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Abstract

It is well known that childbearing is associated with age at migration, but most research has focused on foreign-born women who migrated as adults. Much less is known about immigrants who arrived as children, or male immigrants, despite the importance of studying these groups in order to understand theories of adaptation and assimilation. This study addresses these gaps with a case study of Sweden. It uses longitudinal data for the whole population to analyze the role of age at arrival in determining childbearing. The results suggest that age at arrival has a strong and incremental impact on childbearing, for both women and men, in particular for immigrants from higher fertility origins. This impact is stronger at earlier childbearing ages, and there is little evidence in support of critical ages at arrival. These findings persist after examining sources of selection and reverse causality, including the use of sex-specific family fixed-effects models and separate analyses for specific countries of birth. This case study therefore provides evidence of an underlying process of childhood socialization, followed by adaptation, that is common for women and men who migrate. Theoretical implications are discussed, including the need for further work on determinants and mechanisms of adaptation.

Keywords: *Adaptation, assimilation, socialization, childbearing, fertility, age at arrival, children of immigrants, generation 1.5, gender, family fixed-effects, Sweden*

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A fundamental challenge for sociologists is to understand the adaptation of immigrants and their descendants (Dewind and Kasinitz 1997; Drouhot and Nee 2019; Morawska 2009; Portes et al. 2002; Portes and Rivas 2011). The challenge is fundamental because a lack of adaptation suggests the existence of social inequalities that may have pervasive negative consequences for the lives of immigrants, and for society more generally (Alba and Foner 2015; Alba and Nee 2005; Drouhot and Nee 2019; Massey 1981; National Academies of Sciences, Engineering, and Medicine 2015; Portes et al. 2009; Rumbaut and Portes 2001; Waters and Jiménez 2005; Zhou and Gonzales 2019).

Definitions of adaptation are inconsistent, and often unstated, but several commonalities can be observed, which also help to make the distinction between adaptation and the related concepts of assimilation, integration and incorporation (described in more detail below, see also: Goldlust and Richmond 1974; Zhou and Gonzales 2019). Adaptation can be studied by focusing on the individual lives of immigrants (Milewski 2010a), or on intergenerational comparisons between immigrants and their descendants (Parrado and Morgan 2008). In both cases it can be defined as a bi-directional process of convergence, typically with reference to the native-born population, or children of the native-born (Dewind and Kasinitz 1997; Goldlust and Richmond 1974; National Academies of Sciences, Engineering, and Medicine 2015). In this regard, adaptation is similar to assimilation, which may explain why some authors treat them as synonymous (this issue is returned to below, but for an example see: Kahn 1988). However, for other authors (and this study), the main distinction is that, by preferring the term adaptation rather than assimilation, we make an explicit attempt to avoid subjective or normative judgments about the desirability of difference (Brubaker 2001; Goldlust and Richmond 1974; Lessard-Phillips 2017).

Recent research has shown that debates about adaptation and assimilation remain unresolved (Drouhot and Nee 2019; Zhou and Gonzales 2019). At the same time, these debates suggest the need for a new wave of research that moves beyond universal statements (of 'optimism or pessimism') to instead examine the lives of immigrants and their children in a more complex and nuanced manner. As noted by Zhou and Gonzales (2019), migration scholarship has generated many sophisticated quantitative studies of intergroup differences in outcomes, but these studies *"tend to produce results that largely miss the group-specific nuances, dynamics, and mechanisms of processes"* (2019, p. 395). Part of the reason for this may lie with the fact that data on the adult life course of children of immigrants is often limited (Cerrutti et al. 2021; Zhou and Gonzales 2019), particularly with respect to its quality, coverage

and statistical power. Indeed, for some life course processes it is extremely hard to find data in any setting that have the necessary level of detail in order to analyze the adaptation of specific groups dynamically.

This article sets out to meet this challenge and respond to recently stated calls for new research. To do so, it focuses on childbearing (also referred to as 'fertility' or less commonly in the social sciences as 'fecundity'), which is a life course process that is not only hard to study without detailed data, but also frequently ignored in broader appraisals of immigrant adaptation. With respect to its empirical contribution, this article carries out a quantitative case study of Sweden using longitudinal data for the whole population to address a series of gaps in knowledge, as outlined below. Although much research has been carried out on the adaptation of childbearing, including research that uses register data, the generalizability of prior research has been undermined by its overt focus on women who migrated as adults. In addition, it is increasingly recognized that it is impossible to carry out an unbiased test of fertility adaptation for immigrants who migrate during adulthood because of the well-known endogeneity between migration and fertility. By contrast, there have been far fewer studies of the children of immigrants, and an almost total absence of studies that focus on men, despite the benefits of such a focus (as detailed below).

The rest of this article comprises two broad endeavors. The first is develops a theoretical framework that integrates the life course process of childbearing within a theory of immigrant adaptation. In doing so, it summarizes the current state of research, while determining what remains unknown about immigrant fertility adaptation. The second endeavor is to carry out an empirical case study of Sweden, which seeks to address some of the most prominent gaps in knowledge (identified by the first endeavor). In summary, this case study extends previous empirical research through the unique combination of: (1) dynamic analysis of changes in adaptation over the childbearing life course, (2) tests of childhood socialization, one of the main mechanisms of adaptation, by examining the role of age at arrival for immigrants who arrive as children, (3) analysis that avoids common sources of selection bias, including the use of family fixed-effects models, (4) a focus on differences in fertility adaptation within specific origin groups, in absence of statistical uncertainty, and (5) comparing women and men, which is rarely done in either the literature on fertility adaptation, or the literature on adaptation more generally. This is despite the increasing profile of intersectionality and its application to quantitative research (Bürkner 2012; Sigle 2016; Sigle-Rushton 2014).

The following sections develop a conceptual framework of immigrant childbearing that is more fully integrated with the theory of adaptation.[1] This is followed by the empirical case study of Sweden, after which the article concludes with a discussion of theoretical implications, including for broader studies of immigrants and their children (beyond their childbearing). Taken together, a broad aim of these endeavors is to better integrate the study of childbearing – a core focus of family sociology – with the sociology of migration. In doing so, this study hope to enable research on the fertility of immigrants and their descendants to be better understood by sociologists and other interested scholars who do not study the topic specifically.

CHILDBEARING AND ADAPTATION

Given that childbearing is interlinked with social inequality, it is perhaps surprising that it has not featured more prominently in sociological appraisals of immigrant adaptation and assimilation (including if we consider different variants of these concepts: Kivisto 2017). For example, despite fertility being one of six dimensions in Douglas Massey's review of immigrant assimilation in the US four decades ago (1981), it was apparently overlooked in the follow-up review by Waters and Jiménez (2005), as seems to be the case in recent high-profile reviews of assimilation among the children of immigrants (several brief mentions notwithstanding, Drouhot and Nee 2019; Zhou and Gonzales 2019).

This is not to say that there has been a lack of research on immigrant childbearing (on the contrary, as shown below and for example: J. A. Hill 1913; Kulu et al. 2019; Parrado 2011; Zarate and Zarate 1975), but rather that this research appears to be absent from broader debates about adaptation or assimilation (or integration, or incorporation). This may be because researchers prefer to exclude fertility from discussions about success (e.g. 'successful' assimilation), as seems appropriate, so that normative judgements are not put forward about the number of children born to immigrants. In addition, the absence of childbearing from these debates may be due to research on immigrant fertility tending to be published in journals that focus on demography, rather than broader sociology journals, to the detriment of an opportunity for synthesis and interaction.

Although not a measure of integration, which is typically defined as the degree to which immigrants have the knowledge and capacity to build a successful and fulfilling life (Harder et

[1] We note that scholars do not necessarily agree on the definition of a theory, although we prefer to follow Graham in taking an inclusive view (Graham 2000, 2021), such that a theory may *"refer to any set of ideas that go beyond the particularities of individual cases and contribute to making certain circumstances, relationships, or events intelligible"* (Graham 2021, p. S134).

al. 2018), childbearing is an important aspect of immigrants' lives, especially after migration. Childbearing can be measured in different ways, but its two core components – birth timing (tempo) and number of children born (quantum) – have an enduring impact on social outcomes over the life course, including measures of integration (like earnings). The postponement of parenthood is strongly associated with socioeconomic advantage, whereas early-life childbearing is a known source of disadvantage, notably for labor market outcomes (Leonard and Stanley 2020; Waldfogel 1997). This is not only true for the majority population, but also for ethnic minorities (Florian 2018; Van Winkle and Fasang 2020) and the children of immigrants (Rumbaut 2005).

