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Do Business Cycles Make Babies? The Effect of Business Cycle Fluctuations On Fertility

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Abstract

Economic models often treat fertility as both constant and exogenous, while neither assumption is true. In this paper, I develop a Real Business Cycle model to analyze the impact of business cycle fluctuations on household fertility decisions. I incorporate a fertility decision into a search-based labor market and conduct a general equilibrium analysis of the effects of business cycles. The simulated results show that households increase their fertility during positive economic times, and reduce fertility as unemployment rises.

Honors Thesis

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1 Introduction

Following the Industrial Revolution and the Demographic Transition, economies in the developed world reached a new normal: continual growth and falling fertility. From 1900-2000, the US fertility rate fell by 1.51 births per women to just 2.05 in 2000 Haines (2008). Over that same time period, the US economy has grown at roughly 2% (Solis-Garcia, 2017). Theoretically, economists have not justified how a nation's growth can remain constant against a backdrop of declining population growth. Explanations of modern-day growth typically feature an exogenous population growth rate, where population growth is not crucial to explaining economic growth. Given the large declines in fertility in recent history, continuing to assume a constant population growth rate represents a dramatic oversimplification. With the fertility rate now below the replacement rate[1], the changing demographic climate deserves greater attention FRED (2017). Lower fertility eventually translates to a smaller labor force, and Gagnon, Johannsen, and Lopez-Salido (2016) find that observed reductions in US fertility and subsequently labor supply are responsible for permanent and significant reductions to GDP growth and the real interest rate, with these low growth rates expected to persist. With these demographic problems only expected to worsen, it is high time to further understand how fertility and the economy interact with one another today and in the future.

I develop a Real Business Cycle model that analyzes how household fertility decisions respond to changes in employment over the business cycle. Drawing on Merz's (1995) model of two-sided search in the labor market, I incorporate the decision to have children, enabling me to see how household fertility responds to business cycles. This paper contributes to the theoretical macroeconomic literature by examining how fertility responds to changes in the extensive employment margin due to business cycle fluctuations.

The rest of the paper is organized as follows: Section 2 reviews the literature,

[1]The replacement rate is the average number of children a woman must have for a country's population to stay stable, without migration. In the developed world, this is 2.1 children per women. Craig (1994)

Sections 3 describes the model economy, Section 4 presents the model and its solution, and Section 5 uses the model. Section 6 concludes.

2 Literature Review

Changes in employment are the most direct way that households are affected by economic booms and busts. While there is heterogeneity in how households respond to changes in employment, some patterns do hold. Among developed nations, fertility in that period falls when the household experiences both male and female unemployment. This decline in fertility is typically stronger when households face male unemployment.

When men lose their jobs and experience a fall in income, this should induce a pure negative income effect. Treating children like a consumption good, becoming unemployed should cause fertility to fall. Since women are typically the primary caregiver, children bring about a high time cost. Because of this, women face both income and substitution effects. If a woman becomes unemployed, she can view her unemployment as the ideal time to have a child, because she would minimize the lost labor income associated with childbearing. However, like for men, children are expensive and the loss of income would again be a negative income effect. Sobotka, Skirbekk, and Philipov (2011)

A robust empirical literature analyzes the relationship between fertility and employment over the business cycle, and is comprehensively reviewed by Sobotka et al. (2011). Ahn and Mira (2002) using 21 OECD countries, find that at the beginning of the 1980s, countries with high rates of female labor force participation tend to have lower fertility rates. However, by the end of that decade, the relationship between participation rates and fertility rates had evolved into a strongly positive one.

In addition to the effects of cyclical unemployment, structural unemployment is expected to further reduce fertility through increased uncertainty and lower expected lifetime wealth, as women face higher costs of leaving the labor market to have a child since re-entering the market would likely be more difficult. Women would also have less confidence in their husband's employment prospects. In fact, Kreyenfeld and Andersson (2014) find that amongst older (29-44) German men, unemployment reduces the probability of entering fatherhood by nearly 50%. Although also showing procyclical fertility, female unemployment for the same age group reduces the probability of parenthood by a lesser amount, suggesting that household fertility decisions are more dependent on the economic status of the men. Orsal and Goldstein (2010) find similar results with a larger panel.

