

# How Social Network Structures Modify the U-Shaped Gender Equity–Fertility Relationship

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For decades, demographic theories have recognized gender equity as a pivotal determinant of fertility rates. Throughout the 20th century, the prevailing sentiment amongst researchers was that improvements in gender equity—particularly in improvement of women's access to education and the labour market—would invariably lead to a decline in fertility rates (Campbell et al., 2013; Folbre, 1983). However, the landscape of this discussion began to shift as fertility transitions in countries at the fourth stage of the demographic transition revealed a different pattern. Notably, countries exhibiting high gender equity reported higher fertility rates than their counterparts with lower gender equity (Myrskylä et al., 2011). This observation led to the proposition of a U-shaped relationship, where an initial rise in gender equity would correspond to a fertility decline, followed by a subsequent increase (Anderson & Kohler, 2015; Esping-Andersen & Billari, 2015; Goldscheider et al., 2015; McDonald, 2000a, 2000b). A critical similarity across these U-shaped relationship theories is their assertion that shifts in gender equity influence individuals' fertility decisions and behaviours by first leading to a decrease and then an increase in fertility intentions at the individual level, which subsequently aggregate to the country-level total fertility rate. However, empirically, this U shape hypothesis has stirred considerable debate amongst demographers. Evidence supporting both sides of the argument exist. Yet, a firm consensus remains elusive (Begall & Hiekel, 2025; Kolk, 2019). While certain countries, such as Belgium, Denmark, France, and the Netherlands, have witnessed a fertility recover concomitant with increasing gender equity, others, such as Austria, Canada, Finland, and Germany, report no obvious linkage (Kolk, 2019). This divergence between theoretical expectations and empirical observations has attracted increasing scholarly attention. Notably, the Nordic countries—long characterised by high and stable cohort fertility alongside pronounced gender equality—are now experiencing historically low fertility rates that cannot be fully explained by the postponement of childbearing (Begall & Hiekel, 2025).

Understanding this cross-national discrepancy, and the Nordic fertility paradox, is essential for reconciling theory with observed demographic trends.

Moreover, despite a few exceptions that examine how macro-level gender equity environments influence individual fertility behaviours (Mills, 2010), research on the interaction between micro- and macro-level dynamics remains limited. As Begall and Hiekel (2025) emphasise, greater attention should be paid to the individual behaviours within theories of gender inequality and fertility. At the same time, it is essential to recognise that fertility behaviour is not solely the outcome of individual decision-making, but rather the product of joint action between partners. In this sense, fertility decisions are inherently relational, involving interaction and negotiation within couples. Despite the fact that fertility involving two individuals is common sense, most existing studies fail to explicitly delineate how micro-level fertility intentions between couples interacted with each other and aggregated into macro-level patterns. Furthermore, prevailing theories often overlook the role of social network structure, relying on the simplistic assumption that individuals invariably pair with partners who share identical gender equity values. This oversight is of considerable importance, as mismatches in gender egalitarian values within couples may suppress actual fertility behaviours (Aassve et al., 2015), thereby impeding a potential recovery in total fertility rates at the national level.

In this research note, I delve into the often-overlooked mechanisms of micro-macro aggregation dynamics, highlighting its role as a crucial buffer in the gender equity-fertility nexus. As Billari (2015) emphasized, it is essential to understand how the actions and interactions at individual level lead to macro level demographic outcomes. Using agent-based modelling, I demonstrate that, in contrast to an ideal scenario where each agent pairs with another of the same gender equity level, buffer models incorporating social network structure present a distinct gender equity-fertility relationship. This highlights the potential of social structure as key mechanism influencing national difference in the gender equity-fertility relationship and the effectiveness of the gender equity-based fertility policies. It is essential, moving forward, that research adopts an integrative lens, merging individual and country level perspectives, with a pronounced emphasis on the intricacies of the aggregation process.