There is a rich history of research that examines childbearing, both as a macro-level and micro-level process (Balbo et al. 2012). Esping-Andersen and Billari (2015) have surmised that the theories used to interpret this research rest upon two broad perspectives (to which they add a third). The first is an economic cost-benefit perspective, typically derived from *New Home Economics* (Becker 1960, 1981), while the second perspective focusses on ideational change, typically linked to the *Second Demographic Transition* (Lesthaeghe 1983, 2010; van de Kaa 1987). More recently, a third perspective has emphasized the transformation of gender (*Gender Roles and Relations*) as a determinant of fertility change and variation (Esping-Andersen and Billari 2015; Goldscheider et al. 2015; McDonald 2000). A key aspect of this gender perspective is to acknowledge the role of family policy in determining fertility, as described in feminist theories of the welfare-state (Neyer and Andersson 2008). To these three perspectives, we might add other frameworks that researchers have used to study childbearing, including some that may fit within the perspectives already mentioned, such as the *Theory of Planned Behavior* (which fits within the economic perspective: Ajzen 1991; Balbo et al. 2012), and others that may not, such as *Evolutionary Theory* (Sear 2015) and the first *Demographic Transition Theory* (whose status as a theory is not universally accepted, but whose relevance is certainly not: Kirk 1996). However, despite much scholarship on these different theories of childbearing, there is little research that has sought to use them directly as a framework for studying the fertility of immigrants or their descendants.

One notable exception is a review by Genereux that develops an integrated framework using gender as the central means of connecting three spheres of influence that determine immigrant fertility, namely: (1) the sending country context, (2) the global migration context, and (3) the receiving country context (2007). This is a useful point of departure that we return to below. Yet, aside from this intervention, and some occasional references to general theories

of fertility (e.g. see the brief discussion of *New Home Economics* in Andersson and Scott 2005; and in Milewski 2010a), it appears that a separate set of theories and hypotheses have been developed for studying the fertility of immigrants and their descendants (Milewski 2010a), and one of these is adaptation (Goldstein and Goldstein 1981; Harbison and Weishaar 1981).

A considerable body of research has shown, across a range of high-income destinations, that foreign-born women typically have different (differential) childbearing outcomes, as compared with native-born residents of their destination (Abbasi-Shavazi and McDonald 2002; Adserà and Ferrer 2016; Andersson 2004; Dubuc 2012; Kulu and Hannemann 2016; Mussino and Strozza 2012; Parrado 2011; Tønnessen 2019; Toulemon 2004). Similarly, differentials have been observed for the children of foreign-born parents, as compared with the children of native-born parents (Kulu et al. 2017, 2019; Kulu and González-Ferrer 2014; Parrado and Morgan 2008). This evidence of differential fertility is exaggerated in certain measures of immigrant fertility due to bias, notably when using total fertility rates (which exclude years at risk of childbearing prior to arrival, see: Parrado 2011; Sobotka and Lutz 2011; Toulemon 2006). Nevertheless, differences in childbearing are evident for some immigrant groups when using unbiased methods of estimating fertility, including completed fertility (children ever born at the end of a reproductive career, for example see: Parrado and Morgan 2008; Wilson 2019). A range of explanations have been given as to why some immigrants and their children have different childbearing from the destination or mainstream norm (for example as measured using the native-born average). The majority of these explanations center around the role of migration and migration background (including parental or grandparental migration in the case of immigrants' descendants) (Milewski 2010a).

The hypothesis of immigrant fertility adaptation typically asserts that the fertility of immigrants will initially – i.e. on arrival – be different from that of the destination norm, after which it will gradually become more similar to this norm with increasing duration of residence (Harbison and Weishaar 1981; Kahn 1988; Milewski 2007; Schoorl 1990). In this sense, adaptation appears to make a similar form of prediction to that made by straight-line assimilation (Alba and Nee 2005; Kivisto 2017).[2] The adaptation process may be driven by changes in attitudes, preferences and norms, in a process that is often referred to as acculturation (Adserà and Ferrer 2016; Milewski 2010a), or attributed to changes in culture or cultural norms

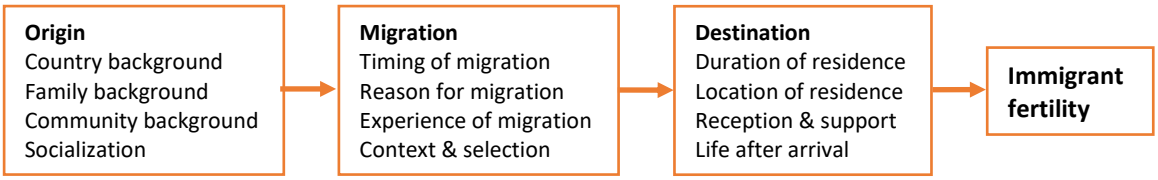
[2] It is perhaps worth noting that adaptation is more typically referred to as a hypothesis, rather than a theory, when used to study fertility (Milewski 2010a). This is important because it suggests that the theoretical link between childbearing and adaptation is not fully developed, in the minds of some researchers at least.

(Kahn 1988; Rumbaut and Weeks 1986). At the same time, the adaptation of fertility may also be driven by changes in socioeconomic decision-making (L. E. Hill and Johnson 2004; Lindstrom and Giorguli Saucedo 2002), in what is sometimes referred to as economic adaptation (Rumbaut and Weeks 1986).[3] Economic adaptation may be driven by responses to the institutional context of the host society, including labor market structures and the incentives to have children. The context-specific nature of structural explanations is important to note because it may help to explain why the transition to parenthood is more likely for employed immigrants in family-friendly contexts like Sweden (Andersson and Scott 2005), but less likely in contexts like the US where employment and childbearing are less compatible (Milewski 2010a).

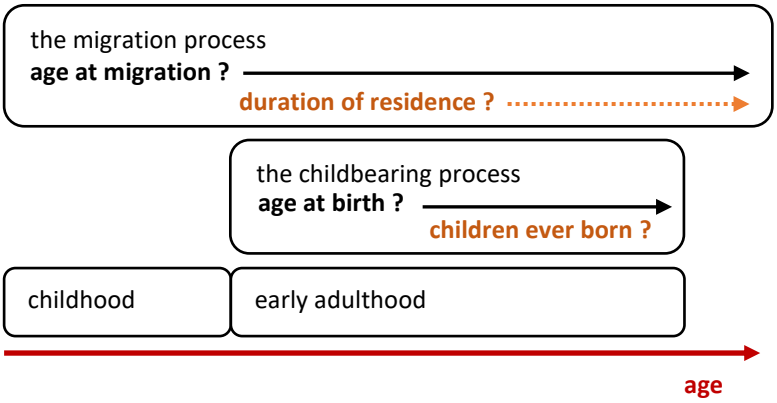
Almost every empirical study of immigrant childbearing over the last few decades has either attempted to test a hypothesis of fertility adaptation directly, or at least referred to fertility adaptation when framing its analysis (e.g. Adserà and Ferrer 2016; Andersson 2004; Dubuc 2012; Kulu et al. 2017, 2019; Kulu and González-Ferrer 2014; Milewski 2010a; Mussino et al. 2021; Parrado 2011). Despite this, there appear to have been limited efforts to derive a conceptual framework for the study of immigrant fertility adaptation. Possible exceptions include the frameworks created by Rumbaut and Weeks (1986) and by Forste and Tienda (1996), which go some way to clarifying the determinants of immigrant fertility adaptation, even if not focused on the concept. Figure 1 builds upon their work and illustrates a broad conceptual framework for the adaptation of immigrant childbearing.

[3] The notion that fertility adaptation is driven by both acculturation and socioeconomic change is commonly stated in most recent studies (Kulu et al. 2019; Kulu and González-Ferrer 2014; Milewski 2010a). However, it is not always agreed upon. Indeed, some authors have said the main difference between fertility adaptation and fertility assimilation is that the former is due exclusively to socioeconomic factors, while the latter is due exclusively to acculturation (L. E. Hill and Johnson 2004).

[1A] THE INFLUENCE OF ORIGIN, MIGRATION AND DESTINATION



[1B] THE LOCATION OF MIGRATION AND CHILDBEARING IN THE LIFE COURSE



[1C] ADAPTATION AFTER ARRIVAL

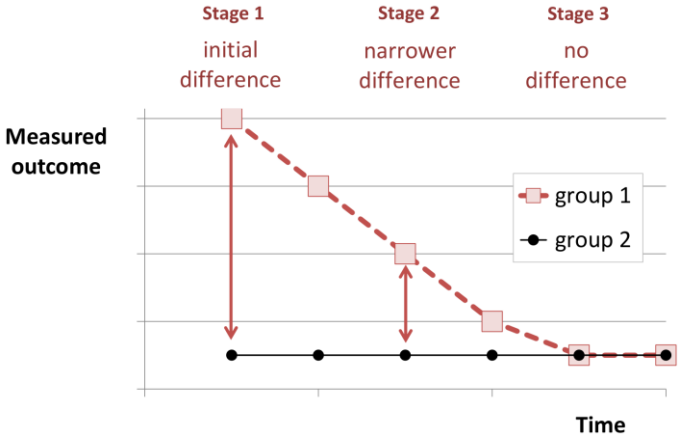


Figure 1: A conceptual framework for immigrant fertility adaptation. Panel 1A shows the three spheres that influence immigrant fertility (in addition to the factors that influence fertility more generally, which are not shown). Panel 1B highlights the location of the two interrelated processes of migration and childbearing within the life course. With respect to migration, immigrants can arrive at any age, and duration of residence is the difference between age and age at migration. With respect to childbearing, births can only occur during early adulthood (i.e. after childhood), where childbearing ages are commonly defined as 15-45 (when the majority of children are born to women and men). Immigrants arriving after childhood have therefore experienced at least some of their childbearing ages in their origin country. Panel 1C illustrates the typical definition of adaptation that is found in the literature on immigrant fertility. In the first stage, two groups – usually immigrants and the native-born – are different in some way (e.g. with respect to their average number of children born). In the second stage, the difference between these groups becomes smaller over time. And in the third and final stage, these groups become indistinct as the difference between them disappears (due to changes in either group). At this point, convergence – and therefore also adaptation – may be assumed to be complete. This framework draws upon prior research. See the main text for further discussion.