The findings of Butz and Ward (1979) continue to be a thorn in fertility researchers sides. They argue that post-war fertility has evolved into a countercyclical relationship. By assuming the opportunity cost of having a child is the woman's lost wages, having a child would be most expensive during peak economic times, thus explaining countercyclical fertility. Among younger couples, Butz and Ward are able to observe countercyclical fertility from 1947-1974. Although the theoretical explanation is attractively intuitive, the results have been deemed an anomaly. However, the literature continues to circle back to these findings and aims to reconcile these results with an overall procyclical pattern.

Another key fertility theory is Easterlin's relative income hypothesis as summarized by Macunovich (2003). Easterlin suggests that individuals consider not only their absolute income, but also how their income compares to that of their parents when determining their fertility. Adult income is inversely related to the size of the birth cohort, or the number of children born in a given year. Individuals aspire to have at least the same standard of living that they had growing up, and use this benchmark to determine optimal fertility. With a given income, individuals will determine how many children can be supported, while following the standard of living constraint. Individuals with a small birth cohort and low standard of living expectations would be expected to have high fertility.

The theoretical work of Becker and Barro (1988), Barro and Becker (1989) has also been key to developing modern day fertility models.In their work, they introduce a "quality-quantity" tradeoff to having children, and have parents explicitly receive utility from that of their children. A significant portion of the literature connecting fertility to economic fluctuations models the baby boom during the 1950's. Jones and Schoonbroodt (2016) develop an overlapping generations model (OLG) to explain fertility behavior during the Great Depression through the baby boom. They follow the convention of Barro-Becker, where parents consider both the "quality" and quantity of their children when choosing how many children to have, and parents derive utility from the expected utility of their children. In the model, having children is costly to the household through forgone consumption and hours not available to the labor market. By simulating the Great Depression as a large negative shock to productivity, they are able to capture 58 percent of the fertility decline during the Great Depression. Continuing their simulations into the post-War era, they use a positive productivity shock and the low fertility of the previous generation to account for over 75 percent of the increase in fertility happening during the Baby Boom. However, by using an OLG model with periods of 20 years, a time-nuanced analysis is difficult. A further limitation of their model is that household labor supply unrealistically responds on the intensive margin.

Looking at the labor market and fertility, Doepke, Hazan, and Maoz (2015) develop a dynamic general equilibrium model for the WWII era. They build a model in which households choose female labor supply and fertility each period, where women exit the labor market to have a child and do not necessarily return. Modeling the war as a large shock that increases female labor supply, they find that these women continue working after the war and crowd out younger women from the labor market. The model predicts that these younger women begin having children at a younger age and have more children, thus generating the Baby Boom. While this model is able to capture these generational differences in fertility, it is less effective at capturing the overall increase in fertility that happened during the baby boom. Unlike Jones and Schoonbroodt (2016), they find that business cycle fluctuations are unable to explain the fertility features seen in the data. Their model fails to take into account changes in labor demand or the effects of male unemployment. Unlike others in the literature, by modeling the labor market with changes to labor demand, labor supply, and market frictions, I am able to more accurately capture the labor market, which enables me to more precisely model how changes in the labor market due to business cycle fluctuations impact household level fertility decisions.

3 Theory

The model economy is an extension of Merz's real business cycle labor market search model, which focuses on the extensive margin of employment Merz (1995). (I also rely on simplifications to the model used by Stern (2016).) I add fertility choice to the model to explore the bidirectional relationship between fertility and the labor market, at the household level.

3.1 Household Preferences

The population of interest is households in the labor force, where the labor force is normalized to 1. The household gets utility from consumption C, leisure $(1 - N)$, and quantity of children K. Each period, the household[2] chooses births B to achieve their desired number of children K. Each birth is costly to the household, costing P units of time and d units of the consumption good. Household choose births in the present period, and these births are added to the existing stock of children in the next period. Accounting for child mortality, (1-δ) children in a given period survive to the next period.

[2]All households are capable of having children and will experience a reduction in market time when doing so.

3.2 Household Labor Supply

The household supplies labor to the firm. Once employed, workers stay employed unless the firm and employee separate or when the worker has a child in that period. The separation rate ψ is the rate at which the firm terminates employment each period. This parameter is exogenous and not explicitly tied to economic conditions. Workers can become employed in the next period after searching for employment today and matching with a firm.