## **Methods**

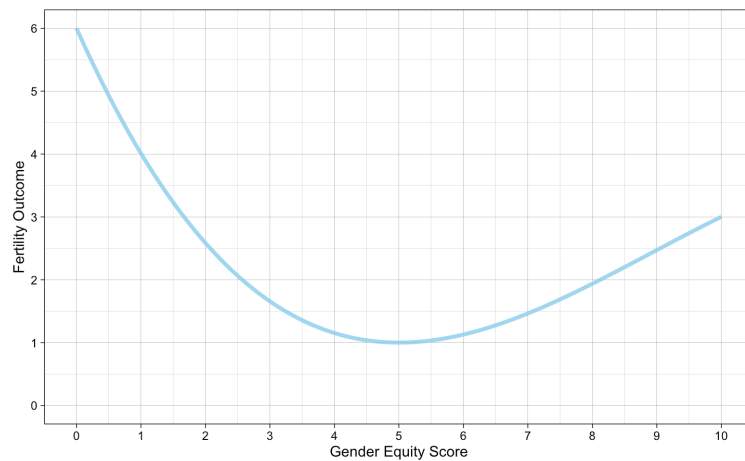
To illustrate this argument, I develop an agent-based model consisting of 100,000 agents to examine how network structures buffer the given U-shaped relationship between gender equity

and fertility intention at individual level. In the agent-based model, each agent, representing an individual, is assigned a sex (male or female) and a continuous gender equity score (GES) ranging from 0 to 10. Individual fertility intentions are modelled using a hypothetical U-shaped function that captures the relationship between fertility and gender equity, defined as:

$$\text{Fertility Desire (GE)} = -0.012GE^3 + 0.32GE^2 - 2.3GE + 6$$

A visualization of this function is provided in Figure 1.

**Figure 1: U-shape relationship between gender equity score and fertility**

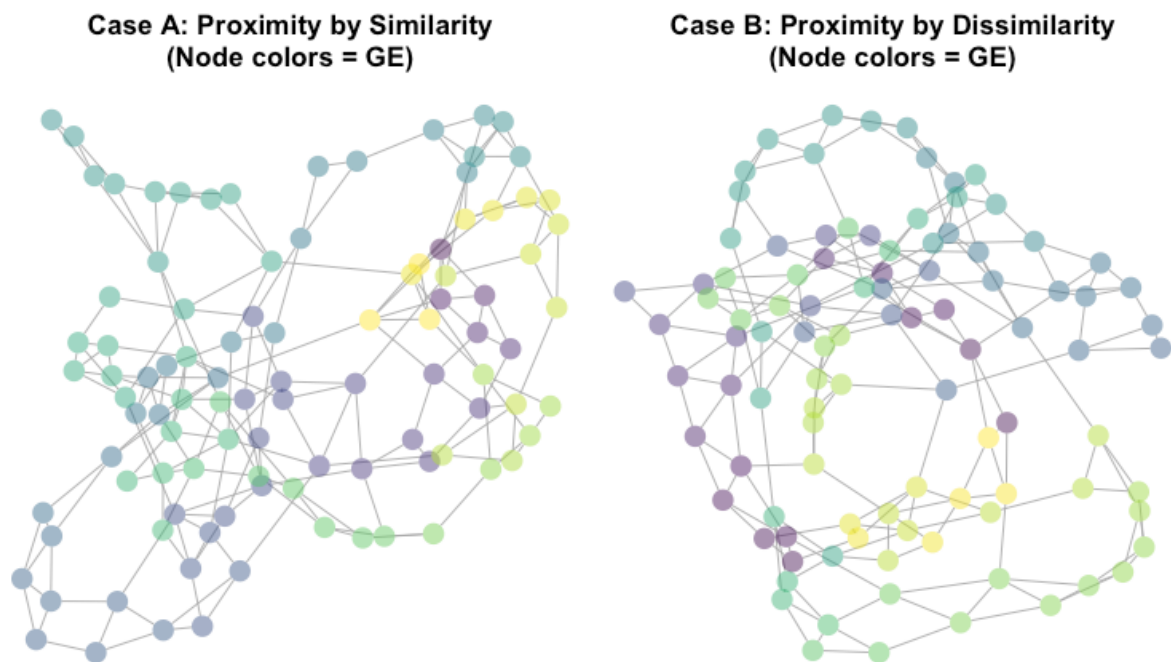


In the ideal matching scenario, agents are segregated by gender, sorted by their GES, and paired sequentially so everyone can be matched to a partner with the same GES. Meanwhile, a couple's fertility outcome is determined by the lower (more conservative) intention of the partners.

