long as the observation window allows. Since each cross-section is representative of the population, we can learn about changes in behavior by examining the participation rates of successive cohorts at the same phase in their life cycles. Individuals in the same cohort would share, for instance, similar educational and job opportunities and exhibit similar attitudes towards birth control, marriage and schooling than individuals of different cohorts. Another distinction between cohorts is the fact that they enter a given phase in their life cycles at different point in calendar time. We use the age-period-cohort (APC) model to decompose the observed participation rates to components captured by sets of dummy variables that track membership in particular age, year, and cohort categories.

3.1. The Age-Cohort-Period (APC) Model

The APC model has a long lineage that can be traced to work by epidemiologists in the late 30s.[13] The task appears simple: Use a pooled cross-section of individuals to decompose the

---

month. From 2000 to 2003, data were released quarterly covering about 23,000 households per quarter and from 2004 onwards on a monthly basis covering about 13,000 households per month. Until 2007, target population estimates were based on projections obtained from general censuses. In 2007 TurkStat started using an address based population registration system. HLFS data from 2004-6 were subsequently revised to reflect the adjustments in the population estimates.

[12] Technically, a major break exists in the series between 1999 and 2000 and a minor one between 2003 and 2004. Since we work with shares rather than levels, the impact on our work is minimal. About the only visible impact on our results is the extra noise reflected in the pre-2000 year effects, especially in rural areas. In 2004, the HLFS questionnaire was revised to align the survey content with EUROSTAT norms. Some minor changes were implemented in the definition of employment which are unlikely to influence our analysis.

[13] Frost (1939) is the earliest reference we have come across. Note that APC is not a model if "model" is taken to represent a population relation. Consequently, alternative terminologies have been used to describe it: APC decomposition, APC accounting method, and Redundant Factor Model. O'Brien (2015b) offers an extremely broad and up-to-date synthesis of the APC approach.

variation in the outcome of interest (y) to components that can be captured by indicators of age (a), period (p, marked by survey year) and cohort (c, marked by birth year). Using information on the pair a, p the cohort can be identified via

(1) $c = \text{cohort (birth year)} = p - a$.

Let y_{iap} denote the value of the outcome for individual i who is observed at age a in year p. Her contribution to our synthetic panel is the quartet $\{y_{iap}, a, p, c\}$. In our study the outcome of interest is labor force participation:

(2) $y_{iap} = \begin{cases} 1 & \text{if participate} \\ 0 & \text{else} \end{cases}$, $i = 1, 2, \ldots, N$.

In what follows we rely on the averaged version, $y_{ap.}$, which shows the observed participation rate for individuals who were of age a, in year p, obtained as $y_{ap.} = (\sum_{i=1}^{n_{ap}} y_{iap})/n_{ap}$, where n_{ap} is the size of the subsample. Once we define age, period and cohort indicators via:

(3) $A_j = \begin{cases} 1 & \text{if } j = a \\ 0 & \text{else} \end{cases}$, $j = 1, 2, \ldots, J$;

(4) $P_k = \begin{cases} 1 & \text{if } k = p \\ 0 & \text{else} \end{cases}$, $k = 1, 2, \ldots, K$;

(5) $C_l = \begin{cases} 1 & \text{if } l = p - a \\ 0 & \text{else} \end{cases}$, $l = 1, 2, \ldots, L$;

the linear APC model can be written as:

(6) $y_{ap.} = \sum_j \alpha_j A_j + \sum_k \psi_k P_k + \sum_l \gamma_l C_l + u_{ap}$,

where u_{ap} denotes an error term. We may collect the age, period, cohort indicators (A, P, C) to form columns of the variable matrix $\ddot{\mathbf{Z}}$, the parameters (α, ψ, γ) to form the vector $\underline{\ddot{\theta}}$, the average outcome for each age, period, cohort combination to form the vector $\underline{y}$, the corresponding average error terms to form the vector $\underline{u}$ and express the APC model as a linear regression model:

(7) $\underline{y} = \ddot{\mathbf{Z}}\underline{\ddot{\theta}} + \underline{u}$.

As described the columns of the $\ddot{\mathbf{Z}}$ matrix consist of a full set of age, period and cohort dummies, which results in a short rank matrix. The standard approach would be to exclude one of the dummies from each group of variables and include an intercept term that captures the combined effects of the age, period and cohort that identifies the reference category. Denoting

the shortened matrix by Z, and the shortened parameter vector by $\underline{\theta}$, the regression model becomes

$$(8) \qquad \underline{y} = \delta + Z\underline{\theta} + \underline{u} = [\underline{1} \ Z \,] \begin{bmatrix} \delta \\ \underline{\theta} \end{bmatrix} + \underline{u} \equiv X\underline{\beta} + \underline{u},$$

where "$\underline{1}$" is a column of ones.

In light of the relation described by (1), a linear combination of the columns of the shortened matrix Z can be shown to equal $\underline{1}$, which results in a short rank matrix X. This being the case, the system of equations used in obtaining the *least squares estimator* of $\underline{\beta}$ in equation (8),

$$(9) \qquad X'X\underline{b} = X'\underline{y}$$

would yield infinitely many solutions for $\underline{b}$.

The traditional APC literature offers two approaches to this complication. The first is to replace the cohort (or period) dummies by a shorter list of proxy variables that can capture the cohort (or period) effects.[14] Since this approach imposes more restrictions than needed, its appeal appears to have declined over time.[15] The second approach is to impose restrictions on the parameter vector $\underline{\beta}$. Technically, only one restriction is required. Uniqueness of the solution vector is typically achieved by restricting two adjacent parameters of the age or the cohort components of the parameter vector, on the grounds that the effects of adjacent age groups or cohorts could not be all that different.[16] Recent work by Browning *et al.* (2012) shows that findings are extremely sensitive to where such restrictions are placed. Since our preliminary investigations also produced similarly erratic results, we did not follow this approach.

Although the arbitrary nature of the restriction has been noted as early as Barett (1973), interest in the APC model continued unabated in the demography and sociology literatures.

---

[14] O'Brien (2000) calls this the Age-Period-Cohort Characteristics (APCC) model. Examples of cohort proxies include the size of cohort (Easterlin, 1978; Welch, 1979; Kahn and Mason, 1987) and the cohort's sex ratio (O'Brien, 1991). Variables that capture business cycle effects are used as proxies of the period effects (Farkas, 1977; Heckman and Robb, 1985).

[15] A variant on this theme is the so-called Age Period Cohort Interaction model, where in lieu of the cohort dummies, interactions of the age and period dummies are used (Luo and Hodges, 2019).

[16] The influential paper by Mason *et al.* (1973) is an early example. The strand of the literature that takes cue from this approach and groups nearby cohorts (to create 5-year birth cohorts, say) is known as the coarse-cohort method (Salehi-Isfahani and Marku, 2011).

Independent contributions by Hanoch and Honig (1985) and Deaton and Paxson (1994) gained recognition among economists. On the surface HHDP operates with three restrictions. In the better known DP (Deaton and Paxson, 1994) version, the first is to constrain the period effects to be orthogonal to a linear time trend. Given the linear constraint (1) that ties the three components, any linear time trend can always be captured by the age and cohort effects (O'Brien, 2000), so this does not resolve the identification problem. The second is to exclude one column from each of the age, period and cohort matrices and to include a common intercept, as we did in going from equation (7) to (8). Thus, the first two assumptions do not fix the short rank problem of the $X'X$ matrix above. The third restriction is to constrain the remaining period effects to sum to zero. Assuming that $k = 1$ serves as the reference period, this last restriction may be written as $\Sigma_{k=2}^{K} \psi_k = 0$. Since this reduces the dimension of the unknown parameter vector by 1, identification is achieved.[17]

In the HH (Hanoch and Honig, 1985) version, authors explicitly specify linear trends for all three components and define full sets of age, cohort and period parameters as deviations from (orthogonal to) their respective trends. By construction, each set of deviation parameters sum to zero. HH also impose the second (innocuous) restriction in DP. Finally, they shut down the linear trend in period effects. Operationally the three restrictions are equivalent to those in DP.

The introduction of the Intrinsic Estimator by Yang *et al.* (2004, 2008) ushered in much optimism because it seems to circumvent the need for an explicit restriction and yields a unique estimator. Recent work by Luo (2013) and O'Brien (2014, 2015a) establish that this estimator also imposes an arbitrary restriction, albeit one that is data-driven.[18] The newest estimator to join the APC contest is the Maximum Entropy estimator (ME) due to Browning, Crawford and Knoef (2016). This estimator only works when the outcome variable is naturally bounded. Our

---

[17] Constraining all period effects to sum to zero (known as centering) would normally be an innocuous assumption. This would change the interpretation of the intercept, but would not influence the estimated age and cohort effects (O'Brien, 2014). Coupled with the first restriction, however, we now have $\{\psi_1 = 0 \text{ and } \Sigma_{k=2}^{K} \psi_k = 0\}$, which is stronger than the condition $\Sigma_{k=1}^{K} \psi_k = 0$.

[18] The origins of the IE can be traced at least to Fu (2000). Recently it has been firmly established that the IE picks the Principal Component Analysis (PCA) solution (obtained from the Moore-Penrose inverse) to the ill-defined inverse problem (Luo, 2013; O'Brien, 2015a). PCA was introduced to the APC literature in a series of papers by Halford (1983, 1985) and Kupper *et al.* (1985).

outcome variable, LFPR, satisfies the requirement. The ME approach acknowledges that equation (9) has multiple solutions. The methodology generates a probability distribution of the estimates that satisfy a linear constraint implied by equation (1) and reports the estimate of the expected value of the parameter vector that is associated with the maximum entropy probability distribution. This amounts to choosing the most uninformative distribution possible. As Browning *et al.* (2012) put it, "[choosing] a distribution with lower entropy would be to assume information which we do not possess" (p.11). Since the ME relies on a different estimation metric and a different identification concept, it seems to escape the "arbitrary restriction" critique directed to the least squares estimators.[19]

The appeal of the APC model is attributable to its purported ability to trace life-course events as a function of age, by allowing for shared but potentially transient shocks captured by year effects and lasting cohort influences that unfold over the lives of individuals. In light of the identification problem described above, there are valid reasons for questioning the merits of this approach. By using all three methods we aimed to check the robustness of our results to the methodology used. In retrospect we are able to do more than that, and explain why results differ if they do. To provide a sense of what is to come, recall an important implication of (1). As O'Brien (2000) has shown, when any two of the three effects are present, the linear effect of the excluded term is captured. HHDP makes the period effects orthogonal to a linear time trend and treats them as random shocks (deviations from trend). It would seem, then, that any linear trend in the age component – such as a decline in participation rates with age – will dictate the form of cohort effects in HHDP. Indeed, this is what we find. Overall the results with the IE and ME are more consistent with one another, a pattern also detected by Browning *et al.* (2012). If the linear trend in the cross-section age profile is stable over time, cohort effects are not affected, and results from all three models are consistent with one another. The upshot of this brief discussion is that the empirical context, combined with an understanding of the implications of the restrictions different models impose, can go a long way in interpreting the results.

---

[19] We think that this assessment may be optimistic. Based on work done in the area of signal separation, Paiva, Xu and Príncipe (2008) establish a connection between Principal Component Analysis (subject of the previous footnote) and Maximum Entropy approach.

3.2. The Synthetic Panel

We construct our synthetic panel by categorizing individuals by their age-cohort identifiers. In our study we have 26 rounds of cross-section data ($K = 26$). We track women during their potential working lives, defined as ages 15 to 64 ($J = 50$). Thus, we are able to see $L = J + (K - 1) = 75$ distinct birth cohorts in our pooled data set. After imposing the exclusion restrictions to create the reference category for the age, period and cohort dummies, and the single additional explicit identifying restriction needed in HHDP, we use $JK = 1300$ observations to estimate up to $(J - 1) + (K - 1) + (L - 1) = 148$ parameters.

As O'Brien (2014) has shown, while different identification assumptions (i.e. constraints on parameters) imposed on the least squares estimator yield different estimates of the age, period and cohort effects, particular linear combinations of the parameters are invariant to the constraints imposed. We therefore refrain from reporting estimates of the age (α), period (ψ) and cohort effects (γ) that would be impossible to compare and shift the focus to the "predicted" labor force participation rate, which happens to be a linear combination that is robust to the choice of the single, arbitrary restriction imposed on the least squares solution (O'Brien, 2014, p.468). Since the IE estimator is a *generalized* least squares estimator and the ME is based on an entropy maximization principle, differences may still emerge. We plot the predicted participation rates against the observed age, period and cohort values and engage in graphical comparisons across the three models.

3.3. Coverage Problem

Technically, the predictions can be made for any birth cohort. However, given that we have only 26 years of data, we cannot cover the full span of an individual's potential working life (say, 15-64). What are the consequences of estimating an age profile defined over 50 years, when all we have are data from a period that is half as long? In the remainder of this section, we discuss the implications of this coverage problem.

With 26 years of data, we cannot observe any birth cohort over their entire potential working life. While we are able to observe 25 cohorts (those born between 1949 and 1973) in all 26 crossü-sections, the remaining birth cohorts are observed in 1 to 25 crossü-sections. For instance, we observe the 1948 and 1974 birth cohorts for 25 years, and our oldest (1924) and youngest (1998) cohorts only once (respectively in 1988 and 2013). Thus, the parameters of the model are estimated on an unbalanced panel. This implies that the life course experiences

of some cohorts are captured more fully than others – a point we will return to in our discussion of the empirical results.

We obtain the predictions for the 1961 birth cohort, who are observed between ages 27 (in 1988) and 52 (in 2013). This is the median cohort among those with maximal coverage. In light of the coverage problem, while behavior attributed to the 1961 birth cohort in earlier ages (15-26) actually reflects the behavior of younger birth cohorts (equal weights placed on the fully represented 1962-73 birth cohorts, but successively less and less on those born in 1974, …, 1998), behavior attributed to the 1961 birth cohort in later ages (53-64) in fact reflects decisions of older birth cohorts (equal weights placed on members of the 1949-61 birth cohorts, but successively less on those born in 1948, …, 1924). Youngest cohorts show up in later surveys and are only observed during the early phases of their work lives. Conversely, oldest cohorts are encountered in earlier surveys and are only observed during the late phases of their working lives. Since younger cohorts stay in school longer, their participation rates are low when young. By the same reasoning, older cohorts typically joined the labor market earlier, and hence withdrew earlier. Consequently, the "true" age profile of labor force participation rates of the 1961 birth cohort, if it could be obtained, is likely to show higher participation rates in the two tails.

The coverage problem can create problems in nailing down time trends (Deaton, 1985). The institutional context, fortunately, provides a neat fix. The *effective* minimum retirement age (MRA), which binds formal workers (those who have social security), has been remarkably low in Turkey during the period under study. In Appendix B, we highlight the evolution of the national Social Security System (SSS) and discuss its labor market consequences in further detail. Here we summarize the implications for our time window. The key implication of the MRA for our study is that work life spans of an overwhelming majority of women who are covered by social security are short enough for our 26-year window to be sufficient. Since school to work transitions can be slow, there will be some additional variation in the entry age. This and variations in the age of retirement for personal reasons can result in considerable variations in exit age. Finally, women with low education are unlikely to have social security and cannot rely on retirement with a pension. As a consequence, the relevant span of the age profile for our synthetic low educated worker will be quite a bit longer.

In the previous section, we made a case for carrying out the decomposition separately by rural and urban location and breaking down the urban subsample further by education. This

stratification strategy provides us with opportunities to focus on profile differences and test hypotheses H1-H3. Presently another opportunity presents itself, which can inform us about the capability of the APC model to capture the differences we expect to see. Work on the family farm is the dominant form of employment in rural areas, so formal arrangements are not prevalent. In our pooled sample, the fraction covered by social security fluctuated between 5 (in 1989) and 15 (in 2013) percent. In urban areas, it fluctuated between a low of 59 (in 2005) and a high of 73 (in 1998) percent. Consequently, we expect our synthetic worker in rural areas not only to enter early (a consequence of lower educational attainment), but also to remain in the labor force longer than her counterpart in urban areas (H4: Later exit in rural areas). In urban areas social security coverage, hence availability of old-age pension increases sharply with education. We, therefore, expect more educated women to exit faster than less educated women (H5: Higher the education, steeper is the exit gradient).

3.4. Closed Population Assumption

As underscored in Glenn (2005), APC analysis is designed for use on cohort data from a "closed" population, defined as one that does not change by movements into and out of it over time.[20] The question in our context is whether stratification by location and/or education violates the closed population requirement. As long as individuals complete their education before reaching the age threshold used in defining the labor force, analysis of labor force participation behavior broken down by education should not constitute a violation. The minimum-age threshold we impose in urban samples stratified by education depends on the education level. For instance, the minimum age is taken as 20 in the sample for urban high-school graduates and as 25 in the sample for urban university graduates. It is plausible to assume that the subpopulations are closed beyond some threshold age higher than what we imposed. We therefore check the robustness of our findings to higher minimum-age thresholds (subject of Section 5).

The fact that individuals may change their residential location after they qualify for entry to the labor force suggests that treating rural and urban subpopulations as being "closed" might not be a good idea. As we pointed out in the background section, the share of the urban

---

[20] Obviously variations in the age of death, and the fact that old cohorts that die are replaced by newly born cohorts does not violate this requirement -- after all a main objective of APC decomposition is to detect differences across cohorts.

population – defined as individuals residing in locations with 20 thousand or more inhabitants – has grown over time, even though fertility in rural areas is higher. In our pooled data set the sizes of the non-institutional population of ages 15 and above in rural and urban areas were about the same in 1988 (respectively 16.5 and 17.2 million). At the end of our time period (2013) urban population more than doubled (reached 38.1 million), while the rural counterpart barely changed (increased to 17.5 million). The main driver of this change was rural-urban migration.

Using the 2013 Turkish Demographic and Health Survey, which contains complete migration histories of women after age 12 -- including the type and location of residence at each move -- we generate the migration hazard rates for urban women and rural women, in turn (Figures A9 and A10 in Appendix A). For rural women, migration to urban areas becomes substantially less likely after age 25. Of 100 rural women at age 15, about 67 migrate to urban areas by age 49; and, of these 67 migrants, 51 do so by age 25. In urban areas, however, migration of women to rural areas is an extremely rare event. Since rural-urban migration before age 25 is likely to affect our decomposition analysis for both rural and urban areas, we repeat our APC decomposition exercise for each area by imposing a minimum-age limit of 25 (and report them in Appendix D). As we document in further detail in Section 5, the estimated cohort and year effects are very similar.

Historically, "adult" female rural-urban migrants who moved after completing their schooling rarely had any more than 5-year primary education. Consequently they feed into the low educated stocks in urban areas.[21] The 1997 compulsory schooling reform altered this, by boosting educational attainment in rural areas considerably (Kırdar *et al.*, 2016). Since this increased educational attainment affected cohorts born after 1986, its effect should be negligible in our pooled data set. In fact, according to the 2013 TDHS (the data set that has migration information), of all rural-urban migrant women, three quarters had five or fewer years of completed schooling (primary school or less) and 86 percent had eight or fewer years of completed schooling (middle school or less). Put differently, the lowest educated group we study in urban areas is a mixture of the possibly different behaviors of urban and rural-born women. Hence, it is especially important to conduct a robustness check of our decomposition

---

[21] If it were not for this flow, the share of the lowest educated in the female labor force (shown in Figure A4) would have gone down faster.

exercise for this particular education group in urban areas by restricting the age window We did, and detected some differences (subject of Section 5), but none that altered our conclusions.

4. Results

In this section, we present the results of our decomposition exercise using three different methods.[22] First, we present the results for the aggregate participation rate and look for evidence on the "U." We then examine rural and urban areas separately, given the structural differences highlighted in Section 2.1. Finally, we focus on urban areas only and present the results by educational attainment, given the differentiating role that education plays as documented in Section 2.2. In all our figures, we display the age, year, and cohort profiles of the *predicted* participation rates. We display the age profiles for an individual who is born in 1961 and for year 2001, the year profiles for a 40-year-old individual who is born in 1961, and the cohort profiles for a 40-year-old individual and for year 2001. Cohort profiles are drawn starting with the oldest cohort and ending with the youngest. Although a total of 75 birth cohorts (1924-98) are present in our data set and contribute to estimation, as we move to the tails ($c < 1936$ and $c > 1986$) cohorts are represented by fewer and fewer data points (12 or less). We, therefore, confine the display range to 1936-86 and save ourselves the trouble of having to explain the distracting noise present at the tails. In each plot, we show 95 percent confidence intervals in addition to the predicted values.

4.1. Aggregate Participation Behavior

Figure 4 displays the predicted age, year, and cohort profiles of the aggregate labor force participation rate for women. Nine panels organized in 3 × 3 format are shown. Each row corresponds to a different method of decomposition. Each column corresponds to a particular component of the decomposition. A first glance at the age profiles shown on the left reveals striking differences. HHDP age profile peaks early, flattens and declines. IE age profile has two modes, first a bit higher than the second. ME version is similar, but the second peak is

---

[22] HDDP and ME methods are estimated using the codes provided by Browning *et al.* (2012) at https://www.ifs.org.uk/publications/5998, whereas the user-written Stata code apc_ie by Yang *et al.* (2004) is used in the case of the IE.

22

higher. Year profiles collected in the middle column and cohort profiles on the right also look different.

<center>\<Insert Figure 4\></center>

Closer inspection reveals that the ME age profile (last row) is similar to the HDDP age profile (top row), except that it has rotated counterclockwise. Another counterclockwise rotation is apparent as we move from the ME age profile to the IE version (middle row). As a result of these rotations, the strong downward trend in participation rates seen in the HHDP age profile is milder in ME and absent in IE. A similar counterclockwise rotation can be detected in the respective cohort profiles. In the case of year effects, a clockwise rotation is apparent as we follow the same order and move from HHDP to ME, and from ME to IE. Obviously age-period-cohort effects are connected, so rotation in one goes hand-in-hand with the other rotations.

As we discuss in some detail later in Section 5, such rotations emerge when cross-section age profiles evolve in particular ways. The apparent inconsistencies are attributable to the differences in the explicit or implicit identifying assumptions of the three models we use. We leave this fragility aside for now, and concentrate on shared features of the same profile across different models. Starting with panels (A) collected on the left, M-shaped age profiles are clearly visible with the ME and IE, but not as much with the HHDP, especially when the confidence intervals are figured into the comparison. Participation rates fall after age 25 in all three graphs. While the ME and IE age profiles rebound and have a second peak around the mid-40s, in the case of HHDP they remain flat after age 30. The M-shape seen in the bottom two age profiles suggests that some women temporarily exit the labor force for childbearing purposes and return later, a phenomenon discussed at length in İlkkaracan (2012) in the context of Turkey.[23]

The year effects are displayed in panels (B), which are shown in the middle column of Figure 4. Apparently random fluctuations around a negative trend are evident prior to 2005. We think these are attributable to the fact that the HLFS had smaller sample sizes before 2004. The fact that the survey was conducted bi-annually prior to 2000 is likely to have exacerbated

---

[23] Although M-shape terminology emerged later, the interruption due to marriage and child bearing was first discussed in the seminal article by Mincer and Polachek (1974). Farkas (1977) detects the M-shape on data from the USA.

<center>23</center>

the randomness. We see that all three year profiles have a V-shape, albeit the HHDP version is rotated counter-clockwise: The left arm of the V obtained from the ME and IE, which implies a strong downward trend in the year profiles up until 2005, is replaced by a weaker one in the case of the HHDP. All three profiles show a strong positive trend after 2007.

Recall that an explicit assumption of the HHDP estimator is the orthogonality of year effects to a linear time trend. Put differently, year effects in the HHDP estimator are uncorrelated shocks. This being the case, the task (so to speak) of capturing any linear trends shifts to the other two components. Indeed, both the age and cohort profiles of the HHDP display strong negative linear trends. Nonetheless, the qualitative aspects of the HHDP year profile are remarkably similar to the other two. Notably the trough of the V occurs in year 2005, which appears as the midpoint of the flat range of the aggregate female LFPR shown in Figure 3, the object of the decomposition exercise.

The cohort effects with the ME estimator contain a wide and shallow U-shape, followed by a smaller inverted U. An eye trained to detect the rotation pattern can find the resemblance of the HHDP version to the other two. The U-shape clearly visible in the IE and ME versions contains an important message: While successive cohorts born between 1936 and 1955/56 were less and less likely to participate, those born between 1955/56 and 1976 were more and more labor force oriented. The reversal seen after 1976 is attributable to the fact that young cohorts in our pooled sample are captured during the early stages of their potential work lives. As we pointed out in the background section, larger and larger majorities in these cohorts stayed in school longer and longer. In light of the arguments given in Section 2, we would expect them to enter the labor force in ever larger numbers upon completing their schooling and to remain there much longer. However, our time window is not wide enough to capture their cohort behavior accurately. With this caveat, we may conclude that year and cohort effects shown in Figure 4 support hypothesis H2 and lend credence to the U-shape characterization that Goldin and others have offered.

4.2. Analysis by Location of Residence

We begin examining the findings from our conditional analyses with rural areas. Rural areas serve as a good starting point for our deeper investigation for two reasons: First, the agricultural transformation (a term we use to summarize the presence of a combination of factors) that brought about a reduction in the share of agricultural employment and fed rural-urban

migration, resulted in a massive shift in the age composition of the agricultural work force, from younger to older workers (İlkkaracan and Tunalı, 2010). As we document below, this shift helps to underscore a key shortcoming of the APC decomposition, but also the opportunity to understand why or when it happens.

The second reason for starting our analysis with rural areas is the near absence of formal employment arrangements. This means that changes in the institutional framework that governs the labor market, in particular potential barriers to entry and exit to employment and the changes in the minimum age for retirement, will not have a direct effect on participation behavior. To be sure, participation behavior in rural areas can be impacted by changes in opportunities present in urban areas, but these do not amount to much given the skill composition of the working age population in the rural areas (İlkkaracan and Tunalı, 2010).

The cross-section age profiles collected in Figure C1 in Appendix C tell the story of compositional changes of the rural labor force in a remarkable way. The strong linear downward trend in the age profiles present in the early years is replaced by a flat one throughout the late 90s and early on in the post 2000 surveys. Starting with 2002 a positive linear trend becomes visible and gets stronger after 2006. A second remarkable finding is the downward shift of the entire profile over time until 2006. The stronger positive trend that emerges after 2006 indicates that the arrest of the decline in the aggregate rural female participation rate seen in Figure 3 and the subsequent rise is attributable to increasing participation rates in later ages.

Figure 5 displays the predicted age, year, and cohort profiles of the labor force participation rate for women residing in rural Turkey. The first impression is that while year profiles are similar across models, age and cohort profiles are not. As was the case with Figure 4 (all Turkey) reviewed in the previous section, ME age profile (last row) is similar to the HDDP age profile (top row), except that it has rotated counterclockwise. A milder counterclockwise rotation is evident as we move from the ME age profile to the IE version. As a result of these rotations, the strong downward trend in participation rates seen in the HHDP age profile is milder in ME and absent in IE. A similar counterclockwise rotation can be detected in the respective cohort profiles. In the case of year effects, a mild clockwise rotation is apparent as we follow the same order and move from HHDP to ME, and from ME to IE. Different identifying assumptions attribute the evolving trends present in the cross-section age profiles to different components of the decomposition. We postpone the reconciliation effort to Section 6

and focus on shared features instead, by focusing on the turning points of a given profile across different models.

As was the case in Figure 4, M-shaped age profiles are clearly visible with the ME and IE, but not as much with the HHDP. While participation rates fall after age 20 in all three graphs, in the case of HHDP they do not rebound after age 30. The valley of the M-shape corresponds to child bearing years, during which time women temporarily exit the labor force. The difference between the peak participation rate and that at the bottom of the valley is 7 percentage points in the HDDP age-profile and about 4 percentage points in the other two.

Turning to the year effects displayed in panels (B) -- shown as the middle column of Figure 5 -- the striking dip in participation observed for 1993 is a statistical anomaly, attributed to problems with fielding the survey in rural areas in that year. Ignoring the anomaly, the year effects estimated with the three different methods show up as fluctuations around a V-shape with a trough in 2007. As we discussed in Section 2.1, the sustained decrease of the share of agricultural employment in the total was halted and even replaced by a mild increase between 2007 and 2011. This episode is captured remarkably well in the form of year effects in participation in rural areas. Interestingly, the sustained decrease followed by an increase is captured even by the HHDP, despite the orthogonality constraint it imposes on the nature of the year effects. Furthermore, more amplified fluctuations in the participation rate attributable to the bi-annual frequency of the survey up until 2000, as well as small to moderate sample sizes prior to 2004 are captured in similar fashion in all graphs.

