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Mankiw's "Puzzle" – Is Durable Consumption Declining?

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ABSTRACT

Mankiw's puzzle of long-term (durable) consumption is a significant topic that needs to be solved. We statistically analyze a time series sample from Germany and from the Czech Republic (2004Q1 to 2016Q4). Furthermore, we discussed the analyses that have been performed to date for the USA and France. These analyses have verified the Mankiw's puzzle theory about the problematic evolution of durable consumption expenditures. The verification itself has led to arguments for the initiation of scrapping old cars in France and many other European countries in the 1990s (mainly the Juppe and then the Balladur administrations in France). Currently, when we experience economic booms, it is important to ask what happens in a recession. (The Czech Republic pulled through one mainly due to the automotive industry.) Furthermore, this recession is strengthened if the depreciation rate is much lower than the growth rate of durable consumption. These factors together could cause durable consumption to stagnate. We disproved Mankiw's puzzle theory using a data sample from the Czech Republic and Germany. This conclusion means that long-term consumption does not disappear. The results of the analysis argue against the initiation of scrapping old cars based on current data. The main explanation of the different conclusions of our analysis and the original analysis is that, currently, the new cars that are sold each year have massive innovations. We have to take into account that the new cars that are sold every year satisfy deeper and wider individual needs. The previous conclusion is extended, owing to the initialization of e-mobility and the shorter lifespans of electronic devices.

KEY WORDS: Durable consumption, ARMA stochastic process, scrapping subsidy, Mankiw's puzzle

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1. Introduction and Overview

Standard Economic Theory, such as that by Cochrane (2009), develops the theory on macroeconomic consumption. Cochrane (2009), Wickens (2012), Cuthbertson and Nitzsche (2005) and others have concluded that macroeconomic consumption acts contrarily to risky assets in the financial sector. The model is called the Consumption CAPM (Capital Asset pricing model). It originally appeared in Lucas (1978). This model and its conclusions are often compared with the original CAPM and efficient portfolio theory of Markowitz (1952), Tobin (1958), Sharpe (1964), Lintner (1965) and Mossin (1966).

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Looking back at original consumption theory and the problems with its conclusions, we have to highlight the risk premium puzzle. Since the relative risk aversion coefficient is reasonably calibrated, we are not able to explain the risk premium that is empirically measured using time series from the USA (Mehra & Prescott, 1985). Weil (1990) adds the problems of the risk free rate and its relationship to the abnormal high relative risk aversion coefficient. The solution is found, owing to many approaches. These include habit formation that was introduced by Campbell and Cochrane (1999), the model with friction of Aiyagari and Gertler (1999) or Pástor and Veronesi's (2009) model with technological bubbles. None of these have included durable consumption.

In this article, we will take into account durable consumption (Mankiw, 2014). Here, we divide consumption into short and long-term consumption (durables). In addition, we will introduce the term "Mankiw´s Puzzle".

The aim of this thesis is to verify the existence of Mankiw's puzzle of long-term (permanent) consumption using the current time series data sample from Germany and the Czech Republic. The following discussion is made, owing to the experience from France and the USA.

Overall, short-term consumption affects the utility in the period when it occurs. Meanwhile, long-term consumption affects not only the current utility period but also future utility. To be complete, we include "the habit formation", and we observe the long term effects on utility, even from the short term consumption of goods. In this text, we follow the theory that is presented in Campbell and Mankiw (1989). We need to know the fundamentals of long-term consumption because of its significant dependence on economic cycles (higher volatility than long-term consumption).

2. Methodology

In this article, the motivation (or article goal) is to formulate conclusions about long-term consumption in the economic model of representative agents (households). In the article, we often interchange the terms long-term household consumption and expenditures on purchasing new cars by households in the economy. We perceive the differences between these two terms, but this is our assumption. Hereafter, we conduct an empirical analysis. There are arguments for and against scrapping subsidies. The scrapping subsidy problem is essentially interconnected with durable consumption expenditures. We explain why we make this simplification (assumption) between long-term consumption, durable consumption and spending on purchasing new cars by households.

The empirical analysis is based on the stochastic analysis method (Box-Jenkins method). Especially, we apply the Autoregressive-Moving Average (ARMA) models method to the stationary time series. We only marginally deal with the co-integration of the time series, vector autoregression, or the error correction model.

