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Impact of urban public services and social integration on the reproductive intentions of migrant populations: An SEM-ANN analysis

Impacto de los servicios públicos urbanos y la integración social en las intenciones reproductivas de las poblaciones migrantes: un análisis SEM-ANN

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Abstract

With the accelerated urbanization process in China, the migrant population has become essential to urban society. However, their reproductive intentions are influenced by various factors, particularly the costs of childbearing and issues related to social adaptability. This paper not only explores how urban public services affect the reproductive intentions of migrant populations but also analyzes the mediating role of social integration in this process. Based on the Theory of Planned Behavior and Assimilation Theory, this study utilizes survey data on the reproductive intentions of 391 migrants nationwide, combined with PLS-SEM and Artificial Neural Network (ANN) models, to conduct an in-depth analysis of the impact of urban public services, such as education, healthcare, and social security, on reproductive decision-making. The findings indicate that while urban public services partially reduce the costs of childbearing, the mediating effect of social integration on reproductive intentions is more pronounced.

Keywords: Urban public services, social integration, migrant population, reproductive intentions, SEM-ANN.

Resumen

Con el acelerado proceso de urbanización en China, la población migrante se ha convertido en un componente esencial de la sociedad urbana. Sin embargo, sus intenciones reproductivas se ven influidas por diversos factores, especialmente los costos de crianza y las cuestiones relacionadas con la adaptabilidad social. Este artículo no solo explora cómo los servicios públicos urbanos afectan las intenciones reproductivas de las poblaciones migrantes, sino que también analiza el papel mediador de la integración social en este proceso. Basado en la Teoría del Comportamiento Planificado y la Teoría de la Asimilación, este estudio utiliza datos de encuestas sobre las intenciones reproductivas de 391 migrantes en todo el país, combinados con modelos de PLS-SEM y Redes Neuronales Artificiales (RNA), para realizar un análisis profundo del impacto de los servicios públicos urbanos, como la educación, la salud y la seguridad social, en la toma de decisiones reproductivas. Los hallazgos indican que, si bien los servicios públicos urbanos reducen parcialmente los costos de la crianza, el efecto mediador de la integración social sobre las intenciones reproductivas es más notable.

Palabras clave: Servicios públicos urbanos, integración social, población migrante, intenciones reproductivas, SEM-ANN.

Introduction

As China's urbanization accelerates, the migrant population has expanded, becoming a significant driving force behind urban economic and social development. However, with the gradual adjustment of fertility policies, how to stimulate the fertility intentions of migrant populations has become a focal issue for society and the government (Gao, Yan, Zhang, Leng, Jiang and Mi, 2023). Despite the significant expansion of urban public services, particularly in education, healthcare, and social security, the fertility intentions of migrant populations have shown a declining trend (Huang, Liu, Zhuo and Sun, 2020). This phenomenon suggests that improvements in public services alone cannot effectively boost fertility intention (Liu, Cai, Wang and Di, 2024). Instead, it highlights the complex interaction mechanisms between urban public services and fertility decisions, prompting scholars to re-examine the underlying factors influencing these decisions (Bu, Wang, Dong and Liu, 2024).

In this context, social integration is considered a key factor influencing the fertility decisions of migrant populations (Coleman, 1994). According to the adaptation-assimilation theory, the level of social integration after migrants move into urban areas directly affects their stability and quality of life in cities (Zheng, Mei, Guo, Zhen and Fu, 2021). This level of integration determines their sense of belonging and access to social support and influences their long-term expectations for urban development and their family decision-making behaviours. Migrants more integrated into urban life are more likely to adapt to city life, thereby developing the intention to settle long-term and have children. In contrast, a lack of social integration increases uncertainty in life, leading to a decline in fertility intentions.

Based on the theory of planned behaviour, individuals' fertility intentions are influenced not only by external factors such as economic pressure and public services but also by psychological and social factors, including attitudes, perceived behavioural control, and social norms. Within this framework, social integration is a mediating variable, influencing migrants' fertility attitudes and perceptions of social norms. By enhancing their sense of security and stability in cities, social integration also moderates the effect of urban public services on fertility intentions (Liu, Huang and Zhang, 2018). Thus, understanding the complex interactions between social integration and public services is crucial for exploring changes in fertility intentions among migrant populations (Lin, Zhang, Chen, Shi, Han, Song and Ling, 2016).

Given this, the present study integrates adaptation-assimilation theory with the theory of planned behaviour to investigate the impact of urban public services on the fertility intentions of migrant populations from the perspective of social integration. Specifically, this paper analyzes the role of public services, including education, healthcare, and social security, in shaping fertility decisions among migrant populations, focusing on examining the moderating effect of social integration as a mediating variable. To achieve this goal, the study employs a combination of Partial Least Squares Structural Equation Modeling (PLS-SEM) and Artificial Neural Networks (ANN) based on survey data from 931 migrant individuals across the country, aiming to reveal the complex interactions and non-linear relationships between variables.

By addressing the gap in research on social integration in the fertility decision-making process of migrant populations, this study offers new theoretical perspectives on the fertility behaviours of migrants but also provides empirical evidence for the optimization of urban public service systems. The findings offer policymakers evidence to enhance social integration and improve the quality of public services for migrant populations, fostering a more inclusive and supportive environment for fertility policies and proactively addressing China's increasingly severe demographic challenges.

Literature Review and Research Hypotheses

As China's urbanization process accelerates, the fertility intentions of migrant populations have become a critical and complex topic in academic research (Tian, Tian and Sun, 2019). Despite the significant improvements in urban public services in recent years, the fertility intentions of migrant populations have shown a persistent decline (Sun, Zhou and Huang, 2024). This phenomenon suggests that fertility decisions involve more complex mechanisms than simple economic considerations. Scholars have thus explored various factors influencing the fertility intentions of migrant populations through multidimensional theoretical frameworks, including urban public services, individual characteristics, and levels of social integration (Ji, Chui, Ni and Dong, 2020).

The adaptation-assimilation theory emphasizes that the ability of migrant populations to integrate into urban society effectively is a crucial determinant of their long-term decision-making behaviours (Alba and Nee, 2014). In an urban environment, public services such as education, healthcare, and social security can not only alleviate migrants' life pressu-

res but also enhance their sense of belonging and social support networks by promoting social integration (Portes and Rumbaut, 2014) (Wang, Liu, Zhu, Bai and Wang, 2023). Recent studies have revealed that urban public services influence fertility intentions through increased social integration, making the interaction between public services and social integration a critical issue in this area of research (Wang and Fan, 2012).

