

DETERMINANTS INFLUENCING TOTAL FERTILITY RATE IN THE CZECH REPUBLIC

Ondřej Šimpach – Marie Šimpachová Pechrová

Abstract

The aim of the paper is to find determinants that influence total fertility rate (TFR) in the Czech Republic. We included indicators describing the maturity of the economy (HDI and GDP/capita), family situation (no. of marriages and divorces), financial background (unemployment rate, number of completed dwellings) and schooling. Data were taken for period 1993–2016. All other variables with exception of HDI and no. of marriages were statistically significantly correlated with the development of TFR. All determinants were included into several regression models. Linear function fitted the best. Statistically significant determinants were only GDP/capita, number of marriages and dwellings constructions, and years of schooling. If the GDP/capita and no. of marriages and households increases, TFR also increases. The largest and the only negative impact has the number of years of schooling. Findings have positive implications that the increasing number of divorces and unemployment is not significant determinant of fertility and that the development of the country does not necessary mean that the fertility will be affected. On the other hand, prolonging the average number of years of schooling has negative influence on TFR despite that education has many advantages and brings development to the country.

Key words: Czech Republic, education, total fertility rate, unemployment

JEL Code: J13, J11, J64

Introduction

Long-term policy planning in the country requires appropriate knowledge of the data. Hence, there is a need to know the age-and-sex specific structure of the population. The fertility is one of the features that determines the population size for each country and influences the available workforce in the country. Projection of fertility in the Czech Republic was done e.g. by Šimpach (2015). The prediction provided by ARIMA (0,1,1) model with drift was the most acceptable and was the closest to the pessimistic projection of the Czech Statistical Office. Even though world population has been increasing, most of developed experience very low fertility levels,

below the replacement level. Countries with very low fertility levels such as Singapore, Japan, and Thailand are concerned about the effects that the insufficient number of young people are having on their labour forces and about their rates of population ageing (McDonald, 2014).

There are many determinants that led to this situation, many of them intangible related to general social environment, family policy and habits in the country. From other factors can be named the economic situation in the country, level of development, and expected trends in the future. For example, Ha and Lee (2016) found that in Asia the fertility is extremely sensitive to the level of development, implying that economic convergence leads to too high child rearing costs and too low fertility. “The population development and improvement of the living standards in the country are closely related to the postponement of first childbirth to the later ages and with the decline of number of live births in total.” (Šimpach, 2017). For the case of Oman, Mazharul (2017) found that “Modernization, educational development of women and their participation in workforce are the likely factors that affect the reproductive behaviour of women and thus help reduce fertility in Oman”. Similarly, total fertility rates in all countries of the Southern African Development Community (SADC) during the 1980–2009 period were affected by education. The results of study by Bittencourt (2018), based on dynamic panel time-series methods, suggested “that primary education is associated with lower fertility in the SADC, or that the community is already trading-off quantity for quality of children” (Bittencourt, 2018). Hofmann and Hohmeyer (2016) used data from the German National Educational Panel Study observed for over 40 years and found that female fertility timing is affected by a recession at graduation. “A downturn at graduation increases the transition rate to first pregnancy among female graduates significantly. We also find a downturn to decrease the probability of holding a degree-adequate job in the first years after graduation.” (Hofmann and Hohmeyer, 2016). Fertility rates can be influenced by development of human development index (HDI) (see study of Amariei Cojocariu, 2015). Another determinant was surveyed for example by Nieuwenhuijsen et al. (2014). They “found a statistically significant reduction of fertility rates with an increase in traffic related air pollution levels” (Nieuwenhuijsen et al., 2014).

