Family Formation and Dissolution in the Context of Dramatic Labour Market Changes Caused by Automation: Evidence from Germany, Sweden and the US

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Short abstract

Recent decades have seen rapid robotization in manufacturing and other automatable sectors. These developments, termed routine-biased technical change, have led to polarization in labor markets. While the highly educated enjoy good employment conditions, the earning and employment opportunities of the other social groups have substantially shrunk, both in the US and Europe. These changes may also affect workers' family-related behaviors as they substantially change the conditions for earning income. We test this hypothesis by investigating how exposure to automation affects the formation of first marriages by workers, their childbearing behaviors, and marriage stability in three countries: Germany, the US, and Sweden. These countries belong to the most heavily automated economies in the world. Yet, they strongly differ in labor market and welfare policies. In contrast to previous studies on the topic, which relied on aggregated data at the regional level, we make use of individual data from high-quality Swedish registers and panel surveys: the German Socioeconomic Panel and the Panel Study of Income Dynamics. We link these data with the annual information on robot use by country and industry from the International Federation of Robotics. Our preliminary findings for Sweden suggest that exposure to automation affects workers' family-related behaviors differently depending on their education level. Robotization has the most detrimental effect on family formation and its stability for low-educated male and medium-educated female workers. Instead, an increase in exposure to automation leads to an increase in marriage and birth risks and a decline in divorce risks among the highly educated.

Extended abstract

Technological progress has changed what work is conducted, how it is conducted, and who gets to conduct it. Technology increasingly replaces labor intense in automatable routine tasks, leading to a decline in the demand for low and medium-skilled workers. At the same time, demand increases for highly skilled labor to conduct non-routine tasks that are not easily automatable (see Acemoglu and Autor, 2011 for the US; Hardy et al., 2018 for the EU). These developments, termed skill-biased and later routine-biased technical change (Autor et al., 1999, Autor et al., 2006), have led to polarization in labor markets. While the highly educated enjoy good employment conditions, the earning prospects and employment opportunities of the other social groups have substantially shrunk, both in the US (Acemoglu and Restrepo, 2020) and Europe (Autor and Salomons, 2018, Bachman et al., 2022).

Structural change in the labor market does not only influence employment opportunities but may also affect workers' fertility behaviours as it substantially changes the conditions for earning income and combining paid work with family life. As traditional low- and middle-skilled jobs in manufacturing disappear in the process of robotization, individuals affected by these changes may postpone or even forego childbearing and may face more difficulties in forming stable unions (Seltzer 2019). In this study, we address these issues by looking into how workers' exposure to these developments, namely automation, affects family formation and its stability in three countries: Germany, US and Sweden.

Past research has indeed demonstrated that unstable economic conditions, including high unemployment and economic uncertainty lead to lower birth risks and higher divorce rates, especially among men (Schneider and Hastings 2015, Alderotti et al 2021). These studies largely concentrated on unemployment and joblessness which are cyclical phenomena. Individuals may indeed postpone childbearing during an economic slowdown, when they experience higher risk of unemployment, and recuperate fertility when the economic situation is better. Structural labour market change is not a cyclical phenomenon, however. It has an enduring character as it changes the structure of the demand for labour permanently, by reducing the demand for certain job tasks (which can be performed by robots) and increasing the demand for other job tasks (e.g. services which cannot be easily replaced by technology as well as jobs in the IT sector or engineering). Furthermore, it does not affect all workers equally. While economic recession usually leads to a decline in the labour demand in general, the structural labour market change has been shown to lead to shifts in the structure of demand from certain job tasks and occupations to others, leading to an increase in the inequalities between certain groups of workers (Autor et al 2006, Goos et al 2014). Finally, exposure to automation does not necessarily mean one is unemployed or in an unstable work contract. It rather means that one is exposed to deterioration in employment conditions which can be a job loss, stagnation in wages or lack of other / better employment opportunities. Meanwhile, demographic research has so far largely concentrated on looking at unemployment or temporary unstable employment and its effects on fertility. Such an approach does not allow capturing the fact that some workers (i.e. those exposed to automation) may face deteriorating working conditions even if they are in permanent employment.

We are not the first who propose to examine the role of the exposure to automation for family formation. Past studies were, however, largely used the regional level data and such a regional analysis may lead to bias findings due to the risk of the ecological fallacy (Freedman 1999). F Anelli et al (2021) exploited variation in robot exposure across community zones in the US and found that an increase in the adoption of robots led to a rise in divorce and cohabitation, declines in marital fertility, and increases in non-marital births. Matysiak et al (2023) conducted a similar study using data from NUTS-2 regions in six European countries. They found that the effects of robotization on fertility are rather weak and are mostly present in regions with lower education levels and larger manufacturing sectors. Nonetheless, the regional-level approach of these studies requires strong assumptions such as that an increase in robot adoption in a certain sector and region affects fertility decisions of individuals living in this region or that the impact of robotization is constant across occupations within industries. The latter is discordant with the argument about routine-based technical change, which predicts that the effects of robotization are highly stratified.