3. The Permanent Income Hypothesis in the Long-Term Consumption Model

Let us begin with a description of a representative household that owns wealth A (or an estimated Gross Return R), a certain long-term consumption D and disposable income y. This household makes consumption expenditures c and the long-term consumption occurs at the relative price pe. In other words, the accumulated relationship is as follows:

$$A_2 = R\left(A_1 + y - c - pe\right) \tag{1}$$

Additionally, the accumulating relationship for long-term consumption is as follows:

$$D_2 = D\left(1 - \delta\right) + e \tag{2}$$

Where δ is the capital depreciation rate (long-term consumption). The utility of a representative household increases from their purchases (short-term consumption) and from utility services stemming from the ownership of physical capital. Let us assume that the long-term consumption that is purchased today ensures the flow of services for the next period. Under the conditions that are presented, the Bellman dynamic optimization equation is as follows:

$$V(A,D,y,p) = \max_{D_2,A_2} u(c,D) + \beta E_{y_2,p_2|y_1,p_1} V(A_2,D_2,y_2,p_2) \tag{3}$$

For all A, D, y, and p, we work with the expectation operator (E). Moreover, we assume rational expectations. We also apply the discount factor β. By putting relation (2) into relation (1) and making a minor adjustment, we get equation (4), which is an optimization constraint:

$$c = A_1 + y - \frac{A_2}{R} - p(D_2 - (1-\delta)D_1) \tag{4}$$

The dynamic optimization results are obtained as follows

$$u_c(c, D_1) = \beta E_{y_2, p_2 | y_1, p_1} V_A(A_2, D_2, y_2) \tag{5}$$

$$p u_c(c, D_1) = \beta E_{y_2, p_2 | y_1, p_1} V_D(A_2, D_2, y_2) \tag{6}$$

Both cases are conditions for balancing marginal benefits and marginal costs. Relationship (5) offsets the effect of the decline in current consumption (increase) with an ever smaller effect on the growth of future consumption, which is, of course, evaluated using the financial markets and discounted to compare today with the discount factor b. The identical context describes the conditions (6) for long-term consumption (services resulting from the accumulation of physical capital over time). In an additional use of function (3), we modify the dynamic optimization conditions as follows:

$$u_c(c_1, D_1) = \beta E_{y_2, p_2 | y_1, p_1} u_c(c_2, D_2) \tag{7}$$

$$p u_c(c_1, D_1) = \beta E_{y_2, p_2 | y_1, p_1} [u_D(c_2, D_2) + p_2(1-\delta) u_C(c_2, D_2)] \tag{8}$$

Condition (7) will be comprehensible without involving long-term consumption. The ultimate benefit of increasing current consumption is offset by the decline in financial assets and the resulting reduction in future consumption. In this case, the marginal utility of short-term consumption depends on the current state of the long-term consumption of goods. Therefore, we need to consider the interconnection within the utility function between short and long-term consumption. In other words, we cannot analyze the effects of long-term consumption separately from short-term consumption.

Equation (8) illustrates the marginal costs and marginal benefits of purchasing a unit of a long-term consumption good. The limit contribution takes two forms. First, there is a direct impact on the benefits in the next period. Second, the standard Euler equation is weakened. We must consider that the marginal costs of additionally purchased long-term consumption units require sacrificing purchasing short-term consumption units (the second member on the right-hand side of Equation 8).

Finally, the model considers that long-term consumption will be immediately reflected. In this case, the standard Euler equation eliminates both short and long-term consumption. If the product of the discount factor and the gross return is equal to one, then the marginal utility of long-term consumption is monitored by the stochastic process with a random walk (which would, of course, also apply to the standardized short-term consumption). Mankiw (1982) concluded that spending on long-term consumption follows the stochastic ARMA process (1, 1)

$$e_{t+1} = a_0 + a_1 e_t + \varepsilon_{t+1} - (1-\delta)\varepsilon_t \tag{9}$$

Here, $a_1 = \beta R$ is the autoregressive parameter that is the product of the discount factor and the gross return. Meanwhile, the MA part is parameterized using the capital depreciation rate for long-term consumption. Using data from the USA, Mankiw concluded that a1 is statistically significantly less than 1 and that the depreciation parameter δ is statistically significantly equal to 1. In this case, long-term consumption would automatically converge to zero (no long-term consumption). Adda and Cooper (2000) conducted their own analysis following Mankiw and using data from the USA and France. These were the time series: "long-term US consumption", "US new car registrations", "long-term consumption in France", "new car registrations in France", and "new car costs in France". Mankiw's puzzle is confirmed for the robust data sample based on their research. However, there were no divisions according to the country, the long-term consumption category, or the frequency of the data. When the depreciation rate is estimated to be 100 percent (1), long-term consumption is self-defeating. Statistically, we cannot expect an increase on the basis of "innovation". The introduced "puzzle" is further explained using a) adjustment costs and b) shocks other than disposable income shocks. Further research on this is found in Bar-Ilan and Blinder (1992). Bertola and Caballero (1990) solve the puzzle by using discretionary household spending on long-term consumption.