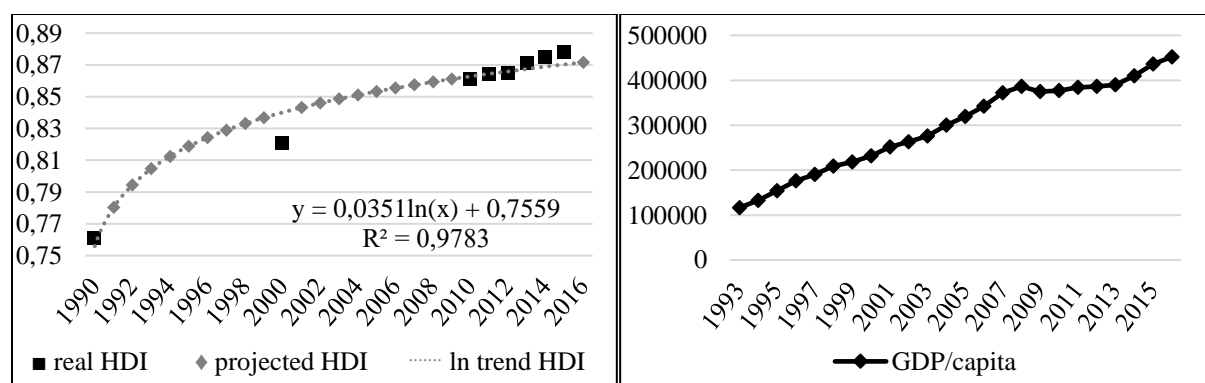
1 Data and Methods

The aim of the paper is to find determinants that influence total fertility rate (TFR) in the Czech Republic. First, the data are described, that the construction of the model is presented.

From global perspective, developed countries usually experience decline of TFR. It is due to many social and economic reasons. Therefore, as the determinant of the TFR development are included indicators describing the maturity of the national economy – particularly Human Development Index elaborated by United Nations and Gross Domestic Product (GDP) per capita. It is supposed that (despite of increasing number of extramarital children) children are born usually in marriage, therefore, the number of marriages and also of divorces is included. People usually consider their financial situation when deciding whether to have children, therefore the unemployment rate is included. The background for family formation is also important, so as one feature that influence the TFR is assumed to be the number of completed dwellings. Besides, TFR is affected by postponing the marriage and children to higher ages also due to longer average time of schooling. Data were taken for period 1993–2016.

HDI was developed by United Nations under their UNDP (United Nations Development Programme) in order to express human well-being. This index is constructed since 1990 and published in Human Development Report. The composite indicator consists of three parts: human health (expressed as the average expected life expectancy at birth because this demographic indicator reflects all the negative and positive influences that affect human health), level of education (determined as share of the literate population and as a combined share of the population of the relevant age group attending the first, second and third degree of schools), and living standard (represented by GDP/cap. in USD, recalculated to purchasing power parity). Development of both variables is displayed at Fig. 1.

Fig. 1: HDI interpolated by logarithmic trend function (left), GDP/capita (right)



