

On the Relationship between Fertility, Development and Gender Equality: A Comparison of Western and MENA Countries

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Abstract: The changing macro-level relationship between fertility and development (i.e., the standard of living, health and education) from negative to positive for the most advanced economies has received considerable attention recently. Using aggregate data, we compare the relationship between fertility and development in Western countries with the Middle East and North Africa (MENA) region, where fertility rates are higher than in other regions with identical levels of development. To understand the drivers of this association, we further link fertility to the components of development as well as female labour force participation separately. Our findings show that fertility and development were positively associated for only a short period in Western countries and that the relationship turned negative again in recent years. Recent data also show that there is no significant relationship between fertility and development in MENA countries. These findings indicate that the well-acknowledged theories of fertility and development do not apply in every context.

Keywords: Fertility · Human Development Index · MENA region

1 Introduction

Seminal demographic literature, such as on the first and second demographic transition theories, have postulated a negative relationship between fertility and development (*Kirk* 1996; *Lesthaeghe* 2010). To explain this negative association between fertility and development, mechanisms such as declining mortality and increasing child survival (*Notestein* 1945), investment in the quality rather than quantity of children and opportunity costs of motherhood in conflict with female employment (*Becker* 1960) have been proposed.

One recognized mechanism used to explain the fertility-development nexus is gender equality, which has been highlighted as a necessary condition for “the transition from very high fertility to fertility around replacement level” (*McDonald* 2000b: 432). More recently, however, new theoretical considerations suggest that

the established negative correlation between fertility and development has turned positive for the most advanced economies (*Anderson/Kohler* 2015; *Goldscheider et al.* 2015). Rising levels of gender equality with development are emphasized as the potential driver of the emerging positive association between fertility and development (*Esping-Andersen/Billari* 2015; *McDonald* 2000a/b). This is empirically supported by *Myrskylä et al.* (2009), who, in their study published in *Nature*, found that the relationship between the Human Development Index (HDI) and total fertility rate (TFR) reverses from negative to positive at advanced HDI levels. Although these findings are consistent with theoretical expectations suggesting a reversal of the relationship between fertility and development from negative to positive due to advanced levels of gender equality, it remains unclear whether the observed association is actually driven by gender equality or other factors, including progress in living standards, education and health.

Moreover, these theories and empirical assessments have focused mainly on Western countries (e.g., *Anderson/Kohler* 2015; *Fox et al.* 2019; *Luci-Greulich/Thévenon* 2014; *Myrskylä et al.* 2009, 2011). Yet the evolutionary process of social change can be modified by cultural and institutional context and is not the same across all societies (*McDonald* 1994; *McNicoll* 1980). Countries of the Middle East and North Africa (MENA), for instance, showed considerable improvements in economic standard of living, education and health, which comprise the three main indicators of development. Despite the development progress, the region falls considerably short of indicators of gender equality such as women's labour force participation and political empowerment (*World Bank* 2004), contrary to theoretical expectations and empirical evidence for other countries (*Forsythe et al.* 2000; *Inglehart/Norris* 2003). According to the *World Economic Forum* (2017), the MENA region globally ranks last in terms of gender equality with an average remaining gender gap of 40 percent. At the same time, the demographic patterns suggested by the demographic transition theory are not followed by all countries and some countries such as Algeria, Egypt and Lebanon have actually experienced an increase in fertility rates in recent years (*Engelhardt et al.* 2018), although these countries have made significant progress toward development. Moreover, evidence indicates that MENA countries have higher fertility rates than would be the case in other countries at identical levels of development and the fertility-development link is weaker in MENA countries (*Tabutin/Schoumaker* 2005). This asserts that fertility and development trends in the MENA region may be different from Western countries and what established theories suggest.

In this study, we examine how the fertility-development relationship has evolved over time in MENA countries and compare it to the relationships in Western countries. We also separately assess how the three components – living standards, education and health – of development, as well as female labour force participation¹ as an indicator of gender equality are related to fertility in these two contexts to test

¹ Similar to the previous studies (e.g., *Luci-Greulich/Thévenon* (2014), female labour force participation has been used as an indicator of gender equality in our analyses.

the relevance of each component of development as well as gender equality. Our study contributes to the literature in two regards.

First, we test the importance of development for fertility in two contexts with substantially different levels and progress in gender equality and fertility: MENA countries with the lowest levels of gender equality and relatively high levels of development and Western countries with advanced levels of gender equality and development. Given the relevance of gender equality to the fertility-development nexus as suggested by theoretical arguments (*Anderson/Kohler 2015; Esping-Andersen/Billari 2015; Goldscheider et al. 2015; McDonald 2000b*), these two contexts might have different fertility-development patterns. We test this by comparing how the correlation between fertility and development differs between Western and MENA countries.

Second, we revisit the relationship between fertility and development in advanced economies. *Harttgen and Vollmer (2014)* showed that the reversal in the TFR-HDI relationship found by *Myrskylä et al. (2009)* is not robust for the UNDP revision of the HDI calculation method. Using more recent data, we test whether a reversal from negative to positive exists between TFR and HDI.

We combine Human Development Index datasets (HDI; *UNDP 2019*), which contain information on various development indicators with datasets from the World Development Indicators (WDI; *World Bank 2018*), which contain annual information on fertility. We first estimate the time-series association between fertility and development (or its components and female labour force participation) while controlling for country-specific fixed effects. Second, we apply the difference-in-differences strategy of *Myrskylä et al. (2009)* to examine the overall relationship between fertility and development.

2 Fertility, Development and Gender Equality

Western countries

In the historical decline in fertility, the key pre-transitional factor was mortality, especially infant mortality (*Davis 1945; Mason 1997*). Western countries have achieved remarkable reductions in mortality rates with rising incomes, urbanization and industrialization. For instance, evidence from four European countries shows that whilst infant mortality rates ranged from 100 deaths per 1,000 live births in the late 19th century, by the 1950s they ranged from 20 to 50 deaths per 1,000 live births (*Corsini/Viazzo 1993*). Subsequently, the decline in mortality led to a shift from a high to a low fertility regime between the late 19th to the early 20th century. Over the course of the demographic transition, Europe's distinct past characterized by Malthusian cycles that emphasize a positive fertility-economic growth link started breaking down with the exception of the baby boom as a period when development was accompanied by a rise in fertility (*Caldwell 1982; Guinnane 2011*). Recent research, indeed, has empirically confirmed the importance of childhood

survivorship in childbearing decisions (*Reher et al.* 2017). Mortality has not only influenced childbearing decisions, but also the timing and prevalence of marriage.