This study combines the adaptation-assimilation theory with the theory of planned behaviour to explore the direct and indirect effects of urban public services on fertility intentions from multiple perspectives (Tian, Wei and Liu, 2023). According to the theory of planned behaviour, an individual's fertility intentions are influenced not only by economic pressure and public services but also by psychological factors, such as subjective attitudes, perceived behavioural control, and social norms (Ajzen and Driver, 1991). As a mediating variable, social integration enhances migrants' sense of stability and security, thereby moderating the influence of urban public services on fertility decisions (Xie, Cao, Li, Yang, and Yu, 2022). Therefore, understanding the complex interaction between urban public services and social integration is essential for examining changes in the fertility intentions of migrant populations.

Educational services are a crucial factor influencing social integration and fertility intentions among migrant populations. Becker (1981) indicated that educational services could reduce economic pressure by improving individuals' competitiveness in the labour market and economic stability, thus increasing fertility intentions. Educational services also raise families' expectations for their children's future, encouraging them to plan more actively for childbirth(Malacrida and Boulton, 2014). Additionally, educational services improve fertility intentions through economic pathways and enhance migrants' social adaptability and sense of belonging, thus promoting social integration (Xu, Ma and Zhu, 2024). Zhou (Zhou, Zhu and Zhang, 2022) further noted that by fostering social capital accumulation and expanding social networks, educational services improve migrants' sense of social integration.

Hypothesis 1a (H1a): The coverage of educational services positively affects household economic capacity and fertility intentions.

Hypothesis 1b (H1b): The coverage of educational services enhances fertility intentions by improving household economic capacity.

The accessibility of healthcare services is a crucial factor influencing the fertility intentions of migrant populations. According to the health capital model (Yang, Han and Wang, 2023), healthcare accessibility reduces

health risks during childbirth and enhances individual confidence in fertility. Eswaran (Eswaran, 2002) found that healthcare services can significantly reduce maternal and infant mortality, leading to more optimistic fertility decisions. Additionally, the expansion of healthcare services improves migrants' overall health, which in turn enhances their social integration and economic independence (National Academies of Sciences, Engineering and Medicine, 2019). Zou and Deng (Zou and Deng, 2022) further pointed out that healthcare services indirectly promote social integration by reducing health risks.

Hypothesis 2a (H2a): The accessibility of healthcare services positively affects household economic capacity and fertility intentions.

Hypothesis 2b (H2b): The accessibility of healthcare services enhances fertility intentions by improving household economic capacity.

As a core component of urban public services, the social security system directly influences fertility decisions among migrant populations. Boldrin (Boldrin, De Nardi and Jones, 2015) argued that social security reduces economic uncertainty and provides long-term support for fertility decisions. Harknett (Harknett, Billari and Medalia, 2014) found that a well-developed social security system not only reduces the economic burden of childbirth for migrant populations but also enhances fertility intentions by improving their sense of social integration. Social security strengthens migrants' sense of belonging through the expansion of social support networks, further boosting their confidence in fertility decisions (Jia, Liu, Wang and Ma, 2023).

Hypothesis 3a (H3a): The coverage of social security positively affects household economic capacity and levels of social integration.

Hypothesis 3b (H3b): The coverage of social security enhances fertility intentions by improving levels of social integration.

Health status plays a significant role in fertility decisions. Li (Li, Xiong and Song, 2022) noted that good health can enhance an individual's ability to cope with the pressures of childbirth and boost confidence in their future life. Studies have found a positive correlation between health status and fertility intentions. In contrast, poor health may lead to higher medical expenses, weakening household economic capacity and suppressing fertility intentions (Jia et al., 2024). Li (Li and Chen, 2021) further emphasized that health status affects fertility decisions indirectly through its impact on mental health and household economic capacity.

Hypothesis 4 (H4): Physical health positively affects fertility intentions.

Household economic capacity is one of the core factors influencing fertility decisions. According to the adaptation-assimilation theory, economic capacity determines whether a household can bear the costs of raising children (Lin, Zhang, Chen, Shi, Han, Song and Ling, 2016). Schneider and Hastings (Schneider and Hastings, 2015) suggested that improved economic conditions alleviate the pressures associated with childbirth, thereby enhancing fertility confidence. Sun (Sun, Chen and Xie, 2022)further argued that wealth accumulation influences a household's investment in education and healthcare resources for their children, thus increasing fertility intentions.

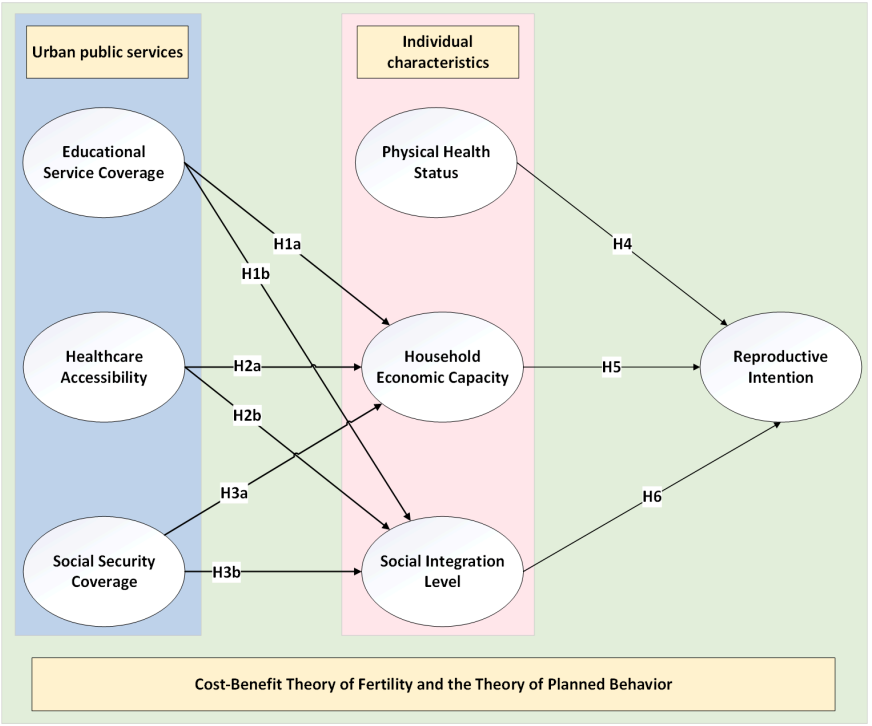
Hypothesis 5 (H5): Household economic capacity significantly correlates with fertility intentions.

