

SOCIO-ECONOMIC DETERMINANTS OF TOTAL FERTILITY RATE IN THE CZECH REPUBLIC

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Abstract

The central aim of this article is to explore how socio-economic variables impact the evolution of the total fertility rate, with a specific focus on the Czech Republic. The study employs dynamic regression analysis of time series data to investigate the associations between the dependent variable (total fertility rate) and a range of independent factors spanning various categories, such as social, economic, and cultural aspects. In our model, social variables encompass a wide spectrum, including the presence of family and child-oriented social support systems, accessibility to child-care facilities, housing conditions, and other relevant factors. Economic variables are comprehensively represented by metrics such as GDP, the unemployment rate, variables indicative of population well-being, and more. Demographic factors, on the other hand, encapsulate the total fertility rate itself. To facilitate this research, data is sourced from the Czech Statistical Office. The analysis unveils distinctive factors that wield significant influence over their respective trends.

Keywords: total fertility rate, dynamic regression analysis, demographic trends, fertility factors

JEL Code: C22, J11, J13

Introduction

The primary objective of this paper is to investigate the impact of socio-economic variables on the evolution of the total fertility rate (TFR), with a specific focus on the case of the Czech Republic. This research employs linear dynamic regression analysis of time series data to explore the associations between the total fertility rate, as the dependent variable, and a range of independent factors that span various categories, including social, economic, and cultural aspects.

In the realm of social variables, our examination encompasses a wide spectrum, including aspects such as the presence of family and child-oriented social support systems, the accessibility of child-care facilities, housing conditions, and other pertinent factors. The

economic variables under consideration are comprehensively represented by metrics such as Gross Domestic Product (GDP), the unemployment rate, variables indicative of population well-being, and others.

The first part of the article offers a theoretical foundation, discussing total fertility trends in past decades and summarizing existing research. This information provides the necessary background to understand the later sections.

In the second part of the article, we present the findings from our analysis of all the variables we examined. This section reveals the results of our research, showing how socio-economic factors relate to the total fertility rate in the Czech Republic.

1 Method and concept of the analysis

The concept of the analysis used in this paper originates from the theories of influences of family planning and fertility that come from the economic environment. These influences, also referred to as factors, can be divided into several categories. Most authors (eg. G. Becker, J. Bongaarts, and R. Lee) use the following categories to sort the factors:

- Economic factors: these would include variables like income, employment opportunities, etc.,
- Social factors: these would include variables describing the social norms of the society like education level and the availability of social protection,
- Cultural factors: these would reflect the cultural norms of the society, for example religiosity of the population (Barro and McCleary, 2006, Becker, 1960, Bongaarts and Casterline, 2013).

Demographic variables represent the trends of fertility and family planning of the population. For this analysis, the level of fertility is represented by the total fertility rate which was withdrawn from the Human Fertility Database. Research has shown that the total fertility rate is a reliable and valid measure of fertility. A study conducted by Bongaarts and Casterline (2013) found that the total fertility rate was strongly correlated with other measures of fertility behavior and the authors concluded that the total fertility rate provides a useful summary measure of current fertility patterns in a population.

The analytical approach employed in this study is built upon the research conducted by Cazzola, Pasquini, and Angeli in 2016. In their work, the authors employ dynamic regression models to investigate the impact of economic factors, with a focus on unemployment as studied in the original paper, on fertility behavior as measured by the total fertility rate. The dynamic

regression model, as utilized by Cazzola, Pasquini, and Angeli (2016) in their research, treats the total fertility rate as the dependent variable while treating the unemployment rate as the independent variable. This model incorporates not only the current values of these variables but also their past values at various lags. For detailed information on the specific procedures and conditions used in this analysis, readers are encouraged to consult the referenced article.

In the context of the Czech Republic, the total fertility rate (TFR) was selected as the dependent variable to gauge fertility levels. The TFR is recognized as a precise measure of fertility behavior within the Czech Republic, as it offers an estimate of the average number of children that a woman is anticipated to have during her reproductive years, considering the current age-specific fertility rates. This metric takes into consideration both the expected number of children per woman and the age at which these births are likely to occur, rendering it a comprehensive indicator of fertility patterns within the Czech Republic.

