3. Data sources and methodology

A. Data sources

Comparatively, the Arab region lacks the availability of reliable and consistent data to measure and monitor child marriage and its causes and consequences. Recurrent conflicts and geopolitical issues in the region worsen the global periodic surveys critical for cross-country comparisons. Of the 22 countries that constitute the Arab region, only 13 countries had relevant data for the time period under consideration (2001–2020).[28] For the exercise of costing child marriage in this region, the data for the input indicators was collected and compiled from multiple sources for the period 2001–2020. The data sources used for analysis include: (i) demographic health surveys (DHS); (ii) multiple indicator cluster surveys (MICS); (iii) labour force surveys (LFS); (iv) United Nations World Population Prospects; (v) world development indicators (WDI); (vi) United Nations Model Life Table (West Asia Model); (vii) country-specific censuses from Arab countries; and (viii) official statistics of the respective Arab countries. The present study adopted interpolation[29] and extrapolation[30] methods to fill the data gaps between any years.

Globally, the DHS is the largest data source for population, health, human immunodeficiency virus (HIV) and nutrition and is internationally comparable and surveyed in about 90 countries. Some of the Arab countries have been covered under the DHS programme, such as Egypt (2014, special DHS in 2015), Jordan (2017/2018), Mauritania (2019–2021), Morocco (2003/2004), the Sudan (1989/1990), Tunisia (1988) and Yemen (2013).[31] The MICS is the largest source of reliable internationally comparable data on women and children globally and has been carried out once or more in 118 countries. The latest MICS within the Arab region are: Algeria (2018/2019), Egypt (2013/2014), Iraq (2018), Mauritania (2015), Oman (2014 restricted), the State of Palestine (2018/2019), Qatar (2012), Somalia (2011), the Sudan (2014), the Syrian Arab Republic (2006), Tunisia (2018) and Yemen (2006). Although the Pan Arab Project for Family Health (PAPFAM) is available in Libya, the study excluded Libya, due to a lack of information comparability in PAPFAM with the DHS and MICS, and Oman, due to a lack of access to the microdata. Overall, the study covers 13 Arab countries that have microdata from the latest available DHS or MICS.[32]

In addition, we collected information on employment and unemployment from the WDI, LFS and official statistics of the respective countries. The total and projected population data were collected from the countries' censuses and United Nations World Population Prospects, respectively. The study used the most suitable model life table from two sets of standard model life table families[33] to derive a variety of mortality indicators and underlying mortality patterns for the estimation and projection of the population for each country. The data on the base year GDP in United States dollars ($), annual GDP growth rate (%), and urbanization (%) were collected from the WDI. In addition, education and health-related indicators were compiled from multiple data sources including DHS, MICS, censuses, and official statistics of the countries (see the details in annex table 1).

B. Approach

The linkage between child marriage and economic growth is not straightforward because it directly correlates with some "conventional" economic growth determinants such as fertility, education, health and employment, among others. Wodon and others (2017) outlined five main channels – health, education, fertility, labour force participation and decision-making – through which child marriage impacts economic growth. In their analytical model, Wodon and colleagues further consolidated these channels into human capital (i.e. education and health), as there is a significant overlap across these channels. Later, the study by Mitra and others (2020) also recognized the interdependence between health, education, economic growth and other intermediates operating under the costing exercise of child marriage.

Following Wodon and others (2017) and Mitra and others (2020), this study used four sets of parameters (i.e. demographic, health, education and economic) in the costing exercise of child marriage in a life course perspective. Child marriage is like a silhouette on lifetime outcomes, as it affects skill formation, health and economic consequences at all stages of life. In this study, by saying "life course", we mean the estimates are cumulative economic costs of child marriage associated with education, health and labour market losses, which operate at different stages of an individual life (box below). Moreover, several other intermediates – such as women's decision-making ability and gender-based violence against women – that influence economic outcomes were not included as separate variables because they are highly collinear with demographic, health, education and employment parameters. Nevertheless, within four broad sets of parameters (demographic, health, education and economic), the model used in this study includes other contingent factors such as age structure of the population and its drivers, economic status and its predictors, and the urbanization level of women's country of residence. Figure 2 explains the complete operational (or analytical) framework of the simulation model and the parameters used to estimate the economic costs of child marriage in the Arab region.