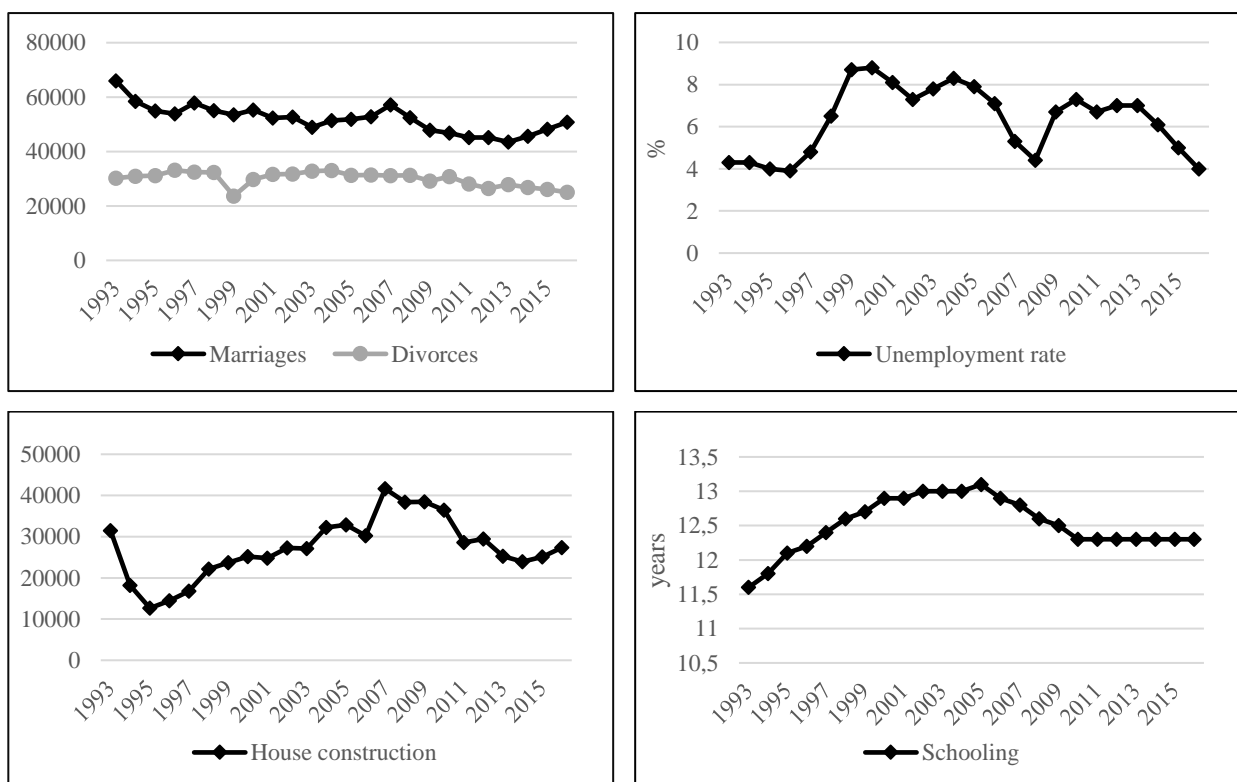
Source: own elaboration based on data from UNDP and from CZSO (2017)

As there were no available data for the whole examined period, an interpolation of the data was done to calculate missing values. HDI experience high increase after the Velvet

revolution in 1989 and its value is mildly increasing since that. There is not expected any steep increase in near future, as the values from 2010 to 2015 did not increased much (by 2% only).

It is supposed that (despite of increasing number of extramarital children) children are born usually in marriage, therefore, the number of marriages and also of divorces is included. Recently the number of marriages has increased and of divorces decreased. Data were taken from CZSO (2016). People usually consider they financial situation when deciding whether to have children, therefore the unemployment rate is included. The background for family formation is also important, so as one feature that influence the TFR is assumed to be the number of completed dwellings (SPS, 2018). Besides, TFR is affected by postponing the marriage and children to higher ages also due to longer time of schooling. All determinants are included into regression model and their development is displayed at Fig. 2.

Fig. 2: No. of marriages, divorces (top left), unemployment rate (top right), no. of house construction (bottom left), average years of schooling (bottom right)



Source: own elaboration based on data CZSO (2016), SPS (2018) and UNDP

1.1 Model

First, the correlation matrix was displayed. Then the explained variable was TFR (y) and explanatory data HDI (x_1), GDP/cap. (x_2), number of marriages (x_3), number of divorces (x_4), unemployment rate (x_5) and average years of schooling (x_6) were included into several types of

regression models (linear and power functions) – with stepwise exclusion of explanatory variables. The mean, minimal and maximal values and standard deviation of yearly data for period 1993–2016 are displayed in Tab. 1.

