Eastern Europe shifts second gear

Mohelsky, Lukas

Vysoká škola ekonomická v Praze (University of Economics in Prague)

24 June 2010

Východní Evropa řadí dvojku
Eastern Europe shifts second gear

Ing. Lukáš Mohelský
Katedra mezinárodního obchodu FMV VŠE v Praze
lukasmohis@yahoo.com

Eastern Europe shifts second gear

The delivery of fresh fruit and vegetable to the convenience store round the corner, everyday commute to school and work, active personal participation on international academic conferences, regular assortment modifications in the fashion stores, late arrival from a party on the other side of the town, or the municipal garbage collection, all of these activities, and many other, would be significantly more difficult and would take much longer time, if we were not able to take advantage of the outputs of the automotive industry. The final goods manufactured by the automotive industry influence our lives more than we usually tend to realize. Living without a personal car is surely a viable possibility, however getting rid of all the conveniences enabled by cars, trucks or buses seems to be nearly impossible in the current world.

The invention of an automobile, as we know it today, was not a matter of an out-of-sudden invention of a genius person. It took many decades before the technological design of a modern automobile was finalized. No matter how humble the beginnings of the automotive industry were, its influence on the social and economic development of the world since the end of the 19th century is unambiguous.

The automotive industry represents one of the few long-term pillars of the world economy. Whereas many industries are being born, and other are losing their importance, the car production and consumption is experiencing continuous growth for many decades. The current tough economy conditions can therefore be seen as another challenge for the automotive industry to be soon overtaken.

The European continent is the homeland of the very first inventions of what then becomes an automobile and was also for a long time the main pillar of the industry's development. French engineer Nicolas-Joseph Cugnot in 1769, Swiss scientists François Isaac de Rivaz in 1807 or German inventor Karl Benz in 1886, they all contributed to the breakthrough of the automotive industry during its initial phase.[1] Even though both the advancement of the automobiles mass production and the popularization of the personal cars are assigned to the American entrepreneur Henry Ford, Europe has always been playing a crucial part in the development.

[1] Based on Bellis (2010).

If you considered the world automotive industry as an independent country, it would be the sixth biggest national economy in the world. In the European continent only, the number of people who are directly employed in manufacturing of motor vehicles and their components exceeds 2.2 million. If the indirect employment driven by the industry is taken into account as well, then the European automotive sector supports more than 12 million jobs within the continent, which is more than the population of Belgium, Greece or Portugal.[2] The EU27 countries managed to manufacture nearly 14 million personal cars in 2009 and approximately the same number of new personal cars was registered within the European Union in the same year.[3]

Personal car ownership models – Main approaches[4]

The personal car ownership[5], which is measured as the number of cars registered per capita (or per 1,000 citizens to get better-looking and easier-to-handle numbers), is determined by a number of various factors. They include the level of citizens' wealth (GDP per capita, annual net income, etc.), the total costs of personal car ownership (price of new car, taxes, fuel price, parking fee, maintenance service, etc.), the demographic statistics (total population, adult population, population with driving licence, number of children per family, etc.), the population density (level of urbanization, population per km^2, population per habitable km^2, etc.), the road network availability (roads length, percentage of highways, road network capacity, roads length per capita or per km^2, etc.), and many other items (national transport policy, public transport availability, housing types, etc.).[6] All of the above mentioned indicators, as well as many other ones, have effect on the personal car ownership, however not all of them can be reasonably incorporated into the economic models. Therefore, no matter how precise the models claim to be (impressive levels of the R^2 values or the F-statistics), they are always limited to only some of the key indicators and do not represent the reality in its richness, which should be always kept in mind.[7] According to my research, there seems to be a general consensus about the most important variables influencing the personal car ownership – these are the gross domestic product (or income) and the size of population, often combined into one indicator and tracked as GDP per capita.[8]

---

[2] EUROSTAT (2010), OICA (2010)

[3] ACEA (2010), OICA (2010)

[4] The models usually distinguish between personal car ownership and vehicle ownership. The vehicle is a general term comprising all road vehicles with at least four wheels, thus including personal cars, trucks or buses. However, the personal cars represent the main portion of all the vehicles. Therefore, the following text deals with the personal cars statistics.