4. Quadratic Adjustment Costs

Bernanke (1985) expands quadratic methods to flexible pricing and adjustment costs. In addition, we must assume that the utility function is incomparable, and we must therefore examine the factors of long-term and short-term consumption together. Let us assume an expanded dynamic optimization formula.

$$V(A,D,y,p)=\max_{D_2,A_2} u(c,D,D_2)+\beta E_{y_2,p_2|y_1,p_1} V(A_2,D_2,y_2,p_2) \quad (10)$$

For all A, D, y, and p, Bernanke (1985) assumes a quadratic utility function with quadratic purification costs as follows:

$$u(c,D,D_2)=-\frac{1}{2}(\bar{c}-c)^2-\frac{a}{2}(\bar{D}-D)^2-\frac{d}{2}(D_2-D)^2 \quad (11)$$

In this case, the adjustment costs are more important than the budget constraints. The quadratic structure of the model explicitly ensures its solvability as a nonlinear function with parameters. Current short-term consumption depends on the amount of short-term consumption, on the current and delayed amounts of long-term consumption and on innovations (the stochastic white noise processes) that are reflected in disposable income.

Long-term consumption depends on the past amount of long-term consumption (the volume of purchased capital goods that allow for long-term consumption services) and "innovations" (shocks) in disposable income. The introduced enlargement is generally rejected because it does not correspond to the conclusions of the empirically obtained data (Bernanke, 1985). Bernanke (1984) tests US car purchase costs using US household panel data at the microeconomic level. Nevertheless, we do not find that the conclusions hold in economic reality since the model assumes a continuous increase in car purchase costs, while in reality, we see flat-rate decisions for long-term consumption expenditures.

5. Nonconvex Adjustment Costs

In the following subchapter, we will retain the assumption from the representative agent model. We must admit that, despite the very precise theoretical elegance, the presented models do not correspond to the empirically measured data, which is a problem. Mankiw estimated the depreciation rate at 100%. Furthermore, it is clear that households do not continuously measure the costs of long-term consumption. Households would rather unpredictably spend their expenses on long-term consumption (Lam, 1991). We must involve the discrete nature of long-term consumption goods and the irreversibility of a purchase decision in light of imperfect information. Moreover, it is necessary to take into account the consumer product quality resulting in the unpredictability of long-term consumption and also depreciation costs (amortization). Bar-Ilan and Blinder (1992) describe the household inactivity model if the value of a capital asset for long-term consumption is far from optimal. Here, the adjustment costs are taken as fixed costs that may occur at any time as long as the long-term service level falls below the lower limit.

6. Irreversibility of the Purchase/ Sale of Goods for Long-Term Consumption

We apply the irreversibility of purchases to our model as follows. Due to the imperfect information and friction in household markets, consumers are usually convinced that they have not bought the long-term consumption product that they wanted. It is, of course, a variation on Akerlof's popular lemon problem (Akerlof, 1970). For example, related to this area, House and Leahy (2000) develop the endogenous "lemon" premium for the long-term consumption model. We practically assume that the costs of goods for long-term consumption are normalized to $p = 1$; however, when the goods are sold, the price is less as $p < 1$.

$$V(A,D,y)=\max\left(V^b(A,D,y),V^s(A,D,y),V^i(A,D,y)\right) \quad (12)$$

$$V^b(A,D,y)=\max_{e,A_2} u\left(A+y-\frac{A_2}{R}-e,D\right)+$$
$$\beta E_{y_2|y_1} V(A_2,D(1-\delta)+e,y_2)$$
$$V^s(A,D,y)=\max_{s,A_2} u\left(A+y-\frac{A_2}{R}+p_s s,D\right)+$$
$$\beta E_{y_2|y_1} V(A_2,D(1-\delta)-s,y_2)$$
$$V^i(A,D,y)=\max_{A_2} u\left(A+y-\frac{A_2}{R},D\right)+$$
$$\beta E_{y_2|y_1} V(A_2,D(1-\delta),y_2) \quad (13)$$