There are many potential ways to conceptualize fertility adaptation, but Figure 1 attempts to synthesize some of the most prominent aspects. The top panel [1A] follows previous frameworks (Forste and Tienda 1996; Rumbaut and Weeks 1986), including the work mentioned earlier by Genereux (2007), to illustrate the three main spheres of influence that determine immigrant fertility: origin, migration and destination.[4] These spheres each contain factors that impact immigrant fertility, in addition to the factors (not shown) that influence fertility more generally. Since adaptation occurs after migration, the mechanisms of adaptation are all located within the destination sphere, which includes adaptation in other domains of life such as acculturation and economic adaptation (labelled 'life after arrival' in Figure 1).

The second panel [1B] of Figure 1 explicates the location of the two processes – childbearing and migration – which interact at various points in the life course in order to determine immigrant fertility. This panel alludes to the work of scholars who have used a life course perspective to study migrant fertility (Andersson 2004; Hoem and Nedoluzhko 2016; Kulu and González-Ferrer 2014), including research that highlights the causal interrelationships between the processes of childbearing and migration (Hoem 2013). In doing so, it makes clear that migration may or may not be simultaneous with childbearing.

The third panel [1C] of Figure 1 presents an illustration of the typical definition of adaptation that is used in studies of immigrant fertility (Goldstein and Goldstein 1981; Harbison and Weishaar 1981; Kulu et al. 2019; Milewski 2007, 2010a). In this form, adaptation is defined as a process of convergence occurring in three stages of: (i) an initial difference, (ii) a narrowing of this difference, and (iii) the disappearance of this difference. A similar definition can be constructed for intergenerational adaptation, but to maintain conceptual clarity we restrict out attention to the adaptation of immigrants here and return to this issue in the discussion.

In addition to explicating the concept, the framework in Figure 1 illustrates several key insights that can be gleaned from prior research. The first is that immigrant fertility is likely to be determined by an interaction between the three spheres of origin, migration and destination, and that most proposed explanations for immigrant fertility can be located within (or across) these three spheres. For example, selection fits within the migration sphere because it is a feature of the migration process (Goldstein and Goldstein 1981; Harbison and Weishaar 1981),

[4] Forste and Tienda (1996) anticipate Genereux's with a detailed framework of the source and destination factors that influence the completed fertility of immigrants (Figure 3, p.129), while following Hirschman (1994) in arguing that a single theory is unlikely to explaining all ethnic fertility differentials.

predicting that immigrants may exhibit particular fertility behavior because they are selectively different (from their origin population) with respect to the characteristics that determine fertility (like age or partnership status) or because of their childbearing history on arrival (for evidence see: Singley and Landale 1998; Tønnessen and Wilson 2020). Selection may impact life after arrival in the destination, but its source is the act of migration. Similarly, the conceptual framework in Figure 1 can be used to help locate other determinants of immigrant fertility.

The second insight is that studies attempting to focus on fertility adaptation must account for competing explanations. This poses a challenge because it can be hard to disentangle the three spheres of influence and the explanations they contain. More specifically, patterns of immigrant fertility that look like adaptation may be the result of determinants prior to arrival in the destination – i.e. determinants from the origin or migration spheres – rather than changes in either the quantum or tempo (level or timing) of fertility after arrival. This point has been noted by many authors, in particular when cautioning against the (over)interpretation of elevated fertility after arrival (Toulemon 2006), and especially when comparing pre- and post-migration fertility in absence of a counterfactual (Hoem 2013).

The third insight, which follows from the others, is that it is extremely difficult to draw reliable conclusions about the adaptation of immigrant fertility (and similarly the assimilation or socialization of immigrant fertility) by studying only immigrants who migrated as adults (Mussino et al. 2021). This is essentially because: (a) they have spent some of their childbearing career in a different country from the destination and (b) migration and fertility are endogenous (including the potential for reverse causality, meaning that those who have children are less likely to migrate: Singley and Landale 1998; Toulemon 2006). Although they may indeed arrive with a different quantum or tempo of fertility from the native-born population (therefore fulfilling the criterion for stage 1 of Figure 1, panel 1C), adaptation may not be possible (i.e. it may be impossible to reach stage 2 or 3) because childbearing is a monotonic process. Perhaps the most obvious example of this issue is if we consider immigrants who have already given birth to more children than the native-born average for completed fertility. It is not possible for these immigrants to ever ‘adapt’ to this native-born average because they cannot have fewer children (than they have ever born). Having conceptualized immigrant fertility adaptation, and the problems of studying this for immigrants who migrate as adults, the following section considers how researchers might move beyond this impasse.

AGE AT ARRIVAL AND FERTILITY

Most of what is known about immigrant fertility currently rests upon studies of foreign-born women who migrated as adults. By comparison, there have been very few studies of male immigrant fertility (a gap discussed further below) and very few studies of women or men who migrated as children (sometimes called 'child migrants', 'childhood migrants', 'the one-and-a-half generation', or 'G1.5'). This is despite the fact that scholars have increasingly recognized the value of studying childhood migrants, in particular when trying to understand immigrant fertility (Adserà et al. 2012; Adserà and Ferrer 2014; Mussino et al. 2021).

Immigrants who arrive as children offer a unique opportunity to examine the role of childhood in the process of adaptation. Unlike immigrants who arrive as adults, their childbearing and migration are not endogenous (Adserà et al. 2012). Unlike native-born descendants of immigrants, they arrive at different ages, which is a unique source of variation in childhood socialization (Bleakley and Chin 2010; Hermansen 2017; Mussino et al. 2021).

One of the most prominent theoretical mechanisms that is used to explain immigrant fertility adaptation is childhood socialization, which is based on the idea that fertility behaviors depend on exposure to norms, preferences and behavior during childhood (Milewski 2010b). Childhood socialization can explain why immigrants from different origins exhibit different fertility patterns in the same destination, in particular if they conform with norms from their country of origin or the neighborhood in which they spend their childhood (L. E. Hill and Johnson 2004; Wilson and Kuha 2017). At the same time, childhood socialization does not exclusively involve norms, but also impacts opportunities and constraints, including with respect to other domains of life – like socioeconomic outcomes – that may influence fertility (Mussino et al. 2021).

Childhood socialization may be determined by many different factors, but it is typically conceptualized as being inextricably linked with 'exposure to destination', which in the context of this article's case study can be described as 'exposure to Swedish society'. Put simply, a lack of exposure to Swedish society may cause immigrants to follow the family formation patterns of their origin country, rather than those of Sweden. Children who arrive at later ages will spend less time in Sweden before reaching childbearing age. This means that they will have less time to adapt to their new environment, which in turn may impact their plans and behaviors with respect to family formation (Adserà and Tienda 2012). A lack of exposure implies less opportunities for adaptation or integration in any domain of life, including those that may

impact preferences, opportunities and constraints with respect to childbearing. For example, later arrival implies less time for language acquisition, interaction with institutions, and the development of social networks. Moreover, the role of age at arrival in determining socialization will be impacted by meso-level factors, in particular families and schools, which may facilitate or impede exposure to the destination (Rumbaut 1994). Such exposure to destination can be measured in different ways, but as argued by many scholars, it is best summarized using age at migration. which determines duration of exposure at a given age (Milewski 2010a).

For childhood immigrants, age at migration can also be used to investigate the role of arrival at critical ages in the process of childhood development (Adserà and Tienda 2012). Critical ages are important, for example, because children who arrive after the onset of puberty may find it more difficult to adapt to life in their new destination (Bleakley and Chin 2010). Arrival after puberty makes partnership with someone who is native-born much less likely due to the difficulties of learning a new language (ibid.). Psychological research suggests that language acquisition becomes much more difficult after reaching a critical age (although there is some debate about this, see: Birdsong 2006). Moreover, it is also possible that the role of age at arrival is different for women and men.