In contrast, the buffered matching scenario randomly embeds agents in a small-world network, where each male is permitted to select a female partner only if she lies within a social distance threshold of one degree. Here, partner selection is conducted stochastically, with eligible partners chosen at random. Similarly, the couple's fertility outcome is determined by the lower intention of the partners. Macro-level fertility rates are then derived by aggregating the outcomes of individual pairings, and the gender equity–fertility relationship is estimated using the locally estimated scatterplot smoothing (LOESS) model. To further illustrate how variations in network composition influence buffering effects, two distinct social network

structures are presented: Case A, where individuals sharing similar gender-equity values are more likely to form connections, and Case B, where connections predominantly link individuals with dissimilar gender-equity values. Figure 2 visually contrasts these two illustrative network scenarios.

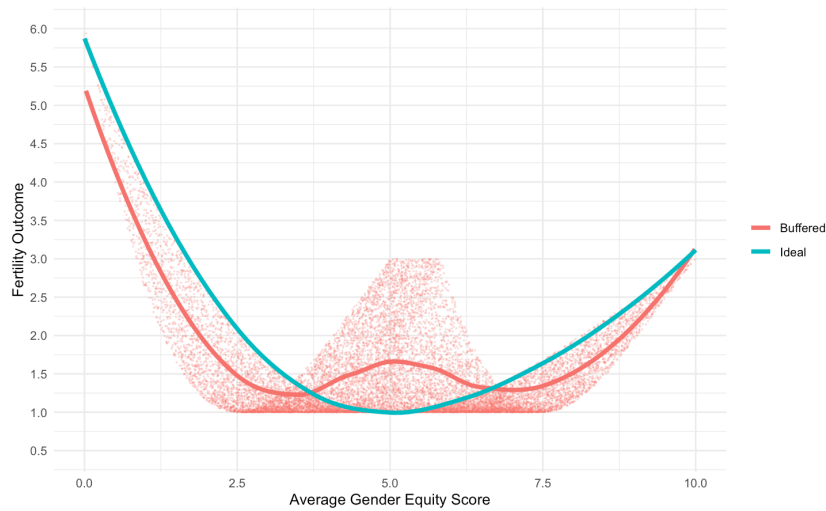
**Figure 2: Illustrative Partner-Matching Networks: Similarity and Dissimilarity by Gender Equity**