Social integration is vital for migrant populations to achieve a sense of belonging and stability in urban life. According to the theory of planned behaviour, social integration influences individuals' social networks, behavioural norms, and psychological security, indirectly affecting their fertility decisions. Kang (Kang, Du, Wang and Du, 2022) found that the stronger the sense of social integration, the more likely migrants are to settle long-term in cities and make fertility decisions. Li and Chen further emphasized that social integration enhances access to social capital, which helps improve fertility intentions (Li and Chen, 2021).

Hypothesis 6 (H6): The level of social integration positively affects fertility intentions and mediates the relationship between household economic capacity and fertility intentions.

Within the framework of adaptation-assimilation theory and the theory of planned behaviour, this study systematically analyzes the influence of urban public services, individual characteristics, and social integration on the fertility intentions of migrant populations. By expanding the existing literature, this study explores the direct effects of public services on fertility intentions and examines the mediating role of social integration in this process. These research hypotheses (as shown in Figure 1) provide theoretical and empirical support for optimizing urban public service systems and enhancing fertility intentions among migrant populations.

Figure 1: Research Framework and Hypotheses



Source: own elaboration of the authors.

Methodology and data

Data collection

The research sample consists of 391 migrants from across the country, covering aspects such as gender, age, education level, and employment type, ensuring the diversity and representativeness of the sample. Migrants from different regions and industries participated in the survey, allowing this study to comprehensively examine how urban public services influence the fertility intentions of various groups (as shown in Table 1).

Table 1: Demographic characteristics of migrant population sample

Demographic Variable	Categories	Frequency	Percentage (%)
Gender	Male	210	53.7
	Female	181	46.3
Age	18-29 years	96	39.5
	30-39 years	150	60.5
Education Level	Below High School	40	10.2
	High School Diploma	125	32
	Vocational/Technical Training	120	30.7
	Bachelor's Degree or higher	106	27.1
Employment Type	Manufacturing	110	28.1
	Service Industry	145	37.1
	Construction	53	13.6
	Other	83	21.2
Region of Migration	Eastern China	130	33.2
	Central China	110	28.1
	Western China	151	38.6
Marital and Fertility Status	Married with no children	205	52.4
	Married with one child	186	47.6

Source: own elaboration of the authors.

The questionnaire was distributed through online and offline channels to ensure broader coverage and that the sample was representative and diverse. This approach allowed the study to reach a broader range of migrant populations, especially those with limited access to the Internet, thereby increasing the comprehensiveness of the survey.

The online questionnaire was primarily distributed through social media platforms, community networks for migrant populations, and various online forums. To increase participation rates, the research team also utilized popular social apps among migrant populations, such as WeChat and QQ, providing convenient access via QR codes or direct links for respondents to complete the survey. The online questionnaire offered the advantages of convenience and speed while covering a large geographic area, ensuring that migrant populations from different regions could participate. To maintain data quality, the online questionnaire was set up to prevent multiple submissions, allowing each respondent to submit only once.

For those who might not be able to participate through online channels, the research team also distributed the questionnaire offline. Offline surveys were mainly distributed in areas with high concentrations of migrant populations, such as factories, construction sites, wholesale markets, and specific community activity centres. The research team collaborated with local migrant service organizations, leveraging their influence and trust within these areas to ensure the smooth collection of offline questionnaires and a high response rate. During the offline distribution process, the team also arranged for personnel to provide face-to-face guidance for respondents unfamiliar with the questionnaire or with difficulty understanding needed help. After the offline questionnaires were completed, designated staff were responsible for inputting the data into the online system, ensuring consistency and uniformity of the data.

Upon completing the data collection, the research team thoroughly cleaned and processed both the online and offline data:

1. Invalid data were removed, such as incomplete questionnaires or those with obvious logical errors.
2. The team cross-checked the online and offline data to ensure no duplicate submissions or participation occurred.
3. Throughout the data processing phase, respondents' privacy was strictly protected.

All personal information was anonymized to ensure data security and the ethical compliance of the study.

By combining online and offline methods, this study was able to include migrant populations from various professions, regions, and age groups. Mainly through the offline channels, the research reached more grassroots workers and migrants who rarely use the Internet—groups often overlooked in traditional online surveys. Integrating online and offline data ensured diversity and representativeness in the sample, providing a solid foundation for analyzing the relationship between urban public services and migrant populations' fertility intentions.

Variable selection and Questionnaire designs

The questionnaire design in this study was based on a comprehensive literature review, incorporating the cost-benefit theory of fertility and the theory of planned behaviour to construct a systematic multi-dimensional variable framework (as shown in Table 2). This framework was used to analyze the impact of urban public services and social integration on the

fertility intentions of migrant populations. As illustrated in Figure 1, the study clearly defined the independent, mediating, and dependent variables, ensuring the structure's scientific rigour and logical consistency.

Table 2: Constructs, Theoretical Frameworks, and Literature Support

Construct	Theoretical Framework	Literature Support
Educational Service Coverage	Cost-Benefit Theory of Fertility	Becker (1981); Becker, 1985; Fouad *et al*. (2021); Matera *et al*. (2023).
Healthcare Accessibility	Cost-Benefit Theory	Grossman (1972); Bongaarts (2006); Ajzen and Klobas (2013).
Social Security Coverage	Cost-Benefit Theory	Myles and Pierson (2001); Zhou and Li (2019); Wang (2020).
Physical Health Status	Theory of Planned Behavior (TPB)	Ajzen (1991); Ajzen and Klobas (2013); Smith and Williams (2020).
Household Economic Capacity	Cost-Benefit Theory	Becker (1991); Lee and Yu (2019); Clark and Sorensen (2021).
Social Integration Level	Adaptation-Assimilation Theory	Alba and Nee (1997); Portes and Rumbaut (2014); Lancee (2012).
Reproductive Intention	Theory of Planned Behavior (TPB)	Ajzen (1991); Ajzen and Klobas (2013); Bongaarts (2006).

Source: own elaboration of the authors.

First, the independent variables include three significant aspects of urban public services: coverage of education services, accessibility of healthcare services, and social security coverage. These variables aim to assess the impact of urban public services on the migrant population. The coverage of education services precisely measures the accessibility of educational resources available to the migrant population in their host cities and their influence on family decision-making. Relevant indicators include the extent of education service coverage, the quality of education, and the ease of access to educational resources. The accessibility of healthcare services evaluates the ease with which the migrant population can access healthcare and the role this plays in ensuring reproductive health, with a particular focus on support for reproductive health and safety. The coverage of social security assesses the extent to which the migrant population benefits from social security in the city and how this reduces the costs of childbearing. Specific indicators include the pervasiveness of the social security system and the participation rate of the migrant population in this service.