Researchers do not appear to have compared the adaptation of immigrant fertility for women and men, but there are multiple reasons to expect sex differences, including the expectation that young boys may find it more difficult to adapt to living in a new destination if they arrive as teenagers (Portes and Rumbaut 2001; Rumbaut and Portes 2001). Research suggests that immigrant women are more likely than native-born women to be in a ‘male breadwinning’ and ‘female caregiving’ relationship (Chuang and Tamis-LeMonda 2013; Pedraza 1991). This does not necessarily imply a lack of agency with respect to female childbearing (Dasgupta 1998). Indeed, early and high fertility for some groups of women may represent ‘a deliberate and strategic choice’, which is not incompatible with other aspects of life such as work or education (Hampshire et al. 2012). Nevertheless, there are considerable grounds to propose differences between women and men, including differences with respect to opportunities and constraints, as well as differences with respect to the influence of parents, peers, and other social networks (Forste and Tienda 1996; Genereux 2007; Hampshire et al. 2012).

A CASE STUDY OF SWEDEN

Despite the potential advantages of studying the fertility of immigrants who arrived as children, only a few studies have tested the influence of age at migration on the fertility of childhood migrants, and none appear to have tested whether the role of age at arrival is different for women and men. One study of Canada has shown that differences between the birth rates of childhood migrants and the Canadian-born population are associated with age at migration (Adserà and Ferrer 2014). This finding aligns with the general findings of a comparative study of France, Canada, and the UK (using the same data for Canada: Adserà et al. 2012). It also aligns broadly with a more recent study of Sweden, which studies immigrants from origin countries with lower fertility (Mussino et al. 2021). However, none of these studies include male immigrants, none attempt to model selection into migration, and the previous study of Sweden excludes immigrants from origin countries with higher fertility. Given what we know about immigrant fertility adaptation, from these and other prior studies, the rest of this article seeks to address some of the main gaps in research with a quantitative case study of Sweden. It focuses on four research questions:

(1) Does age at arrival determine the childbearing of childhood immigrants?
(2) Is this relationship the same for female and male childhood immigrants?
(3) Is the relationship explained by common sources of selection?
(4) Is the relationship generalizable, in particular by country of birth?

These questions are answered with a comprehensive analysis of register data for the whole Swedish population. The data and methods are described in detail below, but in essence the study uses longitudinal data that links childhood conditions and migration background with information on childbearing from ages 15-45. It makes use of the combination of whole population data and Sweden's relatively large numbers of childhood immigrants who are aged 45 or older. This means that there are a large enough number of childhood immigrants to analyze individual ages of arrival, by sex, for different origin-country groups, including many individual countries of birth. It also makes use of parental identifiers in the data, which enables siblings to be linked and family fixed-effects models to be estimated. Taken together, this research design poses strict limits on the data that can be used, and consequently on the contexts that can be studied. In fact, Sweden is one of the few countries of the world for which such a case study can be carried out.

Although the case study focuses largely on the role of age at arrival for G1.5, it also compares them with immigrants who arrived in Sweden as adults (G1) and second-generation children of immigrants (G2). By comparing all three generations, in addition to focusing on variation within G1.5, this study generates new knowledge about the likely trajectory of long-run integration, beyond the first generation (Rumbaut and Portes 2001).

DATA AND METHODS

Sweden represents an ideal context for this case study, in particular thanks to the availability of high-quality longitudinal demographic data from its population registers. Data were obtained via the *Migrant Trajectories* collection of registers that is available for analysis by researchers at the Stockholm University Demography Unit (under ethical approval from the Swedish authorities). These data cover the population who were resident in Sweden from 1968-2017. Data are stored at Statistics Sweden (SCB) and accessed via SCB's micro-online access system (MONA). Members of the population enter the register when they are born, if they are born in Sweden, or when they receive a resident permit or register their immigration. Registration is required in order to live in Sweden, and coverage of the population is close to 100% because it is very difficult to live in Sweden without registering – e.g. it is impossible to access public services or hold a bank account. All members of the population have a unique person number, which is used to link individuals across different registers and is available in our data in an anonymized format.

Swedish population registers collect all demographic events, including the date of the event. Children can be linked to their parents using a register of personal identification numbers (as long as the parents have lived in Sweden, either now or at some point in the past). This enables us to estimate the entire childbearing history of all women living in Sweden with a high degree of accuracy, including for immigrants who arrived in Sweden as children (who are highly unlikely to have had any children prior to arrival) and the second generation, defined here as those born in Sweden with two foreign-born parents. The data include all recorded immigrations, emigrations and deaths, which enables us to calculate age at arrival for all immigrants, and to exclude people who emigrate or die prior to the time at which we measure their fertility.

Given that the data are longitudinal, this allows us to compare and contrast measures of fertility quantum – children ever born – at any age. The term 'quantum' can be defined generally as the frequency that an event occurs (e.g. number of births), and hence can be measured at any

age (Ryder 1980). Initially (in Figures 2 and 3), the analysis focuses on completed fertility (quantum at the end of childbearing), measured here at age 45 (after which age there are very few births to women or men, although slightly more for men). The analysis then examines quantum at age 30 (in Figures 4 and 5), before plotting quantum profiles at all ages from 15-45 (in Figure 6). These profiles compare the fertility of immigrants (by age) with the fertility of native-born women and men. Although this means that birth timing (tempo) is not measured directly, for example with reference to different birth parities, it can nevertheless be inferred by making comparisons across different childbearing ages, in particular when examining the entire profile of fertility quantum (or quantum differentials) from ages 15-45. To facilitate comparisons across fertility profiles, these are calculated using the same study population at each age. The population in each analysis therefore includes only those women who have reached the oldest age at which fertility is estimated (age 30 in Figures 4 and 5, and age 45 in Figures 2, 3 and 6), and who remained resident in Sweden until this age (thus excluding those who emigrate or die). For the analysis of fertility at (or up to) age 30, we therefore focus on women and men born from 1945-1986 (i.e. aged 45-71 in 2016). For age 45 it is those born from 1945-1971.

To the best efforts possible, the case study uses data for the whole population of these cohorts. A small number of cases (less than 1%) are dropped due to missing data on key variables, or because they were born in countries that were not identified. The origin composition of this population is shown in Figure 2. Some countries of birth are grouped in the data that are made available by Statistics Sweden. As such, we use the most detailed country of birth classification that is available.[5] These origins reflect Sweden's migration history, including its receipt of large numbers of refugees since the 1970's (Statistics Sweden 2016). For some analysis, we make use of data on residence permits in order to analyze children of refugees separately from the children of other immigrants (although sadly, permit data are only available for later arrival years). For the second generation, ancestral origin is based on mother's country of birth.

[5] In general, countries are grouped into standard regional groups, but we note that *'Former Yugoslavia (except Bosnia Herzegovina)'* includes Yugoslavia, Croatia, Macedonia, Montenegro, Serbia, Slovenia; *'Former Czechoslovakia'* includes Slovakia and the Czech Republic; *'Spain and Portugal'* includes Andorra and Gibraltar; *'China'* excludes Hong Kong; and *'Somalia'* includes Djibouti.

All analysis is stratified by sex, and the modelling of number of children ever born is carried out using Generalized Linear Models (GLMs) with a Poisson link function. The models take one of two forms, which can be summarized as follows:[6]

$$E\left(Y_{ij}\middle|\, X_{ij}\right) = BX_{ij} \qquad (1)$$

$$E\left(Y_{ij}\middle|\, \text{family } i, X_{ij}\right) = \alpha_i + B_w X_{ij} \qquad (2)$$

Models without family fixed-effects, based on equation (1), include covariates for birth cohort (in single years of age), country of birth (grouped as shown in Figure 2), and birth order (whether individuals are the first-born child, second-born, or 'third and higher'). Models based on equation (2) include family fixed-effects (based on having a shared parent), in order to control for many of the common sources of selection into migration. This includes all factors shared between siblings (of the same sex, since the models are stratified), including migration background (such as reasons for migration) and parental characteristics (such as parental education). Family fixed-effects models include only those siblings who arrived in the same year, such that they are also likely to have migrated for the same reason. These fixed effect models control for birth cohort and birth order (as in the models mentioned above). They do not include a variable for country of origin, but this is effectively controlled for given that they control for parental characteristics.

Childhood migrants are defined as foreign-born individuals who arrived in Sweden (for the first time) aged 0-18. The reference group in most analysis is those arriving at age 15, which is the age at which fertility researchers usually consider women and men to be at risk of childbearing. Nevertheless, most Figures present the results for those arriving at older ages (16-18) to place the findings in context. G2 is used as a comparison group, notably in the regression models. The inclusion of G2 in the family fixed effects models is particularly important because this allows the identification of age at arrival and birth cohort, which would otherwise be colinear (for further explanation and a simulation study, see: Wilson et al. 2021).