[5] Also referred to as the motorization rate and the car density.

[6] Discussion of the factors can be found for example in Dargay (1997, 2007).

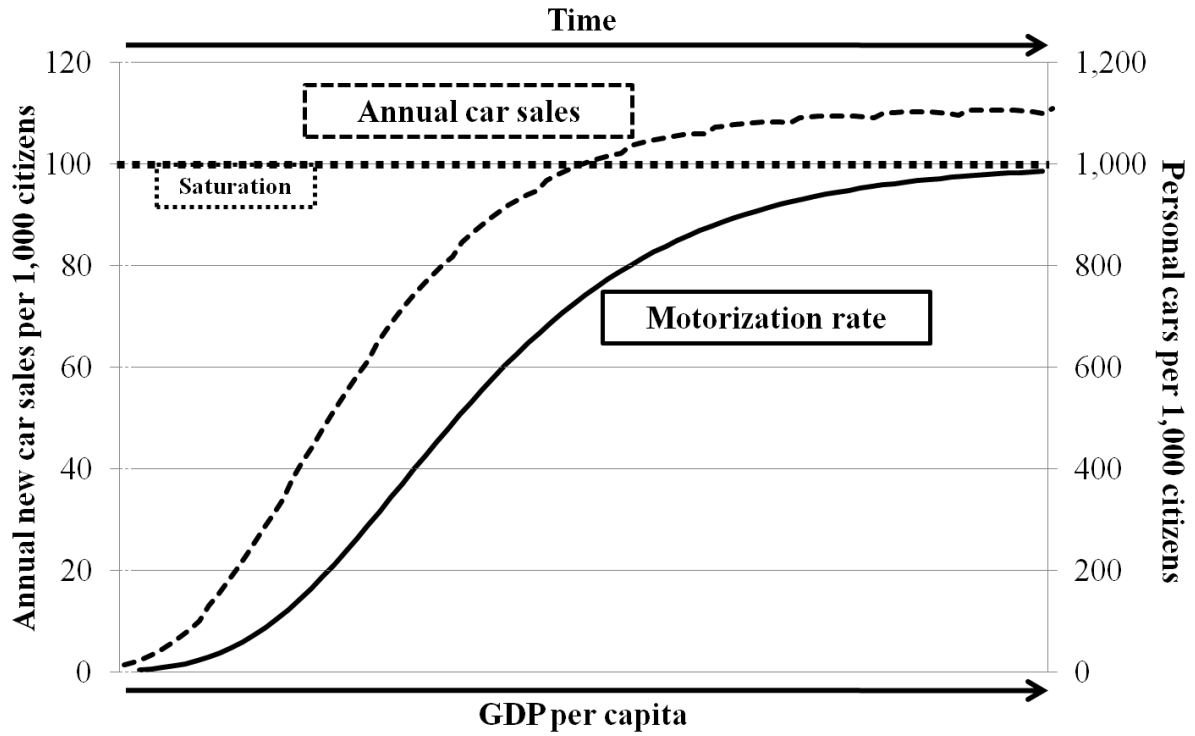
[7] Even though this is an issue in all economic models, the interpretations of the models often seem to neglect it. Therefore, I find it useful to particularly point this topic out.

[8] Either (or both) of them were used in Button (1992), Dargay (1997, 2007), Sivak (2008), and Whelan (2000).

