BASS DIFFUSION MODEL FOR FORECASTING ELECTRIC CAR OWNERSHIP IN BELARUS

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This paper focuses on the diffusion of innovation and the application of the Bass model to forecast the sales of electric vehicles in the Republic of Belarus for the years to come. Despite the small number of private EV owners, both current and predicted, the automobile market in the country has a significant growth potential, making it essential to urge its development.

***Key words*:** economic model, the Bass model, diffusion of innovation, product adoption, electric vehicles, EV market growth estimates.

To analyze different economic phenomena economists use their simplified systematic definitions called economic models.

The Bass model is a model that helps us forecast sales for a product in an industry over a very long period, and if specified well the bass model will produce a product life cycle curve for an industry over a very long period of time [1].

When we talk about the Bass model, we have to talk about something called the diffusion of innovation. Diffusion is the concept that underlies the notion for the bass model. According Dr. Bass, "Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas." A simple model does not take into account external factors and focus on two parameters: p - the coefficient of innovation and q - the coefficient of imitation. Moving forward p, q and M in the standard bass model do not change over time and this is unrealistic. So, a simple model shows what would happen if changes are insignificant [2].

The electric vehicle or EVs, whether we like it or not, is the automobile industry's unconditional and imminent future. Many manufacturers around the world are investing heavily in electric vehicle growth, which is driven by the steady rise in petroleum products prices, the need to minimize toxic car emissions, as well as the growth of energy storage devices and energy management technologies. The only point and difference that can affect road safety is that electric vehicles can pick up speed very quickly. From a safety point of view, it is a sharp increase in speed that can bring some negative consequenc-

es. The forecasting of the number of EVs in Belarus will therefore be of great importance for adjusting the existing industrial and government policies.

As a city car, an electric car is now more than practical in Belarus. At the moment, you can absolutely operate it in the city, even without having your own place to charge. However, for those who need to go on long journeys, and do it quickly enough to get from point A to point B, it will not work yet.

Belorusneft has already built a very serious charging system network. There are about 70 of them in Minsk alone, and about 200 throughout Belarus. At the same time, we have about 751 electric vehicles in the country, that is, on average, there are only about three cars per charging station.

There are a few tax benefits for EVs owners. For example, they will not pay the so-called road tax, VAT and custom duties.

From 1st of July 2020 green numbers are issued to everyone who registers an electric car. A decision was made to do it on separate signs, differing in appearance from the rest, for all vehicles running on electricity.

Statistics show: sales of electric vehicles all over the world are growing by 50–70% per year. Belarus is trying to keep up with world trends. But the number of electric cars in our country is still small – just over half a thousand. The lack of demand for environmentally friendly transport is associated with high prices and a small number of fast charging stations.

Greening the global auto industry is no longer news. Almost every carmaker today has cars with electric or hybrid engines. And even during the pandemic, their sales increased by 50% amid a sharp decline in purchases of new cars with gasoline and diesel engines. According to the most ambitious forecasts, in 5 years the electric park in Belarus will reach 100 thousand cars.

As we can see, the government in Belarus understands prospects of EVs and tries to provide some support.

Estimating potential market size accurately can be quite problematic. To get a precise number a very thorough research must be conducted. Since I do not have the recourses to do that and there is no available data concerning amount of people that are able to buy a car, I tried other methods.

For approximate estimation of a potential private car market, I used the following logic.

- A car isn’t a luxury product anymore. After researching a few online car markets I can conclude that around 2000$ should be enough to buy a car that can drive. This amount of money isn’t that big taking into account that according to official data, average salary is 500$ a month.
- Using BELSTAT data it is possible to calculate the following. There’re 9 485 264 people living Belarus . Kids are not allowed to drive the car until they are 18 years old. The elderly retired people are also less likely to

purchase a car. So if we exclude those categories and keep only people from 20 to 74 years old we get 6 804 563 people.

- There are around 450 thousand people living beyond poverty in Belarus, they are also unlikely to be able to buy a car. Subtracting that we get around 6.3 million people [3].

In other words, theoretically there are approximately 6.3 million people that potentially could buy a car.

Using BELSTAT I was able to find the following data [Table 1] about car ownership in Belarus for further analyses. It shows the amount of private cars as well as electric vehicles owned by Belarusians from year 2005 to 2020 [3].

Table 1

Car ownership in Belarus

Years	Amount of private cars, thousands	Non-cumilative, thousands	Electric cars	Non-cumilative
2005	1737,1	–	–	–
2006	1930,6	193,5	–	–
2007	2084,6	154	–	–
2008	2191,3	106,7	–	–
2009	2339,8	148,5	–	–
2010	2501,2	161,4	–	–
2011	2646,5	145,3	–	–
2012	2640,8	-5,7	–	–
2013	2670,6	29,8	–	–
2014	2827,2	156,6	–	–
2015	2920,2	93	–	–
2016	2951,4	31,2	–	–
2017	2972,7	21,3	–	–
2018	3031	58,3	200	–
2019	3094,6	63,6	360	160
2020	3134,5	39,9	751	391

The numbers giving on the website only show cumulative amount, so I also calculated non-cumulative numbers which we need for the model.