In the model, several different variables were chosen to represent factors that could affect the level of the total fertility rate. Variables included in the model were chosen from different categories with a possibly different effect on fertility behavior and family planning.

Independent variables representing economic growth and well-being of the population were chosen as follows:

- % of total expenditures of a household spent on groceries, industrial goods, and services,
- GDP and GDP growth,
- % of households with internet connection and PC,
- Real wage index, Real income index,
- Number of finished apartments,
- Economic activity,
- Unemployment rate.

Variables representing the cultural and social norms of the population are as follows:

- Number of classes in preschool education facilities,
- Government expenditures on family protection allowances,
- First-order marriage rate,
- The percentage of men/women with completed tertiary education.

All data was withdrawn from the database of the Czech Statistical Office for the longest time series available. The longest time series captures the time from 1989 to 2021.

Given the inherent characteristics and nature of the variables at hand, it is advantageous to employ dynamic regression techniques when examining the connection between fertility and the indicators. Dynamic regression methods enable us to model the interdependence of these

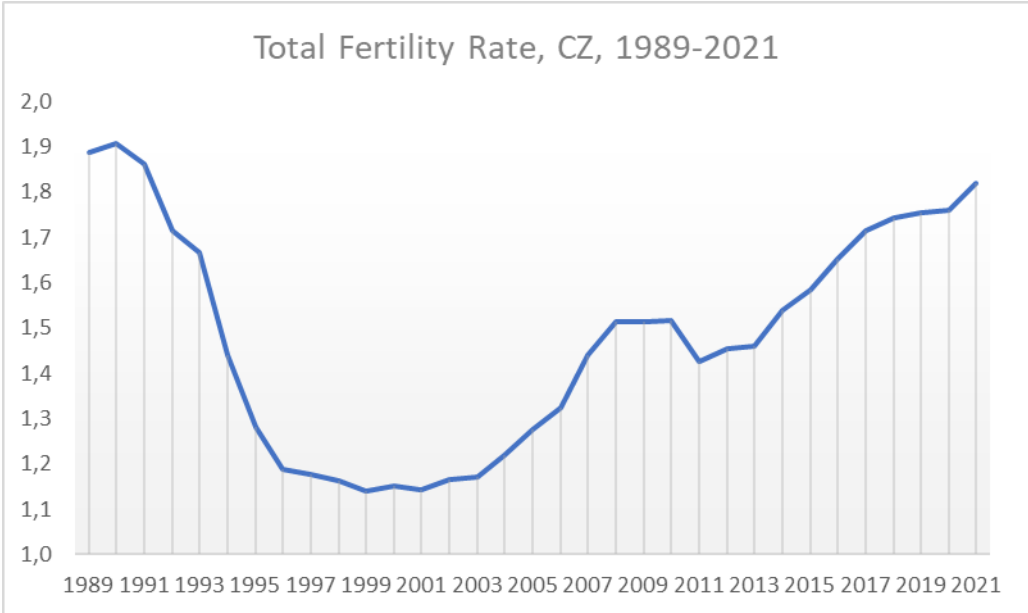
variables by introducing a temporal perspective, as demonstrated by Cazzola et al. (2016). The model can be defined as

$$TFR_t = \beta_0 + \beta_1 TFR_{t-1} + \beta_2 IND_{t-k} + e_t$$

where TFR_t is the total fertility rate in period t , TFR_{t-1} is the total fertility rate in the previous period. IND_{t-k} is the specific socioeconomic variable included in the model at lag k . The residual term of the model is denoted as e_t . Specifically, IND can take on the variations defined above (Un , SP , Rel , $GDPPC$) with the model definition otherwise unchanged.

This equation was performed for each indicator from the second u to the fifth lag. Then it was evaluated which indicators and which lags are significantly affecting the total fertility rate.