There is, however, less consensus about the exact relationship between the personal car ownership and the GDP per capita levels and about the characteristics of the function that represents such a relationship. Nevertheless, most of the researchers in the field agree that the function follows an S-shaped curve in the long term and try to define the proper function to be used.[9] There are also few predictions using linear/multiple regression functions[10], however their application is difficult to justify in the long term.[11]

Generally, it is agreed that the car ownership rises slowly at the lowest income levels, when other items have priority in consumption; more rapidly once a certain level of GDP per capita is reached; and again very slowly (which can even turn to stagnation) as the GDP grows further and the car saturation level approaches. Such a development follows the S-shape pattern and can be represented by various functions – for example, the logistic function, the continuous cumulative distribution function, or the Gompertz function.[12]

Graph 1: Illustrative Gompertz functions of car ownership and annual car sales



These functions have been used to estimate car ownership models by various authors, as they possess slightly different characteristics and thus offer different (dis)advantages. I am personally convinced that the Gompertz function

[9] For example the logistic function in Adams (1981), the quasi-logistics function in Button (1992) and the Gompertz function in Dargay (1997, 2007).

[10] For example Sivak (2008).

[11] It is highly unlikely that the car ownership level will continuously rise with the increase of the GDP per capita, once a certain level of saturation is reached.

[12] These functions are generally referred to as sigmoid functions thanks to their S-shape.

is the most suitable one to model the car ownership development, as it offers higher flexibility of variables than the other ones.[13]

There are many further factors influencing the car consumption (new car sales), as discussed above, but it is possible to estimate the level of car sales based merely on the Gompertz curve of the car ownership level and the car fleet renewal time.[14] The Graph 1 above shows the illustrative Gompertz functions of both car ownership[15] and annual new cars sales.[16]

Socio-economic differences among the EU27 countries[17]

There are significant differences among the EU countries, which have far-reaching socio-economic consequences. After the latest enlargement, which took place in 2007 and covered Bulgaria and Romania, the European Union has around 500 million citizens in 27 countries living on the area of 4.3 million km^2 and, if considered as a whole, is the largest economy in the world with the total gross domestic product (GDP) of €1,200,000 million and the GDP per capita of €24,000[18]. Nevertheless, the average level of GDP per capita does not reflect the different stages of development that the EU27 countries find themselves in. The richest EU member, Luxembourg, with the GDP per capita of €90,000 is more than twenty (!) times richer than the poorest EU country, Bulgaria, with the same indicator at the level of €4,200. The wealth gap between the richest and the poorest country can be narrowed by using the GDP measured in the purchasing power standards (the GDP per capita in PPS for Luxembourg is "only" 6.7 times higher than for Bulgaria), or by using the comparison of net annual earnings (which are 14 times higher in Luxembourg than in Bulgaria). However, the PPS doesn't reflect properly that the personal cars are among the easily traded goods within EU and thus their prices are "more similar" in all European countries. Taking the long-time European bestseller among the personal cars, the VW Golf, in account, than the price of the lowest model offered in Luxembourg is only 1.45 times higher than in Bulgaria.[19] In other words, the average citizen of Bulgaria needs to save his/her whole net average salary for seven (!) years to buy a new VW Golf, whereas the average Luxembourgian can get it in just 9 month, which makes him/her nearly ten times richer.

---

[13] Selection of the most suitable function is not crucial for this paper.

[14] Again, such a model is too simplified to fit reality precisely, it can however provide a reasonably accurate forecast.

[15] The illustrative Gompertz function of car ownership has the saturation level of 1,000 personal cars per 1,000 citizens (one car per capita), the α-coefficient influencing the "lower" curvature of -6 and the β-coefficient influencing the "upper" curvature of -0.15.

[16] Under the circumstances that the motorization rate follows the Gompertz curve, the car fleet renewal time is ten years and the population number is constant

[17] Statistics used in the rest of the article rely on the data provided by ACEA (2010), CIA (2010), and EUROSTAT (2010).

[18] GDP per capita in market prices.

[19] Prices found on the official websites of Volkswagen in Luxembourg and Bulgaria (2010).