The mediating variable is social integration, reflecting the migrant population's adaptability, sense of belonging, and access to social support in the city. Social integration is measured through multiple dimensions, including community involvement, the strength of social support networks, and the degree of psychological security achieved. Based on adaptation-assimilation theory, social integration acts as a mediator between urban public services and fertility intentions. Through these indicators, the study systematically evaluates the indirect effect of social integration on fertility decisions, particularly how enhancing the sense of belonging can increase fertility intentions.

The dependent variable is fertility intention, which primarily measures the attitudes and decision-making behaviour of the migrant population toward having more children. The design of fertility intention focuses on the migrant population's perceptions of childbearing costs, their expectations for future life planning, and the influence of social norms on their fertility choices. This variable is assessed through multiple indicators to ensure it captures the various considerations the migrant population factors into their actual fertility decisions.

To ensure the validity and reliability of the questionnaire, the study referred to a large number of published literature and well-established scale tools. The initial set of measurement items was constructed and localized based on the social context of China's migrant population. All measurement items used a 7-point Likert scale, ranging from "strongly disagree" to "strongly agree" to allow respondents to express their attitudes and positions fully. The questionnaire design was pre-tested on a small scale to verify its logic and reasonableness, and based on feedback, certain items were revised and optimized, further enhancing the reliability and validity of the questionnaire. In summary, the questionnaire design, with the setting of independent variables, mediating variables, and dependent variables, is rigorous and systematic, ensuring a comprehensive reflection of the complex relationship between urban public services, social integration, and the fertility intentions of the migrant population. The specific measurement items can be found in Appendix A.

Methodological analysis

This study is divided into two stages, utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) and Artificial Neural Networks (ANN) to comprehensively explore the key factors influencing the fertility intentions of the migrant population. In the first stage, PLS-SEM was employed

to construct and validate the theoretical model. PLS-SEM is particularly well-suited for handling complex model structures, as it can simultaneously analyze relationships between multiple latent variables. It also demonstrates high robustness and flexibility when dealing with incomplete data and non-normal distributions. Therefore, PLS-SEM is an appropriate tool for constructing and empirically testing the theoretical model. This study used the PLS-SEM method to examine the impact of urban public service levels and social integration on the fertility intentions of the migrant population, revealing the causal relationships and interactions between these factors. The measurement variables were developed based on an extensive literature review and integrated self-determination theory and the theory of planned behaviour. The questionnaire's validity was verified through a pilot survey, which showed that respondents understood the content well, thus providing a solid foundation for data reliability.

In the second stage, ANN was introduced as a supplementary analysis method to further validate and expand the findings from the first stage. As a nonlinear modelling tool, ANN is particularly suited for handling complex data relationships and pattern recognition. Compared to PLS-SEM, ANN has a more robust generalization capability, can handle larger datasets, and is not constrained by sample size or data distribution. Therefore, ANN was used to analyze the critical driving factors identified in the PLS-SEM stage, ensuring the robustness and predictive accuracy of the study's results.

By combining PLS-SEM and ANN, this study not only comprehensively analyzes the key factors influencing the fertility intentions of the migrant population but also uncovers the complex interrelationships between different factors. This multi-method research design provides a solid theoretical foundation and empirical support for an in-depth understanding of the fertility decision-making mechanisms of the migrant population, enhancing the explanatory power and predictive strength of the study and ensuring the scientific rigour and reliability of the findings.

Analysis and Results

Common Method Bias

This study employed a cross-sectional design, which may face the threat of standard method bias (CMB). CMB can affect the validity of the data, leading to bias in the study results, weakening the accuracy of theoretical deductions, and impacting the reliability of policy recommendations. To address this potential issue, this study followed the strategies proposed by

Tan and Ooi (2018). It adopted a series of procedural and statistical remedies to ensure the scientific rigour and reliability of the research results.

For procedural remedies, the study strictly adhered to principles of confidentiality and anonymity to ensure that participants' privacy was fully protected. Research shows that such guarantees can reduce social desirability bias, allowing participants to answer more honestly, thus reducing bias caused by respondents' subjective tendencies. Additionally, the questionnaire design focused on clarity and simplicity, avoiding ambiguous or obscure terms. This design strategy helped participants better understand each question, resulting in more accurate and valid responses.

Regarding statistical remedies, the study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess potential method bias within the structural model. PLS-SEM is a commonly used statistical method for identifying and controlling CMB. PLS-SEM can control potential standard method bias when analyzing relationships between latent variables by introducing a common method factor. This approach improved the model's predictive ability and enhanced its explanatory power, ensuring the robustness and reliability of the study's conclusions. Through this method, the study more accurately evaluated the proper relationships between latent variables, avoiding false correlations or misinterpretations of causal relationships due to CMB.

In summary, the procedural and statistical remedies effectively reduced the potential impact of CMB on this study, thereby enhancing the scientific rigour and validity of the conclusions. These measures provided a more solid foundation for subsequent analyses. They ensured that the findings truly reflected the fertility intentions of the migrant population, offering reliable theoretical and empirical support for relevant policy-making.

Assessing the Outer Measurement Model

In this study, composite reliability (CR) was used to assess the internal consistency of the scales. CR is a standard method for measuring indicator consistency in a measurement model. According to the recommendations of Wong *et al*. (2022) and Lau *et al*. (2021), the minimum acceptable threshold for CR is typically 0.7. This means that when the CR value exceeds 0.7, the scale's internal consistency can be considered reasonable. The analysis in Table 3 found that the CR values for all constructs exceeded 0.7, with the highest reaching 0.92. This indicates that the measurement tools used in the study are highly reliable and have good internal consistency among the measurement items.