[6] Where Y_{ij} denotes the number of children ever born and X_{ij} denotes the explanatory variables for individual j within family i. One the left-hand side of the equations, $E\left(Y_{ij}\middle|\, X_{ij}\right)$ is the conditional mean of Y_{ij} given covariates X_{ij} and $E\left(Y_{ij}\middle|\, \text{family } i, X_{ij}\right)$ is the conditional mean of Y_{ij} given family fixed effect i and covariates X_{ij}. By conditioning on the family, models based on equation (2) control for all confounders that are shared between siblings, such that the model estimates the within-family effect, which refers to a different population than the effect in equation (1).

RESULTS

For the birth cohorts that we study up to age 45, the mean completed fertility (children ever born at age 45) for ancestral Swedes is 2.00 children for women and 1.80 for men. There is considerable variation in the completed fertility of foreign-born women and men living in Sweden (Figure 2), with some origin country groups lower and some higher than this average for ancestral Swedes (the mainstream norm).

Figure 2 sorts every country of birth (or country of birth group) by the completed fertility of G1 women. At the same time, it highlights those countries that have a completed fertility more than +/-10% different from the mainstream norm for women. Those who are 10% higher are considered to be higher fertility origins (here and in the analysis that follows), while those that are 10% lower are considered to be lower fertility origins. The advantage of this approach is that it classifies countries while taking account of selection among the G1. As such, even though most countries appear to be classified in line with the average fertility in their origin (for example when compared with Mussino et al. 2021), there are some exceptions. For example, the USA and Canada have similar levels of national female fertility as Sweden (Human Fertility Database 2021), but average completed fertility is clearly lower for female immigrants to Sweden from USA and Canada. This difference may be due to differential fertility before or after migration, as well as the selective migration of certain types of women, but interestingly it is not apparent for men.

Most origins exhibit similar patterns for women and men, but there are exceptions. Some origins would not be classified as having higher or lower fertility if the classification was based on men, for example China. Similarly, some would be re-classified as having lower (Iran) or higher (India, Nepal & Bhutan). The average completed fertility of immigrants who arrived as adults (G1) ranges from around 1.3 children for men who were born in Estonia to 4.6 children for women born in Somalia. For G1.5 the range is 1.1 for men from Korea to 3.2 for women born in other Middle Eastern countries (not otherwise specified).

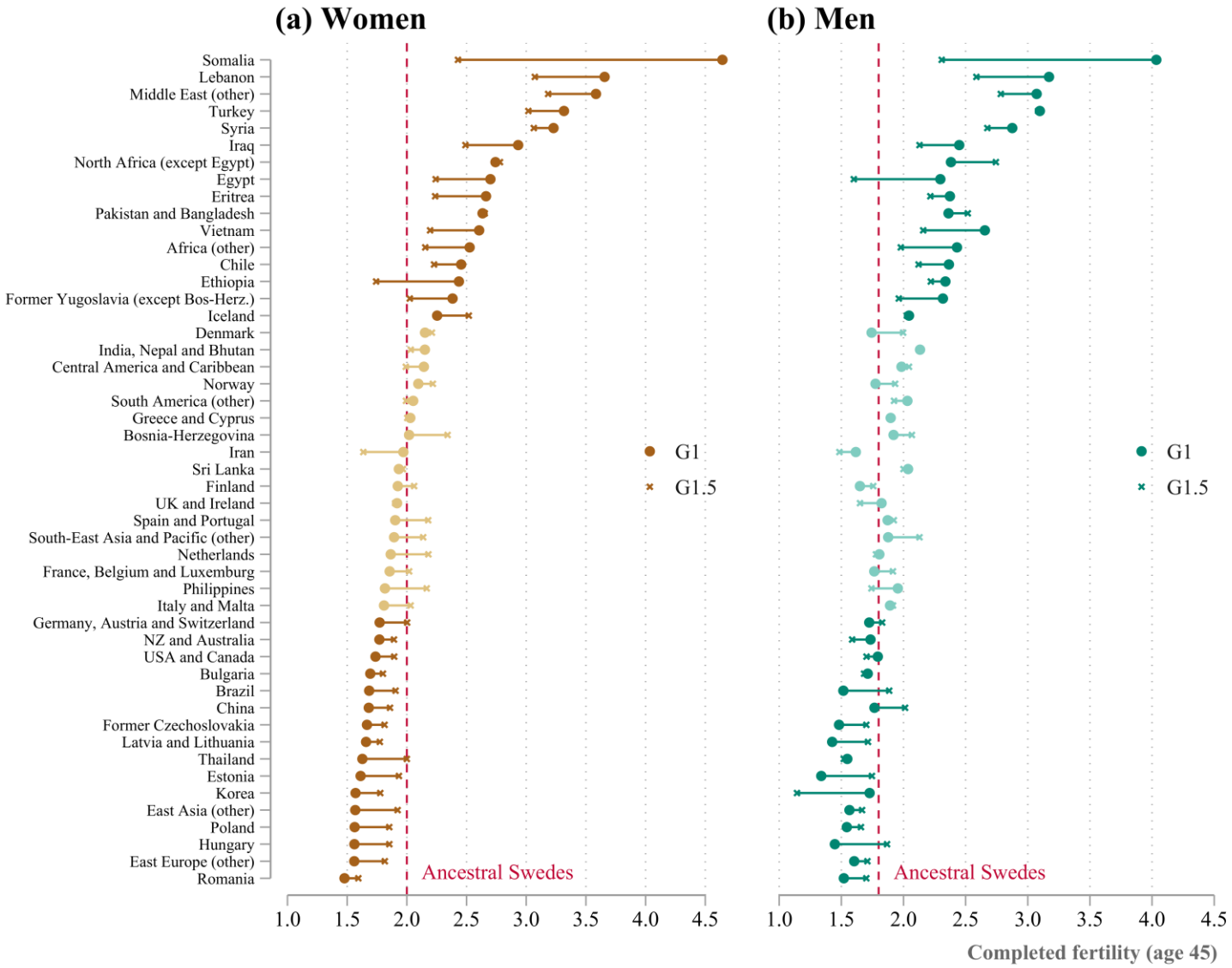


Figure 2: Completed fertility of immigrants who arrived as adults (G1) or as children (G1.5) by country of birth. Mean values of children ever born (CEB) at age 45 for the whole population born 1940-71 (who were alive and resident in Sweden at age 45). Countries of birth sorted by CEB for G1 women, and highlighted if CEB for G1 women is more than +/-10% different from mean for ancestral Swedes.