Although “truly modern demographic behaviour could not begin before childhood mortality declined to insignificant levels” (*Reher* 2021: 4), mortality alone does not explain the shift from very high to very low fertility rates. Many other factors, such as the gender revolution (*Goldin* 2006), the interaction between women’s labour force participation and the lack of institutional adjustment, cultural and ideological innovations that led to greater behavioural freedom (*Lesthaeghe* 1983) and more individualistic attitudes (*Van De Kaa* 1987), have attracted the attention of scholars.

In the 20-30 years that followed the end of the baby boom, Western countries experienced rapid social and cultural changes. The trend converged in most advanced countries, albeit with visible differences in timing, tempo and degree accompanied by rapid economic growth. For instance, the shift away from the male breadwinner model had begun in the 1960s and accelerated in the 1970s in Scandinavia and North America, whereas similar transitions in countries like West Germany and Spain occurred with a delay of one or two decades (*Esping-Andersen* 2009). *Reher* (2021) emphasized the historical baggage of societies that drives these differences. The key determinants of historical baggage were the relative importance of the individual, family and religion in society (*Derosas/van Poppel* 2006; *Inglehart/Baker* 2000; *Reher* 1998).

These progressive tendencies clashed with norms shaped by the regime of male breadwinner/female housewife. Neither the status nor the bargaining power of women increased at the same pace, despite their non-negligible involvement in the economy (*Goldin* 1990). Consequently, a conflict arose between individual-oriented social institutions with a high degree of gender equality and family-oriented social institutions with persistent gender inequality, resulting in very low fertility among Western countries (*McDonald* 2000a/b). Having children and starting a family was associated with child-rearing, domestic work and male breadwinner roles. This in turn was perceived as a barrier to women’s careers. The marketable skills of men and women began to converge as women became more involved in the economy. As a result, the cost of childbearing for women increased substantially, which reduced the returns of marriage (*Becker* 1974). Subsequently, new ways of living together such as cohabitation started emerging, whereas partnerships became less stable and fertility declined (*Lesthaeghe* 2010).

Rising levels of development and gender equality were paralleled by fertility decreases in societies with high levels of gender inequality. Most Western countries had low fertility rates at the end of the 20th century with some exceptions such as France where fertility rates remained relatively high, despite low levels of gender inequality (*Population Reference Bureau* 2007). Yet *Rindfuss* and *Brewster* (1996) argued that changes in the social organization of work and childcare arrangements would alter these trends and that easing women’s conflicts in balancing work and family life courses would lead to an increase in fertility. Similarly, *McDonald* (2000b) pointed to a reversal of the macro relationship between fertility and gender equality in the long run. He argued that institutions would develop reforms that support rising fertility at advanced levels of gender equality. This is more recently supported

by *Esping-Andersen* and *Billari* (2015) who suggested that the declines in fertility with the increasing number of women involved in the economy would be reversed as societies approach gender egalitarianism. Increasing gender equality at both institutional and household levels would allow individuals to have their desired number of children while ensuring the reconciliation of work and family life courses (*Anderson/Kohler* 2015; *Myrskylä et al.* 2011). *Goldscheider et al.* (2015) further emphasized the male involvement in family life for reversing fertility trends. In line with these theoretical expectations, the focus of family policies in many Western countries has shifted to the expansion of parental leave for both men and women and the provision of childcare that aimed at reducing work-family conflicts.

Several studies supported these recent theories suggesting a reversal/U-shaped pattern for the relationship between fertility and development empirically. *Myrskylä et al.* (2009) showed that the relationship between development and fertility reverses from negative to positive after a certain threshold. In the same vein, *Luci-Greulich* and *Thévenon* (2014) found a change in the relationship between fertility and GDP per capita above a certain threshold of economic development for 30 OECD countries. Moreover, by decomposing GDP per capita into several components, they identified female employment as a co-varying factor in the fertility rebound. This conclusion is consistent with theoretical expectations (*Anderson/Kohler* 2015; *Esping-Andersen/Billari* 2015; *Goldscheider et al.* 2015; *McDonald* 2000a/b; *Myrskylä et al.* 2011; *Rindfuss/Brewster* 1996): Countries with high levels of development as measured by health, income and education, but low levels of gender equality, continue to experience declining fertility.

Empirical findings on the relationship between fertility, development and gender equality, however, are not entirely consistent. *Furuoka* (2009) found a negative association between fertility and development in countries with lower levels of development, whereas the relationship remained negative, albeit weak, in countries with a high HDI. In the same vein, *Harttgen* and *Vollmer* (2014) found no evidence for the inverse J-shaped association using the recent revision of the HDI calculation. By utilizing gender equality, *Kolk* (2019) examined the influence of gender equality on fertility in 35 developed countries. The results showed that a U-shaped pattern was only observed across countries and that changes within countries did not lead to a reversal of fertility and gender equality.

MENA countries

In contrast to Western countries, mortality in MENA countries was very high in the first half of the 20th century. Crude death rates were close to 25 percent and life expectancy was about 40 years until the 1950s. In the same vein, fertility rates were very high, reaching seven or eight children per woman. In the second half of the 20th century, mortality in the MENA countries was significantly reduced. Infant mortality rates fell from about 200 deaths per 1,000 live births in the 1950s to less than 50 deaths per 1,000 live births by the end of the century (*Roudi* 2001) reaching levels that Western countries had half a decade ago. Along with the decline in mortality, fertility fell to below six and five in the 1980s and 1990s, respectively and then to

3.1 in the early 2000s (*World Bank* 2017). Nevertheless, these rates were still higher than the average fertility rates that developed countries had in the 1950s (i.e., 2.8; *World Bank* 2018).