Table 3: Loadings, composite reliability and average variance extracted

Constructs	Items	Loadings (p-levels)	Composite Reliability (CR)	Average Variance Extracted (AVE)
ESC	ESC1	0.76 ($p < 0.001$)	0.88	0.59
	ESC2	0.82 ($p < 0.001$)		
	ESC3	0.80 ($p < 0.001$)		
	ESC4	0.74 ($p < 0.001$)		
	ESC5	0.78 ($p < 0.001$)		
HA	HA1	0.81 ($p < 0.001$)	0.9	0.62
	HA2	0.84 ($p < 0.001$)		
	HA3	0.77 ($p < 0.001$)		
	HA4	0.85 ($p < 0.001$)		
	HA5	0.79 ($p < 0.001$)		
SSC	SSC1	0.83 ($p < 0.001$)	0.89	0.6
	SSC2	0.80 ($p < 0.001$)		
	SSC3	0.78 ($p < 0.001$)		
	SSC4	0.81 ($p < 0.001$)		
	SSC5	0.77 ($p < 0.001$)		
PHS	PHS1	0.86 ($p < 0.001$)	0.92	0.66
	PHS2	0.88 ($p < 0.001$)		
	PHS3	0.84 ($p < 0.001$)		
	PHS4	0.82 ($p < 0.001$)		
	PHS5	0.80 ($p < 0.001$)		
HEC	HEC1	0.75 ($p < 0.001$)	0.87	0.58
	HEC2	0.78 ($p < 0.001$)		
	HEC3	0.76 ($p < 0.001$)		
	HEC4	0.80 ($p < 0.001$)		
	HEC5	0.79 ($p < 0.001$)		
SIL	SIL1	0.82 ($p < 0.001$)	0.91	0.63
	SIL2	0.85 ($p < 0.001$)		
	SIL3	0.81 ($p < 0.001$)		
	SIL4	0.83 ($p < 0.001$)		
	SIL5	0.80 ($p < 0.001$)		
RI	RI1	0.77 ($p < 0.001$)	0.88	0.59
	RI2	0.80 ($p < 0.001$)		
	RI3	0.82 ($p < 0.001$)		
	RI4	0.75 ($p < 0.001$)		
	RI5	0.78 ($p < 0.001$)		

Source: own elaboration of the authors.

Additionally, this study tested for convergent validity (CV) using factor loadings (FL) and the average variance extracted (AVE). Factor loadings reflect the explanatory power of each measurement item for its corresponding latent variable. When the factor loading exceeds 0.6 and passes the

significance test ($p < 0.05$), the measurement item has strong explanatory power for the latent variable and sufficient convergent validity. The results in Table 3 show that all measurement items have factor loadings greater than 0.6, and all significance tests were passed at the $p < 0.001$ level, indicating that all measurement items in the study exhibit good convergent validity. Moreover, the AVE values for each construct ranged from 0.58 to 0.66, all exceeding the 0.5 threshold, further demonstrating good convergent validity for the data. According to the standards proposed by Wong *et al*. (2014), these results suggest that the measurement tools used in the study are adequate for convergent validity.

To further verify discriminant validity (DV), this study adopted the standard proposed by Fornell and Larcker (1981), which states that the square root of the AVE for each construct should be greater than the correlation coefficients between that construct and other constructs. The discriminant validity was confirmed using the Fornell-Larcker criterion, as shown in Table 4. The diagonal values in the table represent the square roots of the AVE, and all values were more significant than the correlation coefficients between the constructs. For example, the square root of the AVE for Education Service Coverage (ESC) was 0.77, which was significantly higher than its correlation coefficients with Healthcare Accessibility (HA, correlation coefficient = 0.55) or Social Security Coverage (SSC, correlation coefficient = 0.52). Similarly, the discriminant validity of other constructs also met this standard. Therefore, the analysis results in Table 4 indicate that the study data exhibit good discriminant validity, supporting the distinction between the constructs.

Table 4: Fornell-Larcker Criterion

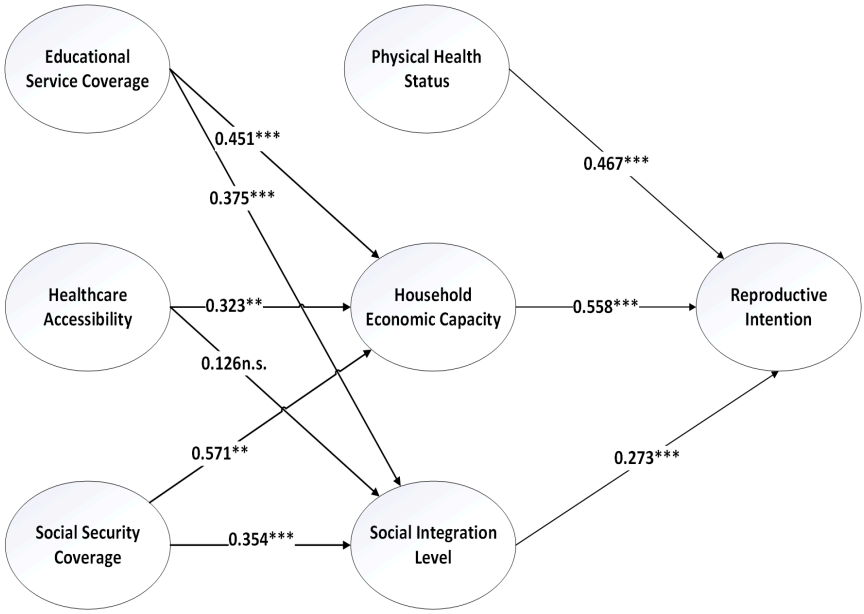
	ESC	HA	SSC	PHS	HEC	SIL	RI
ESC	0.77						
HA	0.55	0.79					
SSC	0.52	0.60	0.77				
PHS	0.50	0.57	0.55	0.81			
HEC	0.48	0.53	0.51	0.58	0.76		
SIL	0.54	0.58	0.57	0.60	0.55	0.79	
RI	0.49	0.56	0.54	0.59	0.52	0.61	0.77

Note: Diagonal elements (in italic) are the square root of the average variance extracted.
Source: own elaboration of the authors.

Inspecting the Inner Structural Model

According to the model testing results in Figure 2 and Table 5, this study reveals the complex interaction mechanisms between household economic capacity, social integration level, and fertility intentions, highlighting the close relationships between these factors. First, education service coverage (ESC) plays a critical role in enhancing household economic capacity (HEC) and promoting social integration levels (SIL). Specifically, the path coefficient from ESC to HEC is 0.451, with a significance level of $p < 0.001$, indicating that access to educational resources can significantly improve a household's economic foundation. This directly contributes to wealth accumulation and provides individuals with more robust support for social integration. Moreover, ESC also significantly impacts SIL (path coefficient of 0.375, $p < 0.001$), demonstrating that educational services play an essential role in increasing individuals' sense of social participation and belonging.

Figure 2: Results of hypotheses testing



Source: own elaboration of the authors.