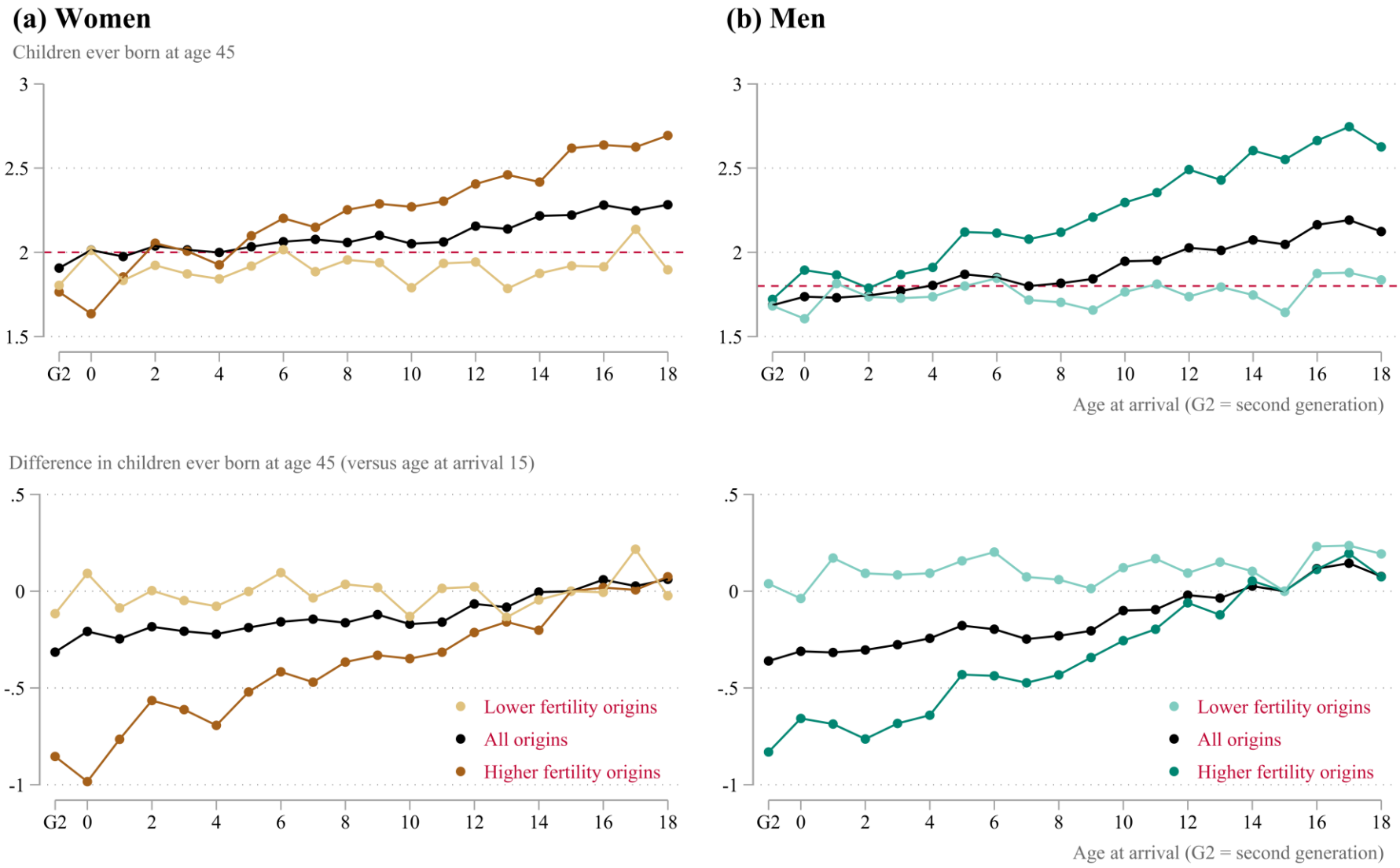


Figure 3: Completed fertility by age at arrival for immigrants who arrived as children (G1.5). The upper panels show mean values of children ever born (CEB) at age 45 for the population born 1940-71 (who were alive and resident in Sweden at age 45). The lower panels show the differences in CEB versus immigrants who arrived at age 15 (for each group of origins). As in Figure 2, lower fertility origins are countries of birth where CEB for G1 women is less than 90% of mean for ancestral Swedes, and higher fertility origins are those more than 110%. G2 are the second generation (Swedish-born with two foreign-born parents).

This article is focused on immigrant adaptation, but given the link between this and intergenerational adaptation, it is interesting to note the differences between G1 and G1.5. For origins with higher and lower fertility (i.e. those where G1 exhibit a difference from the mainstream norm), the completed fertility of G1.5 is more often closer to the mainstream norm, and this is the case for both women and men. Exceptions to this general pattern include Pakistan and Bangladesh, North Africa (except Egypt), Iran, Bosnia Herzegovina, Korea (for men), and Iceland (for women).

Age at arrival

Our first two research questions ask whether the fertility of childhood immigrants is determined by their age at arrival, and whether this differs for women and men. Figure 3 provides evidence that age at arrival is strongly associated with completed fertility, to a similar extent for women and men, but with a much stronger association for immigrants from higher fertility origins. Indeed, the results suggest that there is no material association for immigrants from lower fertility origins.

Strikingly, the gradient in completed fertility differentials is almost identical for women and men from higher fertility origins (see lower panels of Figure 3). As compared with those who arrive as teenagers, immigrants who arrive at pre-school ages have more than 0.5 fewer children (as do the second generation).

Quantum and tempo

Although the patterns that we observe in Figure 3 may be true for completed fertility, this may not be the case for other measures of childbearing, for example measures that indicate variation in the timing of births earlier in the life course. Moreover, the findings suggest that age at arrival is more important for higher fertility origins, but this may be partly due to many immigrants from these origins being refugees. Figure 4 therefore examines whether the age at arrival gradient that we observe for children ever born (CEB) at age 45 (i.e. completed fertility) is also observed for CEB at age 30. It does this for the children of refugees, as well as higher and lower fertility origins. One advantage of analyzing CEB at age 30 is that we can analyze younger cohorts (born 1972-1986) alongside the older cohorts (born 1940-71) that are analyzed in Figures 2 and 3. For the children of refugees it is only possible to analyze the younger cohorts because data on residence permits are only available for those arriving in later years.

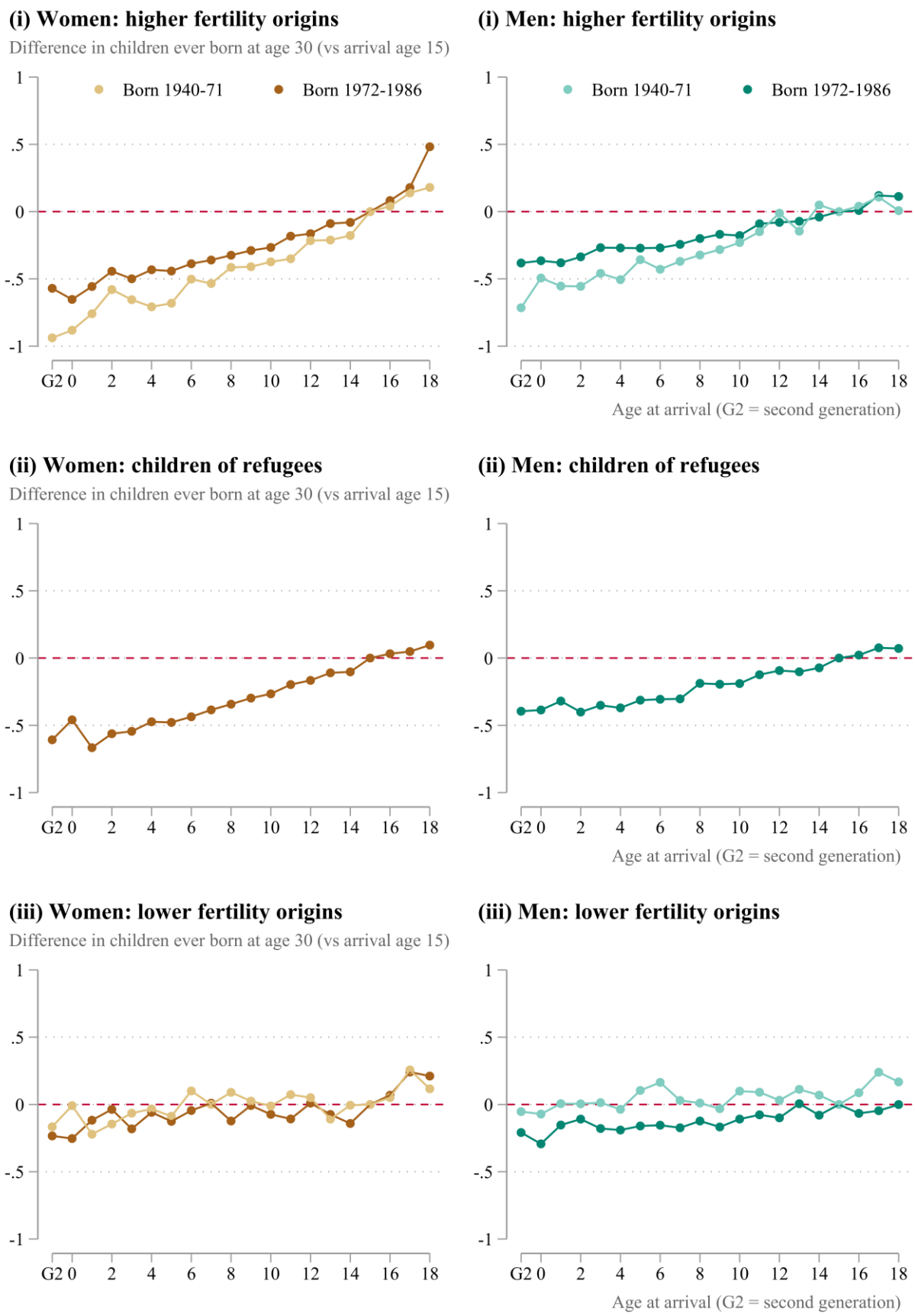


Figure 4: Children ever born (CEB) at age 30, compared with those who arrived at age 15. The panels show the differences in CEB versus immigrants who arrived at age 15 for each origin and cohort group (origins defined as in Figures 2 and 3). Children of refugees are identified based on their (and their parents') first residence permit.

In general, the patterns for CEB at age 30 are similar to those for CEB at age 45. This is true for women and men from both the younger and older cohorts. Four additional findings are worth noting. First, the results for children of refugees are very similar to the results for higher fertility origins (comparing those born 1972-1986). This suggests that refugee status may play a role in explaining the age at arrival gradient, which is also noteworthy because refugee origins are not exclusively those from the higher fertility origins (for example Iran and Bosnia Herzegovina). Second, it is notable that there are differences between birth cohorts in the age at arrival gradient. For higher fertility origins, the gradient appears to be weaker for younger cohorts, whereas the opposite is true for lower fertility origins, such that some systematic differences by age at arrival are apparent for younger cohorts (which does not appear to be the case for older cohorts either in Figures 3 or 4). Third, the differences in the age at arrival gradient between women and men are not sizeable. For higher fertility origins and children of refugees, the gradient for men appears to be slightly shallower (implying a slightly weaker association), whereas the opposite appears to be the case for lower fertility origins. Fourth, and perhaps most interesting of all, the differentials in Figure 4 are very large, including when compared with those observed for completed fertility (in Figure 3). This implies that much of the impact of age at arrival on fertility is occurring prior to age 30.

