Birth rate growth induced by universal 2-child policy in Dongguan will end soon

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abstract

The youngest generation of non-only-child are $2022 - 1979 = 43$ years old now so the comprehensive two-child policy will soon be no more powerful than single two-child policy and the birth rate will be no better than that of the few years after single two-child policy. To further confirm this deduction, this paper present a non-linear regression model on the birth rate in Dongguan, the p-values suggest that all the parameters in the model is highly significant thus confirm the assertion. The algorithm is implemented using nls package in R, code is available at https://github.com/Jayg000e/analysis-of-universal-2-child-policy-by-nonlinear-regression.

1 Introduction

China had implemented one-child policy to control population growth since 1979 by restricting families to born at most one child. The policy has broad effects on Chinese economic and population structure which is highly controversy.

During the implementation of the one-child policy, China has gradually encountered problems such as the disappearance of the demographic dividend, the approaching ultra-low fertility rate, an aging population, and an imbalanced sex ratio at birth,etc.

Recognizing the urgency to maintain a development-friendly population structure, Chinese government began to change the population policy. In November 2011, all parts of China fully implemented the dual one-child policy which permitted couples who are both only children to have a second child. In December 2013, China implemented the two-child policy which permitted couples with one child who are only children to have a second child. On October 29, 2015, in response to the severe situation, it took only 4 years for the government to formally adopt a comprehensive two-child policy at the Fifth Plenary Session of the 18th Central Committee of the Communist Party of China, which permitted all couples to have a second child.

The gist of my observation in this article is that the youngest generation who are not only child are $2022 - 1979 = 43$ years old now so the comprehensive two-child policy will soon be no more powerful than single two-child policy and the birth rate will be no better than that of the few years after single two-child policy. I will illustrate that in the following section use the data from Dongguan which is one of the most industrialized city in China. I construct a non linear regression model on the birth rate in Dongguan, the p-values suggest that all the parameters in the model is highly significant thus confirm my assertion.

2 Analysis of birth rate in Dongguan

Let's take a look at the birth rate in Dongguan between 2002-2020 according to " Dongguan Statistical Yearbook" presented in figure1 first. There is an conspicuous upsurge in 2012 and 2017 which happened right after the implementation of single two-child policy and comprehensive two-child policy. The upsurge in 2012 is far milder than that of 2017 which indicates that the only-child generation is comparatively less willing to born a second child than non-only-child generation.

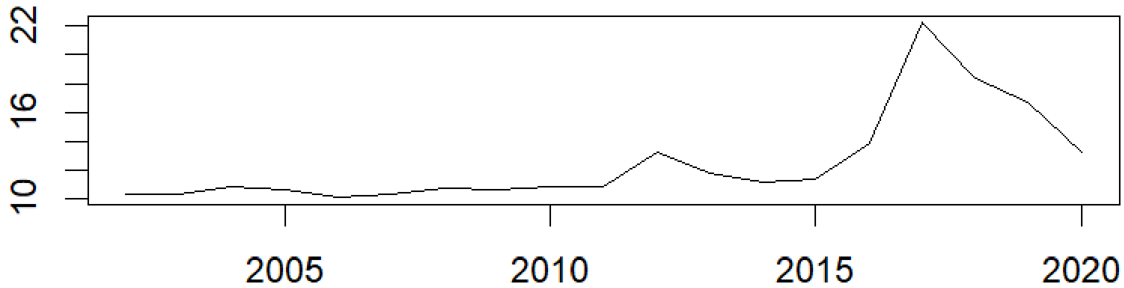

Figure 1: Birth rate of Dongguan during 2002-2020.

Intuitively, the single two-child policy will at least increase the born rate marginally because at least a small fraction only-child generation is willing to born a second child, we denote that effect by R_{prompt_1}. The effect brought by universal two-child policy is denoted by R_{prompt_2} which is obviously decaying over time according to both figure1 and the observation that the youngest non-only-child generation is stepping into their forties and thus unable to born child due to biological constraint.We denote this decay of effect brought by universal two-child policy by $decay_2$. Even though the effect brought by single two child policy is small, but we do not know whether the willingness will decade anyway. Assuming decay happens leads to the model denoted by equation(1) and a steady benefit brought by the policy leads to the model denoted by equation(2).

$$R = R_{base} + R_{prompt_1} \times \mathbf{1}_{T \geq T_{single}} \times exp(-decay_1 \times (T - T_{single}))$$
$$+ R_{prompt_2} \times \mathbf{1}_{T \geq T_{universal}} \times exp(-decay_2 \times (T - T_{universal})) \tag{1}$$

The following snippets of code is procedure to fit the model denoted by equation(1).The results in figure2 suggests that the decay parameter of the effect brought by single two-child policy is not statistically significant which is expected because only-child generation dominate and will dominate the population who is able to fertile in the foreseeable future.

```
fit1 <- nls(birth_rate~base_rate
+prompt1*single*exp(-tsingle*decay1)
+prompt2*universal*exp(-tuniversal*decay2),
start=list(prompt1=2,prompt2=4,decay1=1,decay2=0.5,base_rate=10)
summary(fit1)
```

Parameters:

	Estimate	Std. Error	t value	Pr(>|t|)	
prompt1	1.84997	0.65232	2.836	0.01321	*
prompt2	10.29739	0.96918	10.625	4.39e-08	***
decay1	0.04908	0.13730	0.357	0.72608	
decay2	0.48345	0.12614	3.833	0.00183	**
base_rate	10.59581	0.24762	42.790	3.04e-16	***

Figure 2: Regression result of first model which indicates the effect of single two-child policy is steady.

$$R = R_{base} + R_{prompt_1} \times \mathbf{1}_{T \geq T_{single}}$$
$$+ R_{prompt_2} \times \mathbf{1}_{T \geq T_{universal}} \times exp(-decay_2 \times (T - T_{universal})) \quad (2)$$

The following snippets of code is procedure to fit the model denoted by equation(2).The results in figure3 suggests that two-child policy will steadily brought Dongguan with an increase in birth rate by 1.67‰ but the prompt brought by universal two-child policy will decay from 10.10‰ to nothing due to a high decay rate of $e^{0.52227} = 1.69$.A simple calculation:$10.10/1.69^8 = 0.15$ suggests that this effect will vanish to almost nothing in 2023.

```
fit2 <- nls(birth_rate~base_rate
+prompt1*single
+prompt2*universal*exp(-tuniversal*decay2),
start=list(prompt1=2,prompt2=4,decay2=0.5,base_rate=10))
summary(fit2)
```

```
Parameters:
          Estimate Std. Error t value Pr(>|t|)
prompt1    1.66929    0.41521   4.020  0.00111 **
prompt2   10.09523    0.79524  12.695 2.00e-09 ***
decay2     0.52227    0.08672   6.022 2.34e-05 ***
base_rate 10.59600    0.24066  44.029  < 2e-16 ***
```

Figure 3: Regression result of second model.

3 Remark on p-value of non-linear regression

A crucial step to get p-value in the model is calculation of variance of the estimated parameters. The nls model in R use properties of fisher information to calculate estimated variation by default, but in some circumstances bootstrap method is preferred, we refer readers to [HBP+04] for further readings.

References

[HBP+04] Sylvie Huet, Annie Bouvier, Marie-Anne Poursat, Emmanuel Jolivet, and AM Bouvier. *Statistical tools for nonlinear regression: a practical guide with S-PLUS and R examples*. Springer, 2004.