Fig.1 Total Fertility rate, Czech Republic, 1989-2021



Source: Human Fertility Database

The development of the total fertility rate in the Czech Republic very clearly reflects the political and cultural trends of the country. The highest number of children per woman was recorded right after the change of the political regime in 1989. The following years meant a significant decrease in the total fertility rate which reflected the new possibilities young people gained after the fall of the communist regime. The lowest values were recorded around the beginning of the new century and after that, with a slight decrease in 2011, the total fertility rate remained rising. The strong generation born in the years 2007-2009 was mostly caused by a strong generation of people born during the 1970s who delayed starting their families because

of the regime fall. The overall trend of family planning in modern society is to go from the concept of multiple children to creating families consisting just of the parents and their only child. And even the decision to stay out of the process of having any children has become more common (Hon, 2018).

2 Results of the analysis

In this chapter, the results of the linear dynamic regression analysis will be presented and discussed.

2.1 Total fertility rate (TFR) and household expenditures

The relationship between the total fertility rate (TFR) and household expenditures was analyzed using the percentage of total household expenditures spent on groceries (variable VYD_PO), industrial goods (VYD_PR), and services (VYD_SL) as the independent variables. These variables can help us understand the relationship between the financial stability of the family (household) and their desire or plan to have children.

Tab. 1: Linear dynamic regression output – VYD_PO

VYD_PO	coeff	std. error	t-stat	p-value	
const	0,942956	0,123197	7,654	3,21E-07	***
VYD_PO_5	-0,01667	0,0022716	-7,337	5,91E-07	***
TFR_1	0,641565	0,0596794	10,75	1,62E-09	***

Source: Own calculations

The linear regression model indicates that the percentage of household expenditures spent on groceries is significant in its 5th lag, which means in 5-year delay.

Tab. 2: Linear dynamic regression output – VYD_PR

VYD_PR	coeff	std. error	t-stat	p-value	
const	0,989717	0,125111	7,911	1,98E-07	***
VYD_PR_5	-0,01974	0,0026152	-7,55	3,92E-07	***
TFR_1	0,75365	0,0531928	14,17	1,49E-11	***

Source: Own calculations

The linear regression model indicates that the percentage of household expenditures spent on industrial goods is significant in its 5th lag, which means in 5-year delay.

Tab. 3: Linear dynamic regression output – VYD_SL

VYD_SL	coeff	std. error	t-stat	p-value	
const	0,129986	0,116866	1,112	2,80E-01	
VYD_SL_1	-0,0197	0,0078451	-2,511	2,12E-02	**
VYD_SL_4	0,024927	0,0060633	4,111	6,00E-04	***
TFR_1	0,821807	0,0505219	16,27	1,31E-12	***

Source: Own calculations

The percentage of household expenditures spent on services seems significant in its first and fourth lag.

2.2 Total fertility rate (TFR) and digital affinity

The two variables under consideration pertain to the percentages of households possessing a personal computer (PC) and those possessing a reliable internet connection. Both of these variables are posited to serve as indicators of the digital proclivity within households and are hypothesized to reflect the overall state of well-being and financial stability within the population. The provision of technical or digital resources within households represents a noteworthy indicator capable of elucidating the financial well-being of said households.

Tab. 4: Linear dynamic regression output – PC

PC	coeff	std. error	t-stat	p-value	
const	0,459472	0,072978	6,296	2,01E-06	***
PC_1	0,009457	0,0040317	2,346	2,80E-02	**
PC_2	-0,01199	0,0051926	-2,308	3,03E-02	**
PC_5	0,006829	0,0019635	3,478	2,00E-03	***
TFR_1	0,57907	0,0578594	10,01	7,53E-10	***

Source: Own calculations

The percentage of households owning a personal computer is significant in its first, second, and fifth lag.

Tab. 5: Linear dynamic regression output – INT

INT	coeff	std. error	t-stat	p-value	
const	0,517437	0,173938	2,975	1,16E-02	**
INT_3	-0,0062	0,0022174	-2,797	1,61E-02	**
INT_5	0,00731	0,0022208	3,291	6,40E-03	***
TFR_1	0,69225	0,127468	5,431	2,00E-04	***

Source: Own calculations

The percentage of households owning a stable internet connection is significant in its 3rd and 5th lag.