## Results

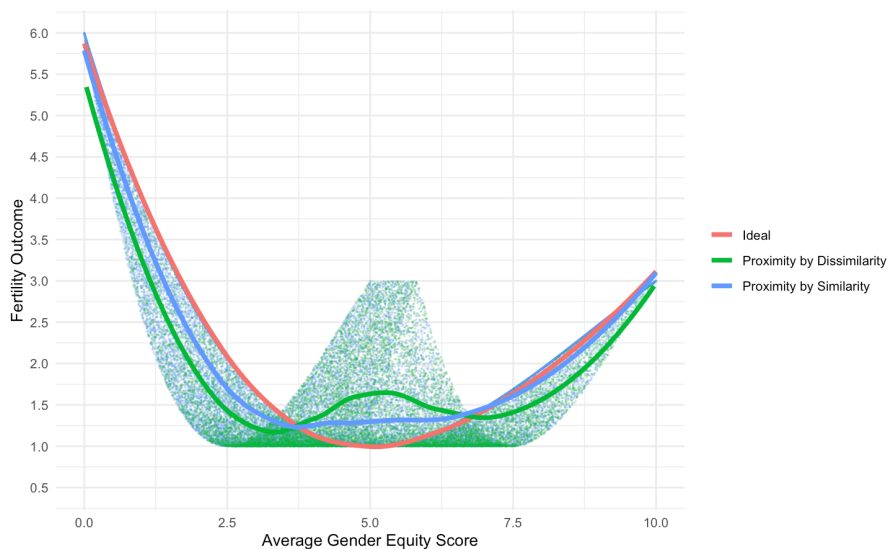
The results of the agent-based modelling are presented in Figure 3. As shown in the figure, in the ideal case, aggregation occurs directly, and the overall macro-level relationship between GES and fertility outcome retains a similar U-shaped pattern observed at the micro level in the GES and fertility intention function. In contrast, under the buffer case, the individual-level U-shaped relationship is transformed into a W-shaped pattern at macro level instead of a perfect U shape. Specifically, as the GES increases, fertility outcome at the population level initially declines. When the average GES reaches a moderate level, fertility experiences a slight increase, suggesting that a moderate degree of gender equity may support fertility. However, this increase is followed by another decline, before a more substantial rise occurs when the average GES reaches a relatively high level (around 7.5).

**Figure 3: Macro-level relationship between GES and fertility outcome based on ABM**



These findings indicate that even when the individual-level mechanism between gender equality and fertility intention remains U-shaped, different macro-level patterns of the gender equity-fertility relationship can emerge due to the influence of social network structures. The presence of a U-shaped relationship between equality and fertility intention at the individual level does not necessarily translate into a corresponding macro-level U-shape between equality and fertility outcome. Moreover, the extent to which the buffer model diverges from the ideal model is largely determined by the clustering patterns of GES among agents within the network.

**Figure 4: Macro-level relationship between GES and fertility outcomes based on ABM**



As illustrated in Figure 4, when agents with similar gender equity attitudes are closely clustered, the buffer effect is minimal. Conversely, when these agents are more dispersed, the buffer effect becomes more pronounced. This buffering mechanism, shaped by social structure, may help explain why the U-shaped relationship between gender equity and fertility is observed in some countries but not others. Additionally, the emergence of a W-shaped pattern in the buffer case could account for fertility trends in certain countries, where fertility initially declines as gender equity increases, then rises, only to decline again.

## **Discussion**

This study utilises a simple agent-based modelling approach to demonstrate that, although a U-shaped relationship between gender equality and fertility intentions is evident at the individual level, the presence of social network structures may buffer the macro-level effects of rising gender equality on fertility, potentially giving rise to fluctuations in fertility during periods of sustained progress in gender equality. Moreover, variations in the way individuals with differing gender-egalitarian values are embedded within the same network may yield divergent outcomes. Such differences in social network structure may offer a potential explanation for the observed inconsistencies between theoretical expectations and empirical findings.

Nonetheless, it is important to acknowledge that the buffering mechanism proposed here is not intended to fully account for intra-country variation in the relationship between gender equity and fertility. Other explanations for the inconsistency between theoretical expectations and empirical observations may also exist. A central argument of this research note is that researchers examining the gender equity-fertility relationship should consider the role of the matching process between individuals, as it serves as a critical link between micro- and macro-level patterns. Furthermore, the extent to which fertility rates respond to gender equity-related policies may be shaped by differences in social network structures, particularly in terms of clustering. In countries where individuals with similar GES are closely clustered, gender equity policies may be more effective in promoting fertility in the later stages of the U-shaped relationship. Conversely, in countries where individuals with similar gender equity attitudes are more dispersed, social network structures may attenuate the impact of these policies on fertility rates. Finally, I argue that greater efforts should be made to collect empirical datasets that capture the fertility intentions of both partners within a union. Such data would enable demographers to assess the extent to which mismatches moderate the effect of gender equality on fertility during the aggregation process.

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