

# Analysis of Consumption on the Goods and Services Market in the Cybernetic Model of Selected Country

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**Abstract.** The paper analyses the consumption on the goods and services market in the cybernetic model of Czechia. The theoretical basis is given by the consumption function in the short-term, the macroeconomic multiplier of the two-sector economy and the cybernetic model with the goods and services market. All the above-mentioned theory is applied to the real conditions of the selected country, which is the Czech Republic.

**Key words:** cybernetic model, goods and services market, consumption, macroeconomic multiplier

## 1 Introduction

A real economy is a complex system that can be simplified into an economic model with inputs, outputs, and links inside. Exogenous inputs are most often considered as autonomous components of consumption, investment, government purchases, exports and imports. The key output is then the amount of product.

One of the most important input and output parts is consumption. There is the input autonomous consumption and the output total consumption as part of the gross domestic product. This article analyses autonomous and total consumption in a two-sector economy.

## 2 Data and Methods

### 2.1 Consumption in the Short-Term

The theory of consumption function is very well explored in the professional literature of the 20<sup>th</sup> and 21<sup>st</sup> centuries [1-3].

Consumption function in the short-term is based on Keynesian theory. It is a relation between consumption and macroeconomic product. Mathematically expressed, these two variables are dependent and independent variable. The equation of the function is as follows in the formula (1).

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$$C = C_0 + c \times Y \quad (1)$$

Where:

C is the total consumption,  
 $C_0$  autonomous consumption,  
 $c \times Y$  induced consumption,  
c marginal propensity to consume,  
Y product.

## 2.2 Macroeconomic Multiplier of the Two-Sector Economy

The so-called Keynesian multiplication process uses the property of consumption function and especially of the post-induced consumption through the marginal propensity to consume. “The Keynesian multiplier process is the economist’s paradigmatic positive feedback loop, in which an initial departure from full-employment equilibrium cumulates instead of being corrected” [4].

The principle of multiplication is infinite and weakening repetition of the original impulse, which is the change in autonomous expenditures. Mathematical evaluation of the strength of the effect is given by the formula (2).

$$\Delta Y = \Delta(C_0 + I_0 + G_0 + NX) \times \frac{1}{1-c} \quad (2)$$

Where:

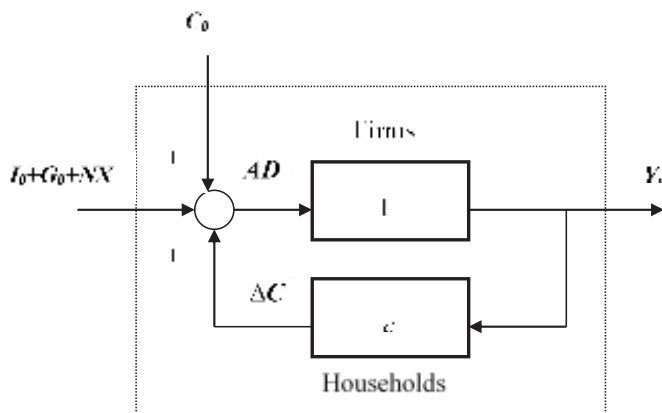
Y is the product (GDP),  
 $C_0$  autonomous consumption,  
 $I_0$  autonomous investments,  
 $G_0$  autonomous government purchases,  
NX net export,  
c marginal propensity to consume.

## 2.3 Cybernetic Model with the Goods and Services Market

“Cybernetics allows expression of the dependence of output change  $\Delta Y$  on exogenous input changes  $\Delta(C_0+I_0+G_0+NX)$ ” [5]. Cybernetic model with the goods and services market has following parameters:

- Inputs
  - Autonomous consumption  $C_0$
  - Other autonomous expenditures  $I_0 + G_0 + NX$
- Internal feedback
  - Marginal propensity to consume c
- Output
  - Product Y

A constant price level is assumed, which can be achieved by calculations with input parameters at constant prices. The graphical interpretation of the above is shown in Fig. 1.