The fertility decline occurred late in comparison to other regions and concealed diversity in the pace of change between countries and sub-regions. For instance, in 2016, Saudi Arabia had a total fertility rate of 2.4, whereas women in Jordan had 3.5 children on average (*World Bank* 2017). *Tabutin* and *Schoumaker* (2005) further showed that the relationship between fertility and development is very weak. At same HDI level, total fertility rates ranged from 2.0 in Tunisia to 4.1 in Saudi Arabia. Moreover, fertility in many MENA countries is significantly higher than it would be elsewhere at the same level of development.

While the rapid decline in fertility in MENA countries is not negligible, fertility in several countries such as Jordan, Morocco, Syria and Tunisia has stabilized since the mid-2000s (*Bel Air* 2017). Some countries such as Algeria and Egypt even experienced an increase in fertility in this period (*Engelhardt et al.* 2018). *Krafft* (2020) recently argued that Egypt's demographic transition is not stalling but reversing by showing that Egypt's fertility rate reached 3.5 in 2012 after reaching a low of 3.0 in 2008. Even in the first decade of the 21st century, about 3 out of 4 MENA countries had fertility rates well above the replacement level (*World Bank* 2018), despite declining infant mortality rates and development progress. One explanation for these observed trends could be that the cultural and ideological innovations that triggered gender equality in Western countries were not yet present in the MENA region. Women's participation in the economy remained considerably low, while the returns of marriage for women were still high. *Moghadam* (2001) emphasized that the kind of development that was witnessed in the MENA countries reinforced patriarchal gender contracts in the MENA region. The idea is consistent with *McDonald's* (2000b: 432) proposition, which posits that "[t]he transition from high fertility to fertility around replacement level is accompanied by an increase in gender equity within the institution of family."

To explain the low level of gender equality in the region, scholars pointed out, on the one hand, that this low level of gender equality is due to the Islamic traditions in the region (e.g., *Sharabi* 1992) and the poor treatment of Muslim women (*Inglehart/Norris* 2003; *Landes/Landes* 2001). On the other hand, *Ross* (2008) argued that low female employment and gender equality and high fertility are not solely due to Islamic traditions, but to structural opportunities. He pointed to the oil revenue-based economies in the region that triggered a shift from export-oriented sectors such as agriculture and manufacturing to non-export-oriented sectors such as construction and retail. Subsequently, economic growth in the region was mainly generated by flows from oil-producing countries. While oil-producing countries mainly comprise the Gulf Cooperation Council (GCC) countries, other countries benefitted indirectly from oil through remittances from migrant labourers and shared the characteristics of a rentier economy (*World Bank* 2013).

Historically, authoritarian regimes provided public sector jobs and the MENA region had one of the largest public sectors in the world (*Amin et al.* 2012). Nevertheless, with this type of economic growth a growing fiscal burden of

an oversized public sector emerged that affected budgetary sustainability and prompted calls for downsizing and cuts in the public sector (*Assaad/Barsoum* 2019). For instance, the pause in public sector hiring began in Egypt in the 1970s and the share of public sector employment in total employment declined from about 35 percent in 2002 to about 20 percent in 2018 (*Assaad/Barsoum* 2019). Accordingly, the public sector share in hiring new entrants has fallen steadily in most MENA countries, despite progress in educational attainment and development.

Women in particular prefer public sector employment to the private sector in most MENA countries. There are several reasons for this, including the fact that public sector jobs are more hospitable and offer favourable and flexible working conditions such as short working hours, job security and social benefits (*Barsoum* 2016). Considering the norms that prioritize women's domestic responsibilities, such characteristics make public sector jobs more popular among women than men (*Barsoum* 2019). As a result, despite the feminized public sector, women's employment opportunities have been negatively impacted as public sector jobs that traditionally employed women have declined and private-sector jobs dominated in many MENA countries (*Assaad/Krafft* 2015). These emerging jobs in the private sector such as construction require physical strength and are dominated by men. Even the other economic pillars of the private sector that do not require physical strength are significantly dominated by men. For instance, in 2020, less than 9 percent of the tourism labour force was women in the MENA region (*UNWTO* 2020). This mismatch between women's rising educational attainment and stagnant labour force participation rates has been termed the "MENA paradox" (*Assaad et al.* 2020). As a result, women's structural opportunities have not increased despite economic growth. Overall, the fertility-development nexus in MENA countries may show different patterns than in Western countries if progress towards development is not complemented by gender equality.

3 Data

We include time series of 19 MENA and 24 Western countries in our analyses. As there is no standardized list, we include those that are generally referred to as MENA countries: Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates (UAE) and Yemen.² Western countries refer to the countries included by *Myrskylä et al.* (2009): Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, Switzerland, the United Kingdom and the United States of America (USA).

² Iran and Turkey are included among MENA countries, given that they are located in the Middle East and share similar structural (i.e., type of economy) and cultural (i.e., religion) characteristics. Yet, as a robustness check, we only considered countries where Arabic is the official language. Findings are reported in the Appendix, Table A2.

We use HDI data from the International Human Development Indicators database (UNDP 2019). It contains information on HDI and its components annually between 1990 and 2018. We use the revised version of HDI in which the calculation method was changed to the geometric mean. The HDI revision provides consistent measurements that are comparable over time and this time consistent index included: (i) gross domestic product (GDP) per capita at purchasing power parity (PPP) referring to the standard of living, (ii) average of the adult literacy rate and the combined primary, secondary and tertiary gross school enrolment ratio referring to the human capital endowment and (iii) annual life expectancy at birth, referring to the health component of development.