When we shift our focus to the apparent differences, we see a very strong downward trend in the cohort effects estimated by the HHDP. It is not possible to reconcile the 25 percentage point drop in the predicted participation rate with the data on rural female LFPR graphed in Figure 3. Evidently the identifying assumption of the HHDP, namely the orthogonality of year effects to a linear time trend, is not innocuous. Since there cannot be any linear trends in the year effects, the task (so to speak) of capturing linear trends shifts to the other two components. Thus, the much stronger linear trends seen in HHDP age and cohort effects should not come as a surprise. While the cohort effects with the ME estimator also display a downward trend, the rate of decline is smaller, and can easily be reconciled with the background we gave in Section 2.1. The IE cohort effects do not show any statistically significant differences among older and middle cohorts. Nevertheless, IE is consistent with the others in capturing the faster decline experienced by younger cohorts born after 1976 who had better educational opportunities,

stayed in school longer, and were arguably not eager to participate full-time as an unpaid family worker. It appears, then, all three methods capture the effect of the agricultural transformation on the rural labor force; however, they implicate different components of the APC model as the key drivers of the behavioral responses.

Figure 6 displays the estimated age, year, and cohort profiles of the labor force participation rate for women residing in urban areas. During our observation window, the urban share of the female labor force increased from 25 percent to 62 percent. Unlike the rural version, the results are remarkably consistent with the three different methods.

Age profiles shown in panel (A) are remarkably similar to the hump shape associated with the behavior of males, except that the humps are realized between ages 20 and 40, and imply a much shorter career. The humps contain a mild dip, so the predicted values at around age 30 are lower than the first peak around early 20s and the second peak at around age 40. Although the M-shape attributable to childbearing is not as strong as that in rural Turkey, it is still there. The sharp fall in participation rates after age 40 is a result of the Turkish social security system, whereby early retirement was possible for most cohorts of women in our sample (see Appendix B).

The year profiles in panel (B) display small fluctuations around 20 percent from 1988 all the way to 2008, after which a sustained rise is observed. In fact, the participation rate in 2013 is about 10 percentage points higher than it was in 2003. This sharp rise results from four main channels. First, the fraction of university graduates in the female labor force rose at a faster rate after 2004.[24] Second, government responses to the global crisis in 2008 included wage subsidies for newly-employed women, as well as for men aged 18-29.[25] Third, the stipulated

---

[24] When we fit two separate lines on a plot of the fraction of college-graduate women in the workforce vs. year in the period of 1988-2003 and in the period of 2004-2013, we find strong statistical evidence that the latter line is steeper (see Figure A11 in Appendix A). In fact, the slope in the latter period is more than twice as much as that in the first period.

[25] The subsidies that targeted women and young males were put into effect before the full impact of the global crisis was felt (Ercan, Taymaz and Yeldan, 2010). Ayhan (2013), Dildar (2014), Uysal (2013) and Balkan *et al.* (2014) report positive effects of the subsidies on employment outcomes of women in Turkey. There were earlier attempts to encourage employment via investment subsidies in Eastern regions of the country. Betcherman *et al.* (2010) uses a difference-in-differences strategy to evaluate the impact of two laws passed in 2004 and 2005 and

gradual increase in the age of retirement contributes to the consistently higher year effects after 2003, the year implementation of the 1999 social security reform started. Finally, in 2011 TurkStat began classifying care givers - women who take care of their children with disabilities and older relatives with health problems in their own homes - who receive monthly stipends from the government as employed.[26]

The cohort profiles, given in panel (C) of Figure 6, show a sustained increase in participation rates for cohorts born after the 1950s, except for the youngest 1986 cohort. This effect is estimated to be larger with the HHDP and the IE, which indicate that the participation rate of the 1985 birth-cohort is about 10 percentage points higher than that of the 1950 birth-cohort. Obviously, these differences across cohorts might just reflect compositional changes in education: As later-born cohorts are more educated, their propensity to participate in the labor market is higher. We address this issue later when we examine the cohort profiles conditional on educational attainment. The results from the subsamples will also come handy in providing an explanation for the small drop observed for the 1986 cohort.[27]

Comparison of the age profiles for rural (Figure 5) and urban (Figure 6) areas yields strong evidence that participation in rural areas is (i) higher, (ii) begins and peaks earlier, and (iii) lasts longer. All three are attributable to the predominance of agriculture. In Section 3.2 we hypothesized that differences in social security coverage should result in variation in the age of exit (H4). We find this is the case. Sharp differences in the rural and urban age-specific participation rates when young (< 20) and the delayed peak observed in urban areas also reflect the fact that urban residents stay in school longer. Obviously the profile in Figure 4 drawn for all Turkey is a weighted average of those in Figures 5 and 6, and as such hides the important distinctions.

---

conclude that the positive employment effects they find took the form of switching from informal to formal employment. They did not stratify by gender.

[26] According to our calculations using microdata from the HLFS, the employment rate of women in 2013 would increase at most by 2 percentage points from 2010 due to the classification of women caregivers as employed.

[27] As we pointed out earlier (see sections 3.2 and 3.3), we have an unbalanced panel which includes data from older cohorts observed late in their work lives and young cohorts observed early in theirs. We confine the range to cohorts born between 1936-86, which contribute 13 observations or more to the decomposition exercise.

4.3. Analysis by Educational Attainment in Urban Areas

In this subsection, we implement the decomposition conditional on educational attainment. We limit this analysis to urban areas because much less heterogeneity exists in educational attainment in rural areas (see Section 2.2 above). Figure 7 shows these profiles for the group with the lowest educational attainment: those with a primary school degree (5 years of schooling) or lower. This group accounted for more than half the female workforce in urban areas in 1988 (Figure A3 in Appendix A). Although it fell over time, as of 2013 their share was 30 percent, still a sizeable fraction. The estimated year-participation and cohort-participation profiles display very similar shapes to those, given earlier in Figure 5, for the aggregate female workforce in urban areas. Notably the secular rise in the year profile starts earlier (after 2000).[28]

Note, also, that the M-shape is much stronger in Figure 6. With all three estimation methods, the trough of the M-shape, realized just before age 30, is at a level that is about 10 percentage points lower than the initial peak of the M-shape (realized at around age 18) and about 5 percentage points lower than the second peak of the M-shape (realized at around age 40). Since women with lower education are concentrated in the informal sector where wage-experience profiles are flat (Tunalı and Ercan, 1998; Tunalı, 2004; World Bank, 2005), a temporary exit from the labor force for childrearing would be much less costly.

Another key feature of Figure 7 is the rising participation rates of later-born cohorts. In fact, with all three methods, the estimated participation rate of the cohorts born in early 1980s is at least 5 percentage points higher than that of the cohorts born in the early 1950s. The cumulative force of this effect is substantial because women with this level of educational attainment still constitute an important fraction of the female workforce in Turkey. Furthermore, these magnitudes establish that the rising cohort effects we saw in Figure 5 for the aggregate urban female labor force cannot be fully attributed to improvements in educational attainment. The rising participation rates of later-born cohorts among the less-educated women (subject of Figure 7) also contribute to the rising cohort-participation profiles in Figure 6. Finally, this finding forcefully contradicts the cultural explanation offered for the low female participation

---

[28] According to Tunalı *et al.* (2018) nearly all females in this group with lowest education worked for minimum wages or below. The secular rise detected by the year effects, despite increased formalization of the workforce, is attributable to the decline in the relative tax wedge, the amount employers have to pay above the minimum wage received by workers. Taking the share of the tax wedge in 2000 as 100 in year 2000, it was down to 60.8 in 2013.

rate. We see sustained increases in labor market orientation over time for the very group that culture is supposed to inhibit the most, evidence that contradicts H3.

Figure 8 provides the estimated age, year, and cohort profiles of participation rates for middle school graduates (who have 8 years of education).[29] This group has the smallest share in the workforce, consistently around 10 percent over time (Figure A5 in Appendix A). A first impression one gets from Figure 8 is that estimations with the three different methods yield remarkably consistent results, with the possible exception of the cohort profiles. While the age-participation profiles display an M-shape, this is not as strong as that for the lowest education group. In fact, when the confidence intervals are taken into account, the difference between the troughs and the peaks of the M-shape are not statistically significant. Year profiles are also similar to those of the lowest education group; the participation rate in 2013 is about 10 percentage points higher than those in the mid-90s. However, confidence intervals are much wider here. Statistically significant differences can only be detected at the tail end of our time window.

Figure 9 displays the estimates for high school graduates. Their share in the workforce has fluctuated between 24 and 32 percent between 1988 and 1999 (when surveys were conducted bi-annually) and has been declining throughout the 2000s.[30] Different methods produce apparently inconsistent results. Once again the counter-clockwise rotation in the age profile, as we move from HHDP to ME and from ME to IE, is attributable to the evolution of the slope of the linear trend present in cross-sectional age profiles (see Figure C5, Appendix C). Leaving the rotation aside, age profiles are consistent in indicating a weaker influence of childbearing on participation rates of groups with higher education than groups with lower education. This finding is attributable to lower fertility rates and much higher average wages that this group of women earns relative to those with lower education.

When we focus on the turning points, we see that the year profile turns up after 2003, consistent with the recovery of the economy after the reforms that followed a major crisis in 2001. Other possible explanations for the prolonged decline followed by sustained increases in labor market orientation after 2003 include: (i) poor management of the economy throughout

---

[29] Our middle school designation combines secondary school and extended primary school categories shown in Figure A5 in Appendix A.

[30] This group includes technical high school graduates, shown separately in Figure A4 in Appendix A.

the 1990s, which suppressed private sector employment growth (World Bank, 2005), (ii) gradual increases in skill requirements after the structural reforms in 2001 (World Bank, 2008, 2013), (iii) subsidies that helped to smooth out the crisis in 2008-9 (Ayhan, 2013; Dildar, 2014; Uysal, 2013; Balkan *et al.*, 2014) and a hoard of others that encouraged new investments (Betcherman *et al.*, 2005; Ercan *et al.*, 2010; World Bank, 2013), (iv) increased services orientation of the economy.

The turning point in the cohort profile suggests that cohorts born before and after 1956 behaved differently. Although both methods concur on the timing of the break, they depict different patterns of attachment before and after the break. As we explain in further detail in section 5, the differences in the cohort profiles have to be assessed together with the differences in the age profiles, because the linear trends are connected. Furthermore, while the age profile of the HHDP resembles the cross-section profiles from the earliest years in the observation window, the age profile of the IE resembles that from the most recent cross-sections. Notably the age profile of the ME most closely resembles the cross-section pattern seen between 2000 and 2002, the middle segment of our observation period. Recall that the age effects are model based predictions for the 1961 birth cohort in year 2001. Given the increased orientation to tertiary education triggered by the rising skill premium, our conjecture is that the age profile of our synthetic woman is more likely to resemble that produced by the IE. The draw of tertiary education is expected to have left behind a high school educated subpopulation which is less market oriented. Hence the break in trend in the cohort profile. Erosion of public sector hiring opportunities for the younger cohorts of high school graduates is another factor.

The last group we study are university graduates in urban areas. During our time window the share of this group in the female labor force increased from just over 10 percent to nearly 35 percent (Figure A5 in Appendix A). To a large extent this remarkable transformation is attributable to demand side developments and was made possible by an even faster expansion of supply (Bakış and Polat, 2015). The higher education system in Turkey consists of 2 or 3 year associate programs that provide vocational degrees as well as 4-year universities. The share of the former was negligible in the early 90s, but has risen over time. Enrollment in post-graduate programs has also been rising.[31] Based on cross-sectional data, female LFPR for

---

[31] Graduates of the different undergraduate and post-graduate programs cannot be distinguished in the public use files of the HLFS. Polat (2016) uses Ministry of Education data to document the expansion of the different tiers of the higher education system in terms of quantity and quality.

university graduates was remarkably high in 1988 (80.3 percent), declined over time, levelled at 70 percent in 2000 and remained there for nearly a decade before registering the first signs of increase. In 2013, the final year in our data, LFPR for this group of women was 72.4 percent. The decline in participation observed in cross-section data may be attributable to the changing composition of the university educated group. It remains to be seen whether the APC model is capable of sorting out the interplay of year and cohort effects by focusing on our synthetic woman.

Figure 10 shows the estimated age, year, and cohort profiles of participation rates. Once again reconciliation of the findings is possible upon comparing the age profiles and noting the mild counter-clockwise rotation as we move from HHDP (top) to ME and IE. The year profiles are consistent in reflecting the changes and identify 2003 as the turning point. Participation rates in the 2000s are indeed lower than those in the 1990s. The cohort profiles from the HHDP and ME detect a secular decline in the participation rates of cohorts born after 1960. In IE post-1960 changes are reflected in the form of a leveling off of an earlier sustained increase. However the differences in year and cohort effects are not statistically significant (at the 5 percent level). In essence, we do not find that participation rates of university graduates differ across cohorts or years. Statistically speaking the year and cohort profiles with the HHDP method are basically flat.

Remarkably, there is no statistical evidence of an M-shape in the age profile our university educated synthetic woman. This is attributable to the ability of university educated women to spread fewer births over a longer time window, and to shorter interruptions in employment compared to their lower educated kin. Although age profiles of IE and ME have a rising segment, the differences are not statistically significant.

4.4. Hypotheses revisited

Although hypotheses that emerged from our discussions of the background and institutional setting were evaluated as we discussed our findings, we end this section with a recapitulation. The first three are the key results from our investigation. The last two hypotheses allow us to check the consistency of the results from the APC decomposition with the institutional framework that governs retirement.

H1: M-shape in age profile weakens with education.

The M-shape is clearly visible in the primary school or lower subsample (Figure 7), and to a lesser extent in the middle school subsample (Figure 8). It is barely detectable in the high school subsample (Figure 9) and washes away in the university subsample (Figure 10). To a large extent these differences are driven by differences in fertility. Also, the ability our synthetic women to afford market-based child care support increases with education. Our findings suggest that calls for subsidized child care by NGOs and academics are well founded.

H2: U-shape is driven by favorable within group changes and compositional changes

Comparison of year and cohort profiles broken by location (Figures 5 and 6) are indicative of favorable changes in urban areas. When broken down by education, we found strong evidence of favorable year and cohort effects in the subsample with the lowest education (Figure 7). The year profiles in all our subsamples point at sustained LFPR increases after 2003. Hence the rise in the aggregate LFPR observed after 2006 is driven by favorable within group changes as well as favorable changes in the educational composition of the female population.

H3. Culture impedes participation of women

As indicated under H2, we found strong evidence against H3 in the very group where cultural identification with Islam, and the constraints this imposes, is expected to be strongest. Younger cohorts of women with primary school education or lower turned to the labor in force in ever greater numbers. To be sure their market orientation was aided by favorable economic developments. Since these changes happened at a time when the government supported an Islamic reorientation, we read the evidence as a strong rejection of the position that culture stands in the way of participation.

H4. Later exit in rural areas

That women in rural areas leave school and enter the work force early is well-established. What we find is that our synthetic woman in rural Turkey remains in the workforce considerably longer than her counterpart in urban Turkey. One explanation for this is the weaker standard used for defining what constitutes work in rural areas where agriculture is dominant (Anker, 1990). This may be attributable to lack of old-age pension, an entitlement that comes with registration in the social security system and premium payments. The rural-urban difference is exacerbated by the low minimum retirement age that was in effect during our time window.

H5. Higher the education, steeper the exit gradient

This hypothesis exploits the differences in social security coverage by education. The likelihood of having old-age pension increases with education. We argued that this would affect the age of exit gradients. Based on our reconciliation of the differences in the age profiles, ME profile emerges as the profile of choice for testing H5. The exit gradients after age 40 are: 4.5 percentage points per 10 years (pp/10) for primary education or lower, 10.5 pp/10 for middle school, 17 pp/10 for high school, and 30 pp/10 for university education. This finding instills further confidence in the findings from our APC decomposition.

5. Robustness Checks

As a robustness check of the closed population assumption discussed earlier, we repeat the decomposition analyses for different age groups of women. As noted in the data section, our working sample consists of 15 to 64-year-old women. In the analysis on high school and university graduates we restrict the sample to 18-64 and 22-59-year-old women, respectively,[32] to allow for the longer duration of schooling for these groups. The robustness checks involve increasing the lower age limits: from 15 to 20 and from 15 to 25 for the aggregate urban and rural subsamples and for the subsamples of urban women with a primary school or lower degree and urban women with middle school degree, from 18 to 25 for urban women with a high-school degree, and from 22 to 25 for urban women with a university degree.

The results given in Tables D1 through D10 in Appendix D show changes in age-participation profiles that are in line with life course events. For the groups that we observed an M-shape - rural women and urban primary-school educated women - increasing the lower age cut-off shaves off the first peak of the M. When we exclude 15 to 19-year-olds, we are essentially missing out on the early years of a woman's life course, before she marries and has her first child, the time period during which her participation is high. Instead, we observe a declining trend reflecting the marriage and child-bearing effects. When the lower age cut-off is pushed further to 25, the first peak and ensuing decline in participation are lost altogether, as our representative woman re-enters the labor market following child birth. The single peak in both cases occurs at around 40, at the same age observed when the entire group of 15-64-year-

---

[32] Due their early exit from the labor force, the number of observations drop beyond age 59 for university graduates, increasing noise.

old women is considered. In the case of middle school graduates, the M-shaped age-participation profile that was visible but not statistically significant for the 15 to 64-year-age group disappears altogether when the lower age cut-off is increased to 20 and then to 25. For the groups of high school educated and university educated women, increasing the age cut-off to 25 does not change the age-participation profiles appreciably.

Changing the age cut-off does not impact on the period effects. However, the cohort-profiles change somewhat. Restricting the sample to older women implies that information on younger cohorts is lost. This reflects on the overall urban and rural cohort profiles as some of the women who were in school and have not yet made the school-work transition are now excluded, with the result that the decline in participation observed for younger cohort in Tables 5 and 6 is smaller.

6. Discussion

In the previous section we used the linear "main effects only" APC model to obtain decompositions of the female labor force participation rate (LFPR) observed in Turkey over the period 1988-2013 using three different approaches: the constrained least squares method proposed independently by Hanoch and Honig (1985) and Deaton and Paxson (1994), which we abbreviate using the initials HHDP; the data driven generalized least squares method developed by Fu (2000) and introduced to the demography community by Yang, Fu and Land (2004), known as the Intrinsic Estimator (IE); and the data driven maximum entropy (ME) method due to Browning, Crawford and Knoef (2012). To better understand the forces that determine the aggregate female LFPR, we then repeated the exercise on subsamples stratified by location (rural and urban Turkey), and finally by education in urban areas (primary education or less, middle school, high school, and university). To render the results comparable, we relied on predictions and discovered that they were similar or very similar for urban, urban primary, and urban middle school, and that they differed to varying degrees for all Turkey, rural, urban high school, and urban university.

The non-trivial differences between the level estimates provided by the different methods underscore the importance of questioning the identification assumptions and the need to work with different models. As we elaborate below, changing time trends in the cross-section age profiles collected in Appendix C are responsible for the apparent inconsistencies. The results are easily reconciled once we recognize how the evolution of the time trend is reflected in the

three profiles produced by the decomposition exercise. When predictions differ, we see that the linear trend present in the age profile rotates counterclockwise as we move from HHDP to ME, and from ME to IE. When this happens, the cohort profile (drawn with the oldest cohorts to the left, youngest to the right) also rotates in the same manner. The period profile rotates in the opposite direction.

To see why different APC models can yield different predicted profiles, it helps to remember that the linear APC model given in equation (6) is not identified. The methods we rely on differ in the manner they pick one solution from the infinitely many defined by equation (7). Two of the three methods we use impose explicit (HHDP) or implicit constraints (IE) to replace (6) by a just-identified version. The third method reports an average solution, by shifting attention to the distribution of parameter estimates in the part of the solution space where information is least scarce (maximum entropy), a manifestation of lack of identification. As such, ME seems to exploit the data patterns in a fashion similar to the IE.

To see why different solutions are related to each other via the rotations described earlier, it helps to remember that the three components of the APC model are tied together by (1), the identity that defines an individual with age a surveyed in year (period) p as a member of the birth cohort $c = p - a$. This equation implies that when the linear trend in a given component is removed (or ignored), it will be picked up by the other two components.

< Insert Figure 11 >

Since the cross-section age profile is an often used statistic for describing participation behavior, we use the cross-section profiles collected in Appendix C to illustrate the manifestations of the observational equivalence. In Figure 11, we plot the magnitudes of the slopes of the linear trend fitted to each cross-section age profile as a function of the survey year, for each stratum examined in section 4. To avoid clutter, we leave out the plot for the aggregate participation rate. We see that while three of the plots display a positive slope, three that are bunched together are almost flat, in the sense that the slopes undergo negligible or very mild changes over time. The latter belong to strata that produced consistent decomposition results. The former are associated with strata that produced the rotation phenomenon. Evidently when the slope of the age profile changes over time, it is equally plausible to express it as a consequence of ageing as it is to describe it as a systematic difference in cohort behavior.

In Section 3.3 we argued that the reforms that increased the retirement age are not likely to have had an effect during our time window. As the bite of the reform gets reflected in the survey

data, the negative linear trend present in the urban cross-section profiles collected in Appendix C are likely to get muted further. This will exacerbate the rotation pattern we detected in our comparison of the age profiles obtained from the three methods and result in more severe apparent inconsistencies.

What is remarkable is how the three methods go about the process of extraction of patterns when slopes evolve systematically, as seen in the rural, urban-high school and urban-university plots in Figure 11. We see that HHDP consistently reports the age profile that resembles the shape from the early rounds of the crossü-section data collection effort, while the IE consistently reports the age profile that resembles the shape seen in most recent rounds. The ME age profile is somewhere in between, and as such resembles the cross-section profiles from the middle years of the period under study.

We find that period effects are similar to each other even when age and cohort profiles appear to tell different stories. Period effects – labor market shocks – hit everyone at the same time, which means different cohorts are affected at different points in their life cycle. Arguably observational equivalence is harder to achieve when fluctuations are present. When period effects persist, they too may be difficult to disentangle. We encountered one such case in our empirical work. In our urban high school sample, the rotation in the year profile is almost as dramatic as the rotations in the other two. However, as we underscored during our review of the results, minus the rotations, the shapes are remarkably similar across methods. As a result, the turning points occur at the same age, year, or cohort. This consistency allows us to reach a horde of important conclusions about participation behavior which are summarized in the concluding section.

Browning *et al.* (2012) also engage in comparisons of results from the same three models. In their LFPR-female example, they find similar results with IE and ME, but not as much with HHDP. They attribute the differences found for HHDP to the fact the period effects have been constrained to be orthogonal to a time trend, and to sum to zero. Indeed, in their study period effects from IE and ME show a strong downward trend while those under HHDP appear to be random deviations around a "V" or "U" shape. But this is not the only difference. Closer inspection reveals that along with the declining time trend observed in the IE and ME year effects, there is a smaller second order effect that implies convexity, something that is amplified in HHDP. In addition, the age profile produced by HHDP reflects a clockwise rotation of the age profiles in IE and ME. The cohort profile in HHDP displays a similar rotation. As we have

shown, this rotation is an artifact of a systematic change in a time trend. Thus their results may be seen as corroboration of our findings.

We end this section with a brief glance at the results of the APC decomposition exercise conducted on males, collected in Appendix E. On the whole male profiles are estimated more precisely, given the stability in the LFPR by age and over time. We see evidence of the rotation pattern in all the figures, which is attributable to the evolution of the linear time-trend in the cross-section age profiles. Age profiles are hump shaped, and reflect a short compulsory military service related interruption after age 20. Remarkably when year profiles show evidence of trend changes, 2003 emerges as the turning point of the year profiles. This corroborates the evidence of favorable changes in the labor market we detected in the female year profiles. Variations in the cohort profiles are a lot more muted. Using the ME profiles, we see that male cohorts in rural areas experienced the decline in the LFPR as early as 1971, ahead of their female counterparts (1976 onwards). A similar comparative pattern emerges from the urban profiles. While the dip we see is confined to the youngest female cohorts (1984 and younger), it is visible for male cohorts born in 1972 and later.

Stratification on education shows that cohorts of males and females with the same level of education typically had shared fortunes. The only exception to this is seen in the cohort profiles for university graduates. In the male profiles, there is no evidence of the trouble that female cohorts born in 1961 or later have been having. As females caught up with males in enrollment statistics (Polat, 2016), the competition in the labor market with similarly qualified males appears to have hurt females.

7. Conclusion

What we know about female labor force participation behavior in Turkey comes from cross-section studies conducted on household survey data. In this paper, we use 25 years of data from the Household Labor Force Survey, the source of official labor market statistics, to engage in a synthetic panel study designed to reevaluate what we know. An advantage of the synthetic panel approach is its prospective design. By marching forward through the historical record captured in the data, one not only learn about the drivers of the changes, but also gather insights about the future. In our case the motivation came from the apparent reversal in the behavior of the aggregate female LFPR around 2006-2008, after a long and sustained decline. This reversal is the crux of the so-called U-hypothesis, which is a collage of explanations for why the decline

in female LFPR occurs, and how and why it rebounds. Since there is no shortage of explanations that can describe the course of events in Turkey, we wanted to construct an analytical framework that would enable us to weave a convincing story, by allowing us to formulate testable hypotheses.

Towards that end we use the age-period-cohort (APC) decomposition to arrive at a "true" age profile that characterizes the life-cycle behavior of our representative woman, as well as year and cohort profiles that reflect changes over time and by cohort. By stratifying the data first by location, and later by education conditional on residence in urban areas, we are able to generate variation that enables us to test hypotheses about what drives the differences in behavior, and how changes in the economic and institutional environment impact the participation outcome.

The motivation for, and the risks involved in using the APC decomposition are well-known. By using three well-established models that have different ways of getting around the lack of identification inherent in the linear main effects only APC model, we thought we could attain our objectives in a guarded fashion. As others who have succumbed to the spell of the APC framework undoubtedly know, we got more than what we bargained for. While half of our subsamples delivered consistent results, the other half left us in wanting for explanations as to why the different models yielded different pictures. Happily, we found *the* explanation and were able to reconcile the apparent differences.

The marker for the problems we faced turned out to be the linear trend in the crossü-section age profiles. If the slope of the linear trend is stable, all three models produce the same decomposition. If it changes and evolves in a particular way, the identification problem comes back to haunt us. For example, if an initially negative linear trend in the age profile (LFPR is high when young and decreases over time) is muted over time and/or gets replaced by a positive one (LFPR increases with age), different models attribute the changes to different components of the APC model. Notably turning points in the profiles remained robust to this fragility. As a result it was possible to weave the story.

Turning to the substantive questions that motivated us, we were able to confirm that Turkey is firmly entrenched in the rising segment of the U-shape. This conclusion is warranted, because we have firm evidence in the results broken down by education that forces operating at group level (captured by the year effects) have encouraged female participation over the 2003-2013

39

period. Given the inertia present in the direction of evolution of correlates such as education and fertility, we are led to believe the rise will be sustained.

The evidence coming from cohort effects is more muted, and is indicative of problems for better educated young cohorts. Although data constraints precluded the extension of our time window past 2013, rising unemployment rates confirm the predicament of the youth. In the case of women with the lowest levels of education, however, the cohort effects reflect a sustained increase for cohorts born between 1956 and 1976. This finding is at odds with the "culture" factor implicated in keeping the participation low. As the decades long process of rural to urban migration shifted the weight of the population in favor of urban areas, it is likely to have helped transform attitudes towards female presence in the work place as well. The evidence that we have is that women are increasingly labor market oriented, and are eager to join the labor force if demand for their skills is present.

References

Anker, R. (1990) "Methodological Considerations in Measuring Women's Labor Force Activity in Developing Countries: The Case of Egypt." *Research in Human Capital and Development,* 6, Greenwich: JAI Press, 27-58.

Ayhan, H. S. (2013) "Do Non-Wage Cost Rigidities Slow Down Employment? Evidence from Turkey." *IZA Journal of Labor Policy*, 2: 20.

Bakış, O. and Polat, S. (2015) "Wage inequality in Turkey, 2002–10". *Economics of Transition*, 231, 169-212.

Balkan, B., Başkaya, Y.S. and Tümen, S. (2014) "Evaluating the Impact of the Post-2008 Employment Subsidy Program in Turkey." Working Paper no. 1414, Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Barett, J.C. (1973) "Age, Time and Cohort Factors in Mortality from Cancer of the Cervix." *Journal of Hygeine*, 71, 253-259.

Başlevent, C. and Onaran, O. (2004) "The Effect of Export Oriented Growth on Female Labor Market Outcomes in Turkey." *World Development* 32(8), 1375–93.

Berker, A. (2011) "Labor-Market Consequences of Internal Migration in Turkey." *Economic Development and Cultural Change*, 60 (1), 197-239.

Betcherman, G., Daysal, M. and Pages, C. (2010) "Do Employment Subsidies Work? Evidence from Regionally Targeted Subsidies in Turkey." *Labor Economics*, 17 (4), 710-722.