3.3 Firm

The firm combines labor N and TFP z to produce its output Y, using a constant returns to scale production technology. The firm terminates employment for ψ percentage of employees each period. If the firm needs labor, if posts vacancies V each period, where each vacancy costs a to post. A vacancy posted today can be filled in the next period if the firm is able to match with a worker. The firm is profit maximizing.

3.4 Social Planner Problem

The social planner chooses infinite sequences of consumption, future employment, vacancies, number of children next period, and number of new births, $\{C_t, N_{t+1}, V_t, K_{t+1}, B_t\}$ in order to maximize the household's total utility.

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, 1 - N_t, K_t) \tag{1}$$

β is the household's discount factor and β takes on values between 0 and 1. Lower β values reflect greater impatience.

The household's preferences are:

$$log(C_t) + log(1 - N_t) + \phi log(K_t) \tag{2}$$

The household gets utility from consumption, leisure, and from the number of children. Leisure is defined as $(1 - N)$. ϕ is the degree to which children influence their parents utility, or altruism per Barro and Becker (1989). ϕ must be greater than or equal to 0.

Employment evolves over time subject to the following Law of Motion:

$$N_{t+1} = (1 - \psi)N_t + M_t \tag{3}$$

where M_t is the number of firm-worker matches in the period.

The number of matches made depends on the number of vacancies V_t and unemployment U_t. Unemployment is defined as $(1 - N_t - P_t)$, those in the population neither working nor having a child in the current period.

$$M_t = V_t^{\theta}(1 - N_t - P_t)^{1-\theta} = V_t^{\theta}U_t^{1-\theta} \tag{4}$$

θ is a parameter denoting the elasticity of matches with respect to vacancies.

The household chooses new births B_t in each period to achieve its desired stock of children in the next period K_{t+1}. The child mortality rate is δ. The Law of Motion for Children is:

$$K_{t+1} = (1 - \delta)K_t + B_t \tag{5}$$

The firm uses labor in its production function to produce output,

$$Y_t = z_t N_t \tag{6}$$

where z_t denotes Total Factor Productivity.

Equation 7 is the aggregate feasibility constraint, which states that output Y_t is allocated between the three expenditures in the economy: consumption, the cost of vacancy posting, and the cost of new births.

$$Y_t = C_t + aV_t + dB_t \tag{7}$$

Finally, there are two potential stochastic processes. A shock to TFP captures a change to technology and the shock is persistent and follows an AR(1) process:

$$z_{t+1} = \rho z_t + \epsilon_{z,t+1} \tag{8}$$

where ρ denotes the degree of persistence between periods, ranging from (0,1). If the TFP shock is positive, TFP in the next period is also expected to be positive but of smaller magnitude. Assuming no new shocks to the economy, the TFP shock will decay away over time. The error term, $\epsilon_{z,t}$, comes from a normal distribution centered at zero.

The TFP shock endogenously affects the separation rate via the following equation.

$$\psi_t = (1 - \rho_{psi})\psi_{ss} + \rho_\psi \psi_{t-1} + \gamma(z_{t-1}) + \epsilon_\psi$$

All else equal, an increase in TFP is expected to decrease the separation rate.

Similarly, ψ, the separation rate can be subject to shocks. The current separation rate ψ_t depends on the previous period's separation rate, the steady state value of ψ (ψ_{ss}) and any shocks in the current period.

$$\psi_t = (1 - \rho_\psi)\psi_{ss} + \rho_\psi \psi_{t-1} + e_{\psi t} \tag{9}$$

4 Model

The Social Planner solves the following maximization problem, aiming to make the household as well off as possible, while abiding by the constraints of the economy. λ_t^1, λ_t^2, and λ_t^3 represent Lagrange multipliers, and the Social Planner maximizzed the household's lifetime utility using the following Lagrangian. The optimal allocations determined by the planner will be equivalent to the outcome of a competitive equilibrium.