For all A, D and y, this is a complex discreet choice problem. In essence, the difference between the buying and selling prices of long-term consumption goods determines the decision-making of households. Consider a household that has a certain level of long-term consumption and that it expects decreased disposable income due to a job loss. Given the irreversibility of the purchase / sale, the household may sell a portion of its goods for long-term consumption. As soon as the household acquires a new job, the volume of goods for long-term consumption increases to its original level. However, if there are different purchase and selling prices of the goods for long-term consumption, the household will not react in the way that is described by changing long-term consumption to disposable income shocks.

Grossman and Laroque (1990) present a long-term consumption model within an optimal portfolio structure. Long-term consumer goods are not liquid due to the necessary transaction costs when they are resold. The essentially representative household monitors the share of assets and goods for long-term consumption and the depreciation rates of goods for long-term consumption. This unpredictable depreciation rate requires this household to keep its use above the minimum value and optimally at the average wear value. Of course, the decision is subject to a constant ratio of assets and goods for long-term consumption. Thus, the final condition is $A / D = s^*$.

Eberly (1994) conducts an empirical test of Grosman and Laroque (1987). Using the "Survey of Consumer Finances" data for assets, pensions and households' main expenditures, he estimates the ranges of S and S^* (as observed using A / D). He further estimates s^* as the average proportion of quantities. In addition, he concludes that retirement and the growth rate of income strongly influence the width of the S-band. Attanasio (2000) estimated the heterogeneity of households. This heterogeneity is manifested by the fact that some households with the same shares of durable good assets are not interested in new long-term consumption goods. They do not experience amortization, and they do not thoroughly maximize their asset inventory for long-term consumption. The described household differences and the age and race of the population are the determinants of the asset band for long-term consumption. In fact, we actually infer the aggregate demand for durable goods.

Caballero (1993) summarizes the previous theories where we can accept the conclusions of the permanent income hypothesis in the long-term consumption model only in the absence of transaction costs. As soon as we consider positive transaction costs, we must assume that the model works as described in the previous paragraphs. This is done by activating the band of assets with width S. However, the target volume of assets for long-term consumption (though, here, it is the virtual wishes of the household rather than reality) follows the described stochastic process.

Aggregate demand for long-term assets is the sum of the demands of all buyers who have decided to improve (refurbish) their long-term assets during that period. Obviously, aggregate demand as defined will have very complex economic dynamics.

6. Data and Results

Taking into account the objectives of the article that are related to the long-term consumption (scrapping) effects in Germany and the Czech Republic, we use different data sources. The Eurostat database did not offer a suitably long time series or suitable data frequencies. Fortunately, the data on "newly registered cars" are reliably statistically captured by national professional associations. The monthly frequencies of "newly registered cars" were obtained from the statistics of the "Union of Automobile Importers" of the Czech Republic. Similarly, data on "newly registered cars" in Germany were obtained from the "European Automobile Manufactures Association" database. For both time series, the monthly frequency data were converted into quarterly data, which resulted in 52 observations in data sample from 2004Q1 to 2016Q4.

We obtained data on the development of long-term consumption for the Czech Republic (in millions of CZK) from the CZSO database (Eurostat lacked data) and for Germany (in millions of Euros) from Eurostat. The quarterly data are reported using current prices over the same time series data sample of 2004Q1 to 2016Q4. Additional information on the properties of the presented time series is provided in the following table Table 1.

First, we will verify Mankiw's puzzle. Recall that this is a test of the presented time series using the ARMA (1,1) stochastic process, mainly with respect to the autoregression parameter and the depreciation parameter in the MA process.

Table 1. Characteristics of the time series

	Average	Standard Deviation	*p* (Jarque-Bera)	Unit Root Test
CZdur	40995	6768	0,95	Nonstationary, I(1)
Gdur	39621	3478	0,76	Nonstationary, I(1)
CZnewreg	43029	12075	0,019	Nonstationary, I(1)
Gnewreg	804205	88793	0,000	Stationary, I(0)