**Fig. 1.** Cybernetic Model of a Static Economy with the Goods and Services Market

Source: [6].

### 3 Results and Discussion

#### 3.1 Consumption in Selected Country

Under the conditions of the Czech Republic, objective time series can begin in 1993 when Czechia and Slovakia became independent. In this case, the relevant data can be traced back to 1996 as shown in Table 1.

**Table 1.** Consumption and product data of the Czech Republic (in CZK million, constant prices) [7].

	Product	Consumption
2017	4612481	3052490
2016	4418198	2955606
2015	4306516	2865773
2014	4089400	2777475
2013	3981303	2734118
2012	4000653	2704547
2011	4032910	2743834
2010	3962464	2765219
2009	3874383	2741341
2008	4069840	2731172
2007	3963527	2667991
2006	3753246	2587425
2005	3512515	2516852
2004	3297100	2453097
2003	3142892	2408273
2002	3033592	2290145
2001	2984277	2193217
2000	2899925	2164111
1999	2781256	2113471
1998	2741968	2050586
1997	2751011	2074671
1996	2767468	2014077

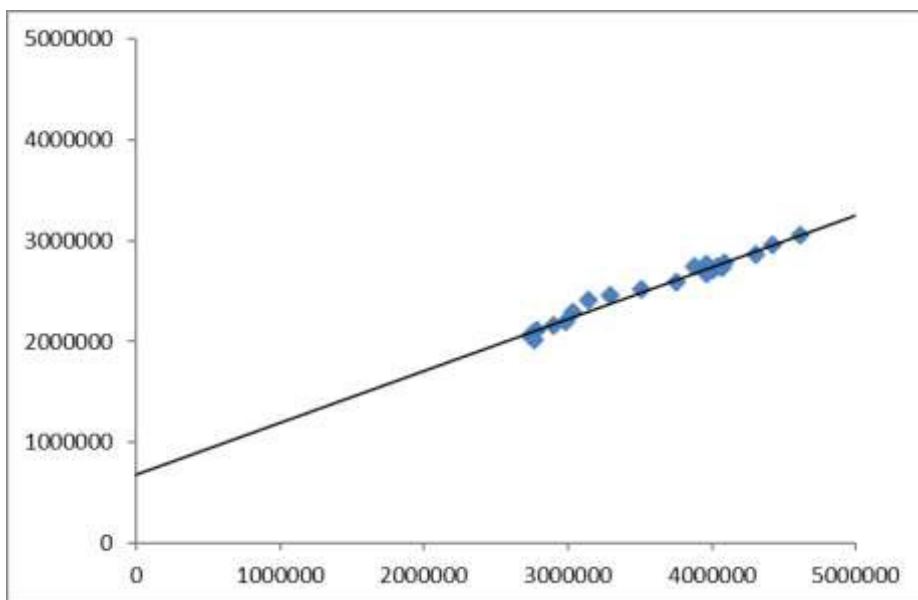
Source: [7].

By fitting the regression line with these points, an accurate consumption function with  $R^2 = 0.9781$  is obtained. The parameters of this consumption function are  $c = 0.5137$  and  $C_0 = 683545$  (Fig. 2). The complete consumption function is given in equation (3).

$$C = 683545 + 0.5137 \times Y \quad (3)$$

Where:

- C is the total consumption,
- $C_0$  autonomous consumption,
- $c \times Y$  induced consumption,
- c marginal propensity to consume,
- Y product.



**Fig. 2.** Consumption Function in the Czech Republic.

Source: Author.