Table 5: Outcome of the structural model examination

PLS Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Bias Corrected Confidence Interval	Remarks
ESC→HEC***(H1a)	0.451	0.432	0.074	6.434	0.000	[0.312, 0.575]	Significant
ESC→SIL***(H1b)	0.375	0.363	0.084	4.634	0.000	[0.216, 0.493]	Significant
HA→HEC**(H2a)	0.323	0.314	0.062	5.335	0.000	[0.223, 0.415]	Significant
HA→SILn.s.(H2b)	0.126	0.116	0.095	1.335	0.183	[-0.052, 0.276]	Not Significant
SSC→HEC**(H3a)	0.571	0.481	0.077	7.147	0.000	[0.362, 0.626]	Significant
SSC→SIL***(H3a)	0.354	0.342	0.086	4.384	0.000	[0.205, 0.486]	Significant
PHS→RI***(H4)	0.467	0.394	0.052	8.256	0.000	[0.308, 0.509]	Significant
HEC→RI***(H5)	0.558	0.534	0.063	9.176	0.000	[0.435, 0.673]	Significant
SIL→RI***(H6)	0.273	0.266	0.071	3.866	0.000	[0.133, 0.418]	Significant

Notes: a. * Significant at $p < 0.05$ level. b. ** Significant at $p < 0.01$ level. c. *** Significant at $p < 0.001$ level. d. n.s. Not supported.
Source: own elaboration of the authors.

Social security coverage (SSC) also significantly enhances household economic capacity and social integration level. The path coefficient from SSC to HEC is 0.571, with a significance level of $p < 0.01$, indicating that the social security system contributes substantially to improving household economic stability. The broad coverage of social security helps families withstand economic fluctuations and enhances individuals' sense of security and belonging. SSC's impact on SIL is also significant (path coefficient of 0.354, $p < 0.001$), showing that social security positively influences individuals' social network building and increases their level of social participation.

In terms of health, an individual's physical health status (PHS) has a significant impact on fertility intentions (RI) (path coefficient of 0.467, $p < 0.001$), suggesting that health is one of the critical factors influencing fertility intentions. A healthy physical state boosts individuals' expectations for the future and increases their confidence in having the next generation. Additionally, household economic capacity (HEC) has the most significant effect on fertility intentions, with a path coefficient of 0.558 and $p < 0.001$, indicating that economic conditions are the core factor in fertility decision-making. A stable household economic foundation significantly enhances individuals' confidence in making fertility decisions and reduces concerns about future financial pressures.

However, not all paths reached statistical significance. For example, the impact of healthcare accessibility (HA) on social integration level (SIL) was not significant (path coefficient of 0.126, $p = 0.183$). This suggests that in the context of this study, more than simply accessing healthcare services is required to enhance individuals' level of social integration significantly. This result may be related to the form of healthcare services or differences in society's perceptions of healthcare accessibility.

In conclusion, the model analysis reveals the profound impact of education services, social security, health status, and economic capacity on household economic capacity, social integration level, and fertility intentions. The study results indicate that the complex relationships between these variables play a crucial role in fertility decision-making and social integration. These findings provide valuable theoretical insights and practical guidance for future policy interventions to improve fertility intentions and social integration levels.

The Predictive Relevance and Effect Size

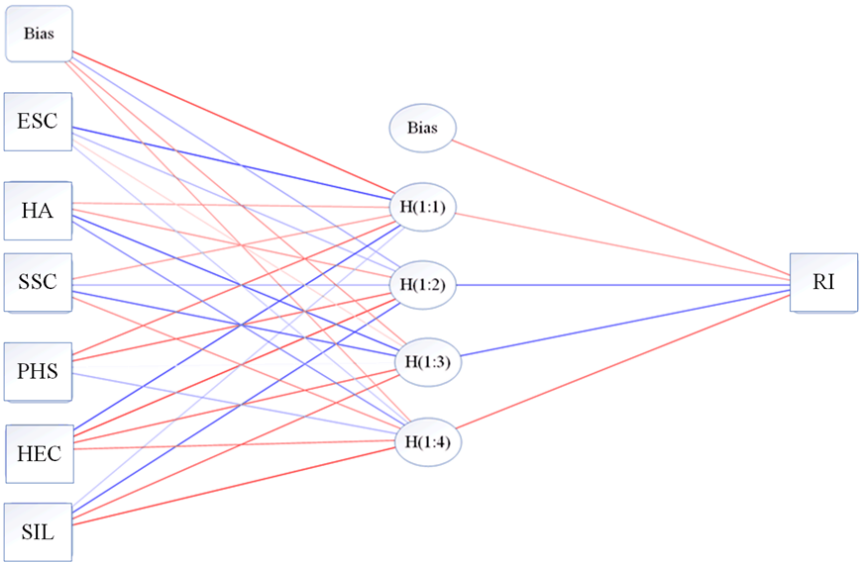
According to Cohen's (Cohen, 1992) effect size standards, effect size (f^2) values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively, while values below 0.02 indicate no effect (Hew, Badaruddin and Moorthy, 2017). In this study, all f^2 values ranged from 0.007 to 0.423, indicating that while some paths had weaker effects, the overall model still demonstrated medium to significant effects. This suggests that although certain variables in the model have limited explanatory power, the overall impact remains significant.

Additionally, all Q^2 values ranged between 0.197 and 0.555, and all were higher than zero, indicating that the endogenous structures in the model possess significant predictive relevance. A Q^2 value greater than zero means the model has a strong predictive ability for the related structures. These data further validate the model's effectiveness and show its robustness in explaining complex relationships between variables.

This study applied PLS prediction analysis to confirm further the model's predictive capacity (Shmueli, Sarstedt, Hair, Cheah, Ting, Vaithilingam and Ringle, 2019). The analysis results showed that for critical target structures such as fertility intentions (RI), the root mean square error (RMSE) value of the linear model (LM) was higher than that of the PLS-SEM model. This indicates that the PLS prediction method demonstrated the model's moderate predictive ability, better handling nonlinear or complex structural relationships and capturing subtle interactions between variables.

At the same time, the model explained the variance of several core structures, including social integration level (SIL), household economic capacity (HEC), and fertility intentions (RI), with explained variances of 49.6, 57.9 and 41.1 per cent, respectively. These proportions suggest that the critical factors in the model have strong explanatory power for their corresponding structures, reflecting the influence of these variables on the target outcomes. Therefore, these data support the idea that the overall model has good explanatory power and predictive ability.

Figure 3: ANN model for RI



Source: own elaboration of the authors.

Although some paths exhibit relatively small effect sizes, the model effectively reveals the complex relationships between variables, particularly demonstrating significant capability in predicting and explaining multiple endogenous structures. As a result, the findings show that the model explains the current data patterns and reasonably predicts future outcomes. The model's medium to large effect sizes and significant explanatory capacity make it valuable for exploring complex relationships between variables.