Tab. 1.: Description of the data for period 1993–2016

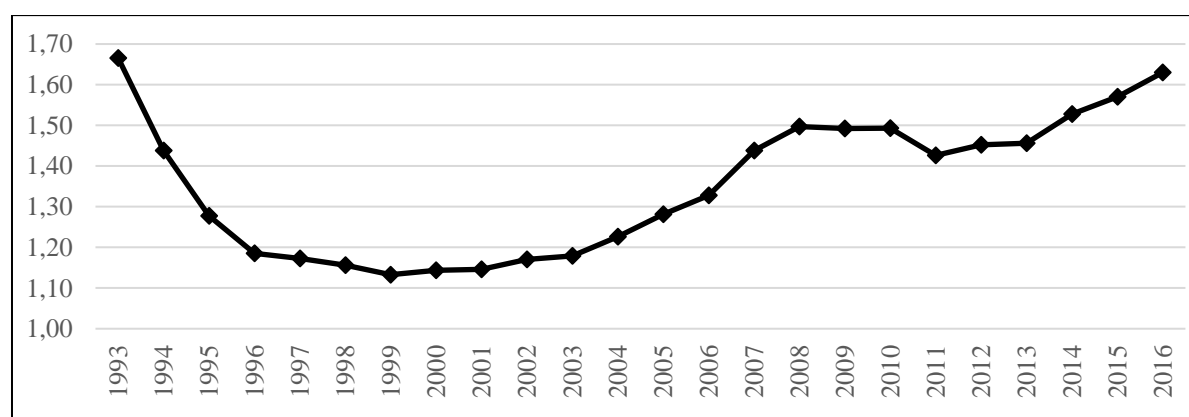
| Variable | Mean | Std. d. | Min | Max | Variable | Mean | Std. d. | Min | Max |
|-----------------------|--------|---------|--------|--------|-----------------------|-------|---------|-------|-------|
| TFR | 1.35 | 0.17 | 1.13 | 1.67 | HDI | 0.85 | 0.02 | 0.80 | 0.88 |
| GDP/cap. [thous. CZK] | 297.71 | 101.51 | 116.27 | 451.79 | House const. [thous.] | 27.24 | 7.43 | 12.66 | 41.65 |
| Marriages [thous.] | 51.99 | 5.16 | 43.50 | 66.03 | Divorces [thous.] | 29.92 | 2.69 | 23.66 | 33.11 |
| Unemployment rate | 6.30 | 1.63 | 3.90 | 8.80 | Schooling | 12.51 | 0.39 | 11.60 | 13.10 |

Source: own elaboration, data from CZSO (2017)

2 Results and discussion

A global fertility decline has left only a small set of countries and a few percent of the global population with very high fertility (TFR > 4, i.e. on average 4 children born in reproductive age of mother). “The dominant pattern is fertility decline to low levels – with over half of the global population now living in countries with below replacement level fertility”. (Morgan and Rackin, 2010). Czech Republic belongs to one of those countries where the number of birth per one woman was above 2 only in the past (1960 to 1966, 1970 to 1981). Despite mild increase since 2000, the TFR is still beyond replacement level. In 2016, TFR was again as in 1993 1.6.

Fig. 3: Total fertility in period 1993–2016



Source: own elaboration based on data from CZSO (2017)

First, the data were displayed in correlation matrix (Tab. 2). Beside number of marriages, all variables were statistically significantly correlated with the development of TFR.

Tab 2. Correlation matrix

| | TFR | HDI | GDP/cap. | Marriages | Divorces | Unemployment | House construction |
|---------------|------------|------------|------------|-----------|----------|--------------|--------------------|
| HDI | 0.4059** | 1 | | | | | |
| GDP/cap. | 0.5042** | 0.9724*** | 1 | | | | |
| Marriages | -0.1471 | -0.8272*** | -0.7612*** | 1 | | | |
| Divorces | -0.4464** | -0.4483** | -0.4693** | 0.3912* | 1 | | |
| Unempl. rate | -0.5009** | 0.1886 | 0.1312 | -0.3603* | -0.0406 | 1 | |
| House constr. | 0.4089** | 0.4800** | 0.5693*** | -0.1699 | -0.0342 | 0.2657 | 1 |
| Schooling | -0.6090*** | 0.2605 | 0.2150 | -0.1968 | 0.2632 | 0.7074*** | 0.3204 |

Note: Statistically significant at * $\alpha = 0.1$, ** $\alpha = 0.05$, *** $\alpha = 0.01$; Source: own elaboration