Borjas, G. J. (2016) *Labor Economics.* New York: McGraw Hill.

Boserup, E., (1970) *Women's Role in Economic Development.* New York: St. Martin's Press.

Browning, M., Crawford I., Knoef M. (2012) "The Age-Period-Cohort Problem: Set Identification and Point Identification." CEMMAP Working Paper CWP02/12, Institute for Fiscal Studies.

Buğra, A. (2014) "Revisiting the Wollstonecraft Dilemma in the Context of Conservative Liberalism: The Case of Female Employment in Turkey." *Social Politics*, 21(1), 148–166.

Bulutay, T. (1995) *Employment, Unemployment and Wages in Turkey.* Ankara: State Institute of Statistics Printing Division.

Çağatay, N. and Berik, G. (1991) "Transition to Export-Led Growth in Turkey: Is There a Feminization of Employment?" *Review of Radical Political Economics*, 22, 115–34.

Çağatay, N. and Özler, S. (1995) "Feminization of the Labour Force: The Effects of Long-term Development and Structural Adjustment." *World Development*, 23(11), 1883–94.

Dayıoğlu, M. (2000) "Labor Market Participation of Women in Turkey." In F. Acar and A. Gunes-Ayata (Eds), *Gender and Identity Construction: Women in Central Asia, the Caucasus and Turkey*. Köln: Brill, 44 –73.

Deaton A. (1985) "Panel Data from Time Series of Cross-sections." *Journal of Econometrics*, 30, 109-126.

Deaton A. and Paxson C. (1994) "Saving, Growth, and Aging in Taiwan." In D. Wise (Ed.), *Studies in the Economics of Aging.* Chicago: National Bureau of Economic Research and Chicago University Press.

Dildar, Y. (2014) "Targeting Women's Employment: Do Employment Subsidies Work? Evidence from Turkey." Working paper, Department of Economics, University of Massachusetts Amherst.

Diwan, I. and Vartanova, I. (2017) "The Effect of Patriarchal Culture on Women's Labor Force Participation." ERF Working Paper no 1110.

DHS-T (1983) HÜNEE (Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü). 1984. "1983 Türkiye Nüfus ve Sağlık Araştırması." Ankara: Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü, T.C. Kalkınma Bakanlığı ve TÜBİTAK.

DHS-T (1993) HÜNEE (Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü). 1994. "1993 Türkiye Nüfus ve Sağlık Araştırması." Ankara: Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü, T.C. Kalkınma Bakanlığı ve TÜBİTAK.

DHS-T (2003) HÜNEE (Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü). 2004. "2003 Türkiye Nüfus ve Sağlık Araştırması." Ankara: Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü, T.C. Kalkınma Bakanlığı ve TÜBİTAK.

DHS-T (2013) HÜNEE (Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü). 2014. "2013 Türkiye Nüfus ve Sağlık Araştırması." Ankara: Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü, T.C. Kalkınma Bakanlığı ve TÜBİTAK.

Easterlin, R. A. (1978) *Birth and Fortune: The Impact of Numbers on Personal Welfare.* Chicago: University of Chicago Press.

Ercan, H., Taymaz, E. and E. Yeldan (2010) *Crisis and Turkey: Impact Analysis of Crisis Response Measures.* International Labor Organization, ILO Office for Turkey, Ankara.

Elson, D. (1999) "Labour Markets as Gendered Institutions: Equality, Efficiency and Empowerment Issues." *World Development*, 27(3), 611–13.

Farkas, G. (1977) "Cohort, Age, and Period Effects Upon the Employment of White Females: Evidence from 1957-1968." *Demography*, 14 (1), 33-42.

Fernandez R., Fogli A. and Olivetti, C. (2004) "Mothers and sons: Preference formation and female labor force dynamics" *Quarterly Journal of Economics*, 119 (4), 1249-1299.

Fernández, Raquel, (2007) "Women, Work and Culture." *Journal of the European Economic Association*, 5(2/3), 305-332.

Fernández, Raquel, and Alessandra Fogli. 2009. "Culture: An Empirical Investigation of Beliefs, Work, and Fertility." *American Economic Journal: Macroeconomics*, 1 (1), 146-77.

Frost, W. H. (1939) "The Age Selection of Mortality from Tuberculosis in Successive Decades." *American Journal of Hygiene, Section A*, 30, 91-96.

Fu, W.J. (2000) "Ridge Estimator in Singular Design with Application to Age-Period-Cohort Analysis of Disease Rates." *Communications in Statistics - Theory and Methods*, 29, 263-78.

Gaddis, I. and Klasen, S. (2014) "Economic Development, Structural Change, and Women's Labor Force Participation: A Reexamination of the Feminization U Hypothesis." *Journal of Population Economics*, 27, 639-681.

Gedik, A. (2003) "Differential Urbanisation in Turkey, 1955–97." *Tijdschrift voor Economische en Sociale Geografie*, 94(1), 100–111.

Glen, N. D. (2005) *Cohort Analysis*. 2nd Edition. Series: Quantitative Applications in the Social Sciences, London: Sage Publications.

Goldin, C. (1995) "The U-Shaped Female Labor Force Function in Economic Development and Economic History". In: Schultz TP (Ed.) *Investment in Women's Human Capital and Economic Development*. University of Chicago Press, Chicago, 61-90.

Gürsel, S. and İmamoğlu, Z. (2013) "Why is Agricultural Employment Increasing in Turkey?" BETAM Working paper, no.4.

Halford, T. R. (1983) "The Estimation of Age, Period, and Cohort Effects for Vital Rates." *Biometrics*, 39, 311-324.

Halford, T. R. (1985) "An Alternative Approach to Statistical Age-Period-Cohort Analysis." *Journal of Chronic Disease*, 38, 831-836.

Hanoch, G. and Honig, M. (1985) "'True' Age Profiles of Earnings: Adjusting for Censoring and for Period and Cohort Effects." *Review of Economics and Statistics*, 67(3), 383-394.

Heckman, J.J. and Robb R. (1985) "Using Longitudinal Data to Estimate Age, Period and Cohort Effects in Earnings Equations." In *Cohort Analysis in Social Research beyond the Identification Problem*. Editor: Mason, W. M., Fienberg S. E. New York: Springer.

İlhan, B. (2012) "Youth in the Labor Market and the Transition from School to Work in Turkey." Ph.D. Thesis, Dept. of Economics, Middle East Technical University.

İlkkaracan, İ. (2012) "Why So Few Women in the Labor Market in Turkey." *Feminist Economics*, 18(1), 1-37.

İlkkaracan, İ. and Tunalı, İ. (2010) "Agricultural Transformation and the Rural Labor Market in Turkey." In Karapınar, B., Adaman, F., Özertan, G. (Eds.) *Rethinking Structural Reform in Turkish Agriculture*. New York: Nova Science Publishers.

Kahn, J.R. and Mason, W.H. (1987) "Political Alienation, Cohort Size and the Easterlin Hypothesis." *American Journal of Sociological Review*, 52, 155-169.

Karapınar, B., Adaman, F., and Özertan, G. (Eds.) (2010) *Rethinking Structural Reform in Turkish Agriculture*. New York: Nova Science Publishers.

Kupper, L.L., Janis, J.M., Karmous, A. and Greenberg, B.G. (1985) "Statistical Age-Period-Cohort Analysis: A Review and a Critique." *Journal of Chronic Disease*, 38, 811-830.

Kırdar, M. G., Dayıoğlu, M. and Koç, İ. (2016) "Does Longer Compulsory Education Equalize Schooling by Gender and Rural/Urban Residence?" *World Bank Economic Review*, 30(3), 549-579.

Luci, A. (2009) "Female Labour Market Participation and Economic Growth." *International Journal of Innovation and Sustainable Development*, 4(2/3), 97-108.

Luo, L. (2013) "Assessing Validity and Application Scope of the Intrinsic Estimator Approach to the Age-Period-Cohort Problem." *Demography*, 50(6): 1945-1967.

Luo, L., and Hodges, J.S. (2019) "The Age-Period-Cohort-Interaction Model for Describing and Investigating Inter-Cohort Deviations and Intra-Cohort Life-Course Dynamics." Mimeo.

Mammen, K. and Paxxon, C. (2000) "Women's Work and Economic Development." *Journal of Economic Perspectives*, 14(4), 141-164.

Mason, K.O., Mason W.M., Winsborough H.H., Poole W.H. (1973) "Some Methodological Issues in Cohort Analysis of Archival Data." *American Sociological Review*, 38, 242-58.

Mincer, J. and Polachek, S. (1974) "Family Investments in Human Capital: Earnings of Women." In T.W. Schultz (Ed.), *Marriage, Family, Human Capital and Fertility*, NBER Book, 76-110.

Moghadam, V. M. (2005) "Women's Economic Participation in the Middle East: What Difference Has the Neoliberal Policy Turn Made?" *Journal of Middle East Women's Studies*, 1 (1), 110-146.

O'Brien, R.M. (1991) "Sex-ratios and Rape Rates: A Power-Control Theory." *Criminology*, 29, 99-104.

O'Brien, R.M. (2000) "Age Period Cohort Characteristics Models." *Social Science Research*, 29, 123-139.

O'Brien, R.M. (2014) "Estimable Functions in Age-Period-Cohort Models: A Unified Approach." *Quality and Quantity*, 48, 457-474.

O'Brien, R.M. (2015a) "Age-Period-Cohort Models and the Perpendicular Solution." *Epidemiological Methods*, 1-13.

O'Brien, R.M. (2015b) *Age-Period-Cohort Models: Approaches and Analyses with Aggregate Data*. Boca Raton, CRC Press.

Özkan, H. and Tunalı, İ. (2014) "Labor Market Mobility and Marginal Attachment in Turkey: Evidence from HLFS, 2000-2002." Koç University, Department of Economics Working Paper.

Polat, S. (2016) "Some Economic Consequences of Higher Education Expansion in Turkey." Munich Personal RePEc Archive, Paper No. 72602.

Paiva, A. R. C., Xu, J. and Príncipe, J. C. (2008) "Kernel Principal Components Are Maximum Entropy Projections." *Independent Component Analysis and Blind Signal Separation Lecture Notes in Computer Science*, 3889, 846-853.

Psacharopoulos G. and Tzannatos Z. (1989) "Female Labor Force Participation: An International Perspective." *World Bank Research Observer*, 4(2), 187-201.

Reimers, C. W. (1985) "Cultural Differences in Labor Force Participation Among Married Women." *The American Economic Review*, 75 (2), 251-255.

Salehi-Isfahani, D. and Marku, M. (2011) "Reversal of Fortunes: The Rise and Fall of Lifetime Earnings of Iranian Men." *Economic Development and Cultural Change*, 59(4), 877-906.

Seguino, S. (2000a) "Gender Inequality and Economic Growth: A Cross-country Analysis." *World Development*, 28(7), 1211–1230.

Seguino, S. (2000b) "Accounting for Gender in Asian Economic Growth." *Feminist Economics*, 6(3), 27–58.

Şengül, G. and Üngör, M. (2011) "Increasing Share of Agriculture in Employment in the Time of Crisis: Puzzle or Not?" Workıng paper no: 11/05, Central Bank of the Republic of Turkey.

Singh, I., Squire, L. and Strauss, J. (1986) "Introduction." In Singh, L. Squire and J. Strauss (Eds.), *Agricultural Household Models*. Baltimore: The Johns Hopkins University Press.

Solati, C. (2017) *Women, Work, and Patriarchy in the Middle East and North Africa*, Cham, Switzerland: Palgrave Pivot/Springer.

Tam, H. (2011) "U-shaped Female Labor Participation with Economic Development: Some Panel Data Evidence." *Economics Letters*, 110(2), 140-142.

Tansel, A. (2002) "Economic Development and Female Labor Force Participation in Turkey: Time-Series Evidence and Cross-Province Estimates." ERC Working Papers in Economics 01/05, Middle East Technical University.

Tunalı, İ. (1996) "Migration and Remigration of Male Household Heads in Turkey, 1963-1973." *Economic Development and Cultural Change*, 45(1), 31-67.

Tunalı, İ. (1997) "To Work or Not to Work: An Examination of Female Labor Force Participation in Urban Turkey." *Proceedings of the 5th Annual Conference of the Economic Research Forum*.

Tunalı, İ. and Ercan, H. (1998) "Labor Market Segmentation in Turkey." In T. Bulutay (Ed.) *Main Characteristics and Trends of the Turkish Labor Market*. Ankara: State Institute of Statistics Printing Division.

Tunalı, İ. (2004) "Changes in the Structure of the Labor Market in Turkey." Mimeo.

Tunalı, İ., and Başlevent, C. (2006) "Female Labor Supply in Turkey." In S. Altuğ and A. Filiztekin (Eds.), *The Turkish Economy: The Real Economy, Corporate Governance and Reform and Stabilization Policy*. London and New York: Routledge.

Tunalı, İ., Bakış, O., İlhan, B. and Polat S. (2018) "Effects of Minimum Wages on the Labor Market in Turkey, 2005-2018." Funded project proposal, in Turkish.

Turkish Statistical Institute (2011) *Turkey's Statistical Yearbook 2010*. Ankara: Turkish Statistical Institute, Printing Division.

Uysal G. (2013) "Incentives Increase Formal Female Employment." BETAM Research Brief 13/151.

Verme, P. (2014) "Economic Development and Female Labor Participation in the Middle East and North Africa: A Test of the U-Shape Hypothesis." Policy Research Working Paper 6927, World Bank.

Verick, S. (2014) "Female Labor Force Participation in Developing Countries." *IZA World of Labor*, 87. doi: 10.15185/izawol.87.

Welch, F. (1979) "Effects of Cohort Size on Earnings." *Journal of Political Economy*, 87, 565-598.

World Bank (2005) *Turkey – Labor Market Study*. Report No. 33254 – TR, Poverty Reduction and Economics Management Unit, Europe and Central Asia Region.

World Bank (2008) *Investing in Turkey's Next Generation: The School-to-Work Transition and Turkey's Development*. Report No. 44048 – TU, Human Development Sector Unit, Turkey Country Unit, Europe and Central Asia Region.

World Bank (2013) *Good Jobs in Turkey*. Report No. 83818 – TR, Human Development Sector Unit, Europe and Central Asia Region.

Yang, Y., W.J. Fu, K.C. Land (2004) "A Methodological Comparison of Age-Period-Cohort Models: The 'Intrinsic Estimator' and Conventional Generalized Linear Models." *Sociological Methodology*, 2, 75-110.

Yang, Y., Schulhofer-Wohl, S., Fu, W. J. and Land, K. C. (2008) "The Intrinsic Estimator for Age-Period-Cohort Analysis: What it is and How to Use it." *American Journal of Sociology*, 113 (6), 1697-1736.

Figures and Tables

Figure 1. Age profiles of participation, urban Turkey, females
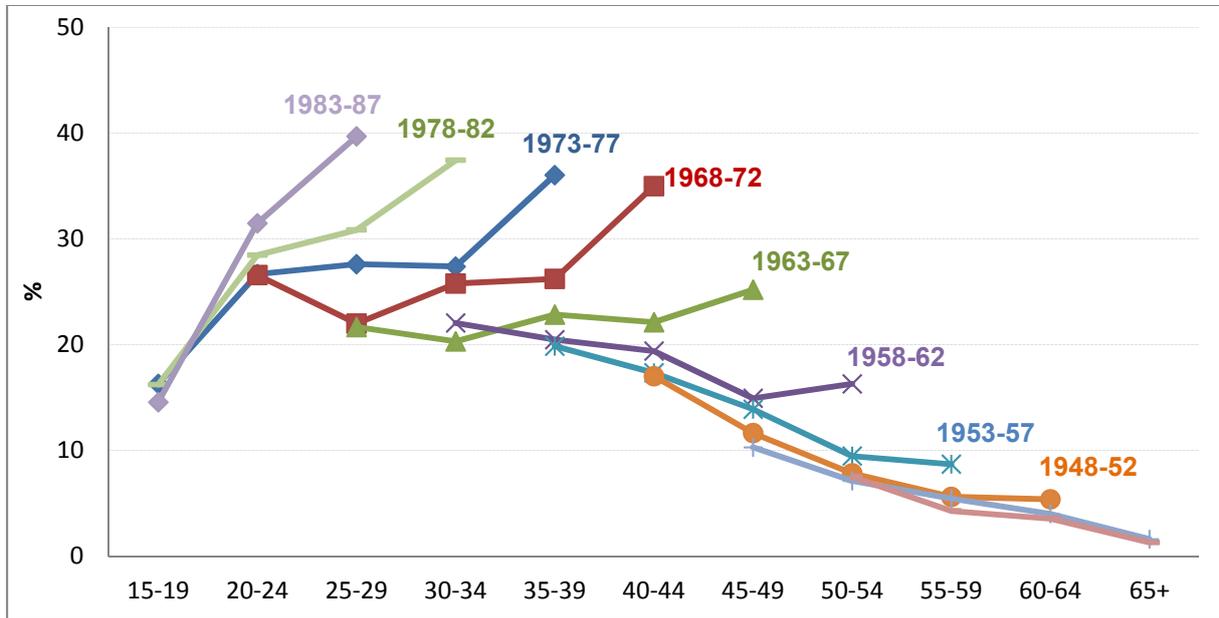
Source: TurkStat, HLFS Web version (1992, 1997, 2002, 2007, 2012).

Figure 2. Age profiles of participation, rural Turkey, females
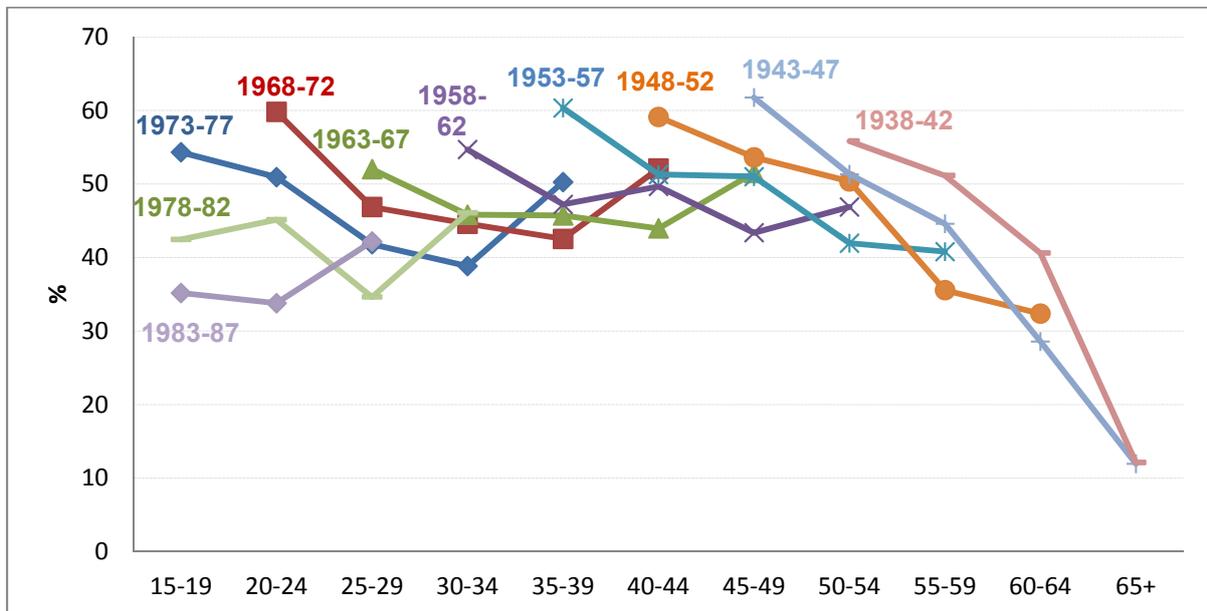
Source: TurkStat, HLFS Web version (1992, 1997, 2002, 2007, 2012).

Figure 3. Labor force participation rates by location and sex, 1988-2016[#]
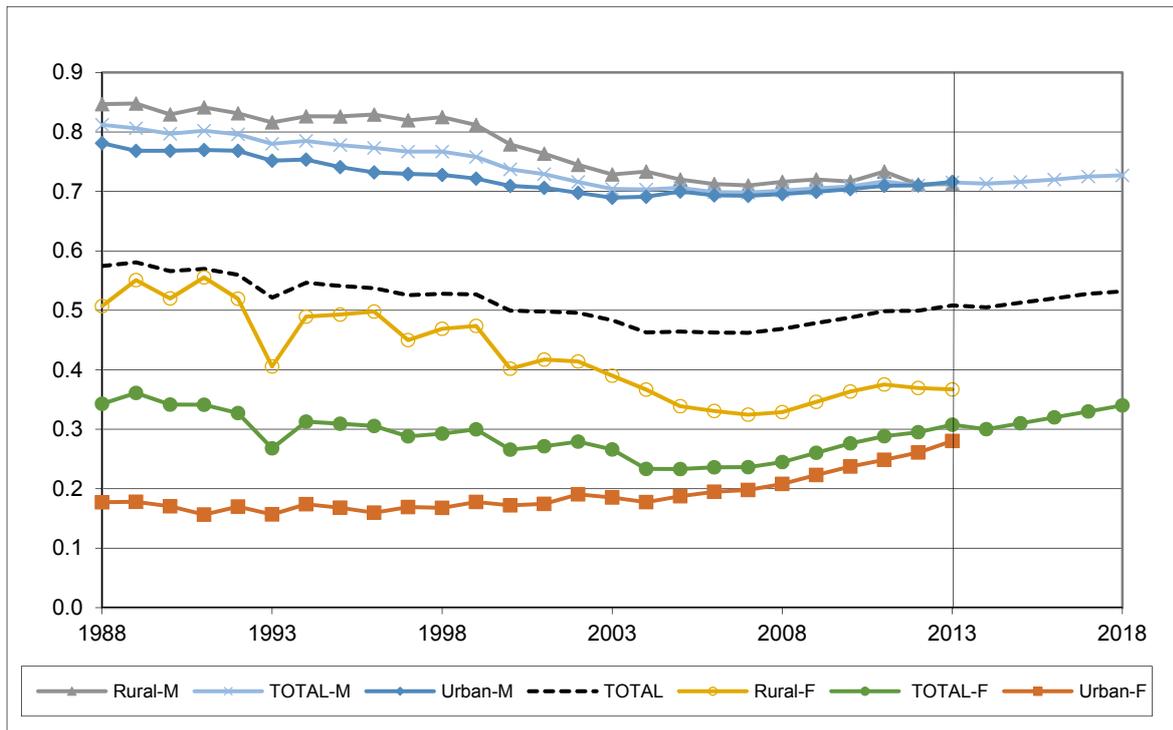
Notes: TurkStat stopped compiling and publishing data by locational breakdown in 2013.

Source: TurkStat, HLFS Web version, 1988-2018.

Figure 4. Decomposition Results – Turkey
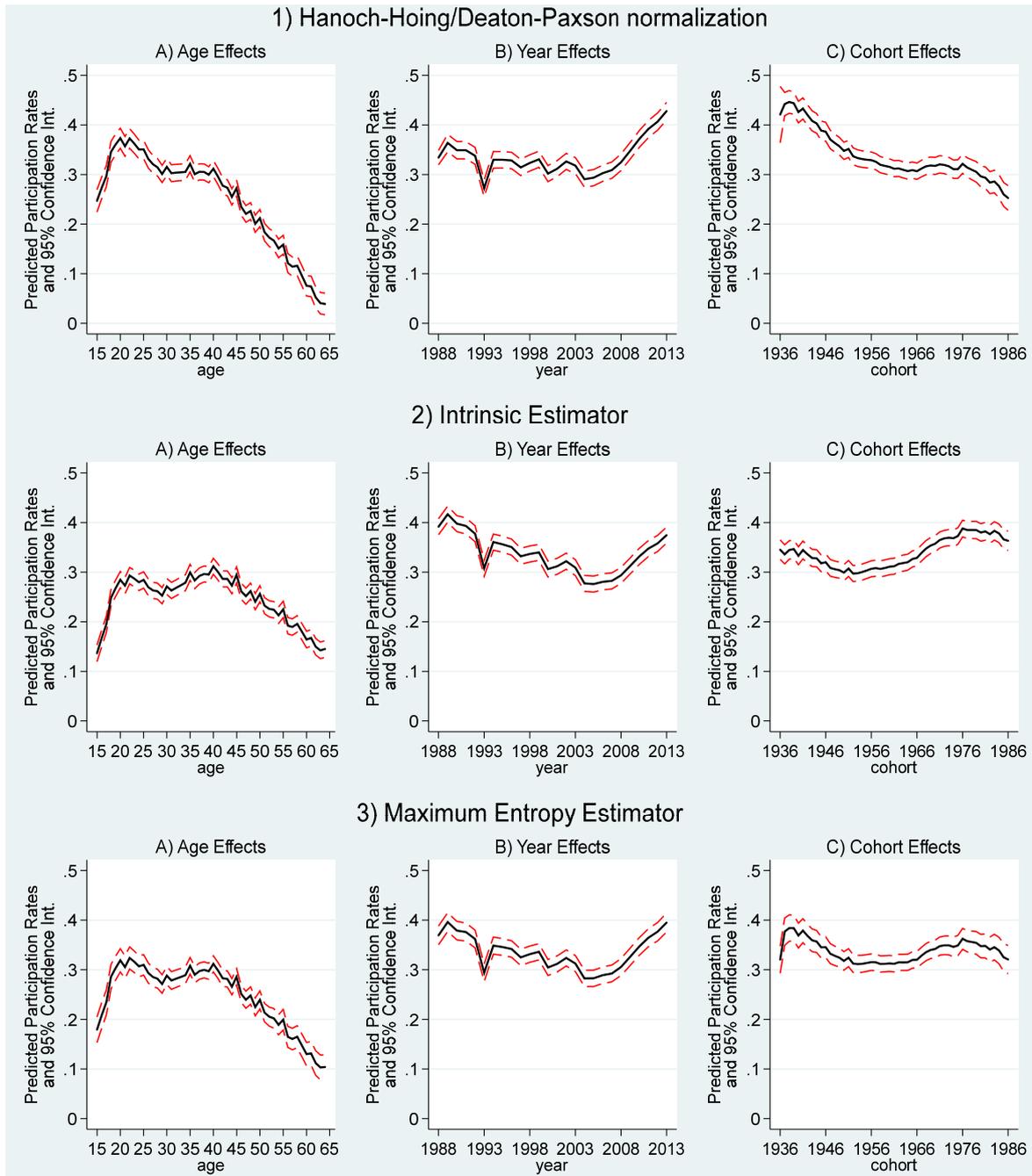
Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 5. Decomposition Results - Rural areas
Share in Female Labor Force: 75 percent (1988), 38 percent (2013)
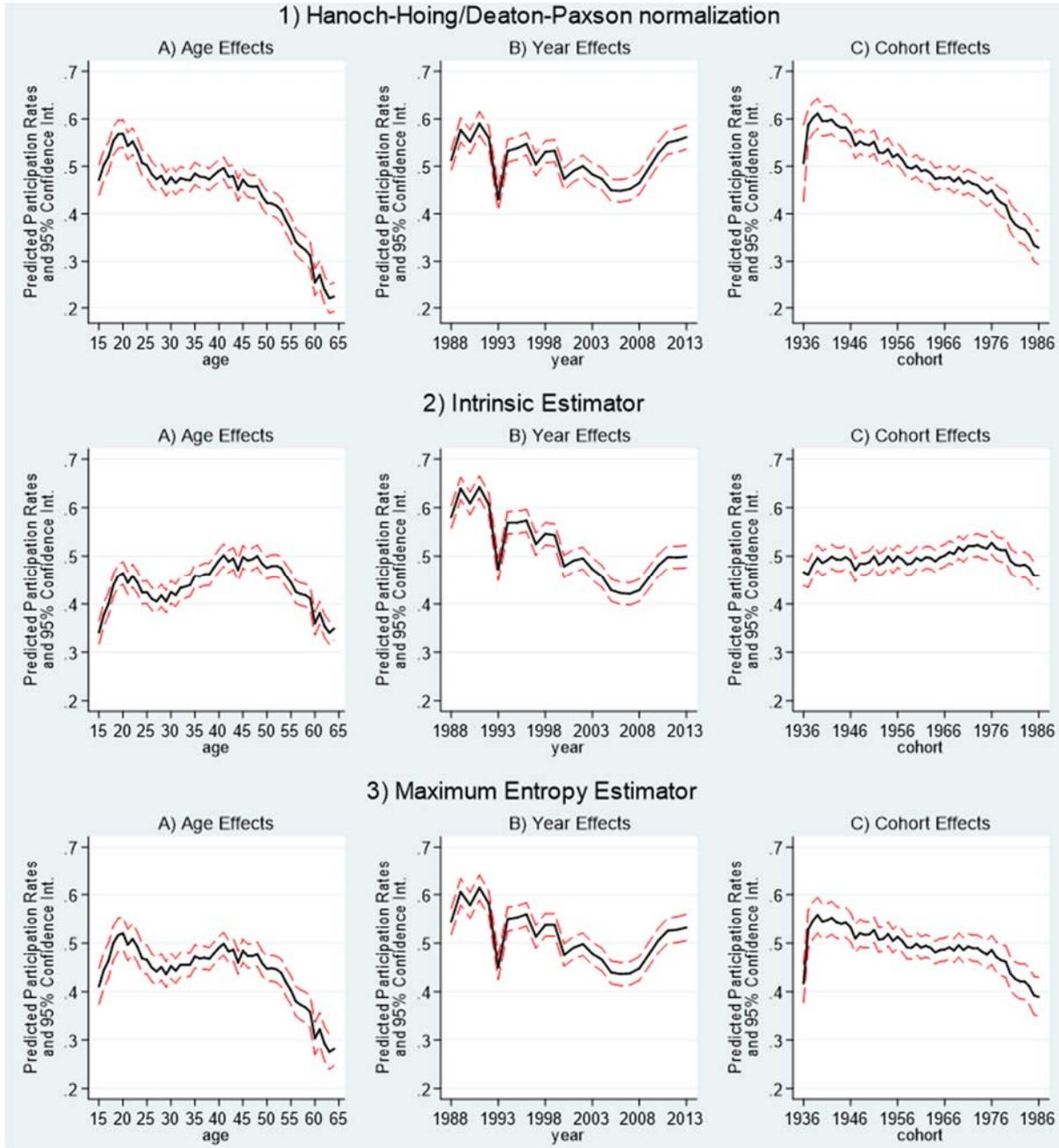
Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 6. Decomposition Results - Urban areas