Fertility data, which is available yearly between 1960 and 2018, comes from the World Development Indicators (WDI; World Bank 2018). It is measured by the country-specific annual total fertility rate reflecting the number of children that would be born to a woman during the considered age window if she experienced the age-specific fertility rates observed in a particular year. The main weakness of the TFR is that it is subject to tempo effects of fertility (Bongaarts/Feeney 1998; Sobotka/Lutz 2011). Tempo adjusted fertility measures may provide a more comprehensive overview of the fertility trends and may (partly) explain changing TFR (Bongaarts/Sobotka 2012). Yet fertility changes in MENA countries differ greatly from those in advanced societies (see Balbo *et al.* 2013 for a review of fertility in advanced societies). Age-specific fertility rates have not experienced a shift to the right in most MENA countries, suggesting that the mean age at first birth has not changed considerably in this region (Engelhardt *et al.* 2018). Accordingly, tempo effects are likely to be an issue only for the analysis of Western countries. While acknowledging this critique, other indicators of fertility such as age at first birth are only available in time-series data every five years between 1990 and 2015 and the TFR is the only available fertility measure for MENA countries that allows a longitudinal analysis of the fertility-development relationship.³ Moreover, it is plausible that the TFR provides extensive insight into fertility comparison between MENA and Western countries because it “is the most widely used indicator of fertility, as TFR is a key determinant of the number of children born in a calendar year and thus of population aging and population growth/decline” (Myrskylä *et al.* 2011: 38) and most public debates on fertility trends focus on the TFR.

4 Method

We estimated the relationship between fertility and development using two approaches. While the first approach focused on how the association between fertility and development varies between different periods, the overall association between

³ Nevertheless, in additional robustness checks, we replicated our models while controlling for the mean age at childbearing. Findings did not deviate strongly from the main outcomes and are reported in the Appendix.

these two indicators was examined with the second strategy. More specifically, we first applied linear regression models with fixed effects at country-level separately for MENA and Western countries to examine the relationship between fertility and development with the following formula using time-series annual data:

$$TFR_{tc} = \alpha + \beta HDI_{tc} + \gamma_c + \varepsilon_{tc}$$

where t indicated the year and c the country. The terms γ_c represented time invariant country-specific effects, which are accounted for with country fixed effects and ε_{tc} is the error term. To examine how the fertility-development link evolved since 1990, we compared the estimated coefficients of HDI (β) between six periods: 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014 and 2015-2018. We used robust standard errors clustered by country in all models to account for heteroscedasticity and deal with atypical countries.

We then examined the fertility-development link by adopting the difference estimation strategy of *Myrskylä et al.* (2009). Specifically, we estimated a piecewise linear model where the coefficient of HDI (or subindices of HDI and FLFP) can differ above and below a predetermined threshold value with the following equation:

$$\Delta TFR_{ct} = \alpha \Delta B_{ct}^{post} + \beta^{pre} \Delta X_{ct}^{pre} + \beta^{post} \Delta X_{ct}^{post} + \Delta \gamma_t + \Delta \varepsilon_{it} \quad (1)$$

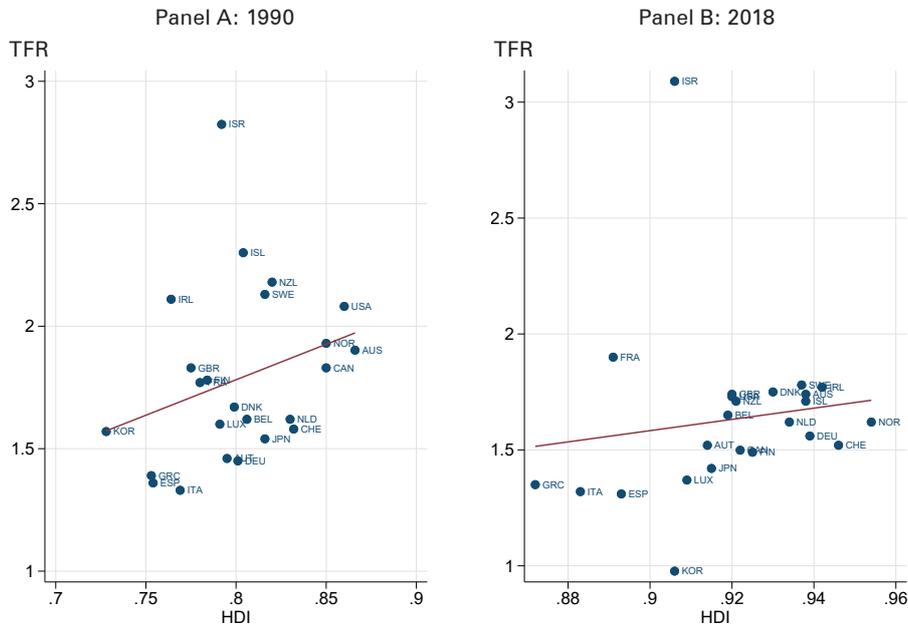
where t indicated the year and c the country. The coefficients β^{pre} and β^{post} estimated the effects of HDI on TFR above and below the threshold value, respectively. Δ referred to the difference indicator: $\Delta X_t = X_t - X_{(t-1)}$ and $\Delta X_{ct}^{post} = B_{ct}^{post} \Delta X_{it}$. Differencing allows us to control for country fixed-effects and account for the unit root from the residual autocorrelation. B_{ct}^{pre} and B_{ct}^{post} were dummy variables indicating whether the HDI was below and above threshold value, respectively. γ_t denoted year-specific effects common to all countries. We tested whether there is a significant reversal in the fertility-development relationship with this specification.

To determine the threshold value, we also followed the strategy of *Myrskylä et al.* (2009) and used maximum likelihood methods. Equation 1 was estimated using a wide range of potential threshold values and the threshold value with the maximum log-likelihood function was used in the main analyses.