### 3.2 Macroeconomic Multipliers in Selected Country

The Keynesian multiplier is naturally based on the values of the consumption function, autonomous consumption and the marginal propensity to consume. For the Czech Republic, the calculation method (4) and the value of the multiplier (5) apply.

$$\Delta Y = \Delta(683545 + I_0 + G_0 + NX) \times \frac{1}{1-0.5137} \quad (4)$$

$$\Delta Y = \Delta(683545 + I_0 + G_0 + NX) \times 2,0563 \quad (5)$$

Where:

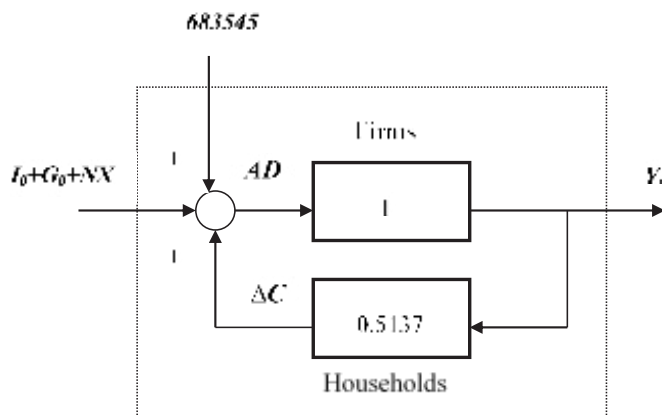
- Y is the product (GDP),
- $C_0$  autonomous consumption,
- $I_0$  autonomous investments,
- $G_0$  autonomous government purchases,

NX net export,  
 c marginal propensity to consume.

### 3.3 Cybernetic Model of Selected Country

The cybernetic model of the Czech Republic is supplemented by specific values of autonomous consumption  $C_0 = 683545$ , and marginal propensity to consume  $c = 0.5137$ . This means that the change in any autonomous expenditures (autonomous investments, autonomous government spending, net exports) will be 2.0563 times in the economy.

Fig. 3 shows an actual cybernetic model of the Czech Republic with the goods and services market.



**Fig. 3.** Cybernetic Model of the Czech Republic with the Goods and Services Market

Source: Author.

### 3.4 Complex Dataset of Selected Country

Czechia can be described from the point of view of consumption, Keynesian multiplier and cyber model by the parameters in Table 2.

Individual quantities were determined as follows:

- $Y$  – real data,
- $C$  – real data,
- $C_0 + I_0 + G_0 + NX$  as the total input of cybernetic model,
- $C_0$  as one parameter of the consumption function,
- $I_0 + G_0 + NX$  as the difference between cybernetic model and consumption function data.

**Table 2.** Consumption and product data of the Czech Republic (in CZK million, constant prices).

	Product Y	Total Consumption C	Total Autonomous Expenditures $C_0+I_0+G_0+NX$	Autonomous Consumption $C_0$	Non- consumption Autonomous Expenditures $I_0+G_0+NX$
2017	4612481	3052490	2243050	683545	1559505
2016	4418198	2955606	2148570	683545	1465025
2015	4306516	2865773	2094259	683545	1410714
2014	4089400	2777475	1988675	683545	1305130
2013	3981303	2734118	1936108	683545	1252563
2012	4000653	2704547	1945518	683545	1261973
2011	4032910	2743834	1961204	683545	1277659
2010	3962464	2765219	1926946	683545	1243401
2009	3874383	2741341	1884112	683545	1200567
2008	4069840	2731172	1979163	683545	1295618
2007	3963527	2667991	1927463	683545	1243918
2006	3753246	2587425	1825204	683545	1141659
2005	3512515	2516852	1708136	683545	1024591
2004	3297100	2453097	1603380	683545	919835
2003	3142892	2408273	1528388	683545	844843
2002	3033592	2290145	1475236	683545	791691
2001	2984277	2193217	1451254	683545	767709
2000	2899925	2164111	1410234	683545	726689
1999	2781256	2113471	1352525	683545	668980
1998	2741968	2050586	1333419	683545	649874
1997	2751011	2074671	1337817	683545	654272
1996	2767468	2014077	1345820	683545	662275

Source: Author.

## 4 Conclusion

Consumption in the short-term, macroeconomic multiplier of the two-sector economy, and cybernetic model with the goods and services market have been used to define conclusions of this paper.

GDP increased by 67%, consumption increased by 52%, total autonomous expenditures increased by 67%, autonomous consumption did not increase or decrease, and non-consumption autonomous expenditures increased by 135%. This has happened over the past two decades.

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