Table 2. Characteristics of the time series

	Constant	Parameter AR	Parameter MA/ Depreciation parameter	Autocorrelation of residuals
CZdur	47340 (0,00)	0,967 (0,00)	-0,997 (0,00)/0,003	YES (DW 2,558)
Gdur	53691 (0,0294)	0,987 (0,00)	-0,953 (0,00)/0,047	YES (DW 2,575)
CZnewreg	29234 (0,00)	1,05 (0,00)	-0,802 (0,00)/0,198	YES (DW 2,468)
Gnewreg	804967 (0,00)	0,200 (0,85)	-0,074 (0,95)/cannot	NO (DW 1,984)

First, we analyze the autoregressive parameter. According to Mankiw's theory, it should be significantly smaller than 1. In the ARMA stochastic process (1, 1), we examined four time series: a) "consumption expenditures" in the Czech Republic (CZdur), b) "consumption expenditures" in Germany (Gdur), c) the number of "newly registered cars" in the Czech Republic (CZnewreg), and d) the number of "newly registered cars" in Germany (Gnewreg).

First, it is necessary to comment that in addition to "newly registered cars" in Germany, this is a nonstationary time series. Using standard statistical analysis methods is very risky. Using cointegration methods for time series or vector autoregression methods is more appropriate. The basic measure of the usefulness of the model is the non-autocorrelation of the residual model.

In our case, the autoregressive coefficient is not significantly less than one (see table), and, further, the depreciation parameter is not 1. Rather, it is zero (as shown in the table). Therefore, we cannot agree with the conclusions of Mankiw's puzzle. According to this theory, the increase in long-term consumption has been converging to zero until long-term consumption stops. This conclusion is the justification for scrapping cars in France in the 1990s under the Balladur and Juppé administrations.

Our empirical analysis of the time series from 2004Q1 through 2016Q4 provides the totally opposite conclusions. Long-term consumption is not stagnating and falling, which does not follow the ARMA (1, 1) model that was introduced. For accuracy, the ARMA model (1, 1) tests Mankiw's inappropriate autoregression and depreciation parameters.

For statistical correctness, let us conclude that the introduced model is inappropriate for infinite time series. In this case, any autocorrelation residuals must accompany the results of the error correction model. This shall be verified. In our case, when we observe the autocorrelation of the residuals for the nonstationary time series, there is a risk of spatial regression in the model. Statistical theory proposes differentiating the time series and using the model for the nonstandard ARIMA time series. In our case, we do not give the results since it resulted in absolutely unusable outputs in the context of this article.

There is certainly a well-founded criticism that differentiation delivers certain information. However, by omitting the nonstationary or possibly autocorrelated residuals, we run the risk of an incorrect regression. This econometric-statistical problem is known and its satisfactory solution is using interconnected Vector Autoregression Models (VAR) or extended the Vector Error Correction Models (VECM).

7. Discussion

For the discussion of the research results, we compare these results with those of Adda and Cooper (2000). We conclude with options to eliminate the linear trend and seasonality. We also present the possibilities for further research and discuss the conclusions of the model with regard to the intense product innovations. This discussion will result in improved numbers of newly sold cars.

Adda and Cooper (2000) conducted similar research on a 1970-1997 time series sample (annual data, five time series) for the following variables: long-term consumption in the US, long-term consumption in France, new car expenditures in France, and newly registered cars in France and the United States.

The autoregressive parameter is always estimated to be less than one and only for newly registered cars in the US this is significantly lower than one (0.36). The more important fact is that the depreciation parameter is estimated to be greater than 1, but it less than 1.5 for all variables. Mankiw's puzzle is confirmed for the investigated time series since long-term consumption steadily decreases. However, the estimated coefficients do not meet statistical credibility standards. They should even theoretically disappear. On the basis of the described research, we could argue for the introduction of scrapping cars, which was first introduced in France and later in Italy and Spain.

Balladur´s government offered everyone 5000 francs (a tenth of the price of a new car) if they let their old car be destroyed. New car sales revenue after the previous slump reached its peak in 1996. The government's goal was to reinforce potential new cycles in the demand for cars. Once the scrappage was abolished, demand for cars stabilized at its original level. It was expected that, ten years later, the demand for cars in France (in Europe) would be at its peak, which is unexpectedly quite coincidental with the start of the 2008 economic crisis. This is a rational argument for the scrapping subsidies in Europe.

In the following table, Tab. 3, we test the original time series for the Czech Republic and Germany 2004Q1 to 2016Q4 for the "newly registered cars" and "long-term consumption expenditures" variables for both countries. However, we remove the linear trend and eventual seasonality.