2.3 Total fertility rate (TFR) and economic growth

The economic growth represented with GDP does affect TFR in its first lag. The growth of GDP does affect TFR in its second lag. This means that the state of the economy does have an impact on the process of starting a family. The direction of the relationship between GDP and TFR suggests that the growth of the economy positively impacts the fertility of the population.

Tab. 6: Linear dynamic regression output – GDP

GDP	coeff	std. error	t-stat	p-value	
const	0,062748	0,0595525	1,054	3,01E-01	
GDP_1	3,66E-08	6,682E-09	5,478	7,52E-06	***
TFR_1	0,874258	0,0414164	21,11	9,80E-19	***

Source: Own calculations

Tab. 7: Linear dynamic regression output – GDP growth

GDPG	coeff	std. error	t-stat	p-value	
const	-0,01375	0,0885966	-0,1552	8,78E-01	
GDPG_2	0,008183	0,0035137	2,329	2,79E-02	**
TFR_1	1,00007	0,0603315	16,58	2,43E-15	***

Source: Own calculations

2.4 Total fertility rate (TFR) and the availability of preschool education

The availability of preschool education which is one of the variables representing the social aspects of the economy overall allows women to successfully return to the work process after having children. This aspect of work-life balance is even more crucial for women with completed higher education as they use preschool education facilities more than women with lesser education (Hon et al., 2021).

Tab. 8: Linear dynamic regression output – MS

MS	coeff	std. error	t-stat	p-value	
const	0,373119	0,150747	2,475	2,05E-02	**
MS_5	-2,6E-05	9,515E-06	-2,757	1,07E-02	**
TFR_1	1,00685	0,0602778	16,7	4,51E-15	***

Source: Own calculations

The number of available classes in preschool education facilities affects fertility in its fifth lag. Surprisingly the direction of the relationship between these two variables is negative.

2.5 Total fertility rate (TFR) and government expenditures on social protection

There are several types of social benefits aimed towards families with children in the Czech Republic. The availability and eligibility criteria for these benefits can vary but they are generally designed to help parents to financially support their growing families or to help struggling parents meet their financial needs.

Specific types of social benefits used as independent variables are as follows:

- Maternity leave (PPM, peněžitá pomoc v mateřství)
- Parental leave (RODP, rodičovský příspěvek)
- Child benefit (PRID, příspěvek na dítě)
- After-birth allowance (POR, porodné)

These social benefits are included in the analysis through the total government expenditures incurred for these benefits.

Tab. 9: Linear dynamic regression output – PPM

PPM	coeff	std. error	t-stat	p-value	
const	0,420608	0,0611034	6,884	5,11E-07	***
PPM_1	0,000106	2,834E-05	3,753	1,00E-03	***
PPM_2	-0,00011	3,468E-05	-3,188	4,10E-03	***
PPM_5	4,48E-05	1,286E-05	3,484	2,00E-03	***
TFR_1	0,564123	0,0538549	10,47	3,16E-10	***

Source: Own calculations

From the dynamic linear regression analysis, it came out that the expenditures on maternity leave (PPM), which are directly proportional to its amount, do affect the fertility of the population in the first, second, and fifth lag. That would mean that the amount of the social benefit influences the decision-making process of having the first as well as the second child (considering the average interval between the first and the second birth is around two years according to Hon, 2021).

Tab. 10: Linear dynamic regression output – POR

POR	coeff	std. error	t-stat	p-value	
const	0,180384	0,076077	2,371	3,06E-02	**
POR_3	-4,1E-05	1,459E-05	-2,801	1,28E-02	**
TFR_1	0,922944	0,0480932	19,19	1,81E-12	***

Source: Own calculations

The government expenditures on the After-birth allowance (POR) do affect the total fertility rate in the third lag. This relationship may also reflect the usual spacing of two siblings as mentioned above.