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t [log(C_t) + log(1 - N_t) + \phi log(K_t)]$$
$$+ \lambda_t^1 [(1-\psi)N_t + M_t - N_{t+1}] +$$
$$\lambda_t^2 [(1-\delta)K_t + B_t - K_{t+1}] +$$
$$\lambda_t^3 [z_t N_t - C_t - aV_t - dP_t]] \quad (10)$$

From the Lagrangian, the equilibrium conditions of the model are:

$$\frac{1}{1-Nt} + \frac{a(1-\theta)V_t}{\theta C_t U_t} + \frac{\psi a V_t}{\theta M_t C_t} + \frac{a\beta}{\theta} E_t \frac{V_{t+1}}{M_{t+1} C_{t+1}} = \frac{z_t}{C_t} \quad (11)$$

$$\frac{\phi}{K_t} + (1-\delta)\lambda_t^2 = \beta E_t \lambda_{t+1}^2 \quad (12)$$

$$\frac{a(1-\theta)V_t}{\theta C_t U_t} + \frac{d}{C_t} = \lambda_t^2 \quad (13)$$

$$N_{t+1} = (1-\psi)N_t + M_t \quad (14)$$

$$K_{t+1} = (1-\delta)K_t + P_t \quad (15)$$

$$z_t N_t = C_t + aV_t + dP_t \quad (16)$$

$$U_t = 1 - N_t - P_t \quad (17)$$

$$M_t = V_t^\theta U_t^{1-\theta} \tag{18}$$

Equation 11 is an intertemporal condition, showing the trade-offs between current and future consumption and the numerous labor market variables. Equations 12 is an intertemporal condition defining a Lagrange multiplier. Equation 13 shows the trade-offs within a given period between vacancies, consumption, and unemployment. Equations 14 and 15 are law of motions defined earlier in the paper. Equations 16, 17, and 18, are the Aggregate Feasibility Constraint, the definition of unemployment, and the matching function, respectively.

4.1 Parametrization

In order to find a solution to the model, I impose the steady states on all equations that characterize the equilibrium and solve the system using the following parameters:

Table 1: Parameter Values

Parameter	Value
ψ	0.07
a	0.05
θ	0.6
β	0.99
δ	0.06
ϕ	2
d	0.05

The values of the separation rate, ψ, the cost of posting a vacancy, a, the elasticity of matches with respect to vacancies θ, and the discount factor β all follow Merz (1995). The child mortality rate δ follows from UNICEF's estimates UNI (2010).

In US time series data, we see that consumption accounts for 70% of GDP WorldBank. However, since the model economy does not include an investment decision, government expenditure, or international trade, I target consumption to be roughly 80% of GDP. The weight on children in the utility function, ϕ and the cost of new births d, were estimated accordingly. If the value of ϕ is too low, the model will predict too few children, so with a shock, the results with respect to children will be greater in magnitude.

5 Impulse Response Functions

5.1 TFP

I simulate an economic boom with a positive 1% deviation shock to TFP, which in turn decreases the separation rate. As expected, output increases. On the consumer side, Consumption, Children, and Births all increase. In the labor market, Employment increases and Unemployment falls. Matches and Vacancies both fall, as firms are holding on to their existing workers at a higher rate. The increase in children/births support the theory. Immediately after the shock, births increase by 0.0093% and remain positively above trend for all 40 periods. Consistent with theory, the model predicts that households respond to positive economic conditions with an increase in children. The impulse response functions are denoted in Figure 1.