Share in Female Labor Force: 25 percent (1988), 62 percent (2013)
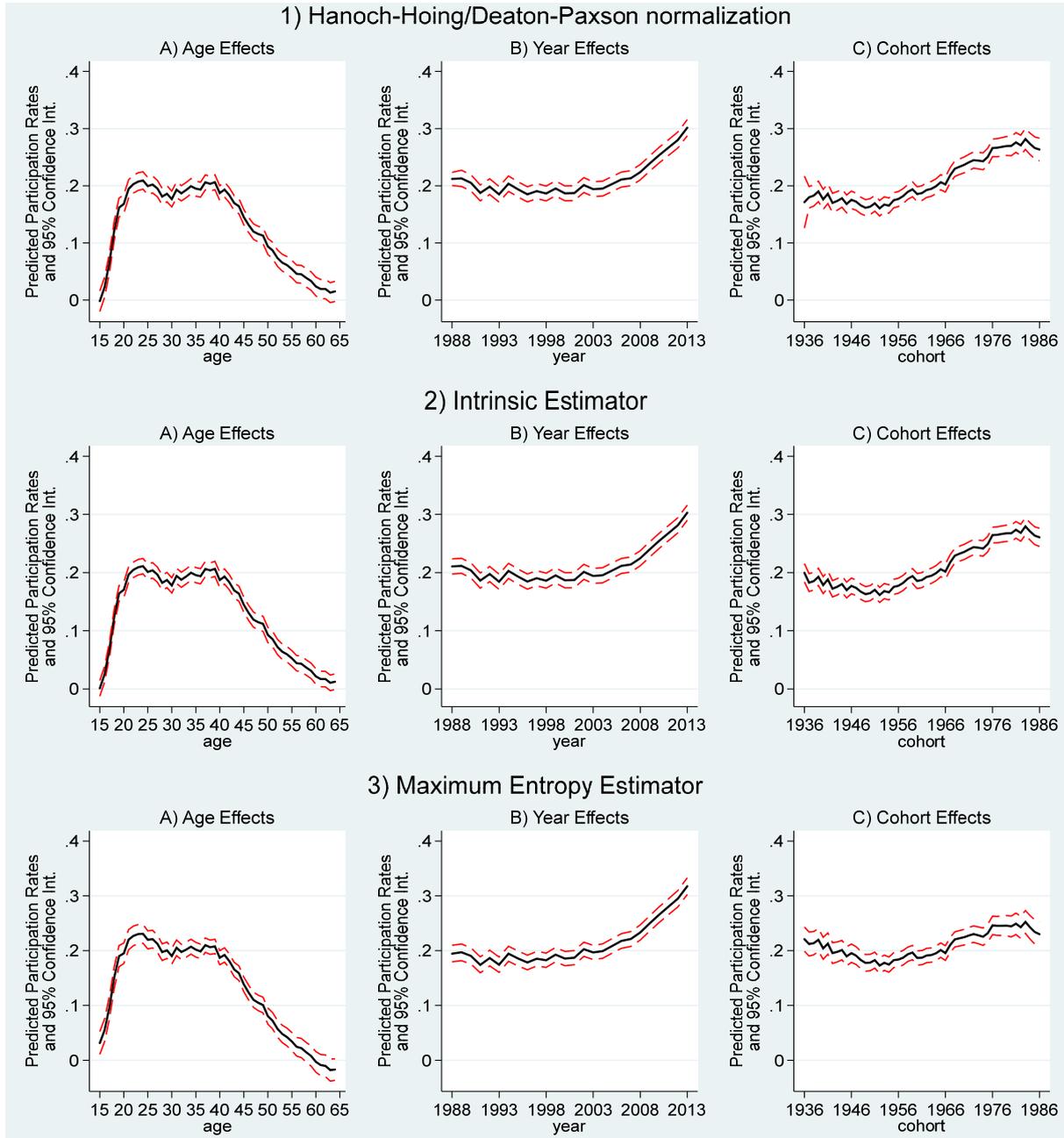
Notes: The sample is restricted to ages 18 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 7. Decomposition Results - Urban areas, primary school or lower

Share in Female Labor Force: 13 percent (1988), 19 percent (2013)
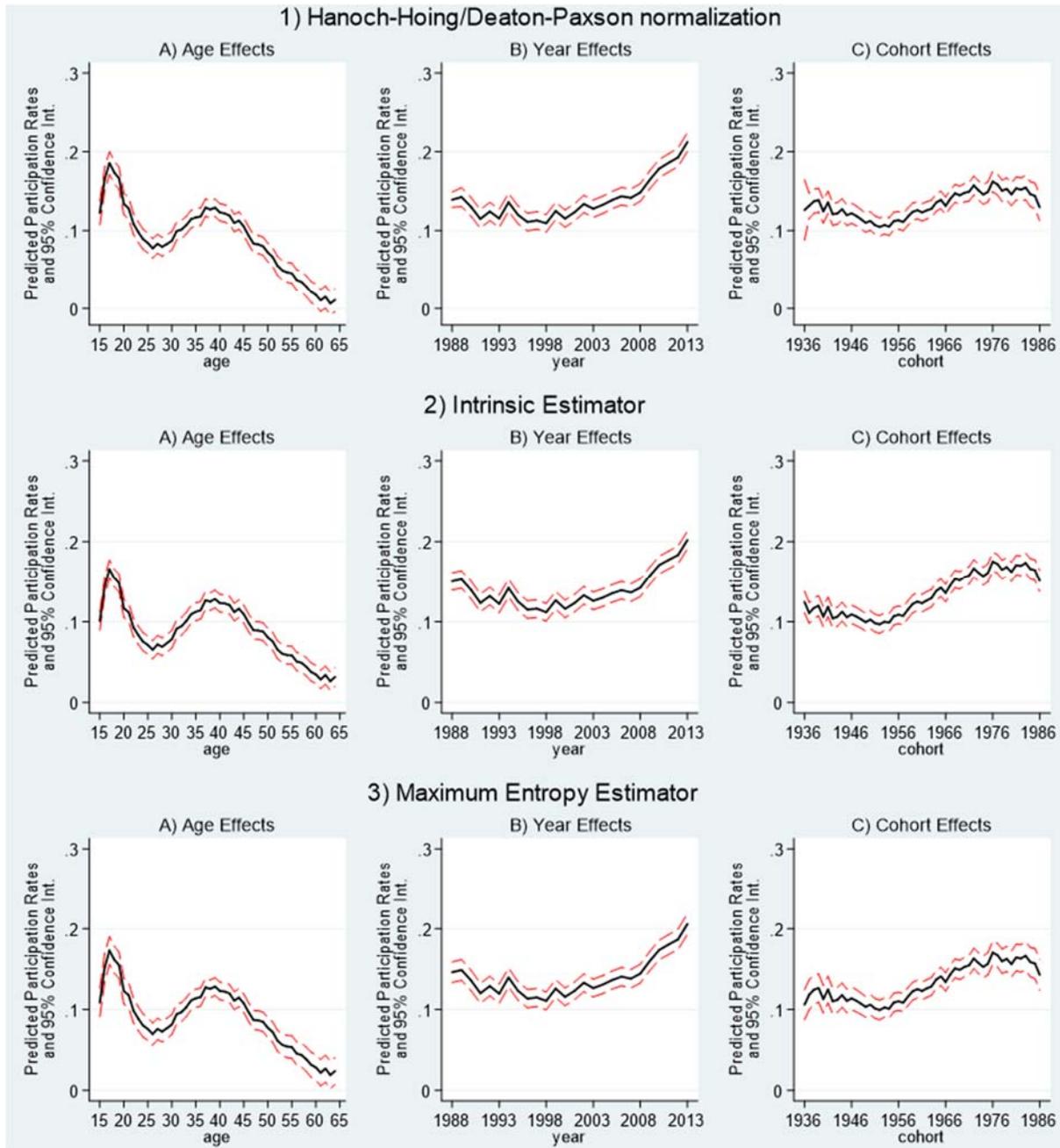
Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 8. Decomposition Results - Urban areas, middle school

Share in Female Labor Force: 2.2 percent (1988), 7.9 percent (2013)
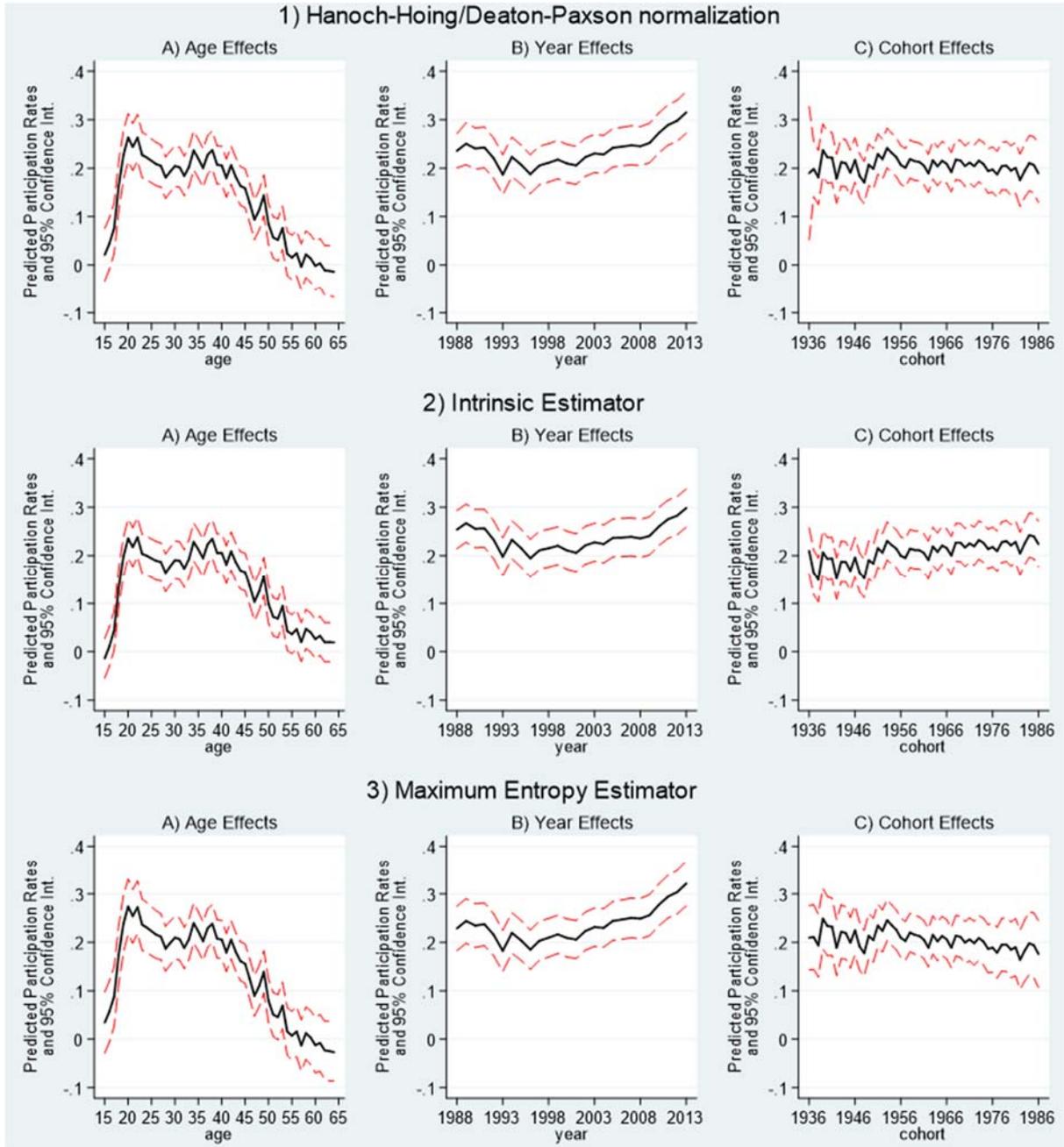
Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 9. Decomposition Results - Urban areas, high school
Share in Female Labor Force: 7 percent (1988), 14 percent (2013)
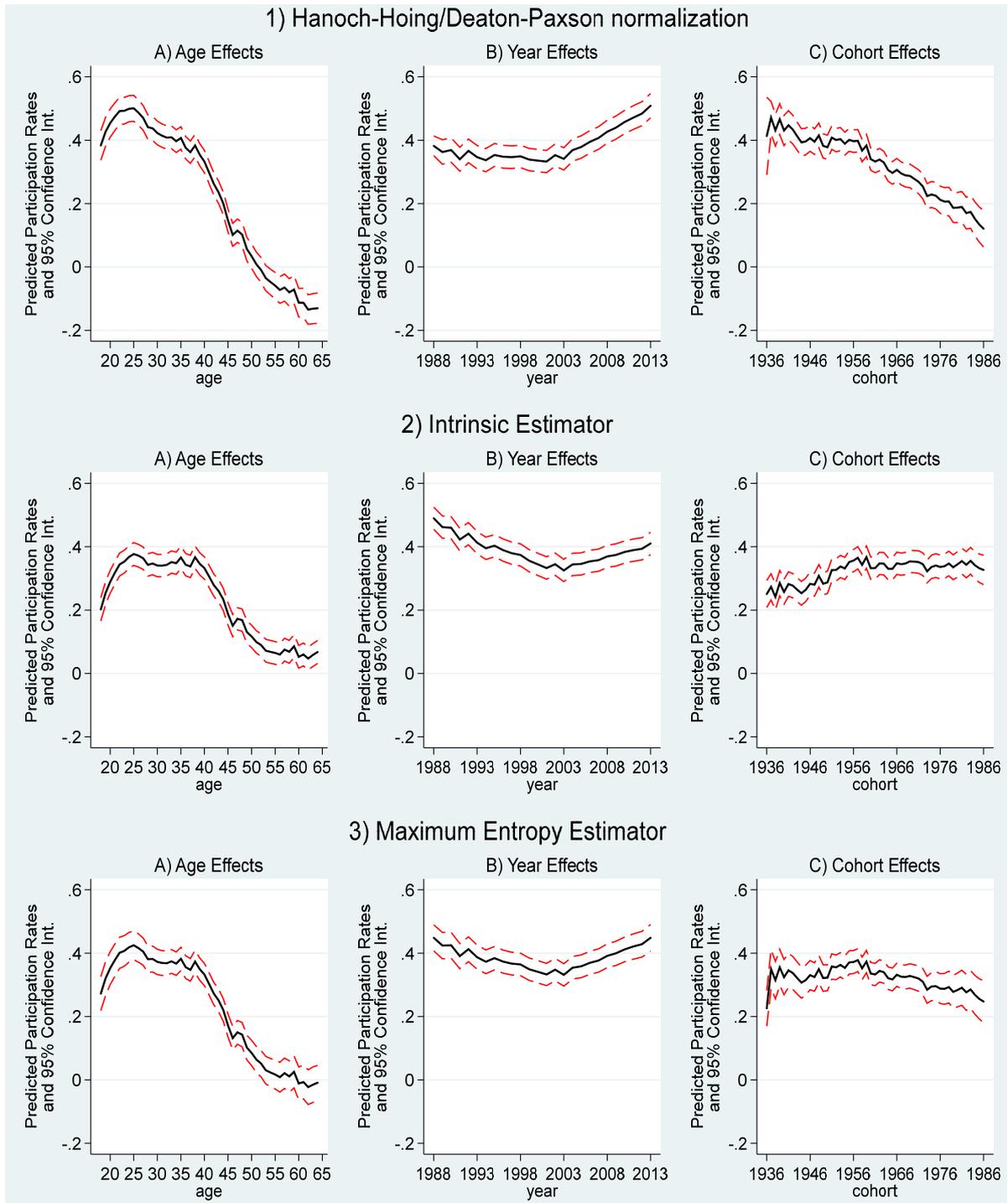
Notes: The sample is restricted to ages 18 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 10. Decomposition Results - Urban areas, university

Share in Female Labor Force: 3.3 percent (1988), 21.5 percent (2013)
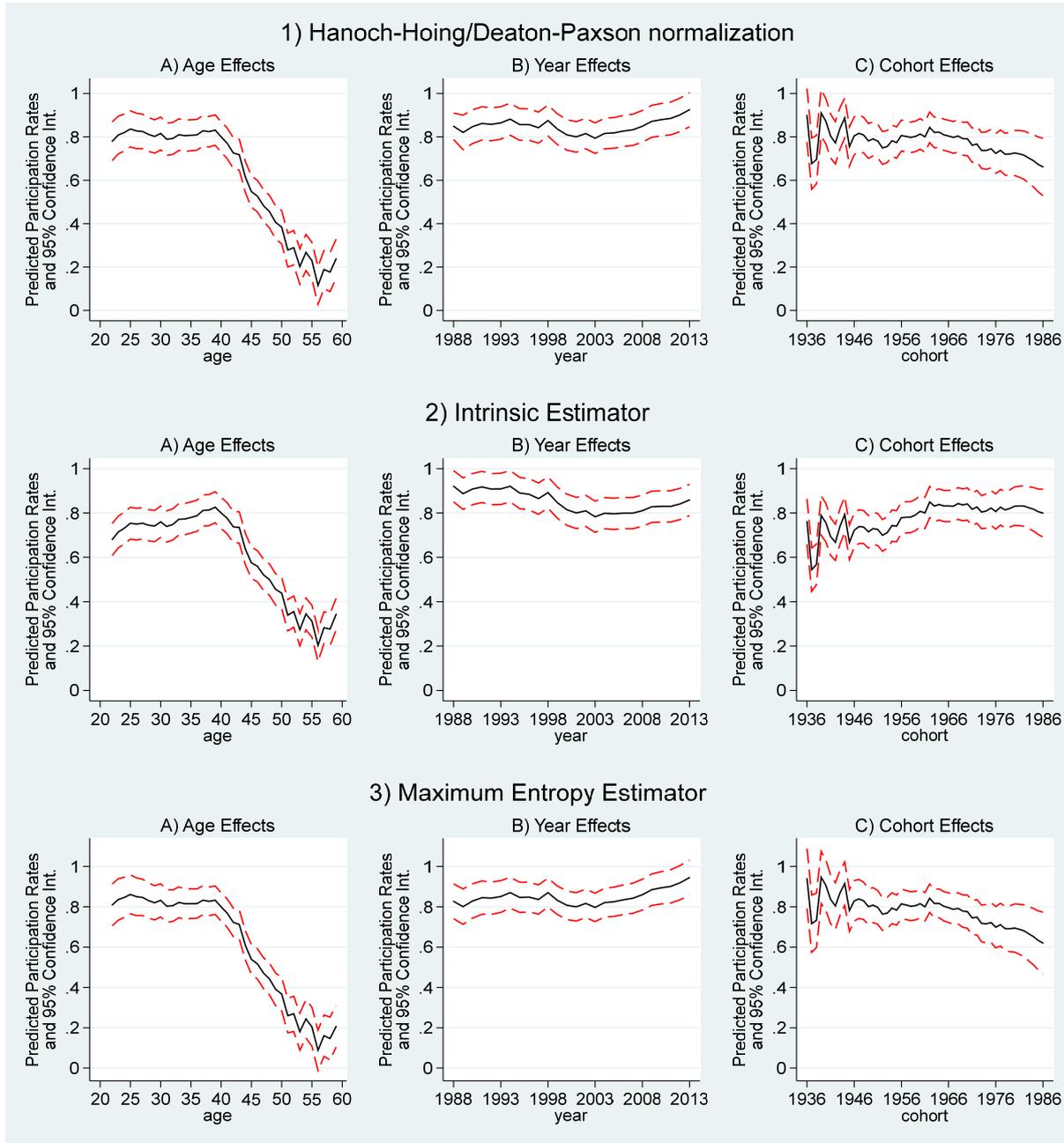
Notes: The sample is restricted to ages 22 to 59. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure 11. Slopes of linear trends fitted to the cross-section age profiles
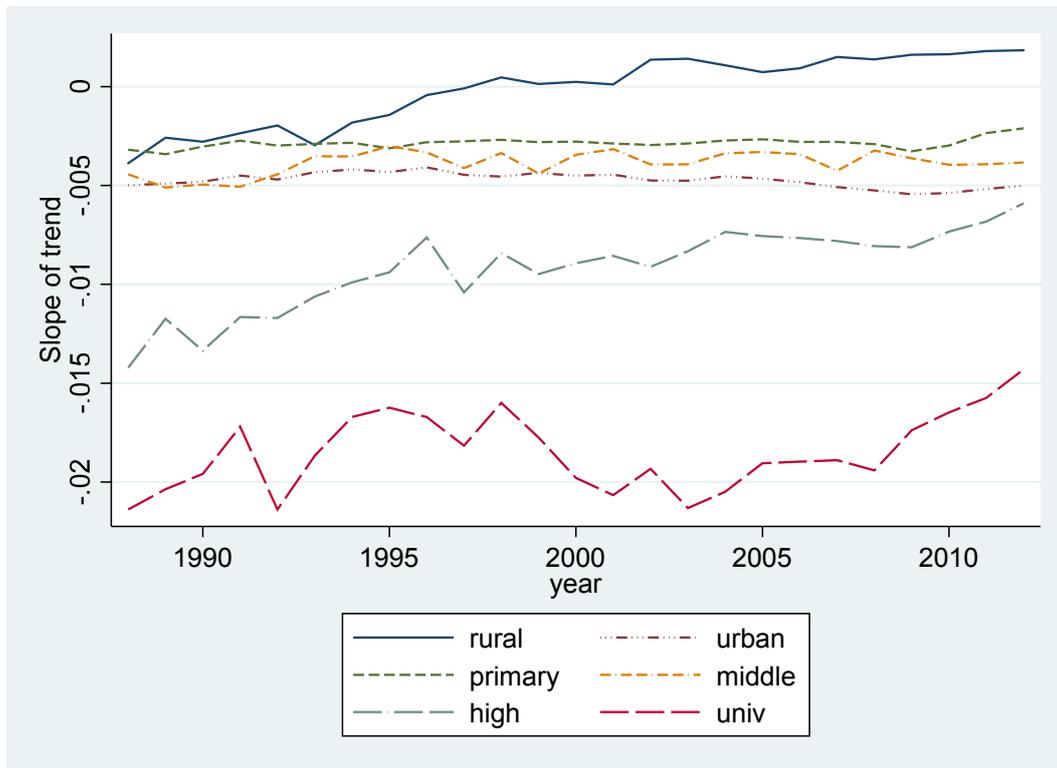
Source: Own calculations based on HLFS cross-section age profiles collected in Appendix C.

Appendix A. Supplementary Tables and Figures

Table A1. Fertility by education and over time

	TFR (15-49)				CEB (40-49)			
Education	1983 (1934-68)	1993 (1944-78)	2003 (1954-88)	2013 (1964-98)	1983 (1934-68)	1993 (1944-53)	2003 (1954-63)	2013 (1964-73)
Below primary	4.42	4.2	3.65	3.76	6.54	5.9	4.98	4.63
Primary	3.27	2.4	2.39	2.75	4.41	3.7	3.21	2.82
Middle school	2.89	1.7	1.77	2.45	2.95	2.2	2.54	2.31
High school and above	2.15	1.7	1.39	1.66	2.27	2.2	1.96	1.72
Highest/ lowest ratio	2.06	2.47	2.63	2.27	2.88	2.68	2.54	2.69

Notes: Cohorts surveyed in the "ever married women" component of the DHS instrument are shown in parentheses under the survey date.
Source: DHS-Turkey 1983, 1993, 2003, 2013; Koc (2017).

Table A2. Fertility by location of residence and over time

Location	TFR (15-49)			
	1983 (1934-68)	1993 (1944-78)	2003 (1954-88)	2013 (1964-98)
Rural	5.08	3.1	2.65	2.73
Urban	3.17	2.4	2.06	2.16
All	4.05	2.7	2.23	2.26
Rural/Urban	1.60	1.29	1.29	1.26

Source: DHS-Turkey 1983, 1993, 2003, 2013.

Figure A1. Employment share by activity, 1988-20
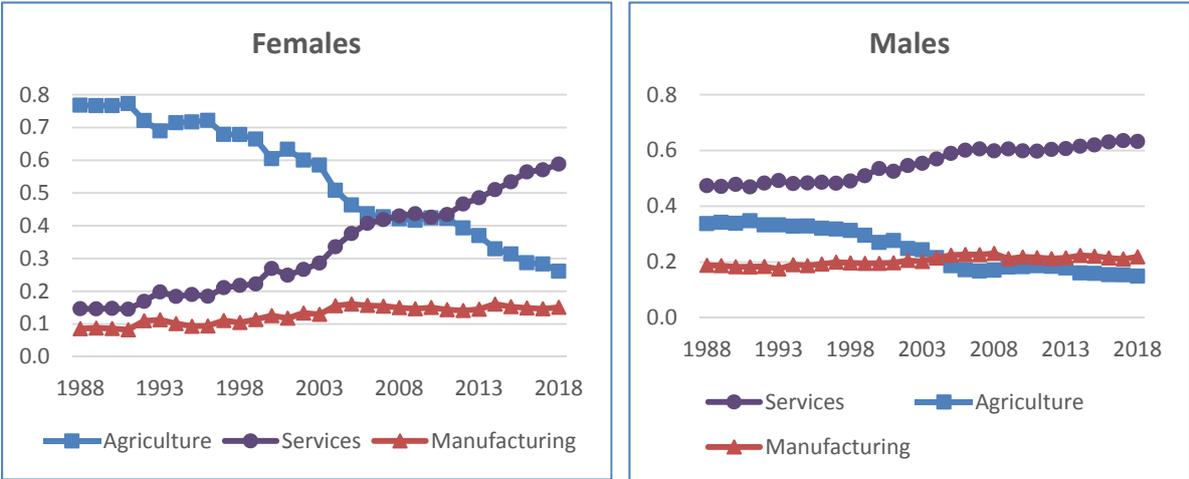
Source: Own calculations, HLFS Web version, 1988-2018.

Figure A2. Employment share by type of employment, 1988-2013
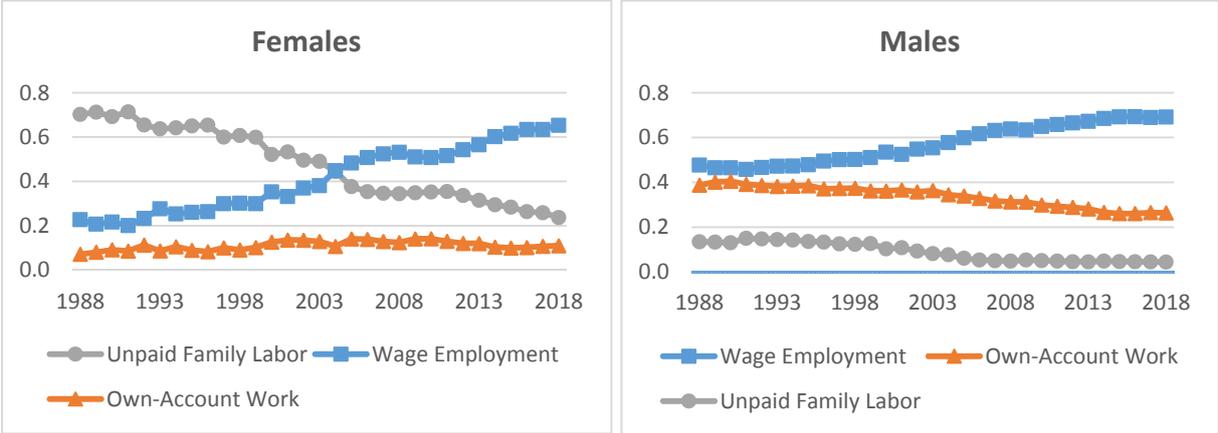
Source: Own calculations, HLFS Web version, 1988-2018.