In this study, we address these challenges by using individual-level longitudinal data for three countries: the high-quality register data from Sweden and data from panel surveys for Germany and the US: the German Socioeconomic Panel (GSOEP) and the Panel Study of Income Dynamics (PSID). All three countries represent some of the most heavily automated economies in the world. Yet, they strongly differ in labour market policies and welfare regimes. In particular, employment is least protected in the US where workers are also least likely to receive unemployment support after they lose a job (Schroeder 2013). The three countries have also displayed different patterns of fertility over the past decades. Germany experienced a largely stagnant low fertility which started to increase in the aftermath of the Great Recession. United States display relatively high fertility, around 2 children per woman, but has been experiencing fertility since the beginning of the Great Recession. Finally, Sweden experienced a decline in the 1990s, then a strong growth up until 2010 followed by another decline in 2010s, particularly pronounced among workers with weaker labour market positions (Comolli et al., 2020; Ohlsson-Wijk and Andersson, 2022; International Federation of Robotics, 2012, 2020). We use these three cases to analyse whether and how automation contributed to these patterns.

We use individual-level data of all working age men and women, domiciled in the given country, for years 1993 to 2017 with yearly information on childbirth, marital status and employment (including information on employment sector, which we call shortly industry). We also use annual data from the International Federation of Robotics (IFR) on the yearly number of robot-units in use (operational stock of robots) across 39 industries in the three analysed countries (Sweden, Germany and the US) across this time period. Using the IFR data we construct a year- and industry-specific measure of exposure to robotization which we link to individuals' employment histories from the registers and panel surveys respectively.

Our measure of the exposure to robotization is defined as the change in the robot-to-employee ratio within a sector across time (Equation 1). It corresponds to the Adjusted Penetration of Robots (APR) proposed by Acemoglu and Restrepo (2020). To account for the yearly change in sector employment, we calculate the change in robots between a given year and the baseline of 1993 and divide this by the number of sector employees in 1993, where i is the sector, t is the year and M is the operational stock and L is the number of employees. Finally, we adjust the values with sector-level output growth from EU KLEMS data, by deducting the robot growth that would be consistent with an adjustment of robot numbers due to the general sectoral growth, where g is the output growth between 1993 and a given year. This approach follows Acemoglu and Restrepo (2020):

$$APR = \frac{M_{i,t} - M_{i,1993}}{L_{i,1993}} - g_{i,(1993,t)} \frac{M_{i,1993}}{L_{i,1993}} \qquad \text{(Eq. 1)}$$

The measure is subsequently standardized to the mean of 0 and standard deviation of 1. This simplification allows to more easily interpret the findings as the measured associations reflect a one standard deviation change in the exposure to robots in a given sector.

Our dependent variables are the transition to the first, second and third parity progressions measured at conception (right censored at age 45), and first marriage and divorce. We apply three approaches to the estimations. First, we estimate the hazard $h_0(t)$ of each of these events in piece-wise constant models (Equation 2), separately for men and women. We control for age and age squared, calendar year, education levels, employment status (whether one works, and whether one works in a sector with any robotization), firm size and job tenure. Second, we expect robotization to differently affect lower and higher-educated workers, which we can account for owing to the individual-level nature of our data. We thus estimate models where robot exposure is interacted with different levels of education. Third, to confirm that the studied relationships are causal in nature and do not stem from omitted country-level changes we instrument sector-level robotization with that experienced by sectors in other countries (e.g. we instrument exposure to automation in Sweden by using data on robots stocks from Finland). This allows us to control for the possibility that the third uneobserved factors (such as country- or sector-specific shocks) affect automation and family-related behaviours in parallel.

$$h(t|X) = h_0(t) \times \exp\left(\beta_{Qapr}\right) \qquad \text{(Eq. 2)}$$

For the moment, we have obtained our findings for Sweden (the analyses for Germany and the US will be completed by the time of the conference). Our results show that robotization had a mostly detrimental effect on family formation and its stability of low educated male workers and medium educated female workers. Instead, an increase in the exposure to automation leads to an increase in marriage and birth risks and a decline in divorce risks among the highly educated (see Fig 1 and 2). Such findings are obtained from the models in which we use robot stocks for Sweden, but they are very consistent with the findings from models in which we instrument robotization using data on robot stocks from Finland. In the paper (to be ready by June 2024), we will also discuss the results for Germany and the USA, focusing on the factors that might explain the differing trajectories and role of robotization.