Tab. 11: Linear dynamic regression output – PRID

PRID	coeff	std. error	t-stat	p-value	
const	0,039167	0,150174	0,2608	7,98E-01	
PRID_1	1,88E-05	5,129E-06	3,662	2,60E-03	***
PRID_4	-1,4E-05	3,878E-06	-3,739	2,20E-03	***
TFR_1	0,999106	0,0857179	11,66	1,36E-08	***

Source: Own calculations

The government expenditures on the Child benefit do affect the total fertility rate in the first and the fourth lag. This also consistently refers to the positive immediate impact the benefits have on childbearing (in the first lag).

Tab. 12: Linear dynamic regression output – RODP

RODP	coeff	std. error	t-stat	p-value	
const	0,14764	0,0776175	1,902	7,95E-02	*
RODP_4	-9,3E-06	2,205E-06	-4,228	1,00E-03	***
RODP_5	8,33E-06	2,08E-06	4,004	1,50E-03	***
TFR_1	0,944182	0,0576751	16,37	4,67E-10	***

Source: Own calculations

Interestingly the parental leave benefit does not have an immediate effect on the total fertility rate. The total government expenditures on parental leave significantly affect the total fertility rate in the fourth and the fifth lag.

Overall, we can say the social benefits targeted at families do have mostly positive effects on the total fertility rate which would mean they fulfill its primary purpose.

2.6 Total fertility rate (TFR) and the housing situation

The availability of housing has been represented by the number of finished apartments in the Czech Republic. The housing market has a significant impact on fertility. The impact of housing price growth on fertility behavior exhibits noteworthy variations within the context of housing tenure. Specifically, it is found that an increase in housing prices tends to elevate fertility intentions and actual fertility among homeowners, yet concurrently diminishes fertility intentions among renters. These dynamics unfold differentially across demographic subgroups,

encompassing marital status, parental status, family income, homeownership status, and liquidity constraints. Such heterogeneity in responses to housing price fluctuations underscores the multifaceted interplay between housing market conditions and individuals' reproductive decisions (Atalay et al., 2021).

Tab. 13: Linear dynamic regression output – BYTY

BYTY	coeff	std. error	t-stat	p-value	
const	0,060745	0,0822065	0,7389	4,67E-01	
BYTY_5	-4,4E-06	1,369E-06	-3,237	3,40E-03	***
TFR_1	1,05402	0,061283	17,2	2,30E-15	***

Source: Own calculations

The independent variable Number of finished apartments (BYTY) does significantly affect the total fertility rate in its fifth lag.

2.7 Total fertility rate (TFR) and real wage and real income

As independent variables reflecting the economic situation of families, the time series of the real wage index and real income index were chosen. According to research conducted on data from England, the fluctuations in the real wage index affect fertility (Bailey & Chambers, 1998).

Tab. 14: Linear dynamic regression output – REALM

REALM	coeff	std. error	t-stat	p-value	
const	-0,0576	0,530799	-0,1085	9,15E-01	
REALM_3	-0,00853	0,0037798	-2,257	3,38E-02	**
REALM_4	0,003967	0,0018604	2,132	4,39E-02	**
REALM_5	0,004605	0,0017472	2,636	1,48E-02	**
TFR_1	1,04979	0,0564397	18,6	2,34E-15	***

Source: Own calculations

The real wage index (REALM) affects the total fertility rate in the third, fourth, and fifth lag. That corresponds with the theory that changes in real wage rates influence fertility (Bailey & Chambers, 1998).

Tab. 15: Linear dynamic regression output – REALD

REALD	coeff	std. error	t-stat	p-value	
const	-0,93975	0,24963	-3,765	9,00E-04	***
REALD_4	0,008927	0,0021106	4,23	3,00E-04	***
TFR_1	1,03152	0,0553273	18,64	3,52E-16	***

Source: Own calculations

The real income index (REALD) also interacts with the total fertility rate in its fourth lag.