The inequalities between Luxembourg and Bulgaria represent the socio-economic imbalance of the European Union at its very extreme, however after six years (three years respectively) since the Eastern enlargement, the difference between the more developed "old" members[20] and the catching up "new" members[21] remains to be obvious. On the other hand, such a situation represents a promising baseline for further development of the EU+12, which has also consequences for the levels of car ownership and consumption.

As mentioned above, the mainstream models of the car ownership development take into account two crucial variables – the GDP and the population, usually represented together as the GDP per capita. Furthermore, to track, or forecast, the sales of new cars it is also necessary to find out the fleet renewal time.

Recent development of key variables in the EU

European continent as a whole is threatened by the negative population development, which is also known as the ageing (or greying) of Europe. The fertility rate has been decreasing below the sustainable level, which is slightly above two children per family/mother, the mortality rate has been also falling down and the life expectancy has been rising.[22] Such a development has consequences not only on the financing of the public budgets, most visibly on the retirement systems, which are unsustainable in many countries in their current versions, but also on the overall structure of demand, including the demand for personal cars. Growing population can afford to buy, and will therefore create demand for, more cars than a stagnant one, ceteris paribus.

The development of population size in the European Union shows slightly surprising results – there are only eight countries that registered population decline between 2001 and 2010. However, seven of them represent the EU+12 and only Germany (with its seventh deepest decline) stands for the EU15. In other words, the markets of the EU+12 countries have been decreasing in terms of population size, whereas the EU15 markets have been growing.[23]

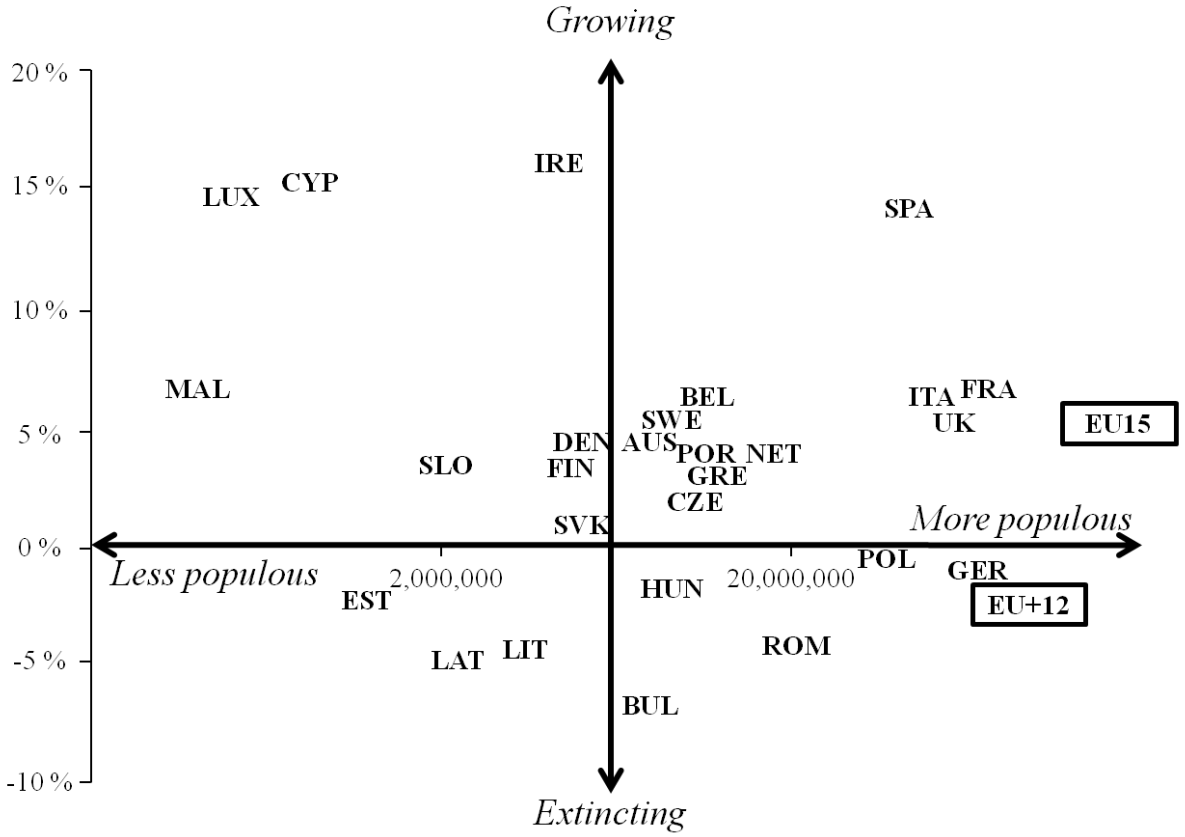
[20] The „old" EU members will be further referred to as the EU15, which covers the countries that created the European Union from 1995 to 2004.