Controlling for selection

A potential challenge to the findings discussed above is whether they are explained (confounded) by common sources of selection (i.e. factors that jointly determine age at arrival and fertility, rather than age at arrival itself). One way to examine this, and answer our third research question, is to estimate the two sets of models shown in Figure 5: (a) with controls for country of birth, year of birth, and birth order, and (b) with controls for year of birth, birth order, and family fixed effects. The inclusion of family fixed-effects is particularly useful because this controls for factors shared between siblings, including migration background (e.g. reason for migration, year of arrival, and parental country of birth) and other parental characteristics (e.g. parental education and employment). This enables the analysis to include all origin groups – and hence be more generalizable – while also accounting for many different forms of selection prior to arrival. Given the magnitude of the findings for CEB at age 30, models are estimated at this age (separately by sex and birth cohort), and are therefore broadly comparable with the analysis in Figure 4.

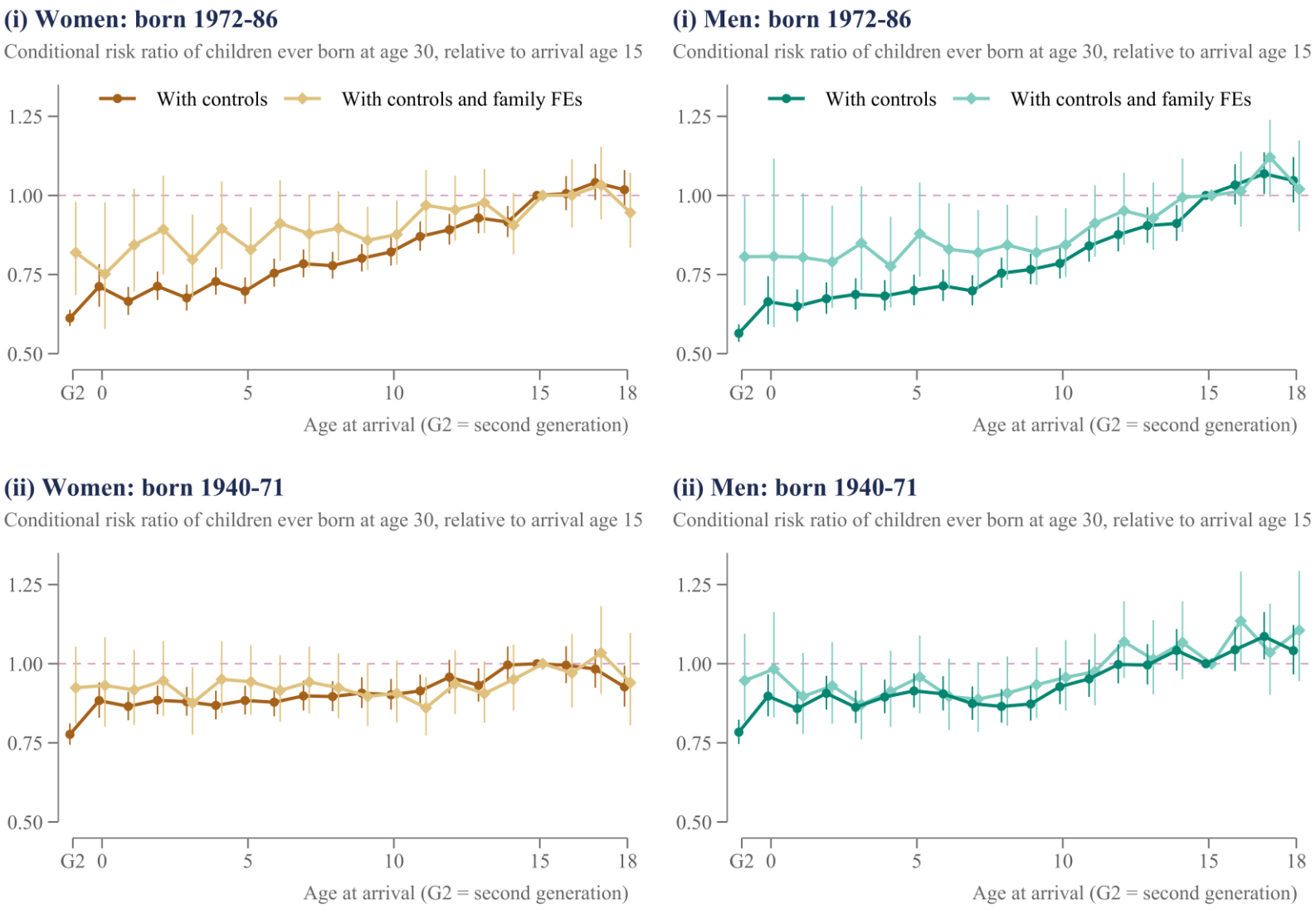


Figure 5: Conditional risk of children ever born (CEB) at age 30, relative to those who arrived at age 15. Each panel plots coefficients from models of CEB at age 30: (a) with controls for country of birth, year of birth, and birth order, (b) year of birth, birth order, and family fixed effects. Upper panels are for the population (alive and resident in Sweden at age 30) who were born 1972-86. Lower panels are for those born 1940-71. G2 are the second generation.

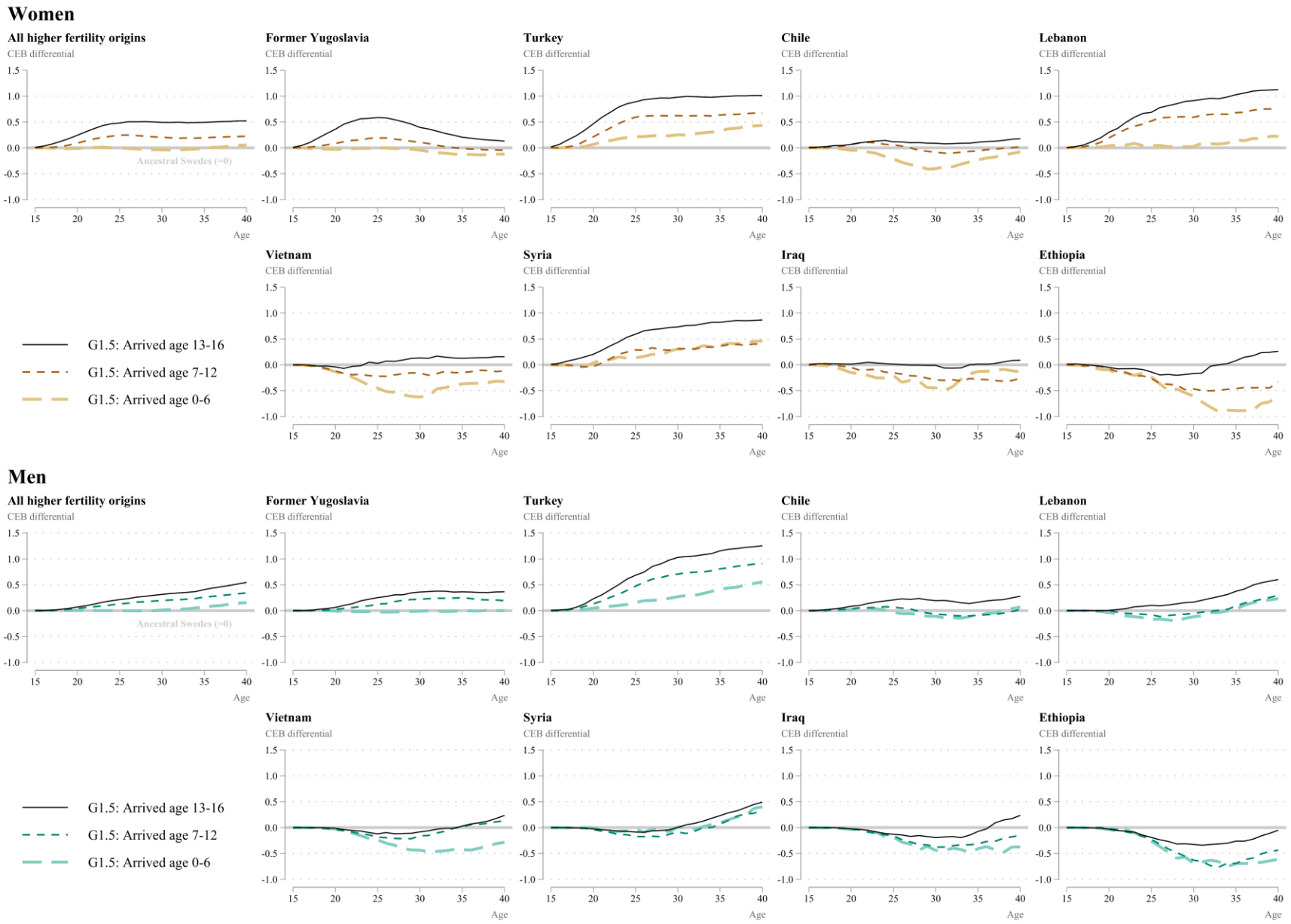


Figure 6: The difference in children ever born (CEB) at each age (15-40), relative to ancestral Swedes. Each panel plots the difference for those arriving at age 0-6, 7-12 and 13-16. Origin-specific plots are for the eight largest individual countries of birth that have higher fertility (see main text for more information).