Then, the linear regression model was estimated in the form of linear and power function. Surprisingly linear form of the relation fitted the best (94.13%). Results are displayed in Tab. 3. Statistically significant determinants were only GDP per capita (on 0.1 level of significance), number of marriages and dwellings constructions, and years of schooling. When the GDP/capita increases by 1 thous. CZK, TRF increases with very low intensity only by 0.001. When the number of marriages increase by 1 thous., then TRF increases with higher intensity by 0.01. If the number of constructions increases by 1 thous. then TRF increases by 0.006. Only the average years of schooling have negative impact, when it increases by 1 year, then TRF decreases by 0.37 child per mother.

If the GDP/capita increases by 1%, TFR increases by 0.24%. Increase of number of marriages by 1% brings increase of TFR by 0.50%, When the number of household constructions increases by 1%, then also the TFR increases by 0.13%. The largest and the only negative impact has the number of years of schooling as increase by 1% brings on average decrease of TFR by 3.42%, *ceteris paribus*.

Our findings have positive implications that the increasing number of divorces and unemployment is not significant determinant of fertility as same as that the development of the country does not necessary mean that the fertility will be affected (because HDI is not statistically significant). On the other hand, prolonging the average number of years of schooling has negative influence on TFR despite that education has many advantages and brings development to the country. It is due to the fact that “better educated and wealthier women have fewer children,” (Flückiger and Ludwig, 2017).

Tab. 3: Results of the estimation of linear regression model

| Variable | Coefficient | Std. err. | t-value | P-value | Elasticity |
|---------------|---------------------|---------------------|---------|---------|------------|
| Constant | 3.3837 | 2.2528 | 1.50 | 0.1530 | --- |
| HDI | 1.5915 | 2.8005 | 0.57 | 0.5780 | 0.9961 |
| GDP/cap. | 1.09e ⁻⁶ | 6.16e ⁻⁷ | 1.77 | 0.0950 | 0.2397 |
| Marriages | 1.30e ⁻⁵ | 6.25e ⁻⁶ | 2.08 | 0.0540 | 0.4992 |
| Divorces | 1.59e ⁻⁶ | 6.65e ⁻⁶ | 0.24 | 0.8130 | 0.0351 |
| Unempl. rate | 0.0050 | .0163 | 0.31 | 0.7630 | 0.0233 |
| House constr. | 6.39e ⁻⁶ | 2.93e ⁻⁶ | 2.18 | 0.0450 | 0.1286 |
| Schooling | -0.3703 | .0596 | -6.22 | 0.0000 | -3.4211 |

Source: own elaboration

Amariei Cojocariu (2015) found that unemployment has a strong negative effect on childbearing while HDI has a very strong negative influence on fertility. In our case, the effect of HDI was statistically insignificant as same as the influence of unemployment, so we cannot compare our results to this study. On the other hand, Khraif et al. (2017) also found that education has high predictive value on age at marriage, age of husband at marriage, ideal family size, and contraceptive use. Besides, “although not predictive, it creates variations on number of children, years lived with husband and intended number of children,” (Khraif et al., 2017).

Conclusion

The aim of the paper was to find the determinants of the total fertility rate development in the Czech Republic. Unlike the expectations, the linear regression model fitted the best the relation between TFR and human development index (HDI), GDP/capita, number of marriages and of divorces, unemployment rate, number of constructed houses and average years of schooling. All data were observed in period of modern history of the Czech Republic, i.e. from 1993 to the latest available data in 2016. However, only level of GDP/capita, number of marriages and house constructions and average years of schooling were statistically significant determinants of TFR in CR. Increase of the GDP/capita by 1%, brings increase of TFR by 0.24%. Increase of number of marriages by 1%, cases increase of TFR by 0.50%. When the number of household constructions increases by 1%, then also the TFR increases by 0.13%. The largest and the only negative impact has the number of years of schooling as increase by 1% brings on average decrease of TFR by 3.42%, ceteris paribus.