5 Results

As the first step of the analysis, we made a cross-country comparison of the relationship between TFR and HDI. We fitted linear and polynomial prediction plots to display cross-country associations in Figure 1-4. These predicted plots describe the cross-country associations between fertility and development at two points in time (i.e., 1990 and 2018). Panel A and B of Figure 1 plot how the linear relationship varies across Western countries in 1990 and 2018, respectively. In both periods, Western countries' fertility levels increased with development. Polynomial

Fig. 1: Cross-country association between fertility and development (Western countries)



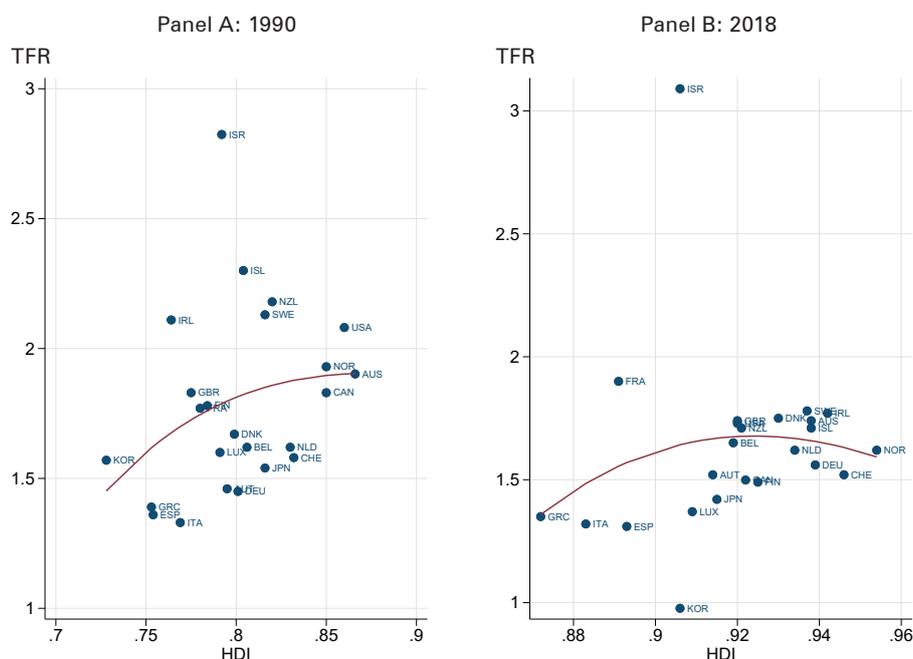
Source: UNDP (2017), World Bank (2018)

prediction plots of Western countries illustrated in Figure 2, however, imply that the positive relationship between fertility and development reversed to negative at very advanced levels of development in 2018. Yet these findings should be interpreted with caution given that the reversal is driven by a few countries.

On the contrary, cross-country analyses of MENA countries indicate that fertility declined at higher levels of development, as shown in Figure 3. The predicted polynomial plots of MENA countries, shown in Figure 4, were similar to Figure 3 with the exception that the negative relationship between fertility and development became weaker at the higher levels of development in 1990. Moreover, most MENA countries experienced notable declines in TFR between 1990 and 2018. While the average TFR of MENA countries was 4.88 in 1990, it decreased to 2.60 in 2018.

Table 1 shows the estimates of the linear regression models with country-level fixed effects. Unlike the cross-sectional analysis in Figure 1, fertility and development trends of Western countries was negative in 1990-1994. This relationship became insignificant in the next two 5-year periods. Consistent with the recent demographic theories (Anderson/Kohler 2015; Esping-Andersen/Billari 2015; Goldscheider et al. 2015), the negative relationship between fertility and development reverses to positive in 2005-2009. This period relates to the most recent data analysed by Myrskylä et al. (2009), who found a reversal of the relationship between fertility and development from negative to positive. Yet the main findings of Myrskylä et al. (2009) disappeared when we examined the most recent periods. In fact, fertility in

Fig. 2: Cross-country association between fertility and development with polynomial prediction plots (Western countries)



Source: UNDP (2017), World Bank (2018)

Western countries were negatively associated with development in 2010-2014 and 2015-2018. These findings suggest that the positive association between fertility and development in Western countries was temporary. In MENA countries, fertility declined significantly and noticeably at the higher levels of development between 1990 and 2004. Yet this relationship became insignificant in 2005-2009. In the subsequent periods (i.e., 2010-2014 and 2015-2018), unlike in Western countries there was also no longer a systematic relationship between fertility and development.

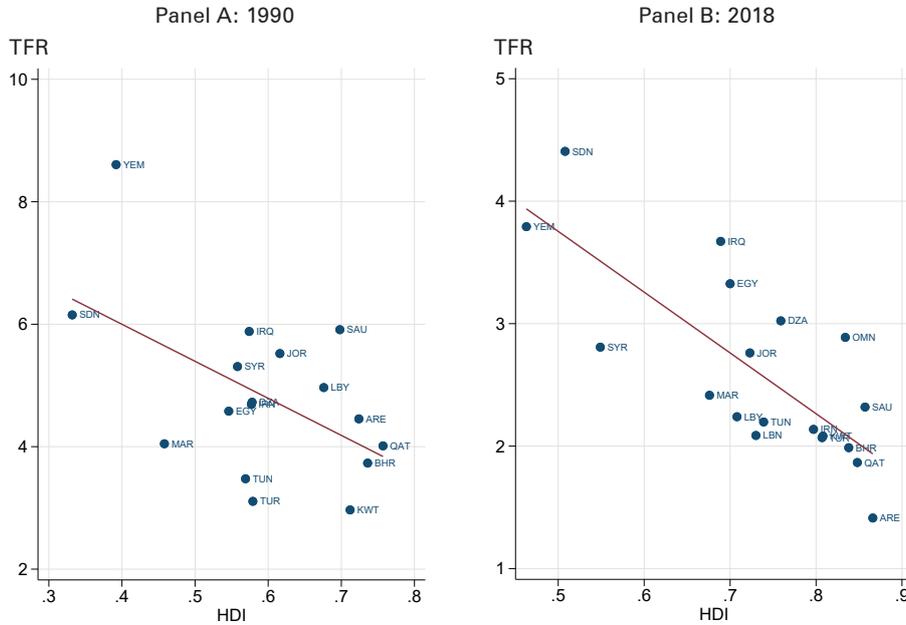
Tab. 1: Regression results (robust standard errors in parentheses)

HDI	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2018
Western	-2.416** (0.753)	-0.966 (0.794)	0.032 (0.979)	4.404** (1.494)	-4.980*** (0.986)	-9.267*** (2.260)
MENA	-15.948*** (4.456)	-14.977*** (3.156)	-10.575*** (2.126)	-3.572 (1.921)	0.830 (1.402)	-2.137 (4.401)