58

Figure A3. Educational Composition of the Female Labor Force
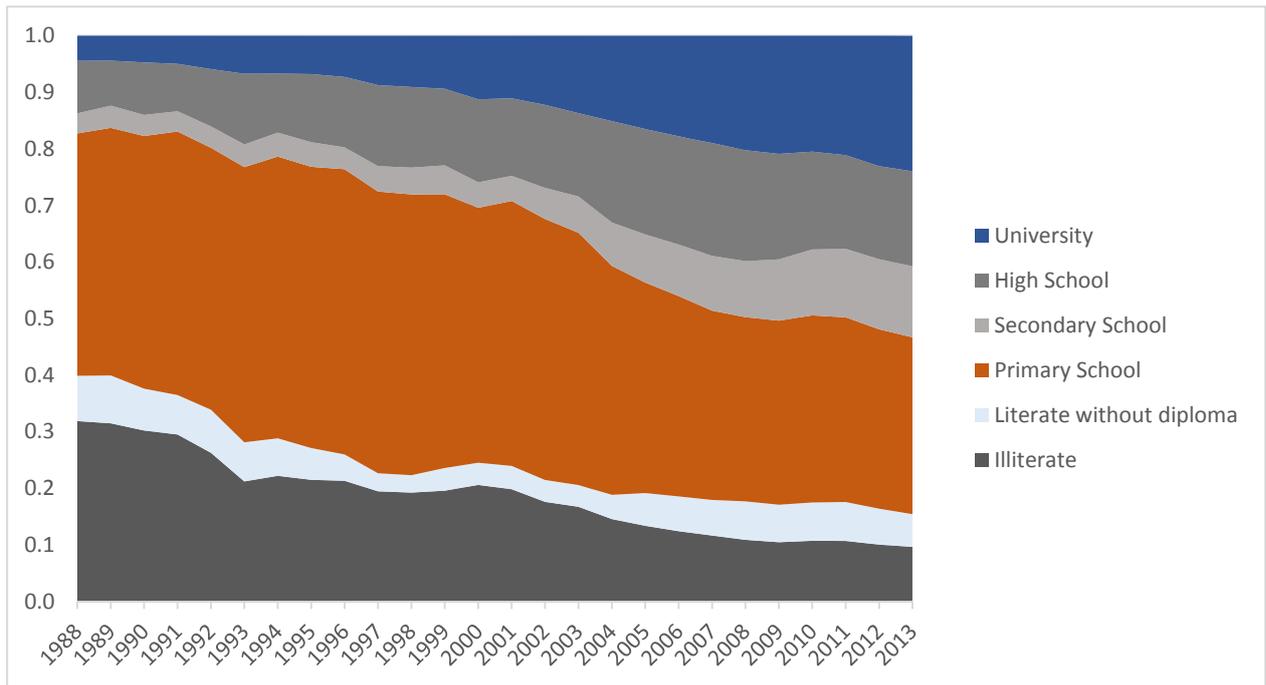
Source: Own calculations, HLFS Web version, 1988-2013.

Figure A4. Educational Composition of the Female Population
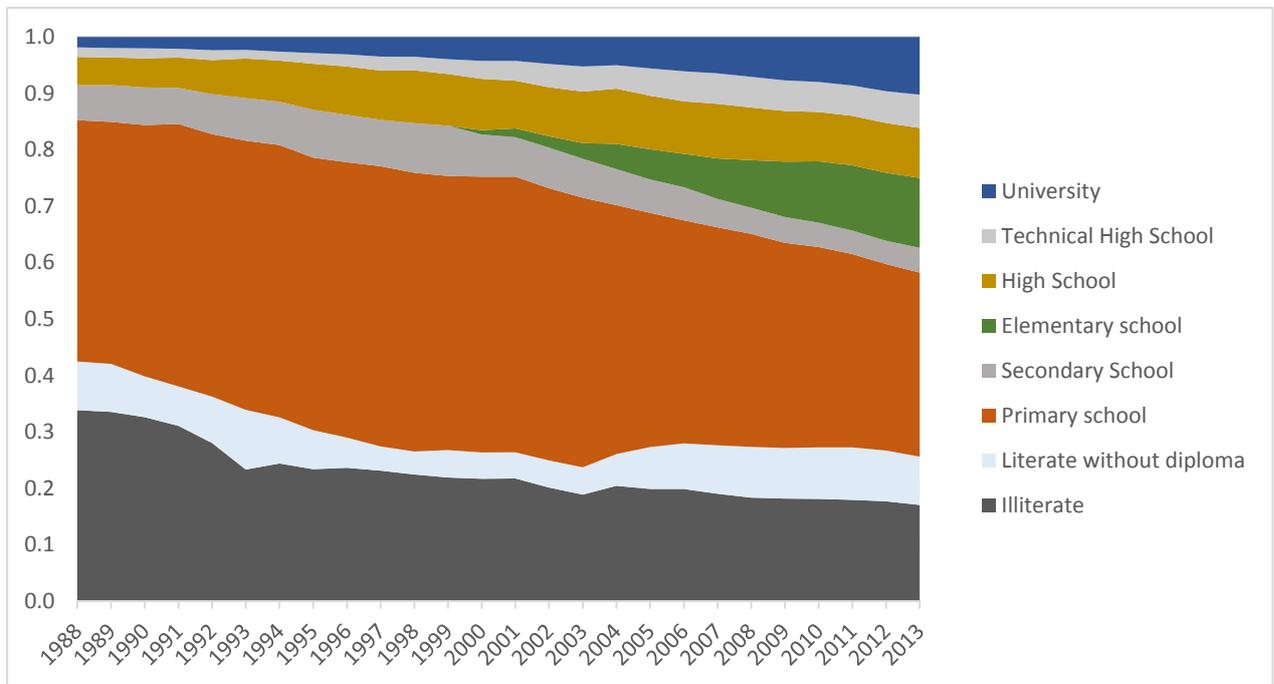
Source: Own calculations, HLFS Web version, 1988-2013.

Figure A5. Educational Composition of the Female Labor Force - Urban Turkey
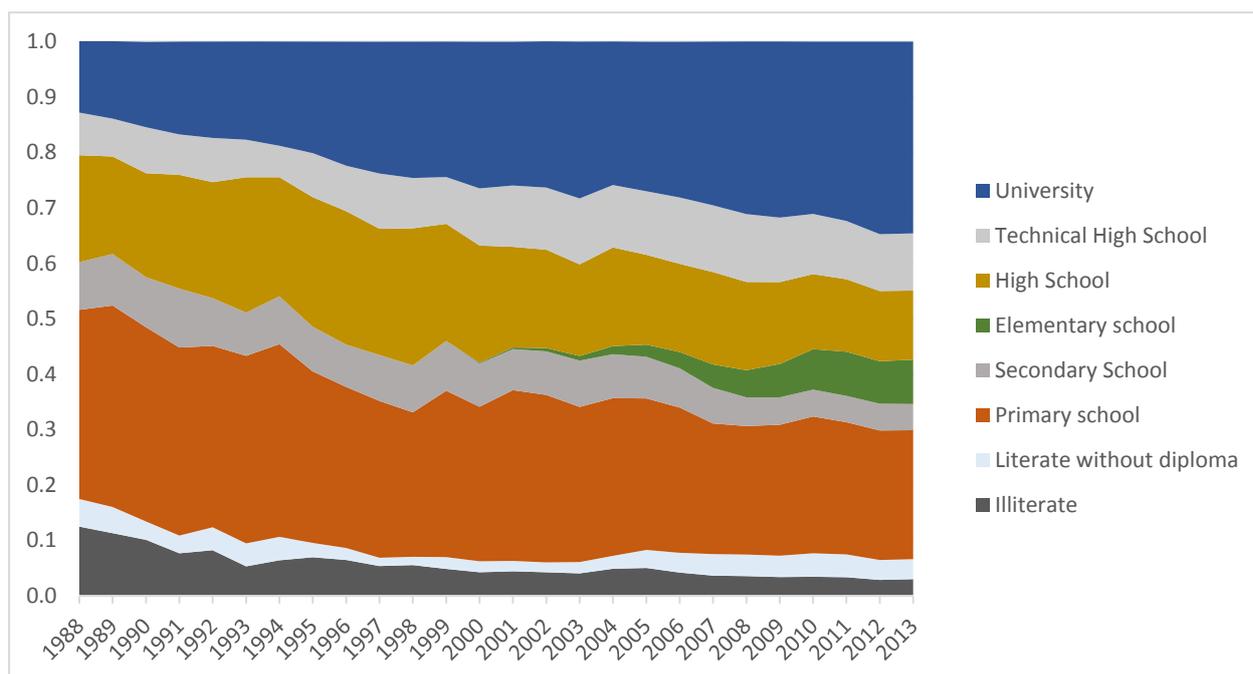
Notes: Primary school is 5-years of schooling. In 1997, compulsory schooling is increased to 8-years, by merging primary and (3-year) secondary schools. This new level is shown as 'elementary school' in the graph.

Source: Own calculations, HLFS Web version, 1988-2013.

Figure A6. Educational Composition of the Female Labor Force - Rural Turkey
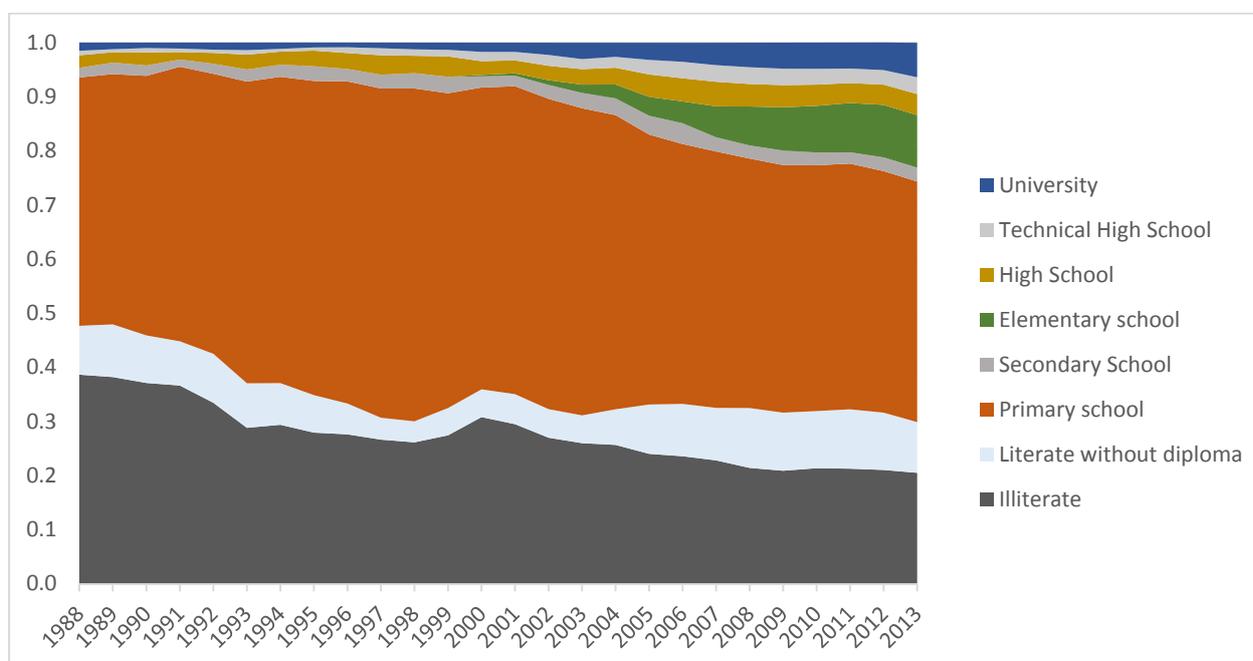
Notes: Primary school is 5-years of schooling. In 1997, compulsory schooling is increased to 8-years, by merging primary and (3-year) secondary schools. This new level is shown as 'elementary school' in the graph.

Source: Own calculations, HLFS Web version, 1988-2013.

Figure A7. Trends in Age-Specific Fertility Rates
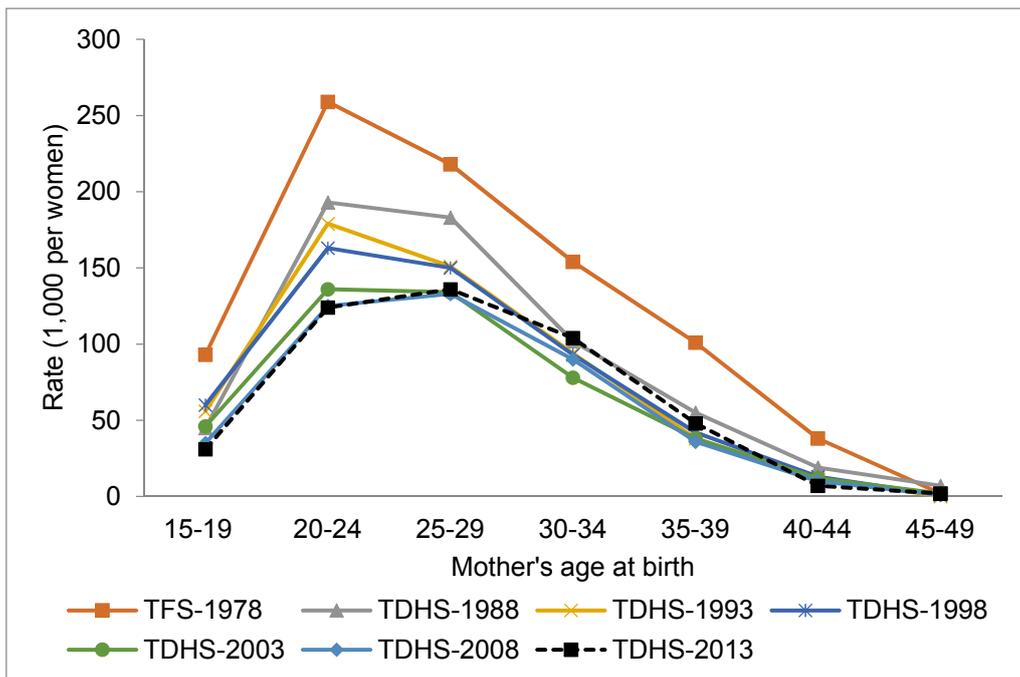
Source: Various printed volumes from the Demographic Health Survey (see references).

Figure A8. Fraction of Women Who Never Worked by Age Group, 2004-18
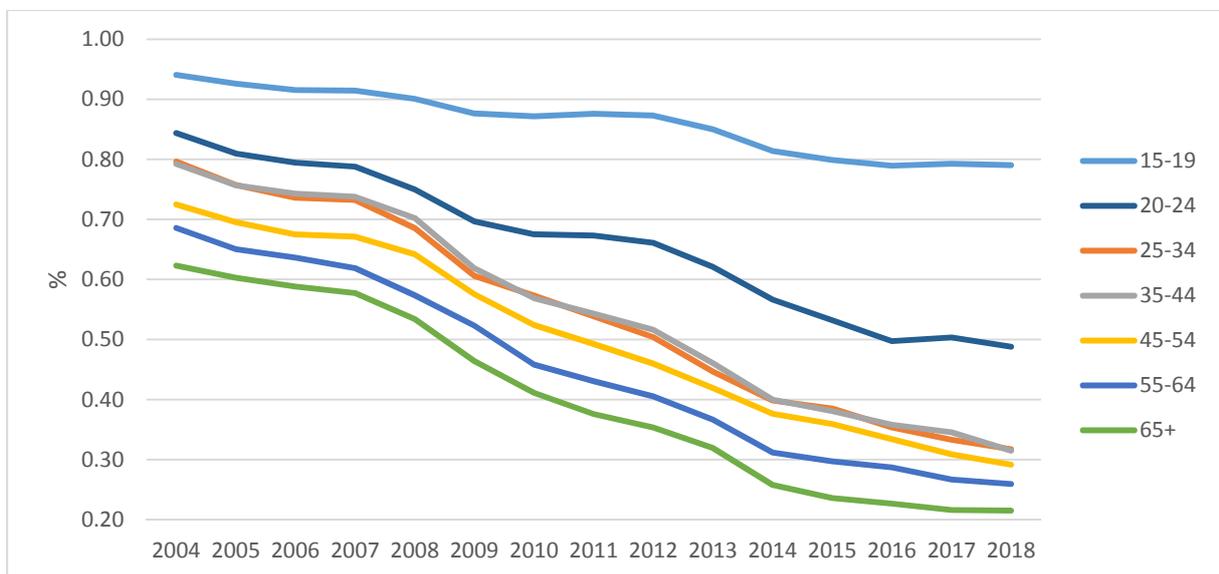
Source: Own calculations, on HLFS Web version, 2004-2018.

61

Figure A9. Migration Hazard Rates for Rural Women
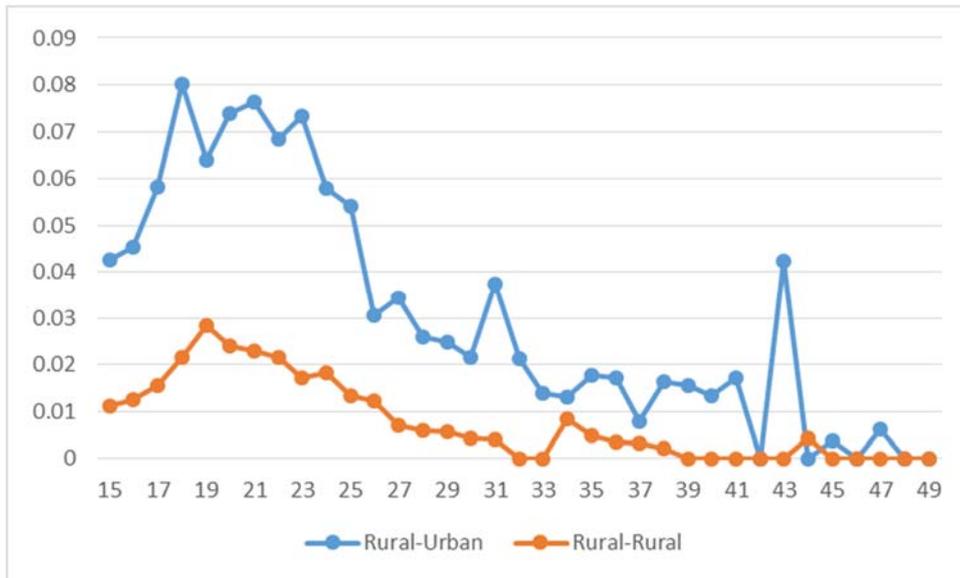
Source: Own calculations, TDHS 2013.

Figure A10. Migration Hazard Rates for Urban Women, TDHS 2013
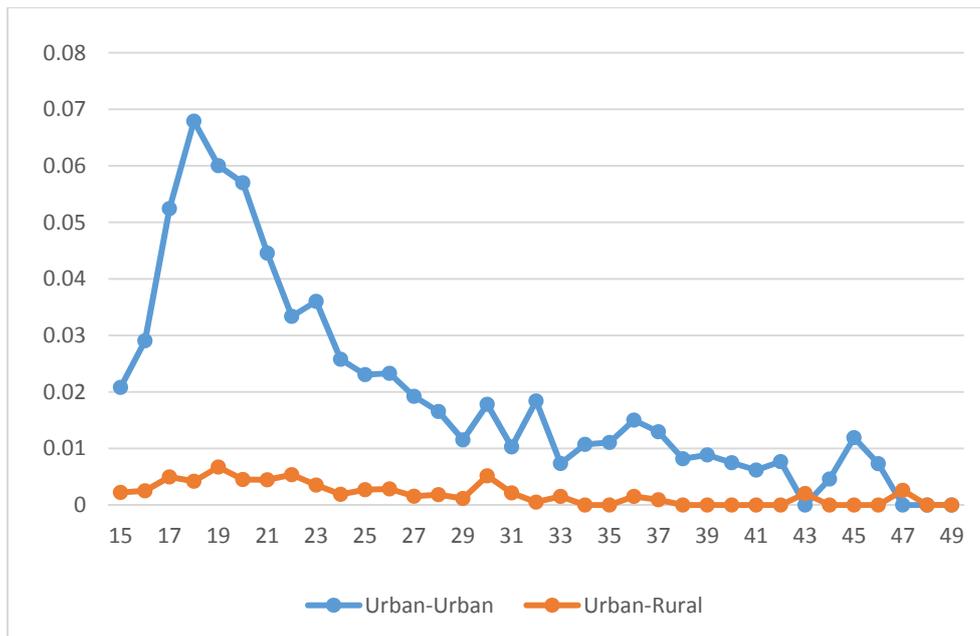
Source: Own calculations, TDHS 2013.

Figure A11. Fraction of College Graduate Women in the Female Work Force
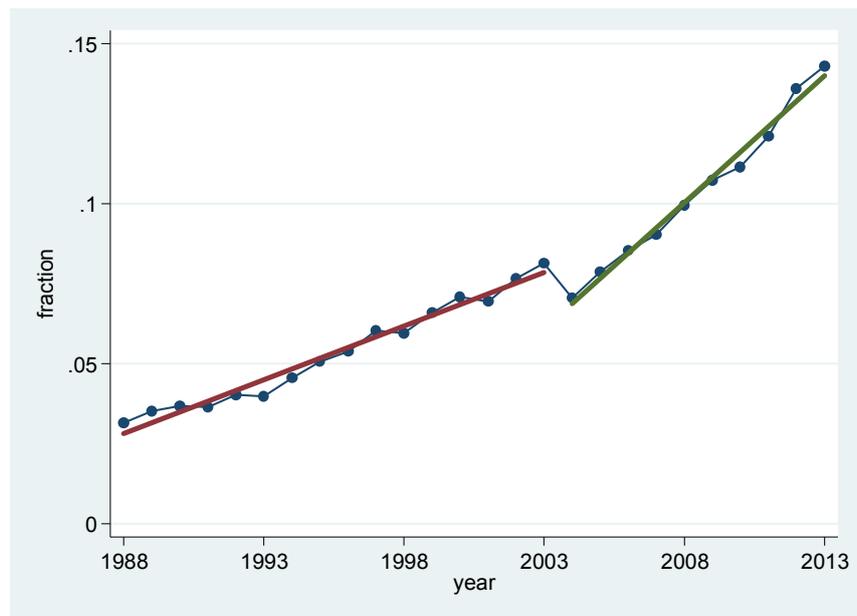
Source: Own calculations, HLFS 1988-2013.

Appendix B. Social Security System

The national Social Security System (SSS) established in Turkey in 1954 has undergone several changes over time. The retirement system directed to workers covered by social security is regulated by three main parameters: (i) minimum retirement age (MRA), (ii) minimum period of SSS coverage (MY), and (iii) minimum days of social security premium payment (MD). The original parameters were MRA = age 60, MY = 25 years, and MD = 5000 days. Between 1965 and 1992 the parameters were adjusted several times, as governments tried to gain polling advantages in upcoming elections. In 1965 MRA was reduced to 55 for women, despite a life expectancy gap of about three years in their favor. In 1969 MRA was abolished, but the other parameters were kept the same. In 1976, MY was reduced to 20 years for women. In 1986 MRA was reestablished (as 55) but MY was abolished. In 1992 there was a reversion to the 1976 regime: No MRA, MY set at 20 years for women, MD kept as 5000. The response to a mounting and unsustainable deficit problem was the 1999 reform of the SSS system, which simultaneously increased the MRA to 58 for women, and the MD to 7000 days (Acar and Kitapçı, 2008). Legal challenges to the reform delayed its implementation until 2003. The transition to the MRA of 58 is being implemented gradually, and will be completed in 2023.

The evolution of the key parameters are shown in Table B1, for women as well as men. Rows that identify the most generous regimes are highlighted. There was another reform in 2008 which increased the MD to 7200 and stipulated a gradual increase in the MRA from 58 (for entrants after 2008) to 65 (for entrants in year 2048 and later). This regime is not relevant for our sample.

Table B1. Key parameters of the Social Security System

Year	Minimum retirement age (MRA)	Minimum period of membership (MY)	Minimum days of premium payment (MD)
1954	60	25	5000
1965	55F 60M	25	5000
1969	None	25	5000
1976	None	20F 25M	5000
1986	55F 60M	none	5000
1992	None	20F 25M	5000
1999	…58F …60M	20F 25M	7000

Source: Compiled by the authors from the information given in Acar and Kitapçı (2008).

In Figure B1 we plot the predicted effective minimum retirement age (EMRA) by birth cohort and education level completed, under the assumption that women enter the labor market upon completion of their schooling and have uninterrupted work lives, and exit when they meet the requirement that binds. As it turns out the reform in year 1986 had no practical effect. Horizontal lines to the left mark the EMRA implied by MY, which was the binding parameter until the reform in 1999. The positively sloped segments capture the phased effect of that important reform. We see that the influence on birth cohorts of the liberal retirement regime that remained in force for 28 years (1976-2003) and the reform that followed, varies by education.

Figure B1. Predicted effective minimum retirement age by education and birth cohort
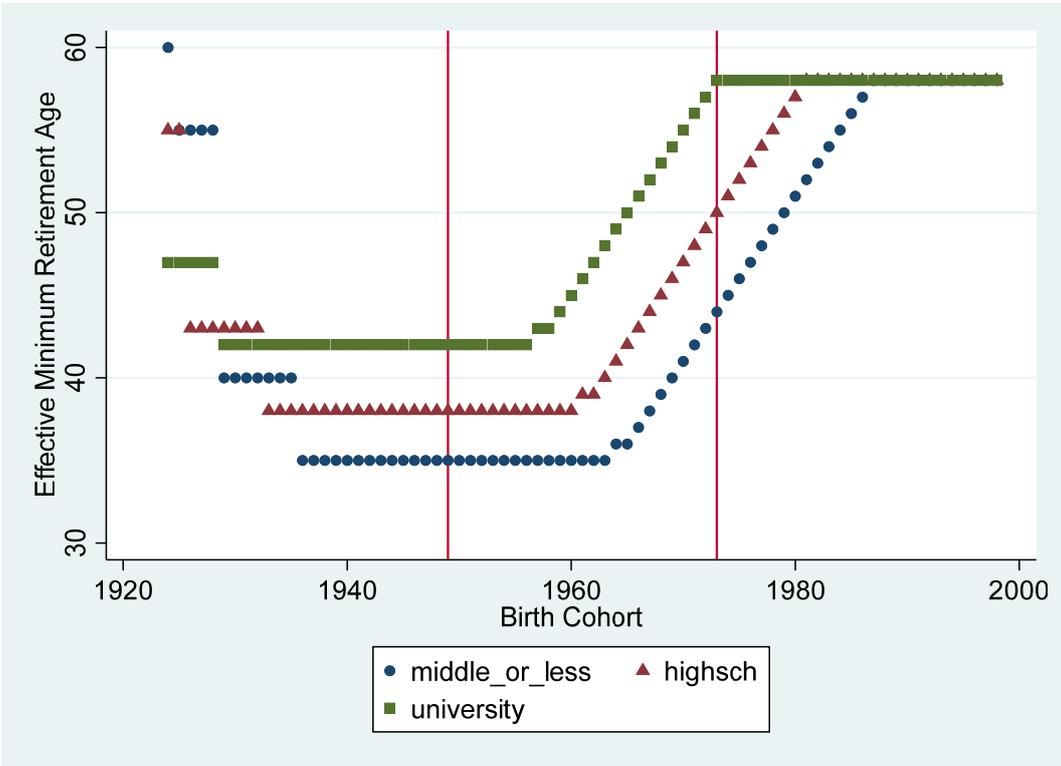
Source: Own calculations, based on Table B1.

The vertical lines mark the birth cohorts 1949 and 1973. As discussed in detail in the main text (Section 3.3), cohorts born between 1949 and 1973 are observed during our entire time window, 1988-2013. While older cohorts (those born before 1949) are seen at the tail end of their work lives, younger cohorts (born after 1961) are seen during the earlier phase. This implies that the effect of the increase in the EMRA on LFPR will be muted in general. The

variation by education seen in Figure B2 suggests that better educated women will be the first to get affected.