Fig. 1. Relative risks of experiencing the event due to an increase in the exposure to automation by one standard deviation, Sweden 1993-2017

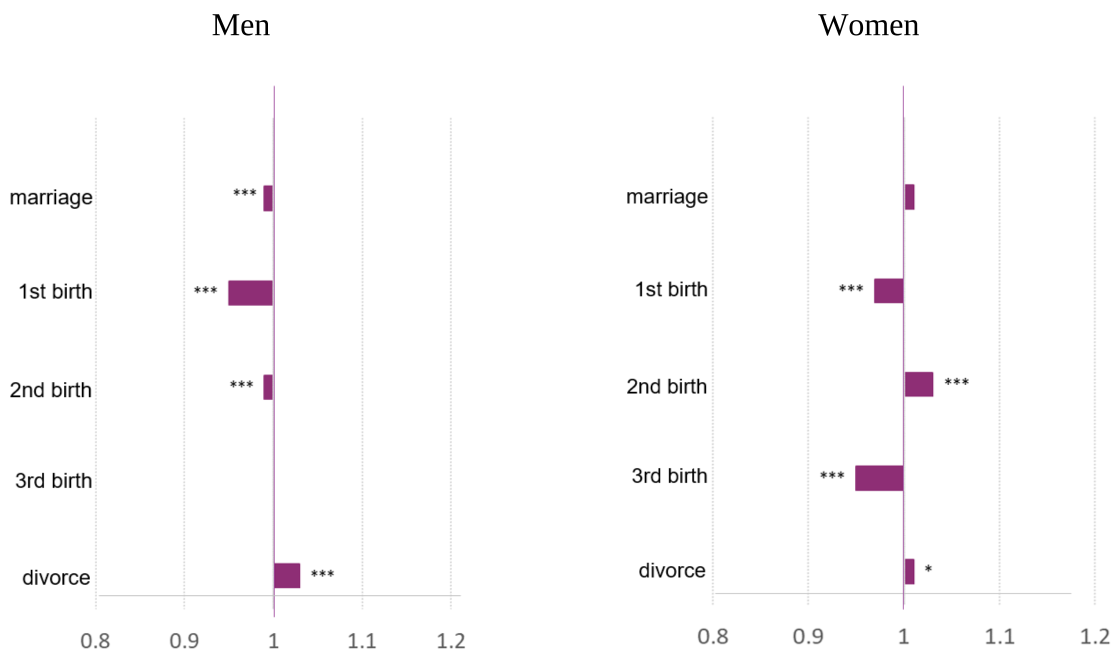
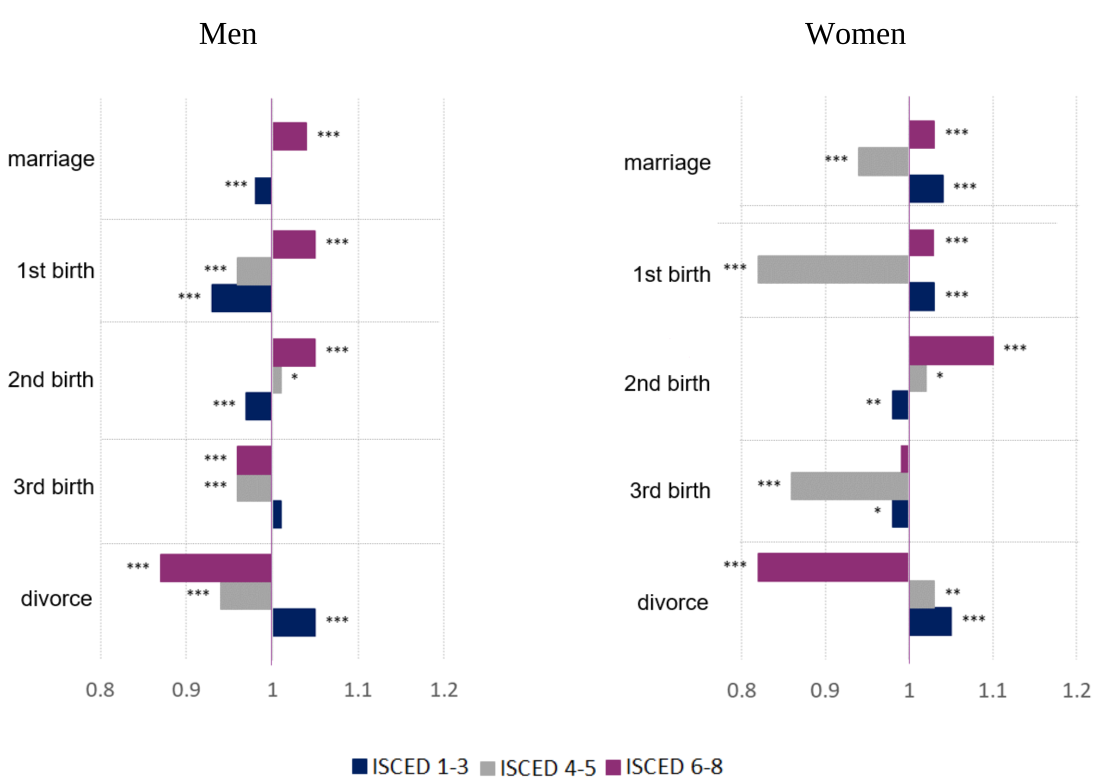


Fig. 2. Relative risks of experiencing the event due to an increase in the exposure to automation by one standard deviation within educational groups, Sweden 1993-2017



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