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: UNDP (2017), World Bank (2018)

Fig. 3: Cross-country association between fertility and development (MENA countries)



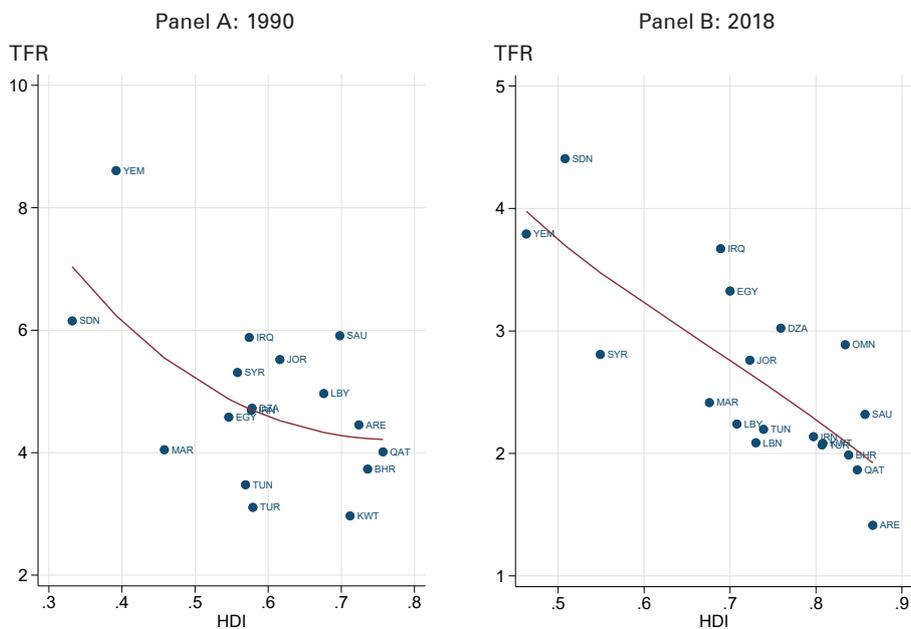
Source: UNDP (2017), World Bank (2018)

Results for the three HDI subindices and female labour force participation (FLFP) are presented in Table 2. For the education and health indices, findings are very similar to Table 1, except that the negative relationship between fertility, on the one hand, and education and health, on the other hand, became significant during the 2015-2018 period. In contrast, both Western and MENA countries' standard of living was weakly associated with fertility.⁴ Only in 2005-2009 – the period when the fertility-development link became positive –, were estimated coefficients of the FLFP significant for Western countries. This is in line with *Luci-Greulich and Thévenon (2014)*, who found a positive relationship between female employment and fertility for within-country variation.

So far, we have examined how the association between TFR and HDI has changed over time. In Table 3, we adopted the difference-in-differences strategy of *Myrskylä et al. (2009)* and examined the overall relationship. In line with the findings of *Harttgen and Vollmer (2014)*, the estimated threshold value of HDI was 0.808 and there was no reversal in the fertility-development link among Western countries.

⁴ Further analyses of MENA countries (not shown) where fertility was regressed on the three components of HDI together had illustrated that standard of living is positively associated with fertility when controlling for health and education in 2015-2018. This suggests that MENA region's insignificant association between fertility and development in 2015-2018 was related to socioeconomic development.

Fig. 4: Cross-country association between fertility and development with polynomial prediction plots (MENA countries)



Source: UNDP (2017), World Bank (2018)

Moreover, while fertility was negatively related to education and health, standard of living was insignificantly associated with fertility in line with the findings shown in Table 2.

Findings for MENA countries showed different patterns than those for Western countries. The calculated threshold was strikingly low, suggesting that the difference-in-differences strategy of *Myrskylä et al.* (2009) was not well suited for the MENA region. Moreover, development was insignificantly associated with fertility below the certain threshold value we determined. Yet fertility started increasing above this threshold value. While increasing levels of education and health were negatively linked to fertility below the threshold value we identified, fertility rates were positively associated with education and health above this threshold value. Strikingly, fertility rates in MENA countries were positively related to socioeconomic development below the determined threshold value. For both Western and MENA countries, the overall relationship between fertility and FLFP was negative above the determined threshold value.

To strengthen confidence in our findings, we performed several additional analyses including controlling for mean age at childbearing, focusing only on Arabic-speaking countries, using quinquennial fertility data, inclusion of a quadratic term and replicating the first model by focusing on 10- and 15-year intervals. Findings were qualitatively robust to these specifications and are reported in the Appendix.

Tab. 2: Regression models with HDI components and FLFP rates (robust standard errors in parentheses)

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2018
<i>Panel A: Education</i>						
Western	-1.196** (0.326)	-0.463 (0.458)	-0.022 (0.382)	1.579* (0.736)	-2.145** (0.533)	-6.818** (2.038)
MENA	-10.238** (3.457)	-9.215* (3.141)	-7.176*** (1.259)	-1.888 (1.031)	0.200 (0.975)	-4.639*** (0.682)
<i>Panel B: Standard of living</i>						
Western	-0.931 (1.564)	-1.277 (0.990)	0.638 (2.598)	0.304 (1.416)	-2.345 (2.539)	-6.182** (1.709)
MENA	-2.111 (1.603)	-7.970** (2.271)	-1.511 (2.465)	-2.353 (2.223)	0.886 (0.751)	1.747 (1.191)
<i>Panel C: Health</i>						
Western	-4.227* (1.752)	-2.449 (1.364)	-0.050 (1.545)	6.124*** (1.079)	-7.572*** (1.545)	-9.991*** (2.395)
MENA	-26.570*** (3.071)	-25.713*** (5.007)	-12.642*** (2.691)	-4.296 (3.333)	-0.196 (3.826)	-7.567** (2.217)
<i>Panel D: FLFP</i>						
Western	-0.005 (0.010)	0.004 (0.005)	0.007 (0.006)	0.032** (0.009)	-0.015 (0.014)	-0.025 (0.018)
MENA	-0.092 (0.080)	-0.076 (0.061)	-0.016 (0.042)	-0.012 (0.023)	-0.009 (0.020)	0.022 (0.016)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: UNDP (2017), World Bank (2018)

6 Conclusion

In this study, we examined the association between fertility and development among Western and MENA countries. The main contribution of the present study is twofold. First, we showed that well-established theories of fertility and development may not apply in every context. While fertility and development have been negatively associated in Western countries in recent years, there was no significant relationship in MENA countries during the same period. Indeed, further analyses where we focused on the overall relationship rather than specific periods implied that fertility and development is positively associated above the identified threshold. A separate examination of the HDI components suggested that this association was mainly related to the standard of living component. These findings of MENA countries are in line with *McDonald* (1994) and *McNicoll* (1980) who emphasize that the process of social change may not be the same across all societies and may be influenced by cultural and institutional contexts.