Based on the demographic data reviewed in Section 2.2, fertility induced interruptions will be longer when education is lower. This is likely to reduce the between variation in MRAs drawn by education. If we relax our assumptions and allow for variation in the age of entry and the length of interruptions, there will be upward cross-section variation in the predicted effective MRAs. This will generate exit gradients in the age profiles. In our calculations we ignored the minor differences in the parameters between the components of the SSS that applied to civil servants and the self-employed. These differences usher in further variation in the MRA. The key take from this discussion for our APC analysis is that any differences in cohort behavior that we detect, are unlikely to be due to the 1999 reform.

m. Using the evidence in Figure B1 and allowing for variation in age of entry and interruptions, for a large majority of the birth cohorts included in our sample, EMRAs were in the 40s and below. Thus another implication of our analysis is that our time window (1988-2013) might be sufficient for capturing the age profile of our synthetic woman (subject to the caveats in Section 3.3 above).

Figure B2. Share of Females with Social Security Coverage in Urban Turkey, by Education
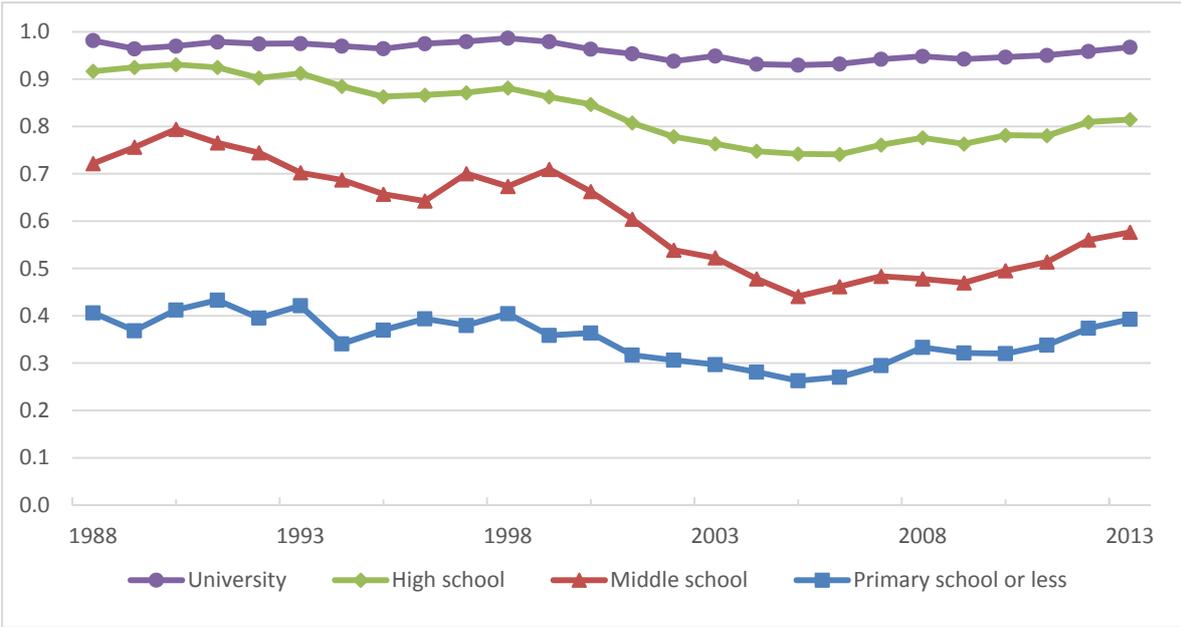
Source: Own calculations, on HLFS 1988-2013.

Obviously the MRA would only influence the behavior of women covered by social security. Figure B2 shows the fraction of women covered by social security in urban areas, conditional on education. For university educated women, coverage was almost universal. Coverage among high school educated women was also very high in the first half of our time window, and remained well above 70 percent in the second half. Except for the 2004-2010 period a majority of middle school graduates had coverage. In the case of our lowest educated group, typically 30-40 percent were covered. Social security coverage is practically non-existent in rural areas where agriculture is the dominant form of employment and women with high school education or higher constitute a tiny minority (see Appendix A, Figure A6). Thus while the sufficiency argument is likely to be valid for better educated women, it might not apply to low educated women, and will surely fail in rural areas where employment on the family farm is an obligation – as long as the individual is healthy.

Appendix C. Cross-section Age Profiles

Figure C1. Cross-Section Age-Participation Profiles by Survey Year – Rural Areas
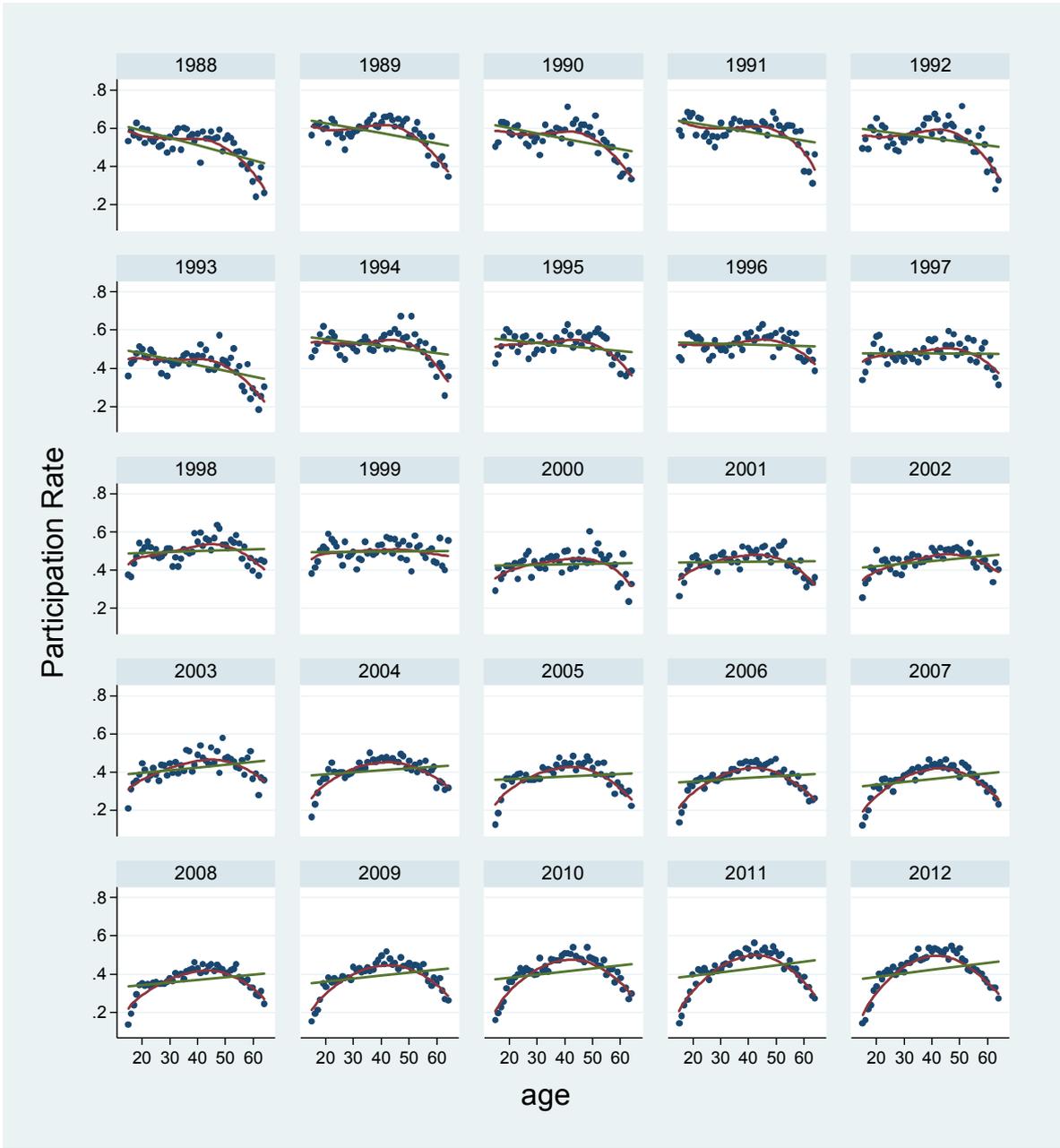
Figure C2. Cross-Section Age-Participation Profiles by Survey Year – Urban Areas
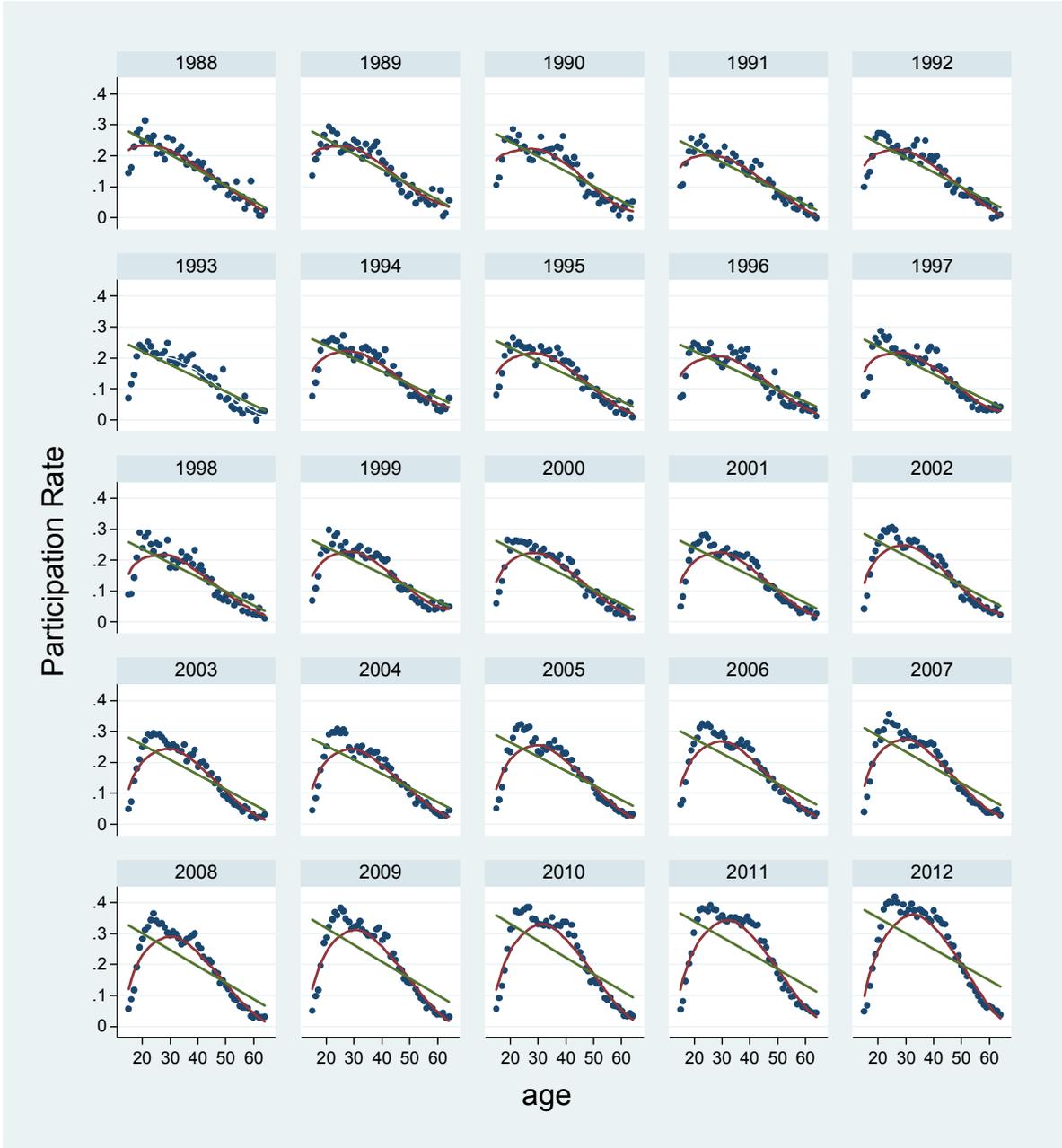
Source: Own calculations, on HLFS 1988-2013.

**Figure C3. Cross-Section Age-Participation Profiles by Survey Year**

Urban Areas, Primary School or Lower
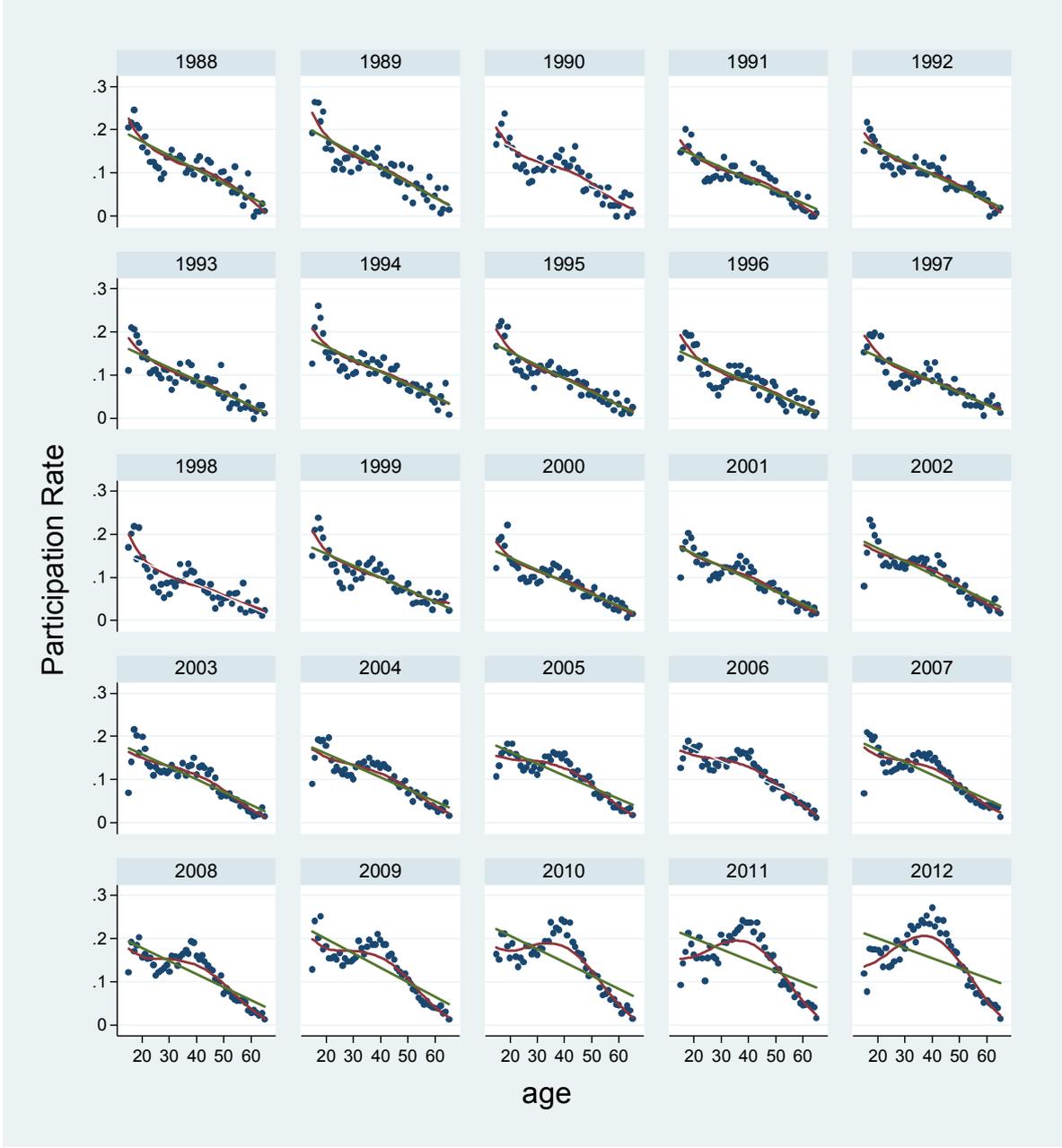
Source: Own calculations, on HLFS 1988-2013.

Figure C4. Cross-Section Age-Participation Profiles by Survey Year

Urban Areas, Lower Secondary (Middle) School
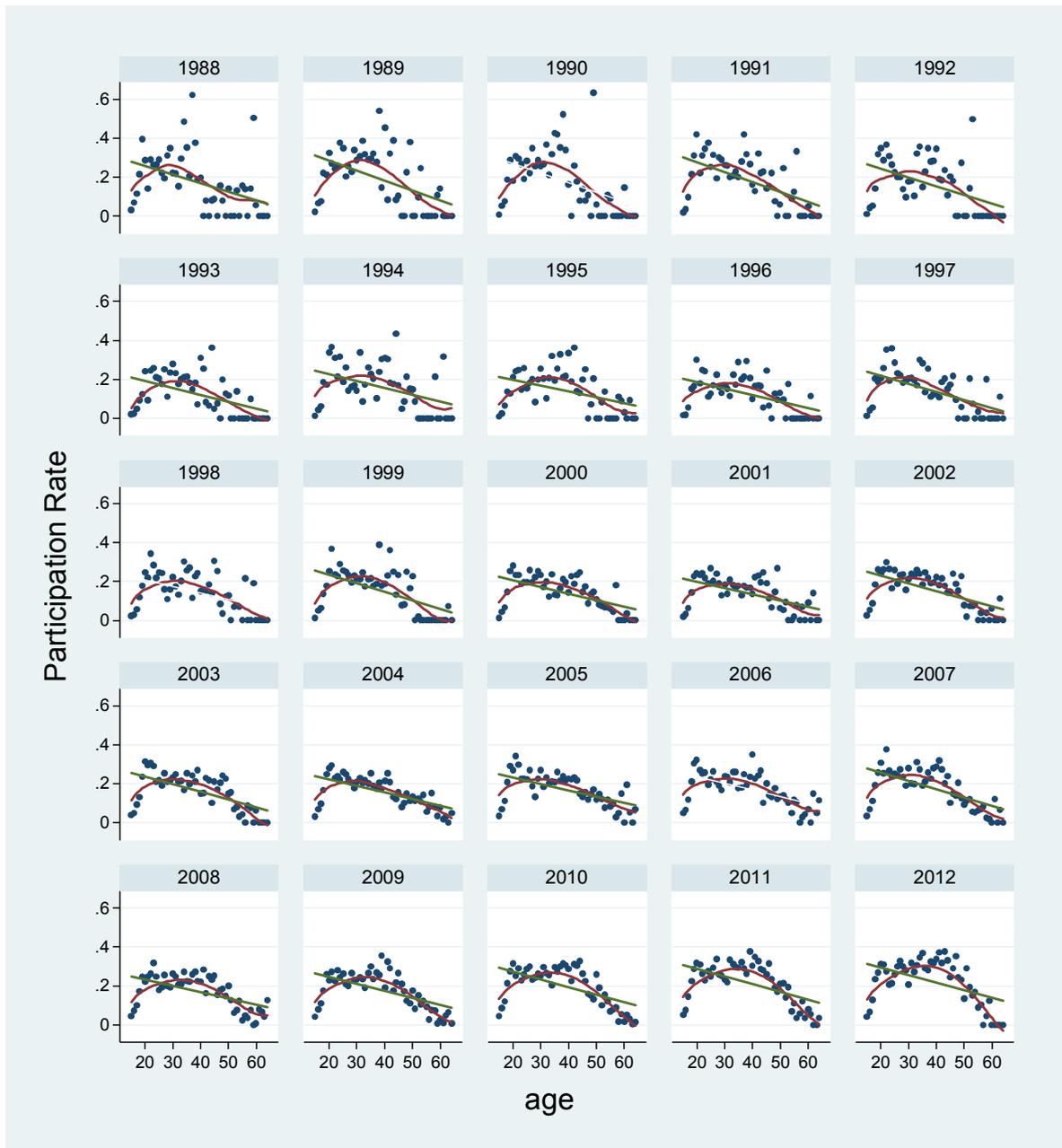
Figure C5. Cross-Section Age-Participation Profiles by Survey Year

Urban Areas, Upper Secondary (High) School
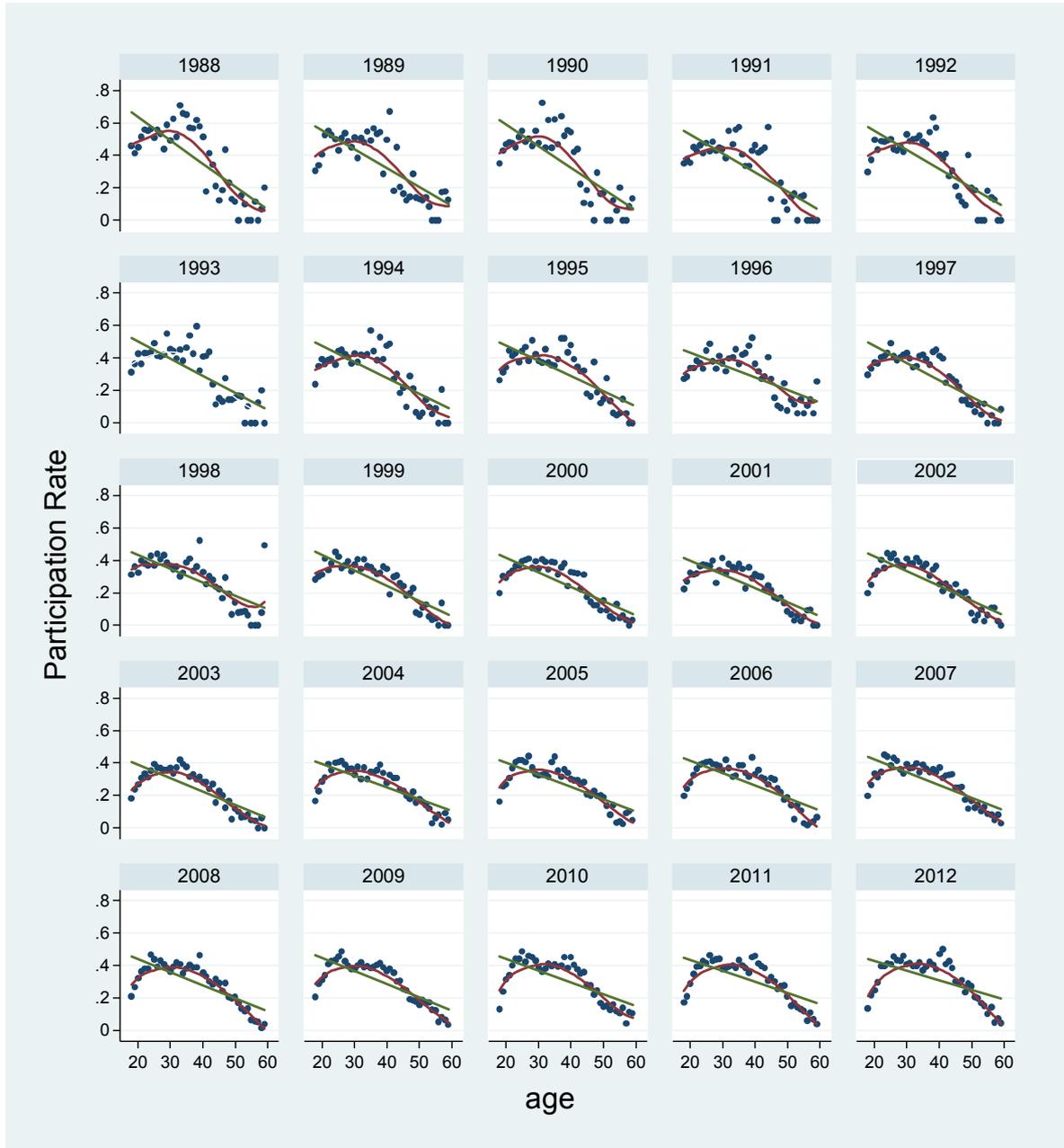
Source: Own calculations, on HLFS 1988-2013.

Figure C6. Cross-Section Age-Participation Profiles by Survey Year

Urban Areas, University
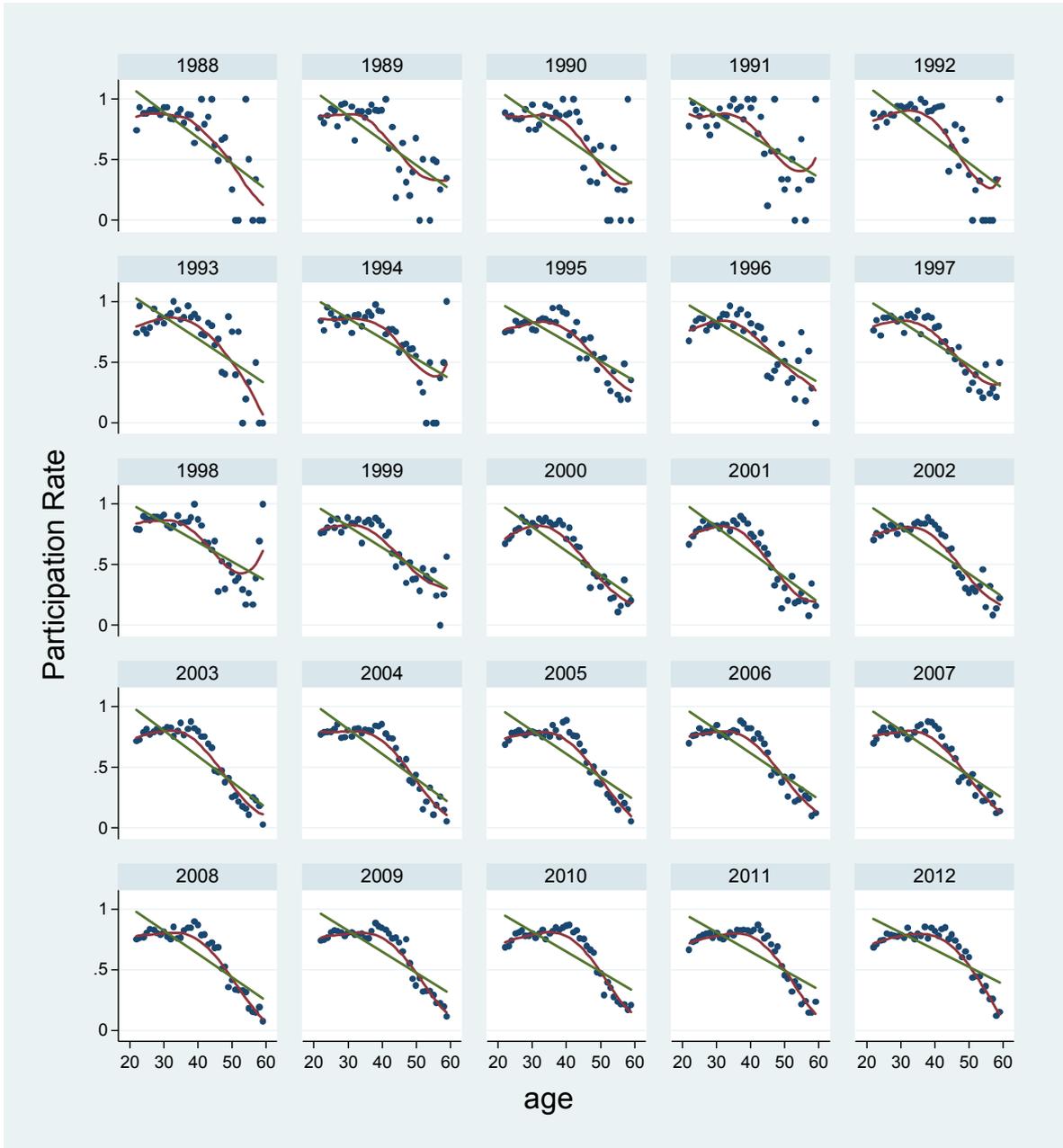
Source: Own calculations, on HLFS 1988-2013.