[21] The „new" EU members will be further referred to as the EU+12, which covers the countries that joint the European Union in 2004 and 2007.

[22] Author of this article promises to do his best to improve the first of the mentioned indicators.

[23] Detailed analysis reveals that only the miniscule countries of Cyprus and Malta showed significant population growth among the EU+12 members.

Graph 2: Population and its development in the EU countries[24]



As documented above on the comparison between Bulgaria and Luxembourg, the EU countries are on a very different level of development. Except for 2009, which was seriously affected by the global economic crisis, there is a continuous growth of GDP per capita in all Union's countries. Furthermore, the difference between the poorest and the richest has been (relatively) declining, but the year 2009 brought negative external shocks into the development, thus slowing down the process of gap narrowing. The average GDP per capita among EU countries[25] was more than 8 times higher than the Bulgarian GDP per capita in 2001, but "only" 5.9 times higher in 2010.

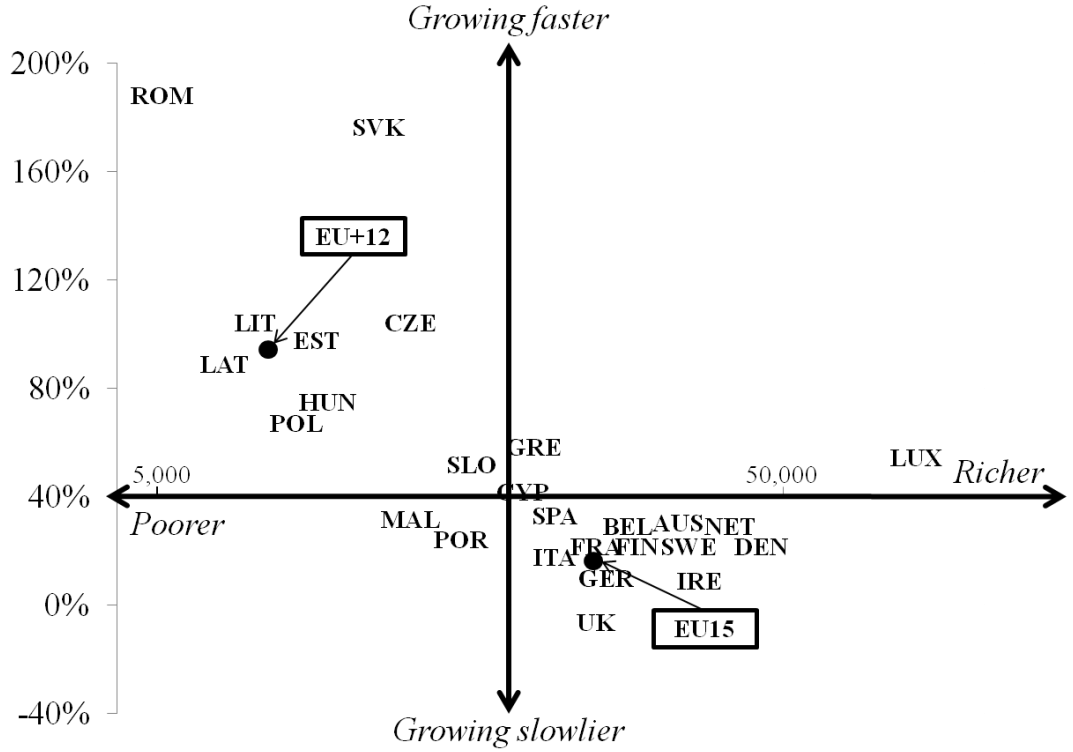
If the curves presented in the Graph 1 are valid, then the country with a faster growing GDP per capita, should experience a faster growth of both car ownership level and new cars sales, ceteris paribus.