Table 6: RMSE values for HEC, SIL and RI

Neural network	Model A (Output: HEC)			Model B (Output: SIL)			Model C (Output: RI)		
	ESC	HA	SSC	ESC	HA	SSC	PHS	HEC	SIL
ANN1	0.218	0.133	0.647	0.564	0.097	0.338	0.357	0.450	0.189
ANN2	0.159	0.133	0.662	0.582	0.119	0.340	0.355	0.448	0.199
ANN3	0.195	0.156	0.690	0.576	0.116	0.311	0.328	0.455	0.223
ANN4	0.167	0.182	0.649	0.526	0.113	0.357	0.308	0.443	0.210
ANN5	0.239	0.150	0.670	0.538	0.108	0.400	0.311	0.441	0.179
ANN6	0.217	0.173	0.662	0.534	0.086	0.374	0.359	0.456	0.211
ANN7	0.239	0.120	0.651	0.541	0.136	0.351	0.380	0.503	0.184
ANN8	0.179	0.165	0.671	0.558	0.100	0.349	0.326	0.432	0.155
ANN9	0.192	0.150	0.695	0.520	0.074	0.347	0.371	0.461	0.206
ANN10	0.190	0.154	0.636	0.539	0.109	0.381	0.384	0.449	0.170
Average relative importance	0.199	0.152	0.663	0.548	0.106	0.355	0.348	0.454	0.193
Normalized relative importance (%)	30.077	22.855	100.000	100.000	19.314	64.768	76.664	100.000	42.442

Source: own elaboration of the authors.

Table 7: Sensitivity analysis

Neural network	Model A (Output: HEC)			Model B (Output: SIL)			Model C (Output: RI)		
	ESC	HA	SSC	ESC	HA	SSC	PHS	HEC	SIL
ANN1	0.218	0.133	0.647	0.564	0.097	0.338	0.357	0.450	0.189
ANN2	0.159	0.133	0.662	0.582	0.119	0.340	0.355	0.448	0.199
ANN3	0.195	0.156	0.690	0.576	0.116	0.311	0.328	0.455	0.223
ANN4	0.167	0.182	0.649	0.526	0.113	0.357	0.308	0.443	0.210
ANN5	0.239	0.150	0.670	0.538	0.108	0.400	0.311	0.441	0.179
ANN6	0.217	0.173	0.662	0.534	0.086	0.374	0.359	0.456	0.211
ANN7	0.239	0.120	0.651	0.541	0.136	0.351	0.380	0.503	0.184
ANN8	0.179	0.165	0.671	0.558	0.100	0.349	0.326	0.432	0.155
ANN9	0.192	0.150	0.695	0.520	0.074	0.347	0.371	0.461	0.206
ANN10	0.190	0.154	0.636	0.539	0.109	0.381	0.384	0.449	0.170
Average relative importance	0.199	0.152	0.663	0.548	0.106	0.355	0.348	0.454	0.193
Normalized relative importance (%)	30.077	22.855	100.000	100.000	19.314	64.768	76.664	100.000	42.442

Source: own elaboration of the authors.

Table 8: Comparison between PLS-SEM and ANN results

PLS Path	Original sample (O)/ Path Coefficient	ANN results: Normalised relative importance (%)	Ranking (PLS-SEM) [based on Path Coefficient]	Ranking (ANN) [based on Normalised relative importance (%)]	Remark
Model A (Output: HEC)					
ESC→HEC	0.451	0.199	2	2	Match
HA→HEC	0.323	0.152	3	3	Match
SSC→HEC	0.571	0.663	1	1	Match
Model B (Output: SIL)					
ESC→SIL	0.375	0.548	1	1	Match
HA→SIL	0.126	0.106	3	3	Match
SSC→SIL	0.354	0.355	2	2	Match
Model C (Output: RI)					
PHS→RI	0.467	0.348	2	2	Match
HEC→RI	0.558	0.454	1	1	Match
SIL→RI	0.273	0.193	3	3	Match

Source: own elaboration of the authors.

Discussion

The Role of Urban Public Services

This study found that education service coverage (ESC) and social security coverage (SSC) are key factors influencing the fertility intentions of the migrant population. This is consistent with Becker's (Bergmann, 1995) human capital theory, which suggests that education enhances individuals' competitiveness in the labour market, improves economic stability, and reduces financial pressure, leading families to consider childbearing more positively. The broad coverage of educational services not only improves the economic situation of the migrant population but also strengthens their social adaptability and sense of belonging, which plays a crucial role in promoting fertility intentions (Liu, Li and Breitung, 2012).

Moreover, the social security system significantly enhances the fertility intentions of the migrant population by providing economic security and reducing uncertainties in life. This finding aligns with the research of Simpson (Simpson, Albani, Bell, Bambra and Brown, 2021), which suggested that a well-established social security system can alleviate the economic burden of childbearing and enhance individuals' sense of social integration (Liu, 2019). Therefore, social security serves not only as an economic support tool but also plays a crucial role in strengthening social support networks and increasing the sense of belonging in cities (Mai and Wang, 2022).

However, this study found that healthcare accessibility (HA) did not significantly impact social integration. This result differs from Mai and Wang, who argued that the availability of healthcare services could enhance the social support system of the migrant population and promote social integration (Mai and Wang, 2022). This discrepancy may reflect the varying roles of healthcare services in different regions and social contexts. In some cases, healthcare services may only serve as a tool for improving physical health rather than being a primary means of promoting social integration. Future research could further explore the different forms of healthcare services and their multifaceted roles in social integration.

The Role of Health Status and Household Economic Capacity

The findings show that physical health status (PHS) significantly impacts fertility intentions, which is consistent with the health capital theory. Grossman's (Grossman, 1972) health capital model emphasizes that improved health status reduces childbearing risks and enhances individuals'

confidence in the future. This study confirmed this theory, showing that the migrant population with good health demonstrates higher fertility intentions. Healthy individuals are more confident in assuming future childbearing responsibilities and can better cope with childbearing physical and financial pressures.

The significant impact of household economic capacity (HEC) on fertility intentions aligns with Easterlin's (Easterlin, 1975) economic decision-making theory, which argues that economic stability is a core determinant of fertility decisions. This study further revealed that improved economic capacity significantly alleviates the financial pressure of childbearing, thereby increasing the fertility intentions of the migrant population. This conclusion is consistent with the findings of Niu and Zhao, who emphasized the positive influence of wealth accumulation on confidence in fertility decisions (Niu and Zhao, 2018). Therefore, this study highlights that policy design should focus on effectively reducing the economic burden of the migrant population through economic support policies to stimulate fertility intentions.