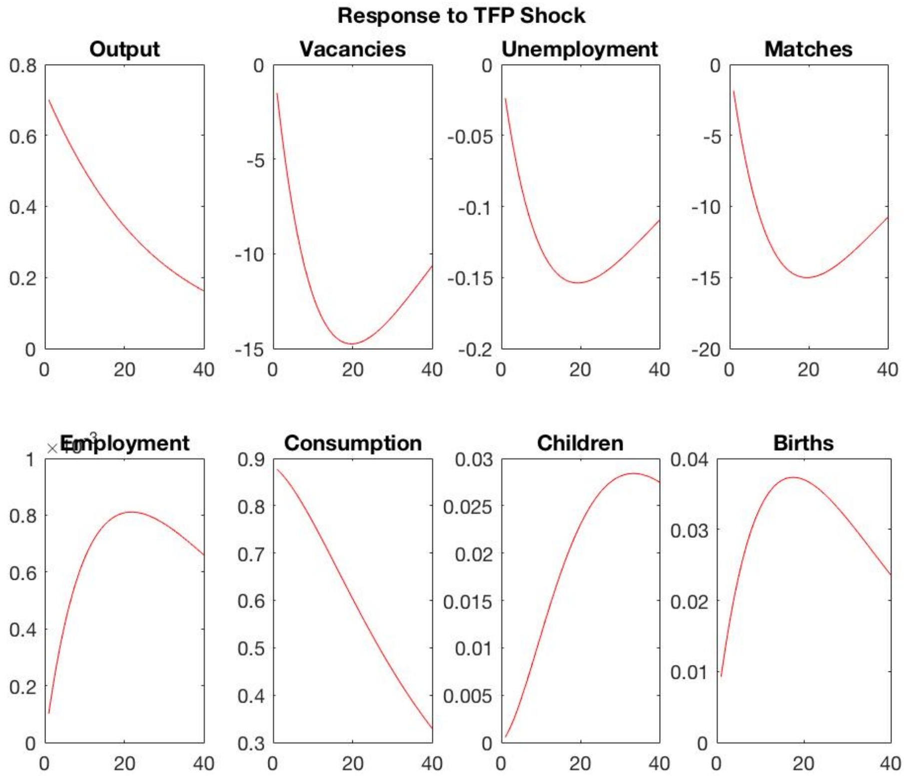

Figure 1: TFP

5.2 Separation Rate

In order to more directly simulate the labor market impact of a recession, I simulate a positive shock to the separation rate, which means more individuals lose their job each period. When the separation rate experiences a 1% shock, output begins to decline. For consumers, consumption falls, as does the number of children and births. As expected, unemployment increases and employment falls. Vacancies increase and since matches are now easier, matches increase. These fertility results are also consistent with the theory, as higher unemployment is inducing a significant and long-lasting reduction in new births. Even without a change to the fundamentals of the economy, the household losing employment more frequently is able to significantly reduce fertility. The corresponding impulse response functions are denoted in Figure 2.

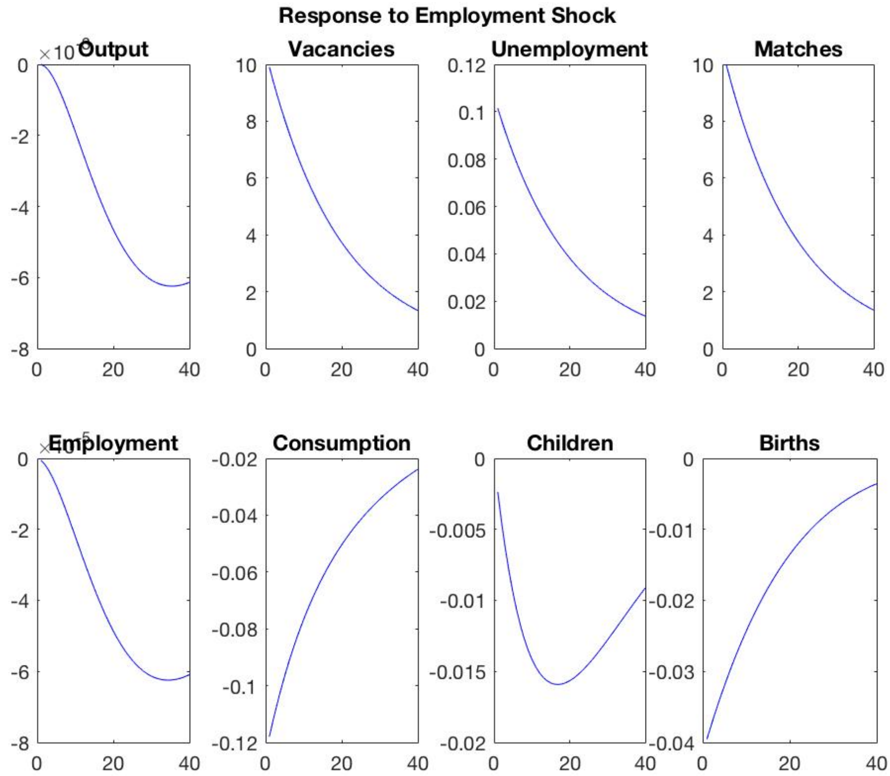

Figure 2: Separation Rate

6 Conclusion

In this paper, I developed a search based labor market with a fertility decision. Given that households are most affected by business cycles through the labor market, I directly and indirectly model the labor market behavior in the business cycle. I find that fertility behaves procyclically, with households increasing their fertility with an improvement to the economy.