The GDP per capita growth statistics bring expected results, with one particular exception – among the top ten countries recording highest growth rates are nine EU+12 countries and only Greece representing the EU15. However, the eleventh highest GDP per capita growth of Luxembourg, which was already in 2001 the richest EU economy, is slightly surprising (the tenth position of Greece could have been expected, as the wealth of Greece was

[24] The x axis represents the population in 2010 and the y axis represents the development from 2001 to 2010. The x axis of the graph is in logarithmic scale. The positions of the EU15 and EU+12 tickers are only approximate, as they don't fit the horizontal scale properly.
[25] Gross unweighted average of all 27 countries.

among the lowest in the EU15). The EU+12 country with the lowest GDP per capita growth is Malta, which ranked fifteenth among all 27 EU members. The EU+12 countries markets are thus increasing in terms of GDP per capita significantly faster than the EU15 members.

Graph 3: GDP per capita and its development in the EU countries[26]



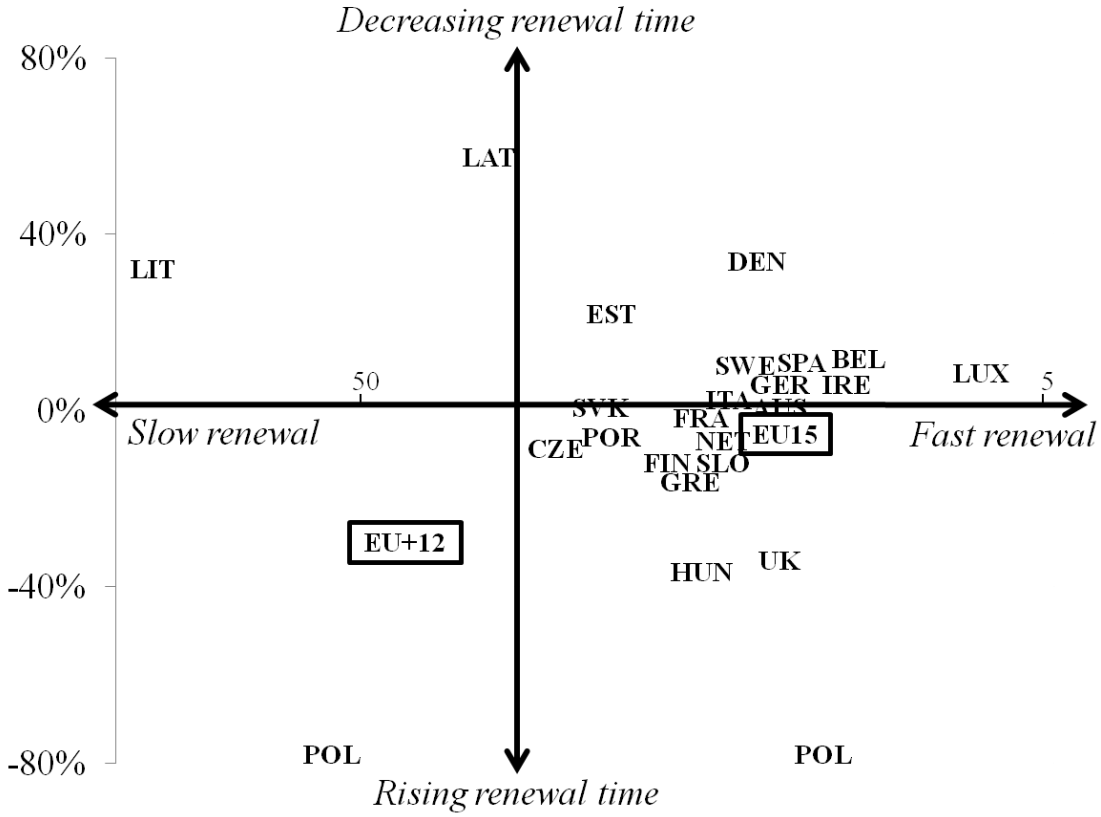
The third crucial variable necessary to track, or estimate, the new car sales is the car renewal time. As expected, even though its calculation is not that difficult in theory, the practical application falls behind. The main reason is the different influence of the used cars sales and old cars de-registration on the total car fleet across countries. Whereas the second hand cars don't seem to play that important role in the EU15, their sales are crucial for the growth of the motorisation rate in the EU+12. Such a fact is hardly surprising, if the different levels of purchasing power are considered. Especially striking is the difference between the average Bulgarian (needs to save the whole net annual salary for 7 years to buy the cheapest new VW Golf) and the average Luxembourgian (needs to save 9 month to buy the same car), which was already presented above. Due to the lack of comprehensive data, the very gross calculation of the car renewal time was used.[27] The total car park in the country was divided by the new cars