While the present study follows the simulation approach used by Wodon and others (2017), its analytical framework for estimating the economic costs of child marriage is slightly different and adheres to a more comprehensive procedure. We have extended the projection of the economic costs of child marriage for the Arab region up to 2050 with the base year of 2001. The period 2001 to 2050 is selected considering the working lifespan of around 50 years for a female married at the age of 15. For instance, in this model, a female who married in the year 2001 at age 15 (base year for this study) is expected to live up to 65 years (up to 2050, a goalpost year for this study) as a worker or a non-worker. However, the input indicators are not available for all countries from 2001. In such cases, the base year has been chosen as per the availability of the data. The life-cycle approach

Life-cycle approach: A life-cycle approach is adopted to study all stages in a person's lifespan to understand the effects of skill formation at one stage upon subsequent stages in terms of human capital and health consequences.

Why is the life-cycle approach important for assessing the economic costs of child marriage?

Cunha and Heckman (2007) introduced the skill formation model to understand the effect of child marriage on a girl's human and social development across her lifespan because cognitive skills and health status acquired at one stage tend to influence the next stage.

Due to child marriage, the process of skill acquisition, mainly educational attainment, is distorted at the stage of adolescence, which consequently has lifetime repercussions on knowledge accumulation and health, particularly the psychosocial aspect of women's health, and the formation of human capital in general.

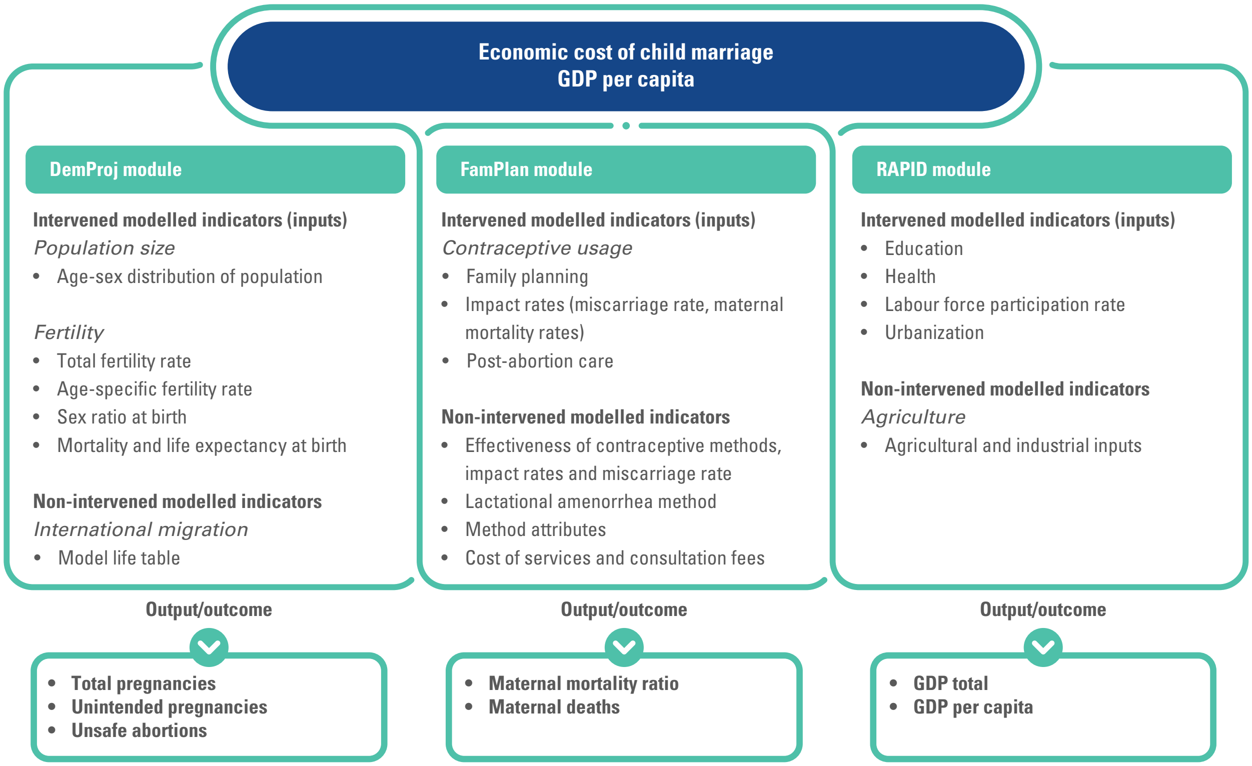
Child marriage affects the childbearing patterns of females, resulting in high fertility rates and lower gaps between childbirths, which risks their own and their children's lives. The negative effects are noted on a girl's psychosocial well-being, education completion and consequently her earning potential. The lack of educational attainment also restricts the intergenerational mobility of married adolescents. Additionally, these adolescent girls have low knowledge accumulation regarding contraception usage and sex-related infections that can seriously endanger their lives.[a]