2.8 Total fertility rate (TFR) and marital status

The marital status has been included in the analysis as the percentage of first-time marriages among all the proceeded marriages. This variable was included separately for men and women. The overall trends in both marriage and fertility go hand in hand since the birth of a first child no longer follows the wedding. This change in the modern family-planning dynamic is closely related to the overall change of the society. (Hon, 2018).

Tab. 16: Linear dynamic regression output – SNATM

SNATM	coeff	std. error	t-stat	p-value	
const	0,559632	0,0903638	6,193	1,50E-06	***
SNATM_4	-0,00548	0,0007667	-7,144	1,38E-07	***
TFR_1	0,866001	0,04054	21,36	5,16E-18	***

Source: Own calculations

Tab. 17: Linear dynamic regression output – SNATZ

SNATZ	coeff	std. error	t-stat	p-value	
const	0,5917	0,0939208	6,3	1,14E-06	***
SNATZ_4	-0,00565	0,0007908	-7,15	1,36E-07	***
TFR_1	0,877505	0,0399573	21,96	2,61E-18	***

Source: Own calculations

The share of first-time marriages for both men and women is significantly affecting fertility in its fourth lag and the direction of the dependency is negative.

2.9 Total fertility rate (TFR) and education

The level of education in the Czech Republic was included in the analysis as the percentage of men and women with completed tertiary education. The variable for women came out

insignificant from the dynamic linear regression analysis, however, the percentage of men with completed tertiary education (VYSM) does affect the total fertility rate in the third lag.

Tab. 18: Linear dynamic regression output – VYSM

VYSM	coeff	std. error	t-stat	p-value	
const	0,078973	0,0732775	1,078	2,92E-01	
VYSM_3	0,018419	0,0075171	2,45	2,23E-02	**
TFR_1	0,782477	0,11231	6,967	4,22E-07	***

Source: Own calculations

2.10 Total fertility rate (TFR) and employment

Employment and economic activity are further representants of the category of economic variables with a social aspect to them since the financial stability of the household or family does have an impact on family planning (Hon et al., 2021). The economic activity itself came out insignificant from the model. However, the unemployment rate affects the total fertility rate in its third lag.

Tab. 19: Linear dynamic regression output – NEZ

NEZ	coeff	std. error	t-stat	p-value	
const	-0,20296	0,0703488	-2,885	8,40E-03	***
NEZ_3	0,015819	0,0045255	3,496	1,90E-03	***
TFR_1	1,09162	0,0391499	27,88	3,12E-19	***

Source: Own calculations

Conclusion

The dynamic linear regression analysis performed for this research was able to determine several external factors that have a statistically significant effect on the trend of total fertility rate (TFR) in the Czech Republic. These variables have been tested in various lags which would determine the delay of the effect of these socio-economic factors on the total fertility rate.

Economic variables that came out with a significant relationship to the total fertility rate were expenditures of the households on groceries, industrial goods, and services. Also, digital affinity expressed as the possession of a personal computer and reliable internet connection is significantly affecting TFR. All the real wage index, real income index, and Gross Domestic Product (GDP) demonstrated a statistically significant effect on the TFR, implying the substantial influence of economic well-being on fertility choices.

Contrary to expectations, economic activity was found to be statistically insignificant in its relationship with the TFR. This suggests that the labor force participation rate may not directly impact fertility decisions.

Variables that combine the economic as well as the social aspects of the environment were the number of finished apartments (representing the availability of housing) and the employment rate. Both of these variables were found to be significantly affecting the total fertility rate.

From the spectrum of social and cultural variables, the educational level of men, specifically attainment of tertiary education, displayed a noteworthy influence on the TFR. Surprisingly, the tertiary education level of women was not identified as statistically significant in explaining variations in the TFR, suggesting a nuanced interplay of gender dynamics in fertility decisions. The proportion of first-time marriages within the population was found to be a statistically significant cultural factor for both men and women. It signifies that marriage trends affect fertility rates.

The availability of preschool facilities was a significant social determinant, indicating that the accessibility of child-care resources plays a role in influencing TFR. The presence of social protection benefits also exhibited a significant association with the TFR.

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