[26] The x axis represents the GDP per capita in 2010 and the y axis represents the development from 2001 to 2010. GDP per capita is measured in the current market prices. The x axis of the graph is in logarithmic scale.

[27] The calculation may be useful as a comparison, it can't be, however, understood as an actual and accurate calculation of the fleet renewal time.

registrations, thus giving the very gross estimation and neglecting all the other relevant factors.

Graph 4: Fleet renewal time and its development in the EU countries[28]



The gross estimation of the car fleet renewal time proved both expected - the time is significantly higher in the EU+12 than in the EU15, and unexpected results - the fleet renewal time has been rising both in the EU15 and the EU+12, with a faster pace in the EU+12. All eight EU+12 countries analyzed ranked in top eleven in terms of the highest fleet renewal time. Especially the difference between Luxembourg (total fleet is renewed in 6 years) and Lithuania (in 112 years) is elusive. Furthermore, only three EU+12 countries are represented among the ten highest declines of the car renewal time (Latvia, Lithuania, Estonia), and Poland and Hungary even experienced the highest growth of the fleet renewal time.

This analysis revealed interesting information – the level of the total national car fleet compared to the new cars sales (the gross estimation of the fleet renewal time) is significantly higher in the EU+12 countries. Furthermore, there is no trend of positive development and the numbers for the EU+12 as a whole have even been worsening.

The consequence of such a result is that the new car sales should be considerably lower in EU+12 than in EU15, ceteris paribus, due to longer

[28] The x axis represents the car renewal time in 2006 and the y axis represents the change from 2003 to 2006. The x axis of the graph is in logarithmic scale. Bulgaria, Romania, Cyprus and Malta were excluded due to lack of data.

renewal time. On the other hand, the long renewal times represent an opportunity for the future, when its shortening might be expected.

The above mentioned analysis tracked the development of three key variables – the population size, the GDP per capita and the car fleet renewal time. The analysis revealed that there are significant differences among the EU countries in all three indicators. The trend of society ageing and population extinction seems to be more pressing among the EU+12 countries than in their EU15 counterparts, which also suggest that their markets have been shrinking in size. On the other hand, the growth of GDP per capita is significantly faster among the EU+12 members, which stands for a faster market growth and increasing citizens' wealth. Furthermore, the longer time of the car fleet renewal in the EU+12 may be understood as an opportunity for future. However, if the car fleet renewal time remains intact (or will follow the recent negative trend), the EU15 countries will further record higher relative new car sales than the EU+12 members. As a whole, the development of the key variables is ambiguous and doesn't reflect a clear trend, it is therefore necessary to analyse the development of the car sales in the European Union in more detail.