The Mediating Role of Social Integration

This study shows that social integration (SIL) is essential in the relationship between urban public services and fertility intentions. This aligns with Ajzen's (Ajzen and Driver, 2018) theory of planned behaviour, which emphasizes the role of social norms and perceived behavioural control in individual decision-making processes. The study found that by enhancing individuals' sense of belonging and social support networks, social integration reduces uncertainties in urban life, thereby increasing the likelihood of having more children. Improved social integration not only brings psychological security to individuals but also boosts their confidence in future life, which significantly impacts fertility decisions. Similarly, Peng and Ling (Peng and Ling, 2019) pointed out that social integration can further promote fertility intentions by enhancing access to social capital. Therefore, social integration is a critical mediating variable, bridging the gap between economic capacity and fertility intentions. Based on this, governments and policymakers could enhance the social support networks and sense of belonging among the migrant population to boost their fertility intentions indirectly.

The above results indicate that this study reveals the complex relationships between urban public services, health status, household economic capacity, and social integration. By emphasizing the mediating role of social

integration and the influence of economic factors on fertility intentions, this study provides important references for further formulating effective social policies.

Conclusion and Limitations

The theoretical contribution of this study lies in systematically integrating adaptation-assimilation theory and the theory of planned behaviour to comprehensively analyze the combined effects of urban public services, health status, economic capacity, and social integration on the fertility intentions of the migrant population. Compared with the existing literature, this study explores the direct effects of urban public services on fertility decisions. It introduces social integration as a variable, revealing its significant mediating role between urban public services and fertility intentions. By integrating these two theories, the study deepens our understanding of the fertility decision-making process of the migrant population in urban environments, especially in the complex interactions between public services and social integration. Specifically, the study found that education services and social security have a significant positive impact on the fertility intentions of the migrant population, validating the applicability of human capital theory and the effects of social security. Moreover, as a mediating variable, social integration further strengthens the influence of public services on fertility intentions, highlighting the critical role of social integration in enhancing the sense of belonging and social support networks in cities. This finding provides a new theoretical basis for government policy-making, emphasizing the linkage effects between public services and social integration.

In practical terms, this study offers new perspectives for governments and policymakers. In efforts to enhance the fertility intentions of the migrant population, governments should focus on optimizing the social security system and education services and strengthen social integration mechanisms to create a more inclusive and friendly social environment. This suggests that single public service measures, such as healthcare services, may not significantly enhance the sense of social integration. Future policy-making should focus on multi-sectoral coordination by integrating various public services, such as education, social security, and healthcare, to improve the overall quality of life for the migrant population and indirectly influence their fertility intentions.

Despite revealing the complex relationship between urban public services and the fertility intentions of the migrant population, this study has certain limitations. First, the research data were primarily sourced from speci-

fic regions in China, limiting the generalizability of the results. Therefore, future studies could explore the applicability of the findings across different cultures and social contexts through cross-national or cross-regional comparative studies to verify the global relevance of the results. Expanding the sample scope will further deepen the understanding of the diverse factors influencing the fertility intentions of the migrant population. Second, this study utilized cross-sectional data, which can reveal correlations between variables but cannot capture dynamic changes over time. Future research could adopt a longitudinal design to examine the causal relationships between public services, social integration, and fertility intentions and how these relationships evolve. Longitudinal studies can better reveal the long-term effects of public services and the varying impacts of social integration on fertility intentions at different stages.

Furthermore, although this study explored the effects of education, social security, and healthcare services on fertility intentions, it still needs to fully consider the potential impact of other public services on fertility decisions. For example, housing support, transportation convenience, and cultural and recreational facilities may have new impacts on the social integration and fertility intentions of the migrant population. Future research could expand the scope of public services and examine the roles of different types of services in the quality of life and fertility decisions of the migrant population. By overcoming these limitations and expanding the scope of the research, future studies could provide policymakers with more comprehensive and empirically enriched guidance, thereby offering more robust theoretical support and practical references for improving fertility intentions and optimizing urban public service systems.

Abbreviations Table:

Full Name	Abbreviation
Artificial Neural Network	ANN
Educational Service Coverage	ESC
Healthcare Accessibility	HA
Household Economic Capacity	HEC
Physical Health Status	PHS
Partial Least Squares Structural Equation Modeling	PLS-SEM
Reproductive Intention	RI
Social Integration Level	SIL
Social Security Coverage	SSC

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Authors' curriculum summary

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Appendix A

Constructs	Measurement Items
Educational Service Coverage	I believe the educational resources (e.g., schools, training centers) in the destination city are very adequate.
	I am highly satisfied with the quality of education in the destination city.
	Educational costs (e.g., tuition, after-school tutoring fees) significantly influence my reproductive intention.
	I believe the local education policies strongly support child-rearing.
	I think the educational environment in the destination city is conducive to my child's development.
Healthcare Accessibility	I am highly satisfied with the availability of healthcare services (e.g., hospitals, clinics) in the destination city.
	Healthcare costs significantly influence my reproductive intention.
	It is easy for me to access maternal healthcare services (e.g., prenatal care, delivery services).
	I am highly satisfied with the quality of healthcare services in the destination city.
	I believe the local healthcare policies strongly support childbearing and parenting.
Social Security Coverage	I believe the social security system (e.g., pension, unemployment insurance) in the destination city is very well-established.
	I am enrolled in the local social security system.
	I am highly satisfied with the coverage and quality of social security in the destination city.
	I believe the social security system significantly influences my fertility decisions.
	I believe the social security policies significantly reduce the financial pressure of raising children.
Physical Health Status	My health status is good enough for me to consider having more children.
	Health issues significantly influence my reproductive intention.
	I believe regular health check-ups help inform my fertility decisions.
	My physical health status greatly impacts my decision to have more children.

Source: own elaboration of the authors.

	I can easily access the necessary healthcare services to maintain my health.
Household Economic Capacity	My household's financial situation is sufficient to support having more children.
	Financial pressure significantly affects my reproductive intention.
	My income level gives me confidence in raising more children.
	When considering having more children, I heavily consider the financial burden on my household.
	Confidence in my household's financial status strengthens my reproductive intention.
Social Integration Level	I have integrated well into the community in the destination city.
	The friends I have made in the destination city provide strong support.
	I feel that my family and I are accepted by the local society.
	The support from my social relationships has strengthened my confidence in having more children.
	I believe the community support network in the destination city helps me in my fertility decisions.
Reproductive Intention	I plan to have more children in the next few years.
	I have a positive attitude towards having more children.
	I feel confident in taking on the responsibilities of raising more children.
	When considering having more children, I take the economic and social impacts into account.
	My partner supports my decision to have more children.

Source: own elaboration of the authors.