As we can notice electric cars are very from being called “wide-spread” in Belarus. They add up to only 0.0002 % from total private cars owned in the country. This means that we are facing just the beginning of the penetration of the EVs to Belarusian market.

Before predicting the ownership of EVs in Belarus it makes sense to test the Bass model on the whole market of private cars in Belarus.

Excel software was used to do it. With the help Visual Basic it is possible to program an Excel spreadsheet to calculate parameters needed to build the model.

Since the Bass model is empirically based, coefficients p and q are possible to know with the use of Excel solver software. However, it was impossible to make a perfect prediction so it is an approximation. The parameters obtained are p=0.009246 and q=0.0415. Such low coefficients suggest that we are relatively slow in adopting the product, as can be seen in Fig. 1.

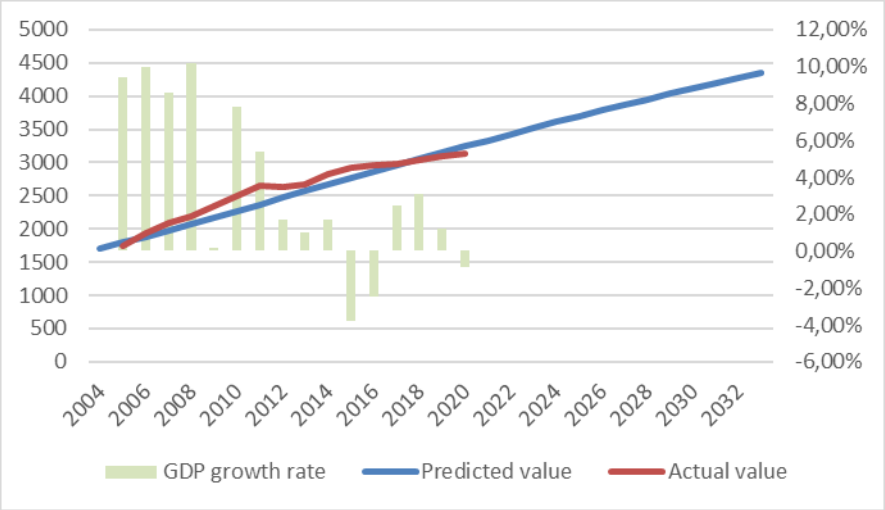

Fig.1. Comparison of predicted and actual values

As was mentioned before, this simple version of the Bass model does not include many external factors. If we look at the economic situation in Belarus, we could derive a few explanations. The GDP growth rate is one of the main indicators of how successful the economy is doing.

While our economy was flourishing, people had more money and thus could afford more cars: we were above the trend line. We can clearly see the deep crisis in 2011 when the amount of cars even decreased and did not start growing as fast in 2012 as well. Followed by another major crisis of 2015-2016. We are still in a recession nowadays. The Coronavirus also contributed negatively to the overall health of the economy. We can suppose that is one of the reasons why we deviate from the trend line [4].

Overall, we can see that the Bass model can be used to estimate the growth of car market in Belarus. Unfortunately, we do not have much data concerning amount of electric cars in Belarus. According to BELSTAT there are now around 751 registered EVs in the country. Last year there were 360 cars. Using Excel Solver with those numbers and the potential market size the p and q parameters which are p=0.0031 and q=0.4813 we can build the model. Due to the lack of data the results are less accurate than in previous model. The results of calculations are shown in Table 2.

We can suppose that we are somewhere in the 5th-6th period.

As the model suggests 6250 people will have electric cars in 20 years. This amount is small in comparison with the total market size. That might be be-

cause of current economic situation, higher price of EV compared to regular cars and lack of trust and awareness.

Table 2

Calculations results

t	Adoptions	Cum Adoptions
0	0	0
1	24	24
2	40	65
3	65	130
4	**105**	**234**
5	**166**	**376**
6	**395**	**798**
7	467	1 131
8	553	1 555
9	669	2 224
10	771	2 995
11	787	3 782
12	712	4 494
13	575	5 069
14	425	5 494
15	293	5 787
16	193	5 979
17	123	6 102
18	77	6 179
19	47	6 226
20	29	6 255

However, the car market in general has significant growth potential, the number of EVs in Belarus, like in the whole world, will grow as well. The government has to provide reasonable infrastructure and adjust legislation to help the amount of electric cars grow further and faster that it is now.

References

1. Rogers, Everett M. Diffusion of innovations. Simon and Schuster, 2010.
2. Bass, Frank M. / A new product growth for model consumer durables. – Management science 15.5, 1969. – 215–227 p.
3. Среднегодовая численность населения // Национальный статический комитет Республики Беларусь [Electronic recourse]. – 2021. – Mode of excess: http://dataportal.belstat.gov.by/Indicators/Preview?key=128626#. – Date of access: 28.03.2021.
4. IMF Executive Board 2018 Article IV Consultation with the Republic of Belarus // International Monetary Fund [Electronic resource]. – 2018. – Mode of access: https://www.imf.org/~/media/Files/Publications/CR/2019/cr1909.ashx. – Date of access: 30.03.2021.