Appendix D. Sensitivity of APC results to changes in lower age cut-offs

## Figure D1. Decomposition Results - Rural areas (Ages 20-64)
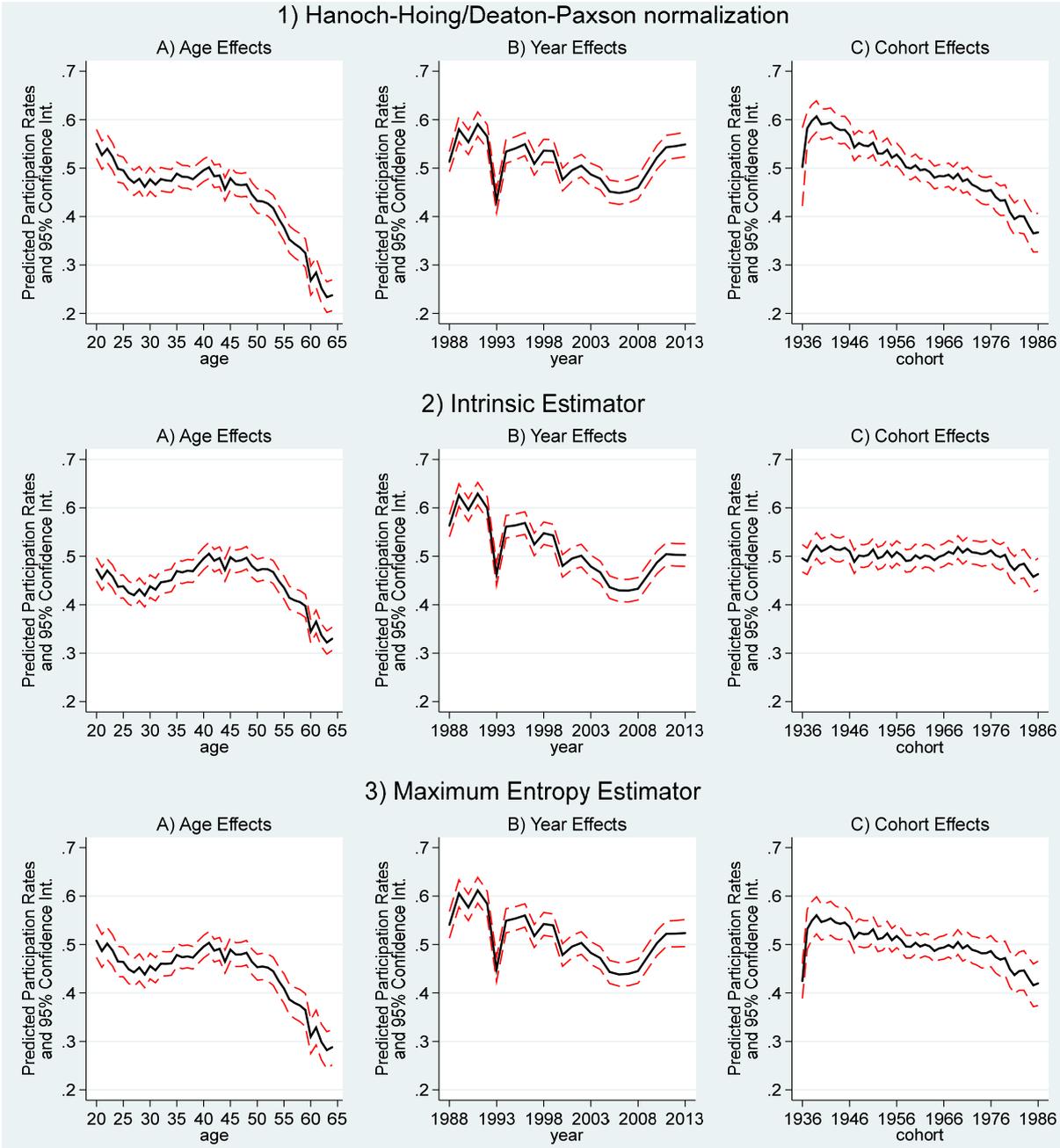

Notes: The sample is restricted to ages 20 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D2. Decomposition Results - Rural areas (Ages 25-64)
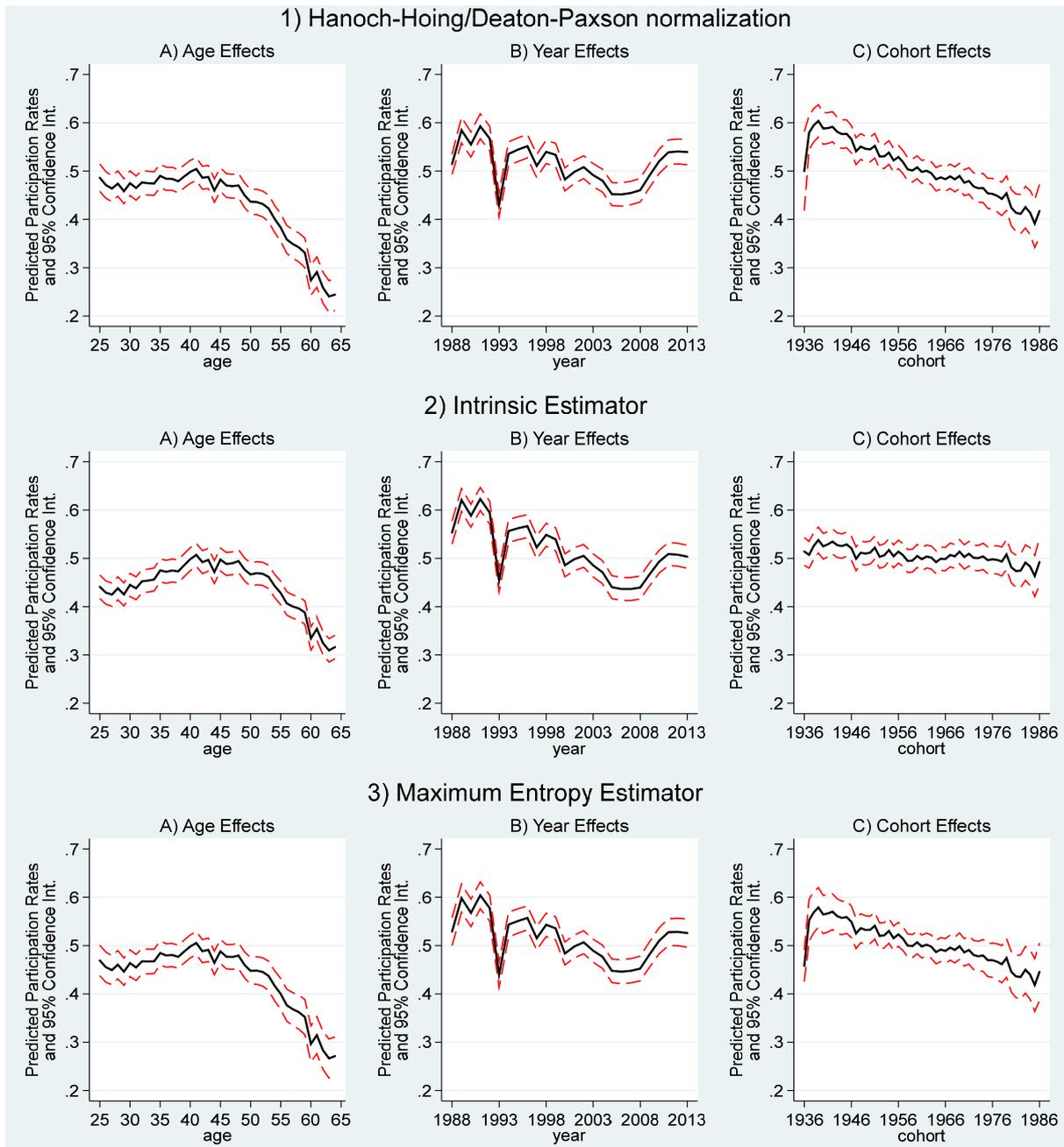
Notes: The sample is restricted to ages 25 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D3. Decomposition Results - Urban areas (Ages 20-64)
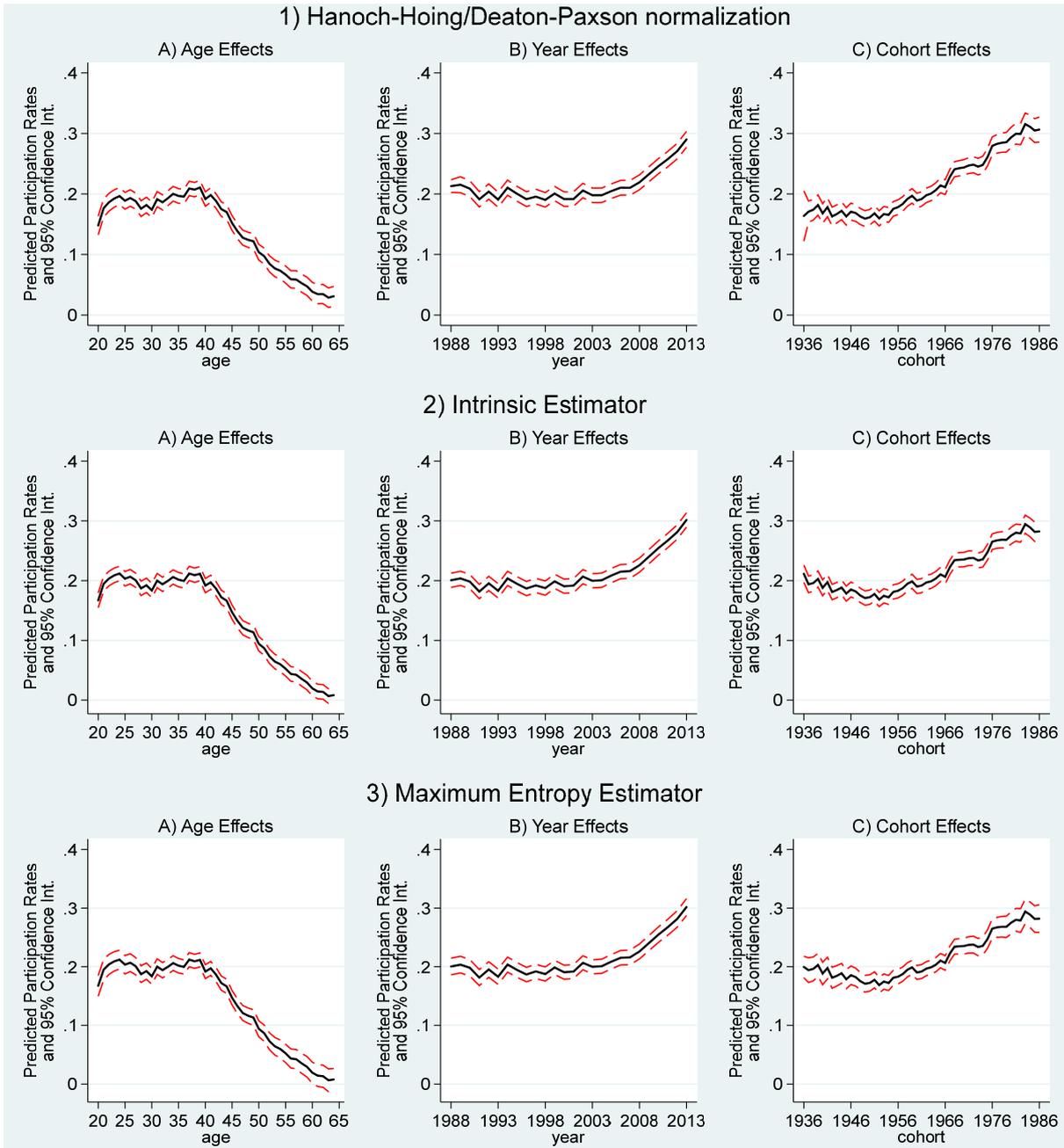

Notes: The sample is restricted to ages 20 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

**Figure D4. Decomposition Results - Urban areas (Ages 25-64)**
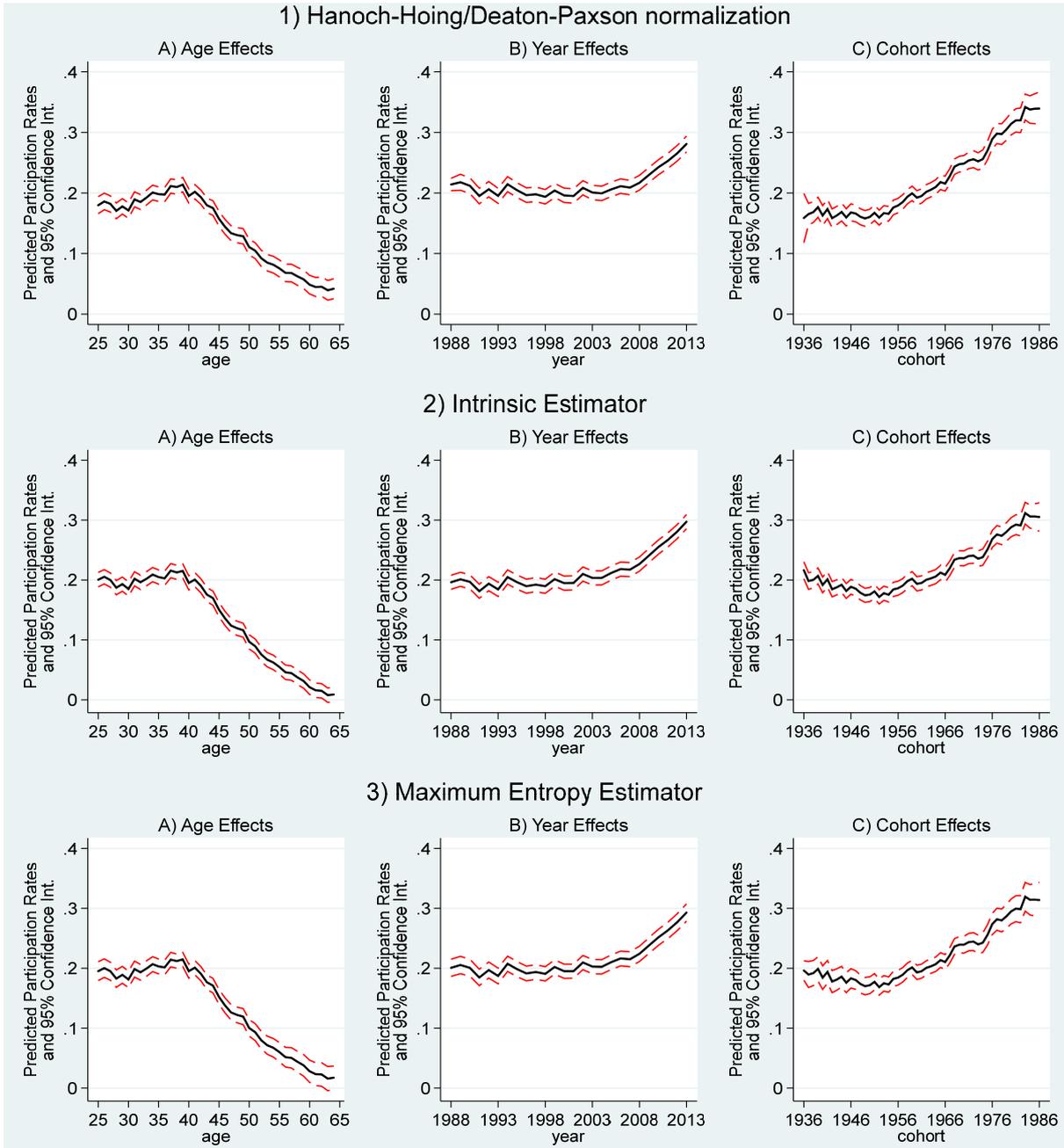
Notes: The sample is restricted to ages 25 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D5. Decomposition Results - Urban areas, primary school or lower (Ages 20-64)
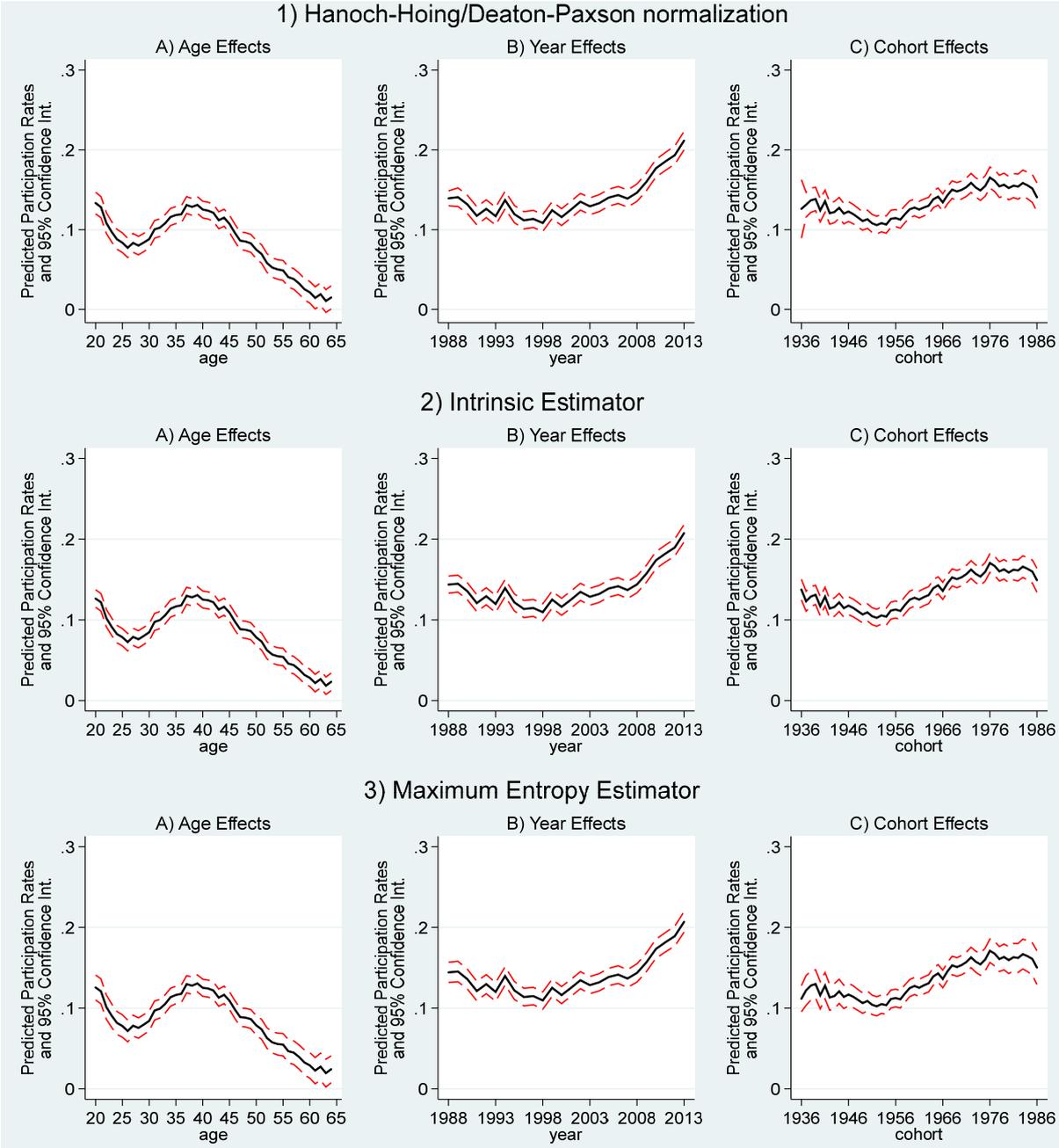
Notes: The sample is restricted to ages 20 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

**Figure D6. Decomposition Results - Urban areas, primary school or lower (Ages 25-64)**
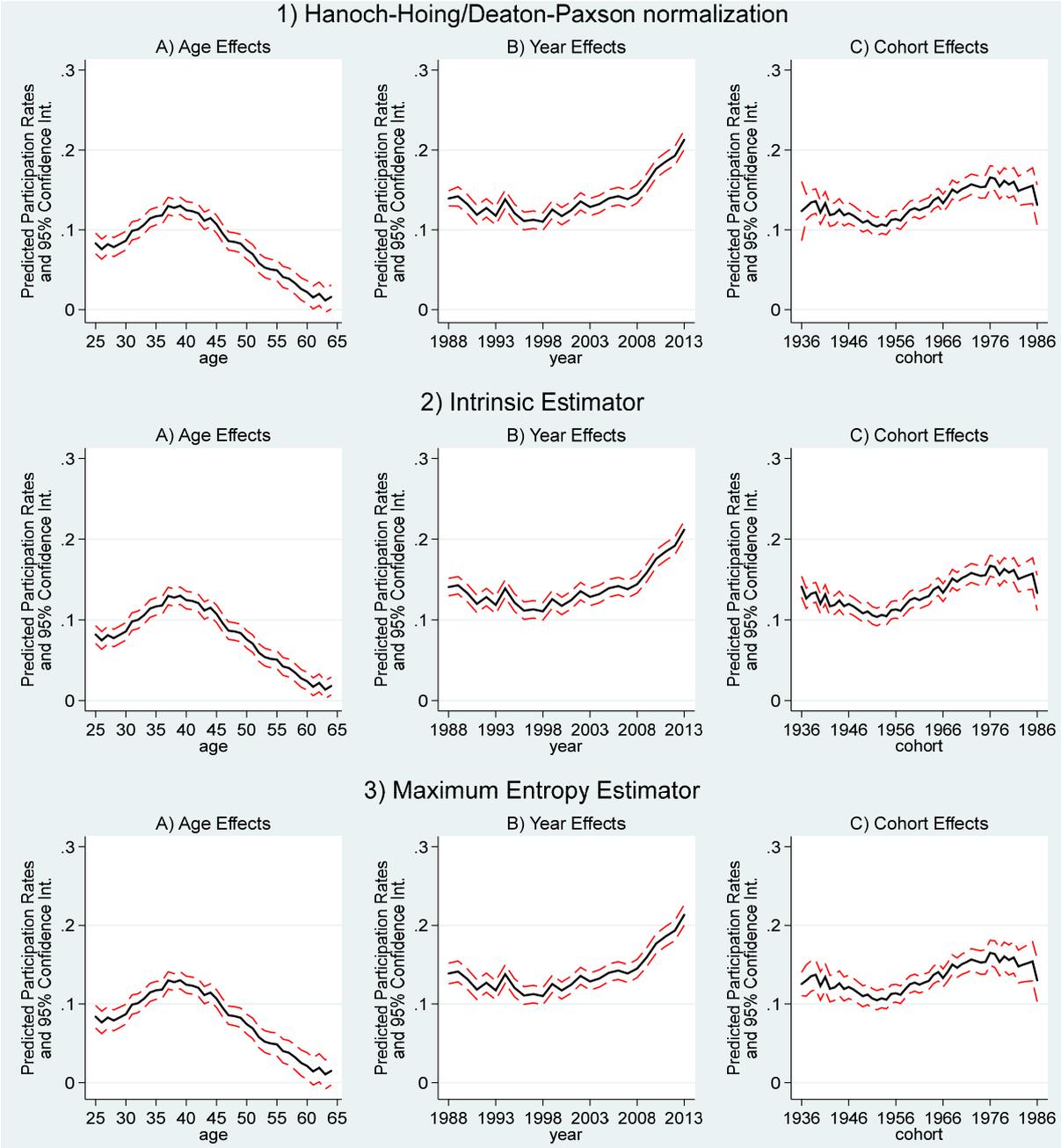
Notes: The sample is restricted to ages 25 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D7. Decomposition Results - Urban areas, middle school (Ages 20-64)
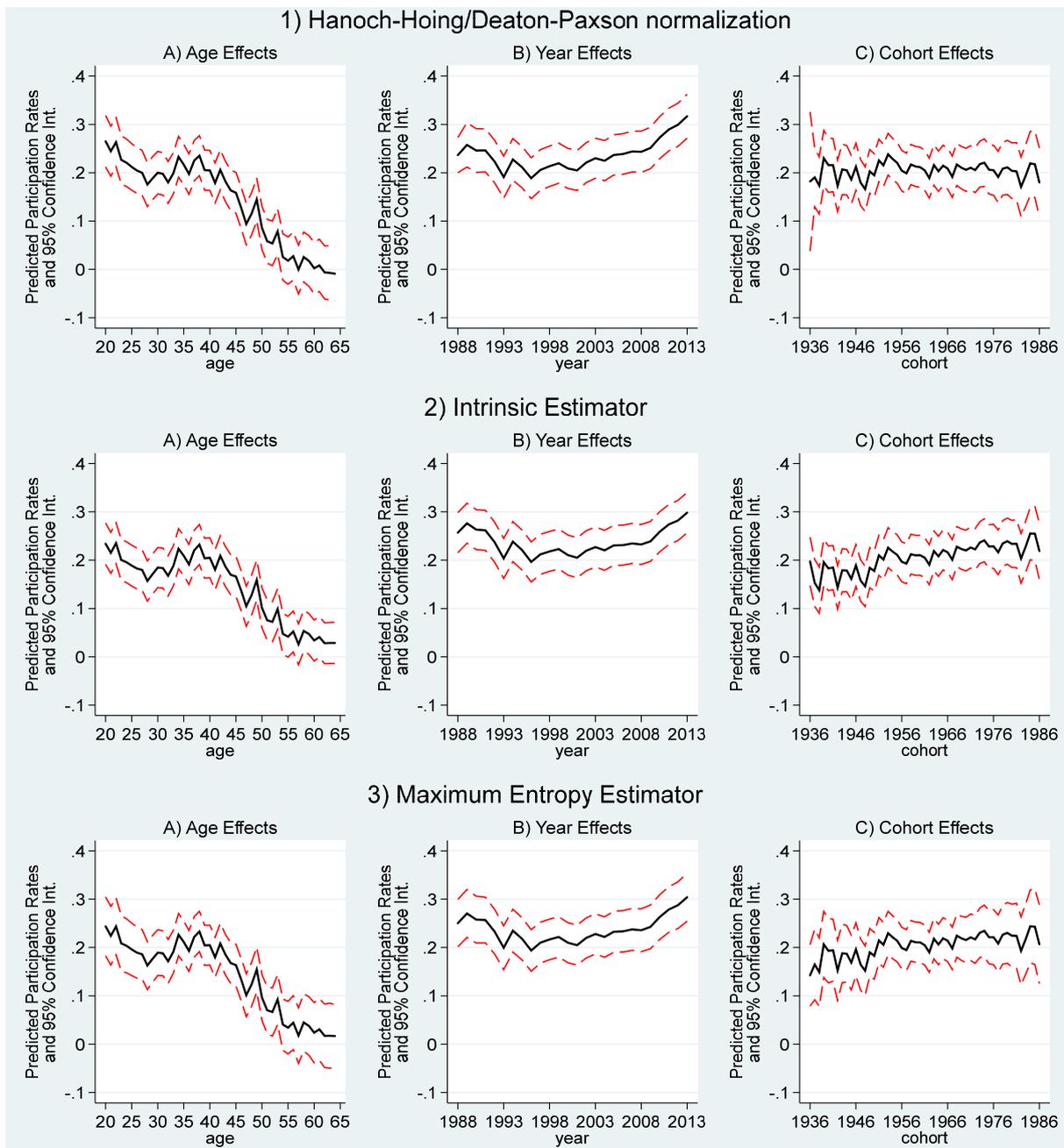
Notes: The sample is restricted to ages 20 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D8. Decomposition Results - Urban areas, middle school (Ages 25-64)
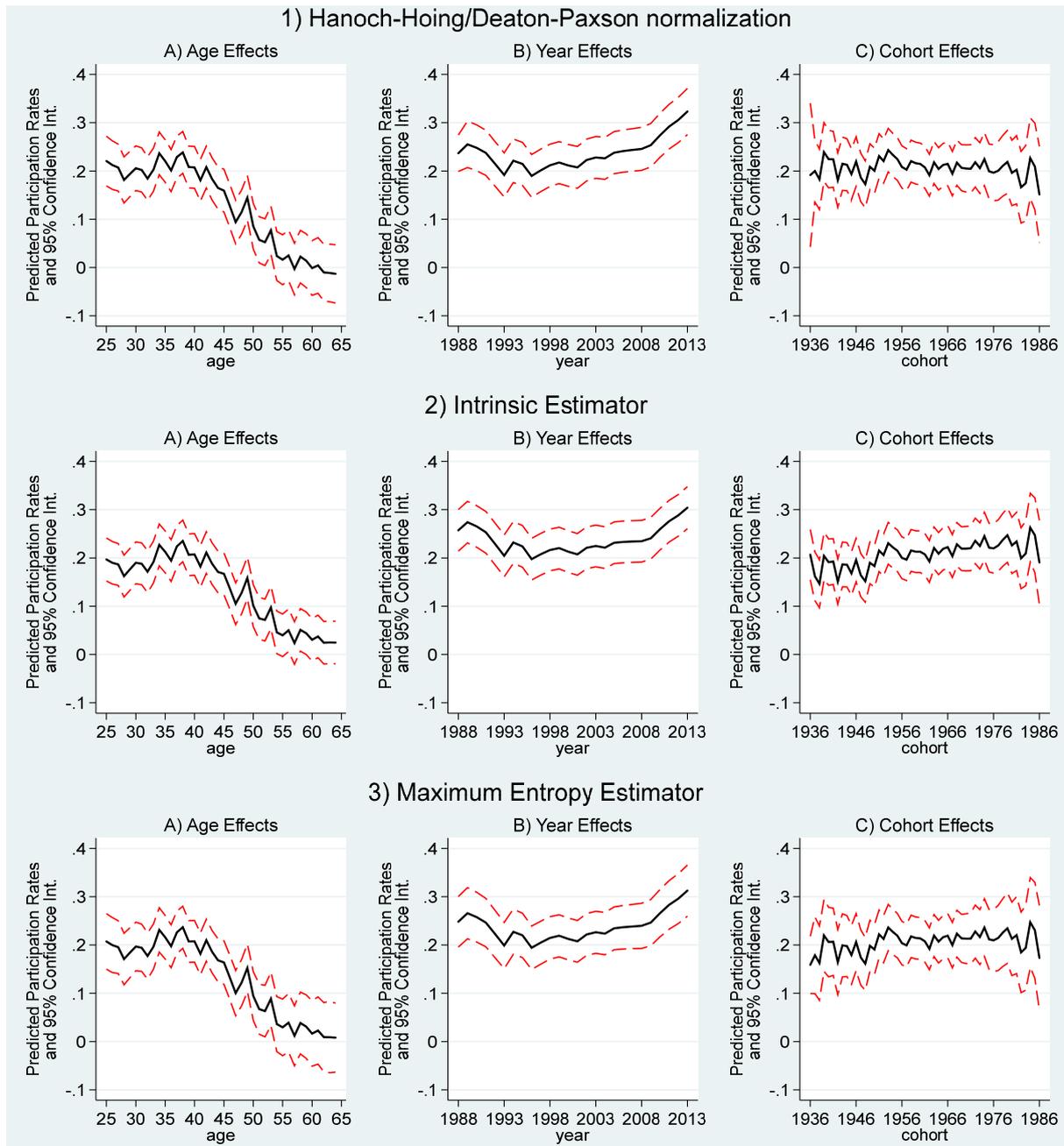
Notes: The sample is restricted to ages 25 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D9. Decomposition Results - Urban areas, high school (Ages 25-64)
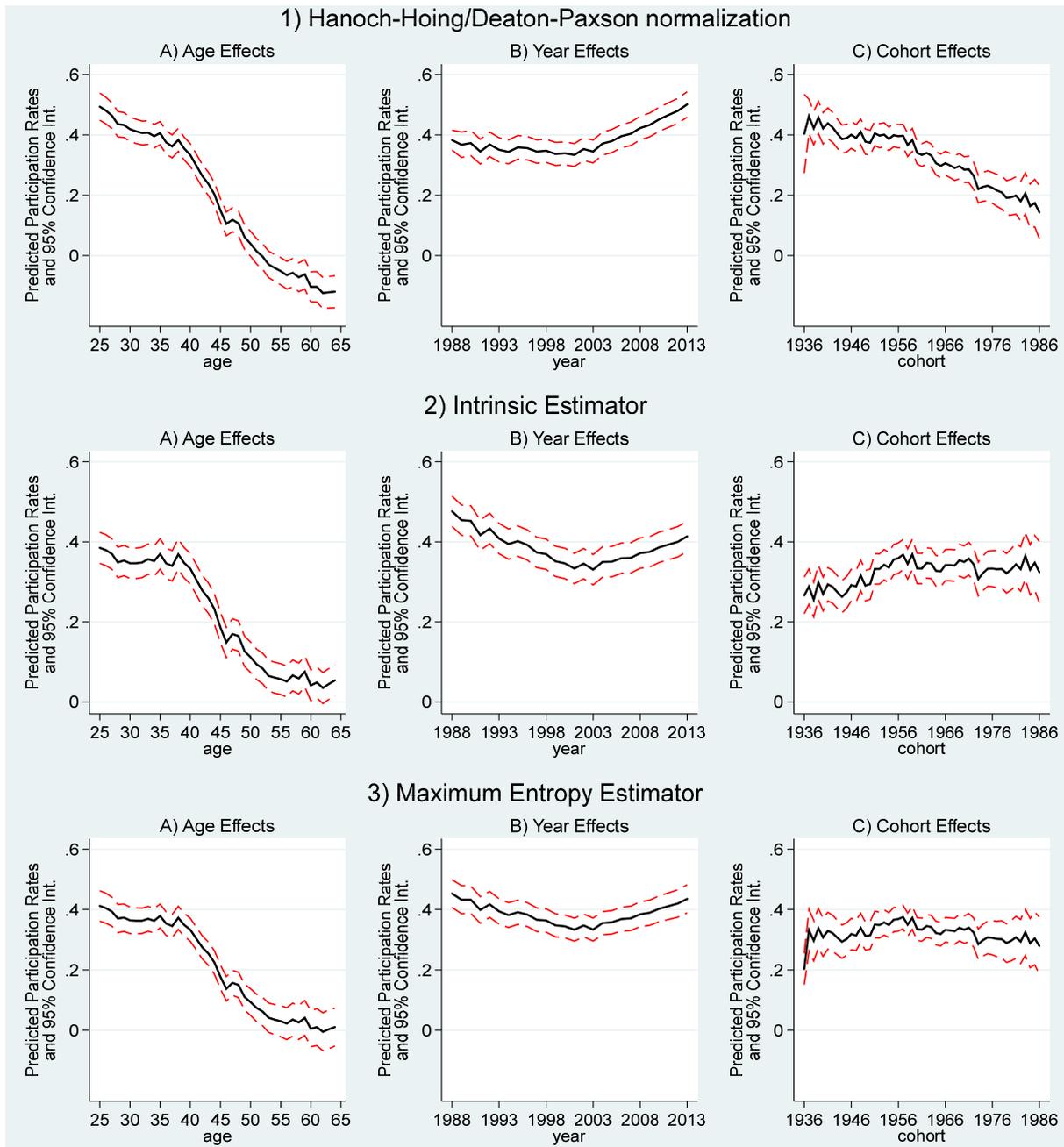
Notes: The sample is restricted to ages 25 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure D10. Decomposition Results - Urban areas, university (Ages 25-64)
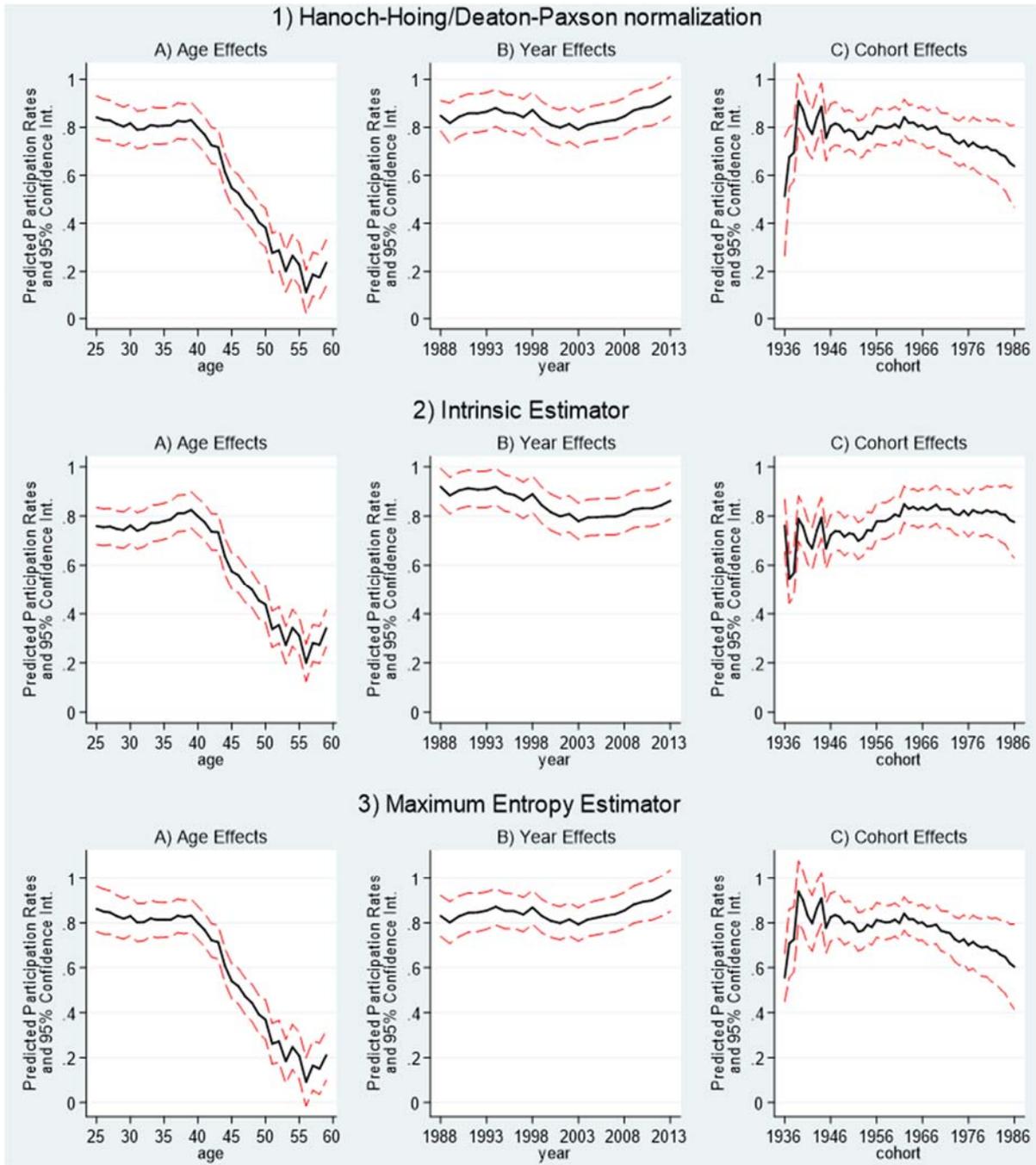
Notes: The sample is restricted to ages 25 to 59. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Appendix E. APC Decomposition for Males