The disadvantage of child marriage reflects in females' decision-making ability, in particular their reproductive choices and decisions related to their children's lives.[b] These disadvantages spill across life stages and generations, and the costs are borne by these women, their children as well as the society in which they live. Therefore, it is imperative to study the costs of child marriage through the life-cycle approach.

[a] Alderman and others, 2001; Corak, 2006; Black and Devereux, 2011; UNFPA, 2013.
[b] Kabeer, 1999, 2008.

The study used three key modules of the spectrum-based simulation approach: DemProj, FamPlan and RAPID (figure 2). DemProj stands for demographic projection module in the spectrum simulation model. It provides age-sex population base parameters and their projection for the simulation module. The projection function works on a set of assumptions about fertility, mortality and migration for goalpost years.

Figure 2. Analytical framework of the simulation model in the spectrum suite 6.19: Costing of child marriage in Arab countries



Source: Authors' compilation.

The FamPlan module stands for the projection of family planning parameters. Family planning inputs are needed to reach national goals for addressing unmet needs or achieving desired fertility. For this study, the family planning module provides necessary parameters that can predict probable differences in family planning indicators and their consequences for the fertility of child-married women and non-child married women.

Resources for the Awareness of Population Impacts on Development (RAPID) projects the social and economic consequences of high fertility and rapid population growth for such sectors as labour, education, health, urbanization and agriculture. For the simulation model, RAPID provides the differential probability of socioeconomic achievements of child-married and non-child married input and outcome indicators. A detailed explanation of these modules is presented in annex table 2.

The study also differs in terms of its outcome measures. We have provided macro-level demographic and health costs alongside the economic costs (GDP loss) for three different scenarios. These three scenarios include: (i) child marriage scenario – a hypothetical case where we assume all women across the Arab region are married below the age of 18; (ii) non-child marriage scenario – the best hypothetical case where we assume that all women across the Arab region are married at 18 years of age or above; and (iii) overall scenario (as usual scenario) – a case where the status quo continues, that is, child marriage continues to prevail at the current level in the Arab region.

1. Structure of the spectrum simulation model

The differences in the level of per capita income across countries can be examined by backward tracing to examine the child marriage status of a given population. This is based on the argument that in any given time, a girl married as a child would have faced demographic, health, education and labour force participation penalties that would have impacted her education, wages, income and savings, thereby having implications for economic growth and per capita GDP.[34] To estimate this, it is assumed that aggregate income can be represented by the Cobb-Douglas production function:

$$Y = M \times (A_w \times hc)^{\sigma} K^{1-\sigma} \quad (1)$$

Where Y is aggregate income; M is the residual total productivity factor; A_W is the number of workers; hc is human capital per worker; K is the aggregate physical capital; and is the elasticity of income with respect to aggregate human capital.