Tab. 3: Regression results: Difference-in-differences (standard errors in parentheses)

	HDI	Education	Standard of living	Health	FLFP
<i>Western</i>					
Pre	-0.656 (0.976)	-0.017 (0.448)	1.070 (2.042)	-1.332 (2.762)	0.000 (0.003)
Post	-1.093* (0.446)	-0.390* (0.161)	-0.231 (0.472)	-4.784* (1.873)	-0.024** (0.008)
Threshold value	0.808	0.716	0.806	0.866	0.737
<i>MENA</i>					
Pre	0.059 (0.571)	-1.583* (0.806)	3.657*** (0.902)	-5.581*** (1.518)	0.003 (0.005)
Post	1.604* (0.628)	0.541* (0.260)	0.230 (0.207)	2.745* (1.060)	-0.022*** (0.005)
Threshold value	0.675	0.383	0.478	0.775	0.416

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: UNDP (2017), World Bank (2018)

Secondly, our analyses focusing on Western countries have shown that the relationship between fertility and development were significantly positive for a short period (i.e., 2005-2009), yet afterwards the relationship became negative again. Moreover, analyses where we employed the difference-in-differences strategy of *Myrskylä et al.* (2009) indicated no reversal from negative to positive in the fertility-development link. Accordingly, we found no empirical evidence supporting recent demographic theories that suggest a reversal from negative to positive in the fertility-development link (*Anderson/Kohler 2015; Esping-Andersen/Billari 2015; Goldscheider et al. 2015*). Furthermore, the difference-in-differences strategy implied that the overall association between fertility and female labour force participation was negative among both Western and MENA countries above the threshold value we determined. Yet these findings should be interpreted with caution because we observed no significantly negative relationships in the analyses where we focused on how this relationship changed over time in both Western and MENA countries. Moreover, the identified threshold for MENA countries was considerably low, suggesting that the strategy of *Myrskylä et al.* (2009) is not particularly compatible.

We conclude with limitations and suggestions for further research. TFR is used to measure fertility throughout the analyses. Yet TFR is an imperfect measure given that it is affected by the timing of childbearing and both Western and MENA countries have experienced notable shifts in age of first childbirth (*Bongaarts 1999*). At the same time, union formation was postponed in the MENA region in the 2000s together with development, resembling the nuptiality patterns of the Western world in the 1970s (*Kuhn 2012; Ortega 2014*). Moreover, evidence indicates that no

marriage regime has been able to reduce fertility in the MENA region (*Engelen/Puschmann* 2011). Given that childbearing is mostly within marriage in MENA countries, fertility could be reduced due to the postponement of marriages among younger generations, leading to rebounds in the latter period. Accordingly, we note that TFR could not capture these trends. However, additional analyses where we controlled for timing of childbearing supported our main findings, although these findings should be interpreted cautiously due to limited available data on the timing of childbearing. Moreover, annual UN data on TFR is primarily based on a later interpolation of the quinquennial base data in most developing countries. Thereby, there could be less variability in TFR among MENA countries leading to biased standard errors. To acknowledge this, we replicated our analyses using the original quinquennial fertility data as a robustness check.

We assumed that development affects fertility in the analyses. Yet the effects could work in both directions: Fertility may affect development. We also expected that the fertility-development link of MENA countries is different from Western countries due to the distinct progress and evolution of gender equality in the region. Indeed, fertility-development trends of MENA countries are noticeably different from findings on Western countries (*Fox et al.* 2019; *Myrskylä et al.* 2009, 2011) and theoretical expectations (*Anderson/Kohler* 2015; *Esping-Andersen/Billari* 2015; *Goldscheider et al.* 2015). Consequently, there could be factors such as barriers in the use of contraception, problems in women's reconciliation of work and family life or unwanted fertility affecting these trends. These factors are not tested in this study. Why MENA countries show different fertility trends and have not become more gender-equal societies with increasing levels of development is beyond the scope of this paper and it would be interesting to elicit the drivers such as religion and/or structural opportunities of this trend. In conclusion, future research may elicit the drivers of a positive fertility-development link among Western countries that only emerged for a short period.

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Appendix

Additional analyses

Table A1 presents the findings where we replicated the models focusing on 5-year intervals by considering 10- and 15-year intervals, respectively. In Table A2, we replicated the main models focusing on 5-year intervals with different specifications. In Panel A, we included only Arabic-speaking MENA countries by excluding Turkey and Iran and including Mauritania and Palestine. Although Malta has different structural and cultural characteristics than the MENA countries considered, we additionally used the World Bank definition of MENA countries and included Djibouti and Malta (not shown). In Panel B of Table A2, we examined how the TFR-HDI relationship changed in every five year between 1990 and 2015 while controlling for timing of childbearing.⁵ The models were replicated using quinquennial fertility data in Panel C, given that the UN's annual information on fertility is based on a later interpolation of the quinquennial base data in most developing countries.⁶ Using these three specifications included in Table A2, we replicated the difference-in-differences models of *Myrskylä et al.* (2009) and findings are reported in Panel A-C of Table A3. All these models supported the conclusions drawn from the main models.