While these results are generally consistent with the theory, there are several limitations. First, households are assumed to be homogeneous. In the fertility processes, the model does not account for medical difficulties and assumes that if the household decides to have children, it will be able to. With the current time cost for children, the household gives birth in one period, and then in the following period, is in the unemployment state. It would be worthwhile to develop a mechanism by which at least some households immediately return to employment following a birth. Finally, the quantitative results depend on the parameter values used, and alternate parameters would produce slightly different results.

The following model only addresses how fertility responds to the business cycle, which are relatively small changes in magnitude compared to the level declines in fertility seen in recent history. While this would be a significant expansion of the model, given that current fertility levels are concerningly low, a model that can capture both level and cycle deviations in fertility could potentially explain fertility behavior.

References

Child mortality rate drops by a third since 1990, Sep 2010. URL https://www.unicef.org/media/media_56045.html.

Namkee Ahn and Pedro Mira. A note on the changing relationship between fertility and female employment rates in developed countries. *Journal of Population Economics*, 15(4):667–682, 2002. ISSN 09331433, 14321475. URL http://www.jstor.org/stable/20007839.

Robert J. Barro and Gary S. Becker. Fertility choice in a model of economic growth. *Econometrica*, 57(2):481–501, 1989. ISSN 00129682, 14680262. URL http://www.jstor.org/stable/1912563.

Gary S. Becker and Robert J. Barro. A reformulation of the economic theory of fertility. *The Quarterly Journal of Economics*, 103(1):1–25, 1988. ISSN 00335533, 15314650. URL http://www.jstor.org/stable/1882640.

William P. Butz and Michael P. Ward. The emergence of countercyclical u.s. fertility. *The American Economic Review*, 69(3):318–328, 1979. ISSN 00028282. URL http://www.jstor.org/stable/1807367.

J Craig. Replacement level fertility and future population growth. *Population Trends*, 1994.

Matthias Doepke, Moshe Hazan, and Yishay D. Maoz. The baby boom and world war ii: A macroeconomic analysis. *The Review of Economic Studies*, page 1031–1073, Mar 2015.

FRED. Fertility rate, total for the united states, May 2017. URL https://fred.stlouisfed.org/series/SPDYNTFRTINUSA.

Etienne Gagnon, Benjamin Johannsen, and David Lopez-Salido. Understanding the new normal: The role of demographics. *Finance and Economics Discussion Series*, 2016.

Haines. Fertility and mortality in the united states, 2008. URL https://eh.net/encyclopedia/fertility-and-mortality-in-the-united-states/.

Larry E. Jones and Alice Schoonbroodt. Baby busts and baby booms: The fertility response to shocks in dynastic models. *Review of Economic Dynamics*, page 157–178, Oct 2016. doi: 10.3386/w16596.

Michaela Kreyenfeld and Gunnar Andersson. Socioeconomic differences in the unemployment and fertility nexus: Evidence from denmark and germany. *Advances in Life Course Research*, page 59–73, 2014.

Diane Macunovich. *Economic Theories of Fertility*, page 105–124. Blackwell, 1 edition, 2003.

Monika Merz. Search in the labor market and the real business cycle. *Journal of Monetary Economics*, 36(2):269–300, 1995. doi: 10.1016/0304-3932(95)01216-8.

Deniz Orsal and Joshua Goldstein. The increasing importance of economic conditions on fertility. 2010.

Tomas Sobotka, Vegard Skirbekk, and Dimiter Philipov. Economic recession and fertility in the developed world. *Population and Development Review*, 37(2): 267–306, 2011. doi: 10.1111/j.1728-4457.2011.00411.x.

Mario Solis-Garcia. Econ 371: Intermediate macroeconomics, 2017.

Cory Stern. Is the affordable care act's individual mandate a certified job-killer. *Economics Honors Projects*, 2016.

WorldBank. Household final consumption expenditure, etc. (% of gdp).