In log term, the equation can be specified as:

$$Iny = InM + \sigma lnA_w + \sigma lnhc + (1 - \sigma)\ InK \quad (2)$$

We assume that human capital, in turn, is a function of education and health and is specified as:

$$Inhc = rE_w + \delta H_w \quad (3)$$

Where E_w is education completed in years; r is the returns to an additional year of education; H_w is the health; δ is the returns to an additional gain in health.

Substituting equation (3) into (2) produces the following equation:

$$Iny = InM + \sigma lnA_w + \sigma[rE_w + \delta H_w] + (1 - \sigma)\ InK \quad (4)$$

The percentage effect on income due to a change in the rate of child marriage can be derived using the total differential of equation (4) for a fraction of the workforce at time t that was child married (CM_W) as:

$$\Delta lny_{(t)} = \sigma[r \frac{\Delta E_w}{\Delta CM_w} + \delta \frac{\Delta H_w}{\Delta CM_w}]\ \Delta CM_w \quad (5)$$

Where ΔIny is the difference in income at time t; σ is elasticity of income with respect to human capital; $\Delta E_w/\Delta CM_w$ is the loss in years of schooling due to child marriage; r is the average returns lost for an additional year of schooling unattained; $\Delta H_w/\Delta CM_w$ is the loss in health due to child marriage; and δ is the average labour market premium lost for additional unattained health outcomes.

2. Estimation of outcome indicators

Given these assumptions, we represent economic losses due to child marriage as a gap between GDP per capita in two scenarios (child marriage scenario and non-child marriage scenario) in the simulation modelling exercise:

$$Economic\ Loss = GDP\ Per\ Capita_{As\ Usual\ Scenario} - GDP\ Per\ Capita_{Child\ Marriage\ Scenario} \quad (6)$$

In other words, we can also predict economic gain by estimating the gap between per capita GDP in two scenarios (as usual scenario and child marriage scenario) in the simulation modelling exercise as:

$$Economic\ Gain = GDP\ Per\ Capita_{As\ Usual\ Scenario} - GDP\ Per\ Capita_{Child\ Marriage\ Scenario} \quad (7)$$

The aggregate production or GDP in our simulation model is estimated as:

$$GDP_{t,j} = GDP_{t-1,j} * (1 + Annual\ GDP\ Growth_{t,j}) \quad (8)$$

Where $GDP_{t,i}$ is the gross domestic product in time t under j^{th} scenario. Therefore, GDP per capita is projected as:

$$GDP\ Per\ Capita_{t,j} = GDP_{t,j}\ /\ Projected\ Total\ Population_{t,j} \quad (9)$$

Where $GDP\ Per\ Capita_{t,j}$ is the estimated GDP per capita in time t under j^{th} scenario.

Economic cost as a percentage of GDP is estimated as follows:

$$= \left\{ \frac{\dfrac{(GDP\ Total_{Non\text{-}Child\ Marriage\ Scenario} - GDP\ Total_{Child\ Marriage\ Scenario})}{Time\ Interval}}{GDP\ Total_{As\ Usual\ Scenario}} \right\}$$

Where time interval is the interval between the base year to the respective time points of the estimation.

Economic cost for households is estimated as shown below:

$$= \frac{Economic\ Loss\ as\ Given\ in\ Equation\ (6)\ for\ a\ Country}{Number\ of\ Households\ in\ a\ Country} \quad (10)$$

Health-care cost for households is estimated as follows:

$$= \frac{Health\text{-}care\ Costs_{Child\ Marriage\ Scenario} - Health\text{-}care\ Costs_{Non\text{-}Child\ Marriage\ Scenario}}{Number\ of\ Households\ in\ a\ Country} \quad (11)$$

The spectrum simulation model estimates health-care costs based on average health-care spending inputs provided in the model. Differential health-care costs incurred by child married and non-child married women are derived based on differential risks to various maternal and child health-care problems. A detailed technical note about the methodology of computations is given in the Annex and in a supplementary file hyperlinked at the end of this report.