Figure E1. Men -- Rural areas
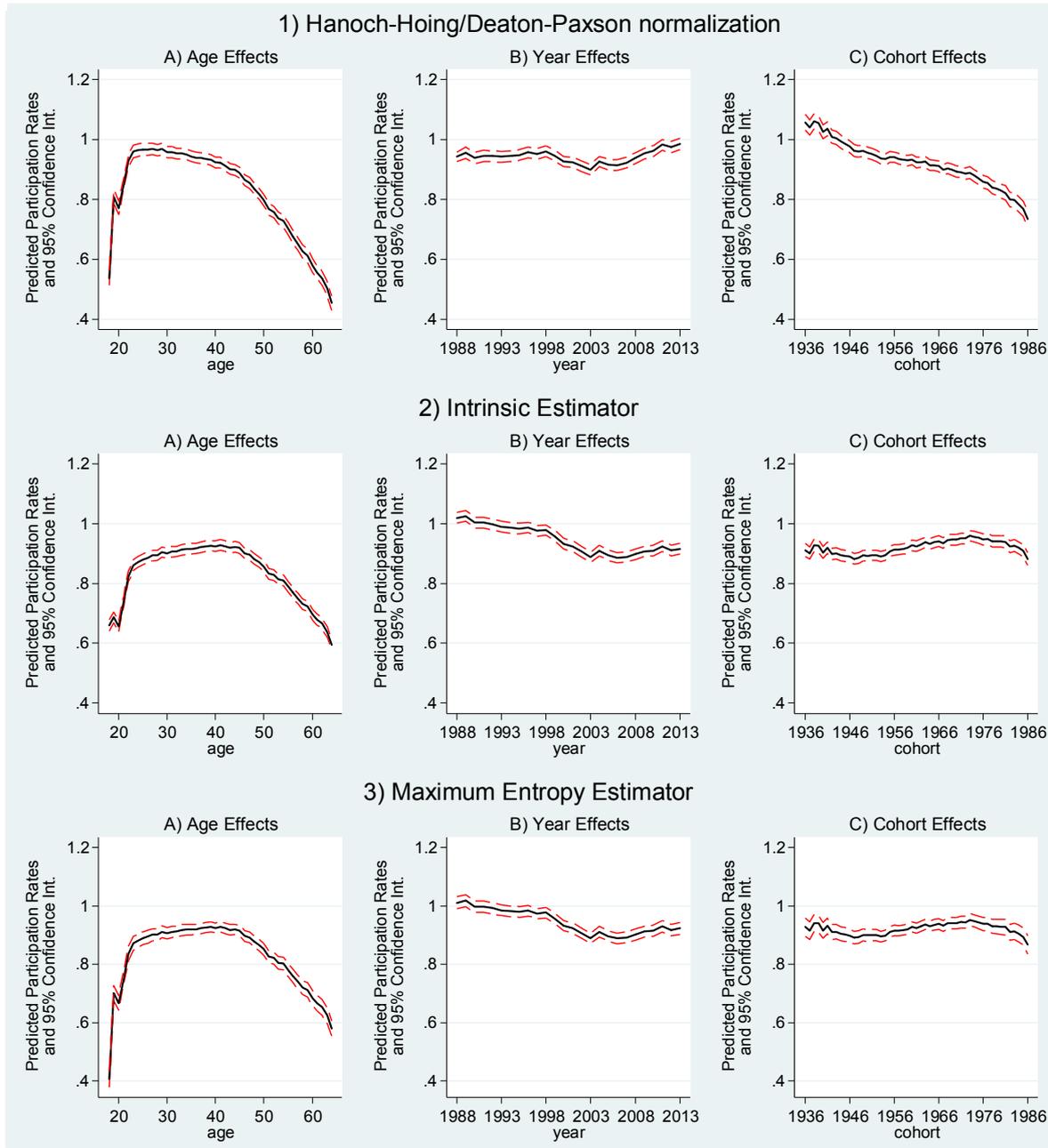
Notes: The sample is restricted to ages 18 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure E2. Men - Urban areas
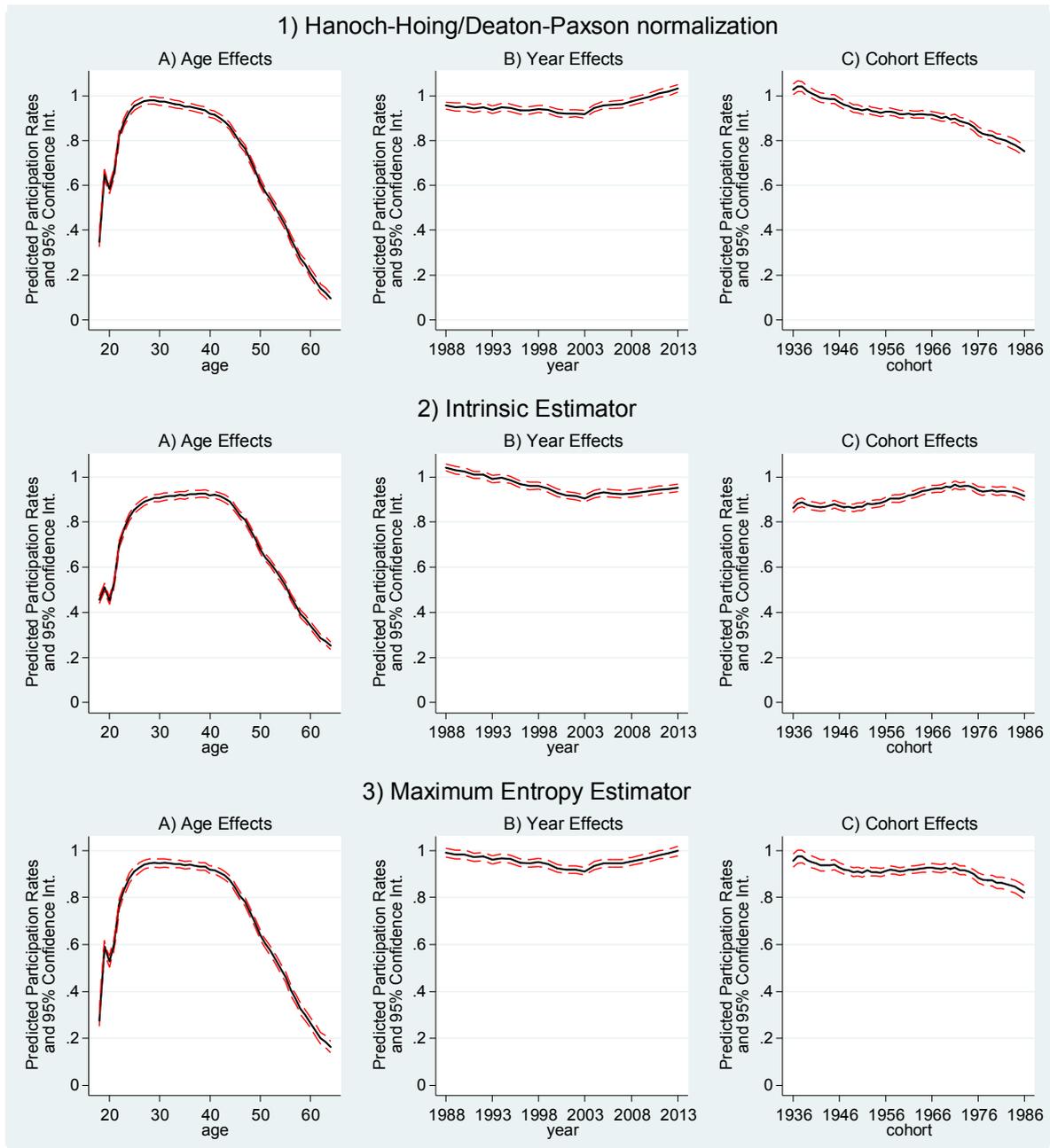
Notes: The sample is restricted to ages 18 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

**Figure E3. Men - Urban areas, primary school or lower**
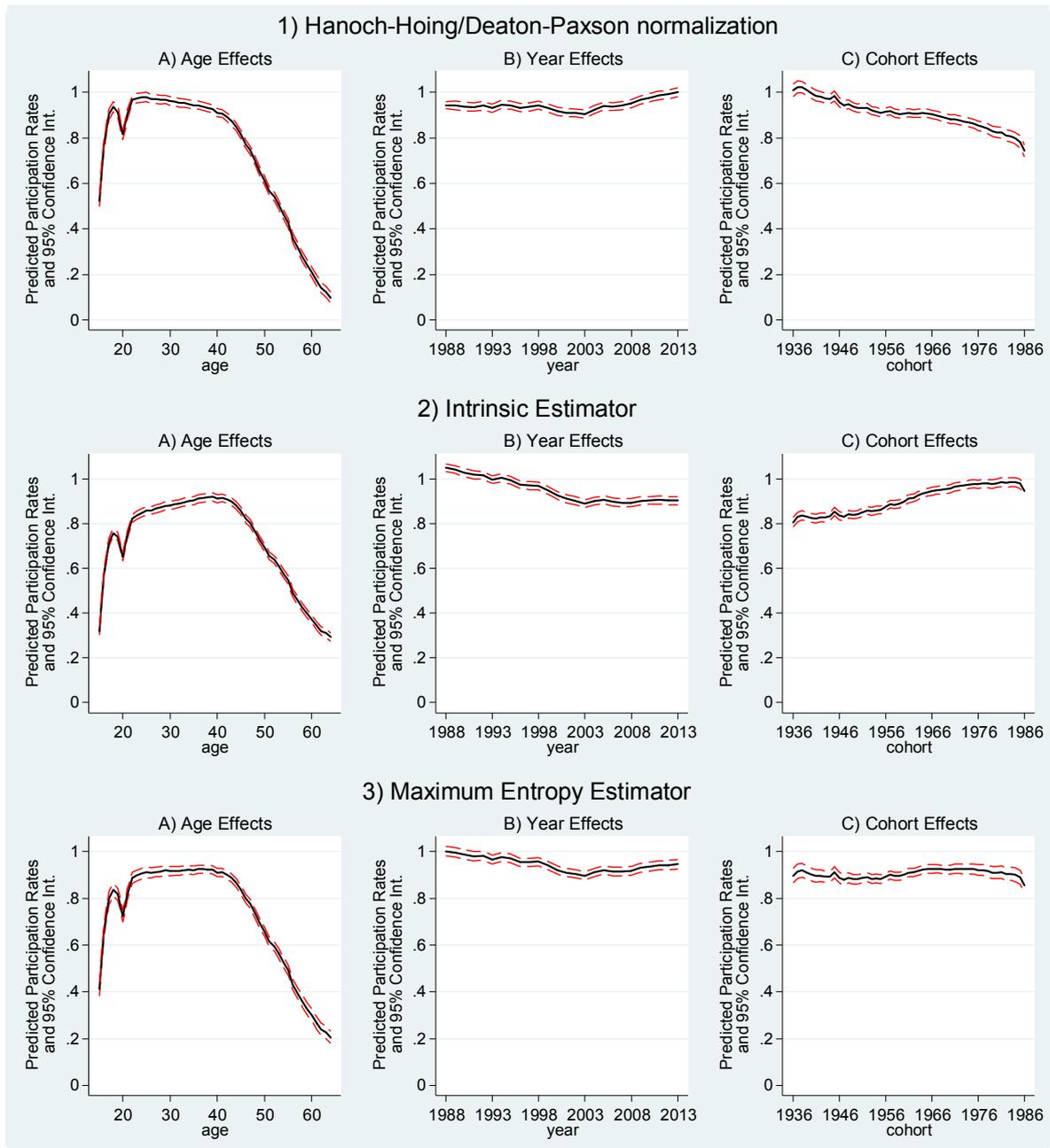
Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure E4. Men - Urban areas, middle school
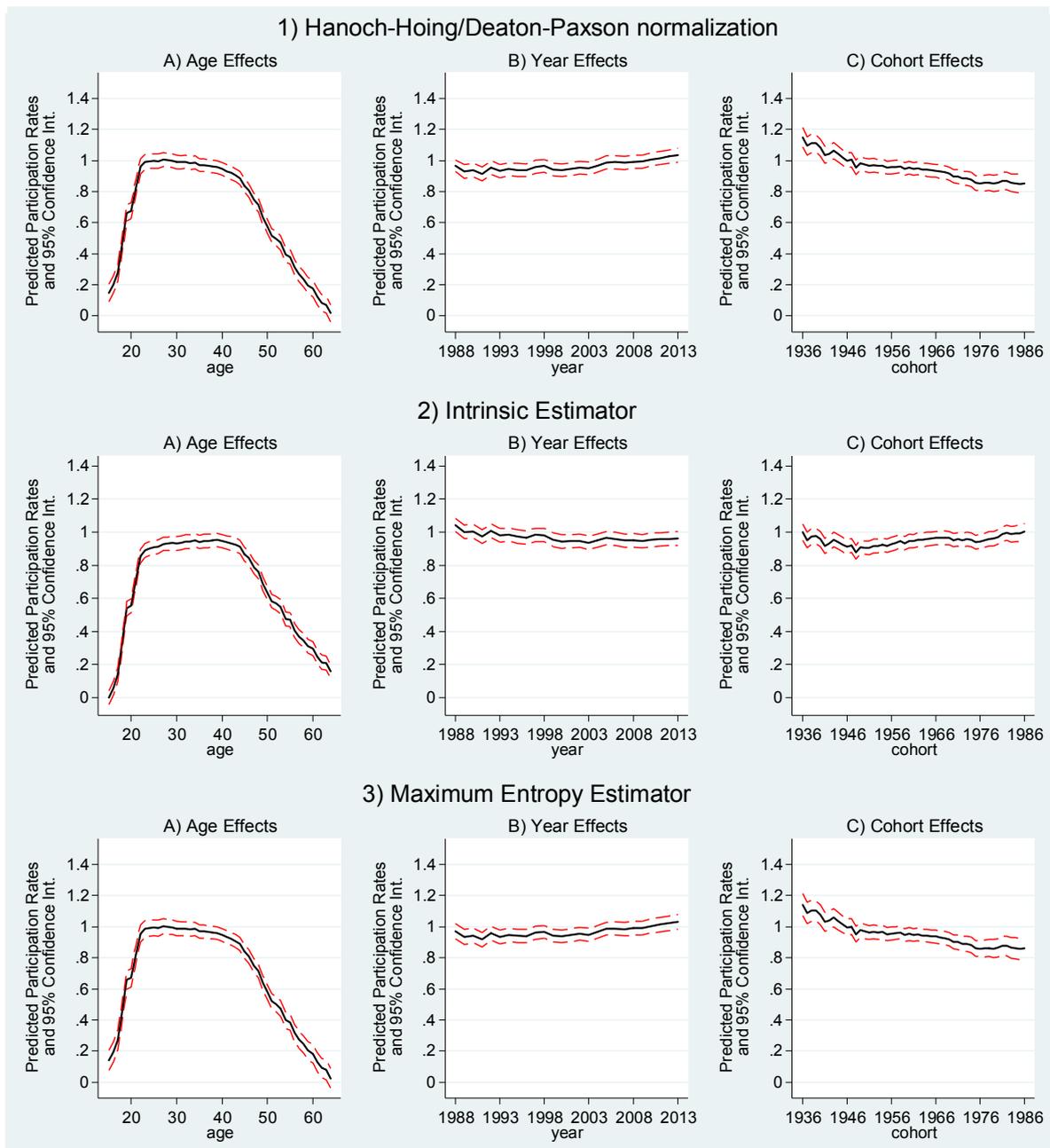
1) Hanoch-Hoing/Deaton-Paxson normalization

A) Age Effects

B) Year Effects

C) Cohort Effects

2) Intrinsic Estimator

A) Age Effects

B) Year Effects

C) Cohort Effects

3) Maximum Entropy Estimator

A) Age Effects

B) Year Effects

C) Cohort Effects

Notes: The sample is restricted to ages 15 to 64. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

87

Figure E5. Men - Urban areas, high school
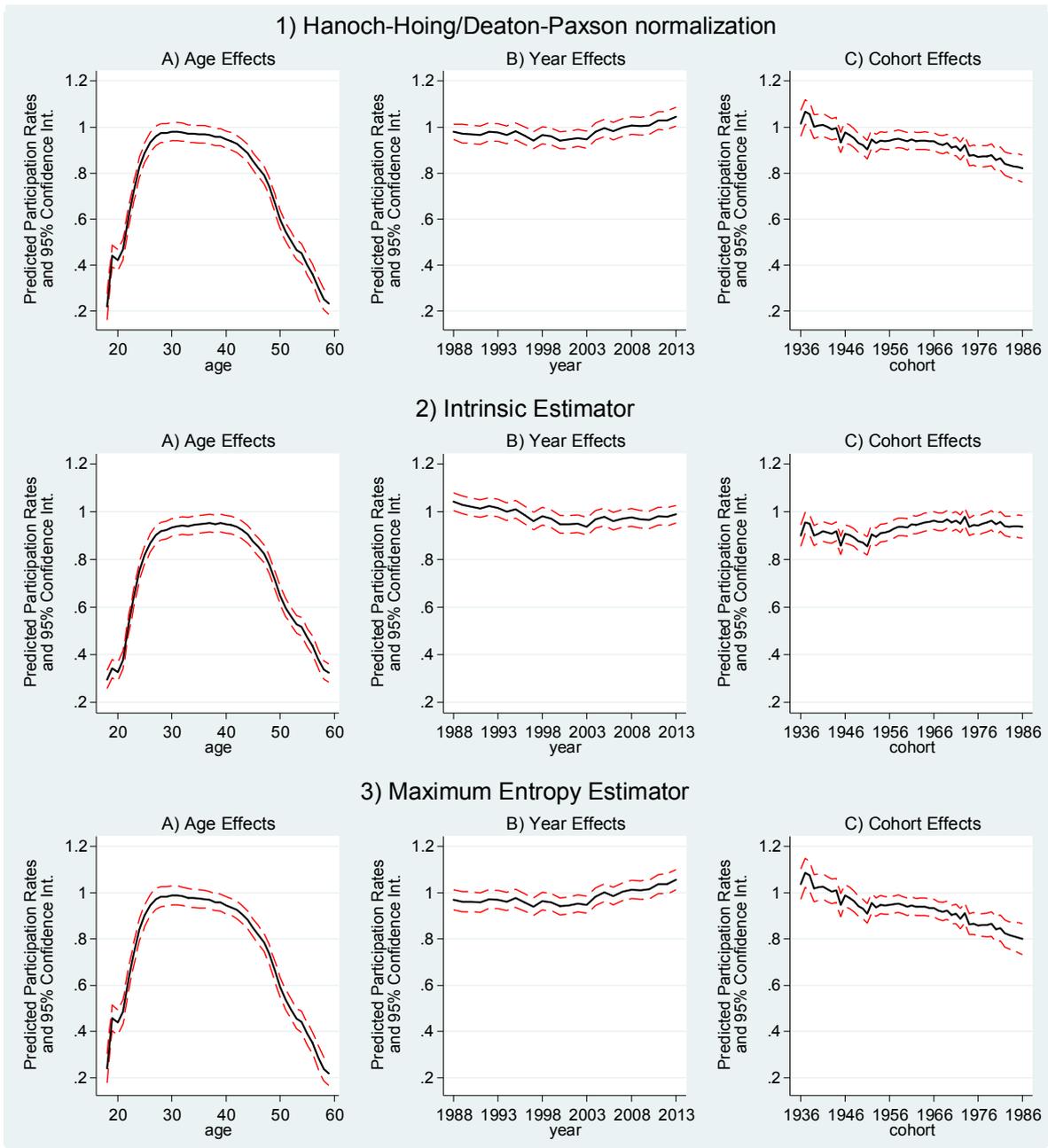
Notes: The sample is restricted to ages 18 to 59. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.

Figure E6. Men - Urban areas, university

Notes: The sample is restricted to ages 22 to 59. Age effects are drawn for the 1961 birth cohort in 2001; year effects are drawn for the 1961 birth cohort at age 40; cohort effects are drawn for 40 year-olds in 2001.