Our findings have positive implications that the increasing number of divorces and unemployment is not significant determinant of TFR as same as that the development of the country does not necessary mean that the fertility will be affected. On the other hand, prolonging the average number of years of schooling has negative influence on TFR despite that education has many advantages and brings development to the country. Nevertheless, our model is basic and based on relatively short time series. The challenge for future is to find better model that will express the relations of TFR and determinants even better.

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References

- Amariei Cojocariu, A., A. (2015). Estimating the negative influences on fertility. A case study-Romania. *Procedia Economics and Finance: (7th International Conference on Globalization and Higher Education in Economics and Business Administration, GEBA 2013)*, 20: 28–34.
- Bittencourt, M. (2018). Primary education and fertility rates: Evidence from Southern Africa. *Economics of Transition*, 26(2): 283–302.
- CZSO (2016). *Demografická příručka – 2016, 4-5 Sňatky a bilance manželství v letech 1920–2016*. Retrieved from: <https://www.czso.cz/documents/10180/45948568/130055170405.pdf/de7764a5-b572-4a08-803c-fb5c610e7cfb?version=1.0>
- CZSO (2017). *Česká republika od roku 1989 v číslech – 2016, Tab. 04.01 Základní ukazatele národního hospodářství v České republice*, Retrieved from: https://www.czso.cz/documents/10180/46173161/32018117_0401.pdf/e98cdd8f-6ef4-412f-9ae1-c5df2dbef29e?version=1.2
- Flückiger, M., Ludwig, M. (2017). Urbanization, fertility and child education in Sub-Saharan Africa. *Economics Letters*, 157: 97–102.
- Ha, J., Lee, S. (2016). Demographic dividend and Asia's economic convergence towards the US. *Journal of the Economics of Ageing*, 8: 28–41.
- Hofmann, B., Hohmeyer, K. (2016). The effect of the business cycle at college graduation on fertility. *Economics of Education Review*, 55: 88–102.

Khraif, R. M., Salam, A. A., Al-Mutairi, A., Elsegaey, I., Jumaah, A. A. (2017). Education's impact on fertility: The case of King Saud University Women, Riyadh. *Middle East Fertility Society Journal*, 22(2): 125–131.

Mazharul, I. M. (2017). Rapid fertility decline in Oman: Understanding the role of proximate determinants. *Middle East Fertility Society Journal*, 22(4): 275–284.

McDonald, P. (2014). The Demography of Indonesia in Comparative Perspective. *Bulletin of Indonesian Economic Studies*, 50(1): 29–52.

Morgan, S., Rackin, H. (2010). A Half Century of Fertility Change. *Journal of Comparative Family Studies*, 41(4): 515–535.

Nieuwenhuijsen, M. J., Basagaña, X., Dadvand, P., Martinez, D., Cirach, M., Beelend, R., Jacquemina, B. (2014). Air pollution and human fertility rates. *Environment International*, 70: 9–14.

SPS (2018). *Svaz podnikatelů ve stavebnictví v ČR, Bytová výstavba v České republice - byty dokončené 1998–2017*. Retrieved from: http://www.sps.cz/RDS/_PDFDoc_2018/6-Byty%20dokon%C4%8Den%C3%A9.pdf

Šimpach, O. (2015). Fertility of Czech Females Could Be Lower than Expected: Trends in Future Development of Age-Specific Fertility Rates up to the Year 2050. *Statistika*, 95(1): 19–35.

Šimpach, O. (2017). Normality and Principal Component Approach Towards Fertility Time Series in Poland and Czechia. In *Applications of Mathematics and Statistics in Economics – AMSE*, 431–440.

Contact

Ondřej Šimpach

University of Economics Prague, Faculty of Informatics and Statistics

W. Churchill Sq. 4, 130 67 Prague 3, Czech Republic

ondrej.simpach@vse.cz

Marie Šimpachová Pechrová

Institute of Agricultural Economics and Information

Mánesova 75, 120 00 Prague 2, Czech Republic

simpachova.marie@uzei.cz