Broadly speaking, the results in Figure 5 show that at least some impact of age at arrival is persistent after controlling for different forms of selection. As in previous figures, the reference group is those arriving at age 15. Compared with these immigrants who arrive as teenagers, the relative risks of CEB at age 30 are lower for those arriving at earlier ages, especially for younger cohorts. As is to be expected, the age at arrival gradient attenuates somewhat after the inclusion of family fixed effects (which also changes the estimate itself), and the confidence intervals increase in size. However, the role of age at arrival in determining fertility remains clear, for women and men, even if only clearly evident for the younger cohorts (the top panels of Figure 5). In drawing this conclusion, it may be important to note that the confidence intervals are based on data for almost the whole population.

Specific countries of birth

The final research question that this article sets out to explore is the extent to which the relationship between age at arrival and fertility is generalizable, in particular for different countries of birth. The averages in Figures 3-5 may well mask variation between origins (such as those shown in Figure 2). Moreover, such variation by origin is hard to examine in absence of highly detailed data. Figure 6 therefore makes use of the Swedish data to not only illustrate the role of age at arrival for the eight largest individual countries of birth that have higher fertility, but also to examine profiles of childbearing across almost all of the childbearing life course. Profiles show the average difference in number of children born, at a given age, between ancestral Swedes and members of the G1.5 who arrived in one of three age groups: 0-6, 7-12, 13-16.

For all eight countries of birth, there is evidence that age at arrival and fertility are interlinked across the life course, with differentials starting to manifest very early in childbearing, sometimes even before age 20 (e.g. for Turkey). However, one of the most obvious findings is that the role of age at arrival is not consistent across origins or across fertility profiles, especially when considering the interaction between the two (origins and profiles). For example, the plots show that by their mid-20's, women from Former Yugoslavia who arrived at older ages (13-18) had given birth to around 0.5 more children on average than ancestral Swedes, whereas this differential has become much smaller by age 45. This is very different from the patterns for women from Lebanon, which show a gradually increasing differential by age. In both cases, age at arrival plays a role in determining fertility, but the impacts upon quantum and tempo are very different. The results for men are not dissimilar from those for women, and for some origins (e.g. Turkey) they are very similar. Perhaps the clearest

differences between women and men are that differentials for men do not begin to manifest until slightly older ages (e.g. Former Yugoslavia), and that differentials are more often smaller in magnitude for men (e.g. Lebanon).

DISCUSSION

This article set out to achieve two broad goals. The first was to develop a theoretical background that better integrates the life course process of childbearing within a theory of adaptation. The second was to carry out an empirical case study of Sweden that seeks to address some of the most prominent unknowns relating to immigrant fertility adaptation.

With respect to addressing the first goal, the article generated a conceptual framework that builds upon prior research. In doing so, several conceptual challenges were highlighted. Immigrant fertility is likely to be determined by an interaction between three spheres – origin, migration and destination – and most of the prominent explanations for immigrant fertility can be located within or across these three spheres. A key challenge therefore, when attempting to establish whether the adaptation of immigrant fertility occurs (or not), must be to account for competing explanations. Patterns of immigrant fertility that look like adaptation may be the result of determinants prior to arrival in the destination, in particular factors relating to selection. Moreover, the conceptual framework established how and why it is extremely difficult to draw reliable conclusions about the adaptation of immigrant fertility when studying only immigrants who migrated as adults.

Having obtained greater conceptual clarity and established prominent gaps in knowledge, the article then carried out a case study of Sweden. This case study extends previous empirical by combining dynamic analysis of changes in adaptation over the childbearing life course with tests of childhood socialization, one of the main mechanisms of adaptation. It did this by examining the role of age at arrival for immigrants who arrive as children, with analysis that avoids common sources of selection bias, analysis of specific origin groups, and detailed comparisons of women and men.

In answer to four research questions, the case study generated four main findings. First, it found that age at arrival does determine the childbearing of childhood immigrants. Second, it found that the relationship between age at arrival and childbearing is similar for women and men. Third, it found that this relationship was not explained by common sources of selection, (or at least not to any great extent for factors that are shared between families who migrate at the same time). Fourth, it found that the link between age at arrival and fertility appears to be

common across many countries of origin, but that the precise nature of the relationship was very heterogeneous, in particular when considering the interaction between origin, sex, and age (i.e. stage of the life course).

In summary, the results of this study suggest that age at arrival has a strong and incremental impact on childbearing, for both women and men, in particular for immigrants from higher fertility origins and for the children of refugees. With respect to theoretical implications, this can be taken as evidence in support of an underlying process of childhood socialization, followed by adaptation, that is common for women and men who migrate. Indeed, it may be that the impact of childhood socialization is underestimated in this study, at least when using sex-specific family fixed-effects models. This is because these models control for aspects of childhood socialization that are shared between siblings of the same sex.

The fact that the impact of age at arrival appears to be stronger in general at earlier childbearing ages highlights the importance of taking a life course perspective when analyzing adaptation. Indeed, one implication of this study is that it highlights the importance of 'time' (and different measures of time) in determining adaptation. This is highlighted in the conceptualization of immigrant fertility adaptation (Figure 1), where time is a pivotal concept for adaptation. It is an integral component of the stages of adaptation, and is a potential obstacle to its study with respect to the 'timing' of events, for example whether migration occurs before or after the end of childhood. Another important aspect of time, as evidenced in the empirical results, is cohort. Findings often differed by birth cohort, which may in fact be driven as much by year of arrival as year of birth (because the two are collinear given the same age at arrival). Finally, with respect to time, it is interesting to note that there was little evidence in support of critical ages at arrival. Despite this, there are clear implications that the sociology of migration may benefit from a more rigorous consideration of the role of time, and process, in determining adaptation. This is not only true for research on adaptation over the life course, but also for research on intergenerational adaptation, where conclusions about fertility adaptation can depend on whether generations are lagged over time (Parrado and Morgan 2008). Future research on fertility adaptation may therefore benefit from a more thorough conceptualization of the role of temporal processes, not only for theory but also for empirical research design.

This case study has several limitations, including that fertility is estimated based on children resident in Sweden. This is unlikely to impact the results for G1.5 and G2, but the estimates for G1 may be biased slightly (downward). This is unlikely to impact the

classification of origins to any great extent, but it may have some impact on the comparisons between G1 and G1.5 in Figure 2. Despite the fact that the Swedish data are highly detailed, the study was also limited in its ability to examine factors that measure selectivity and characteristics prior to migration. The family fixed-effects may control for many of these, but this modelling strategy does not enable such factors to be examined. A further limitation is that the findings relate only to Sweden, which may be seen by some as atypical, or at least different from other contexts. It is possible to argue that Sweden provides more comprehensive support for newly arrived immigrants than most other countries (OECD 2016a, 2016b), which in turn may counteract the impacts of age at arrival on adaptation (of fertility or other outcomes). That said, this does not negate the need for research that seeks to replicate this study in other contexts.

A broad aim of this study was to better integrate the study of childbearing – a core focus of family sociology – with the sociology of migration, partly to enable research on immigrant fertility to be better understood by sociologists who do not study the topic. We hope that this aim has been achieved. Clearly, however, this is only an incremental part of a broader endeavor. Clearly, age at arrival appears to determine the childbearing of immigrants who arrive as children, just as it appears to determine many of their other outcomes, such as education, employment, occupation, language acquisition, marriage, mortality and segregation (Åslund et al. 2015; Bleakley and Chin 2010; Böhlmark 2008; Hermansen 2017; Kilpi-Jakonen and Heath 2012; Mehta et al. 2019; van den Berg et al. 2014). However, this suggests the need for research to better understand how different domains of adaptation are interlinked. On the one hand, this might be achieved by studies that generate deeper insights about the mechanisms of adaptation, including to examine the factors – in other domains (outside fertility) – that mediate the role of age at arrival on fertility. On the other hand, it also suggests the need for more research that uses a multi-outcome or multi-process framework to study adaptation. Indeed, these approaches are not mutually exclusive, but it is only via such developments that the role of age at arrival, and the role of childbearing, in determining the lives of immigrants and their descendants can be more fully understood.

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