Now, let us just briefly comment on the previous table in which we analyzed the linear trend and seasonality in the analysis. For the first two time series, we estimate the coefficients with satisfactory p-values for the long-term consumption of households in the Czech Republic and Germany (we dismiss Mankiw's puzzle). However, for the other two time series, "the number of newly registered cars" in the Czech Republic and Germany, there are no satisfactory p values for the trend and the components of the ARMA (1,1); therefore, it is absolutely unusable.

For the sake of completeness, let us add that in the conclusions of Adda and Cooper (2000), which performed a similar analysis for the 1970 to 1997 time series data sample (with data with an annual frequency), they confirmed Mankiw's puzzle, even on degraded time series (with problematic p values of the coefficients and probably also autocorrelated residuals).

In view of the above conclusions, the question arises as to where the future analysis of long-term consumption should go. Adda and Cooper (2000) conducted a robust structural analysis. Simply put, on the basis of the theoretical model, the dynamic discreet choices estimate the distribution of the "autohazard" risk for cars for France and the US. In essence, they explain the likelihood of disposing of cars based on the age of the car. They conclude that the depreciation parameter for relatively new cars is between 5 and 10 percent. Thus, they explain Mankiw's puzzle, and their conclusions argue against the existence of scrapping

Table 3. Testing presented time series using the ARMA (1, 1) stochastic process "Mankiw's puzzle"

	Constant	Parameter AR	Trend
CZdur	35221 (0,00)	-1,007 (0,00)	231,64 (0,00)
Gdur	34960 (0,00)	-0,988 (0,00)	182,58 (0,00)
CZnewreg	-715710 (0,97)	0,99 (0,00)	5477,5 (0,93)
Gnewreg	834564 (0,00)	0,163 (0,89)	-1147,5 (0,297)
	Seasonality	**Parameter MA / Depreciation parameter**	**Autocorrelation of residuals**
CZdur	We reject	0,997 (0,00)/1,997	YES (DW 1,1815)
Gdur	We reject	0,958 (0,00)/1,958	YES (DW 2,575)
CZnewreg	We reject	-0,737 (0,00)/0,263	YES (DW 2,524)
Gnewreg	We reject	-0,074 (0,95)/cannot	NO (DW 2,003)

subsidies. Finally, we must also consider e-mobility as a new phenomenon, as in Augenstein (2015). This innovate shift biases the conclusions on Mankiw´s puzzle and creates differences throughout the EU countries.

8. Conclusion

The aim of this paper was to verify the existence of Mankiw's puzzle of long-term (durable) consumption using current time series from Germany and from the Czech Republic (data sample from 2004Q1 to 2016Q4). Mankiw´s puzzle in simply addresses whether the observed long-term consumption tends to spontaneously disappear or not in the economy. We have terminologically tested whether the stochastic ARMA process (1,1) of the given time series contains an autoregression parameter that is less than 1. Furthermore, in addition, we also test whether the more important deprecation parameter is equal to 1 (MA parameter equal to zero).

In the analyses that have been performed so far, the time series data of the United States of America and France, which concerned long-term consumption, demonstrated the statistical significance of the mentioned coefficients. Mankiw's puzzle has been proven. This all together has led to arguments for the initiation of scrapping old cars in France and many other European countries in the 1990s. Additionally, demand growth was expected to increase in the ten-year cycle of new car consumption.

In our analysis, which was based on quarterly data from 2004 Q1 to 2016Q4 in Germany and the Czech Republic, we have also run similar statistical tests. We conclude with other autoregression parameters and depreciation parameters than those that are suggested by Mankiw's puzzle theory. In general, innovation (parameter MA) is nonzero. It means that "innovation" affects long-term consumption over a longer period of time. The results of the analysis argue against the initiation of scrapping old cars based on current data. The main explanation of the different conclusions of our analysis and the original analysis is that, currently, the newly sold cars each year contain massive innovations. Moreover, e-mobility and its potential surely influence the empirical verification of Mankiw´s puzzle. Thus, electronic product lifespans are getting shorter. More generally, the basic point of the Mankiw´s puzzle is the economic trade off of new purchases and repairs. These preferences might differ across countries, even in the comparison of the Czech Republic and Germany. Moreover, the purchasing power of Czech citizens is much lower than those in Germany. The marginal benefits and costs of new purchases and repairs also differ.

We have to take into account that the newly sold cars each year satisfy deeper and wider individual needs. In this light, it is naturally hard to find similarities between "economic laws" and Mankiw´s puzzle. We can also offer many other explanations for the presented facts.

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