In Table A4, we estimated the non-linear time series association between fertility and development separately for Western and MENA countries by introducing a quadratic term of HDI with the following form:

$$TFR_{tc} = \alpha + \beta_1 HDI_{tc} + \beta_2 HDI_{tc}^2 + \gamma_c + \lambda_t + \varepsilon_{tc}$$

where t indicated the year and c the country. The terms γ_c represented country-specific effects, λ_t denoted year-specific effects common to all countries and ε_{tc} is the error term. The models focused on the period between 1990 and 2018 and included country-level and period fixed effects to account for unobserved time-constant country heterogeneity and variation in outcome over time that is not attributed to the predictors, respectively. For a better illustration of the results, we plotted the marginal effects obtained from the regression models in Figure A1. Accordingly, we present the expected instantaneous changes in the outcome as a function of a change in the main predictors. Overall, estimated results supported our main findings. While fertility insignificantly decreased at higher levels of development among Western countries, MENA countries had higher fertility rates with increasing development.

⁵ These findings should be interpreted with caution, given that the timing of childbearing data is available every five years for the period 1990 to 2015.

⁶ Information on timing of childbearing and quinquennial base data is available until 2015. Therefore, these models were not estimated for the 2015-2018 period.

Tab. A1: Regression results focusing on 10- and 15-year periods (robust standard errors in parentheses)

HDI	1990-1999	1995-2004	2000-2009	2010-2018
Western	-2.238** (0.735)	-0.364 (0.624)	2.472** (0.766)	-2.633* (1.098)
MENA	-15.856** (4.730)	-14.134*** (2.104)	-7.281** (1.934)	-0.204 (1.915)
HDI	1990-2004	1995-2009	2000-2018	
Western	-1.387* (0.526)	0.982 (0.631)	-0.048 (0.552)	
MENA	-16.078*** (2.951)	-10.885*** (1.925)	-3.177 (1.743)	

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: UNDP (2017), World Bank (2018)

Tab. A2: Robustness checks focusing on 5-year periods with different specifications (robust standard errors in parentheses)

HDI	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2018
<i>Panel A: Focusing on Arabic-speaking countries</i>						
MENA	-13.267** (4.014)	-14.920*** (3.265)	-10.884*** (2.301)	-4.642 (2.432)	0.585 (1.647)	-0.170 (0.199)
<i>Panel B: Controlling for the timing of childbearing</i>						
Western	-1.117 (1.231)	1.497 (0.991)	1.071 (1.665)	0.571 (2.017)	-6.474** (2.144)	
MENA	-21.106*** (3.421)	-15.812*** (2.958)	-9.798*** (2.307)	-1.932 (2.121)	1.297 (1.752)	
<i>Panel C: Using quinquennial fertility data</i>						
Western	-1.921* (0.736)	-0.387 (0.641)	2.967*** (0.595)	0.572 (0.959)	-3.985*** (0.882)	
MENA	-16.647*** (2.920)	-12.835*** (1.770)	-6.602* (2.506)	-1.221 (2.015)	-0.248 (1.144)	

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: UNDP (2017), World Bank (2018)

Tab. A3: Robustness checks with difference-in-differences strategy and different specifications (robust standard errors in parentheses)

	<i>Panel A: Focusing on Arabic-speaking countries</i>	<i>Panel B: Controlling for the timing of childbearing</i>	<i>Panel C: Using quinquennial fertility data</i>
Western			
Pre		-0.747 (0.888)	-4.711* (2.215)
Post		-2.723 (2.758)	4.474 (2.282)
Threshold value		0.906	0.823
MENA			
Pre	2.041 (1.161)	6.009 (4.812)	0.759 (1.396)
Post	-1.105 (1.237)	-4.661 (4.910)	1.435 (1.989)
Threshold	0.4	0.53	0.6

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: UNDP (2017), World Bank (2018)

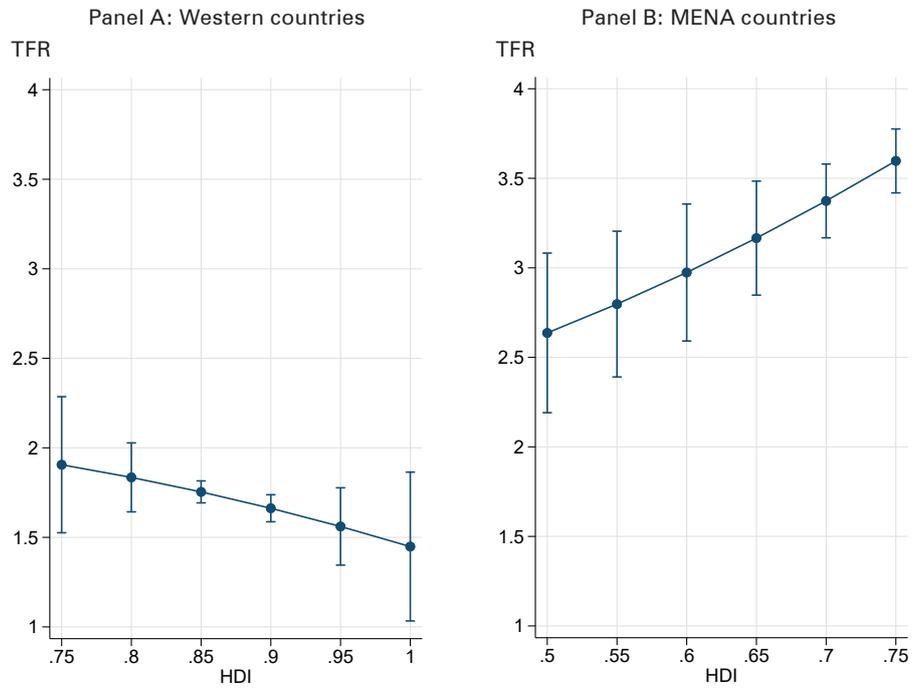
Tab. A4: Non-linear association between fertility and development (robust standard errors in parentheses)

	Western	MENA
HDI	1.803 (14.999)	-0.069 (11.556)
HDI x HDI	-2.074 (8.581)	3.128 (9.363)

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: UNDP (2017), World Bank (2018)

Fig. A1: Non-linear association between fertility and development (estimated marginal effects)



Source: UNDP (2017), World Bank (2018)

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