National automotive markets in the European Union

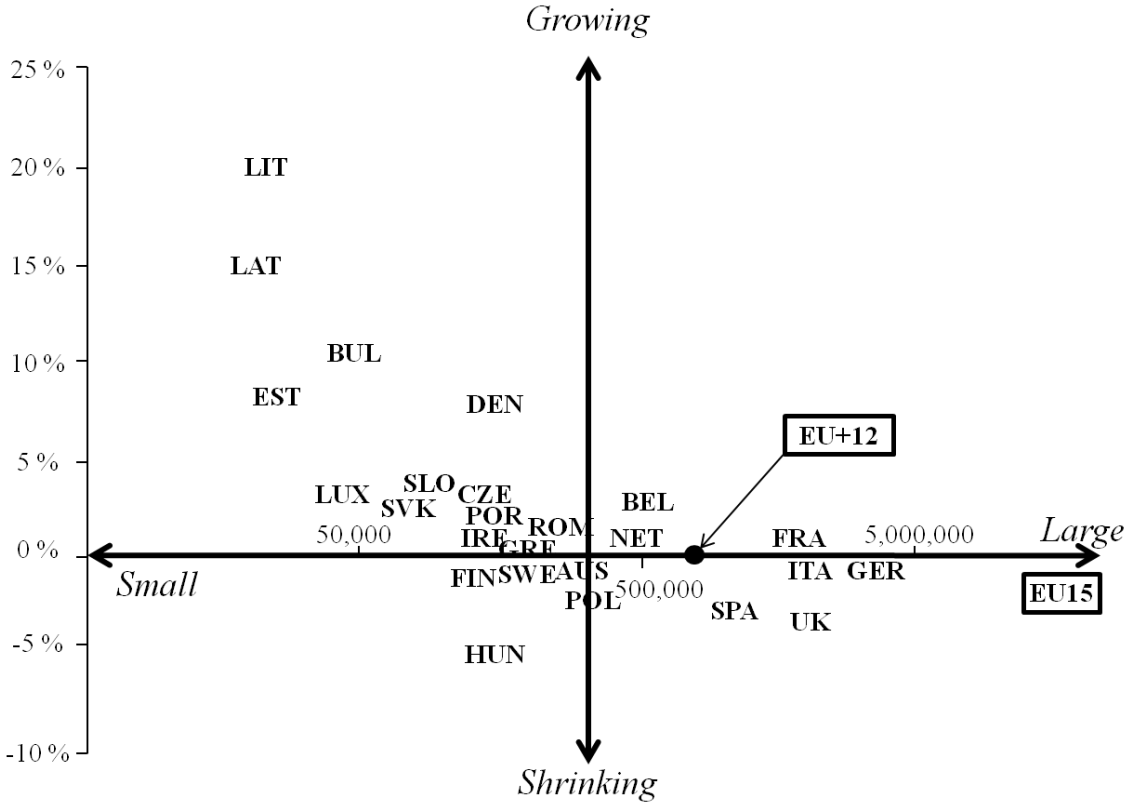
The analysis of the new passenger cars registrations in the European Union reveals that whereas the EU15 markets are, generally, the bigger ones (top five size ranking: Germany, France, Italy, Great Britain, Spain), the EU+12 markets EU+12 are, generally, the emerging ones (top five growth ranking: Lithuania, Latvia, Bulgaria, Estonia, *Denmark*).

The results match the expectations – the EU15 markets are the more mature ones with higher sales, but lower growth, whereas the EU+12 is an emerging region with lower level of current consumption, but with higher growth potential.

If the car market analysis is compared to the recent development of the key three variables, it documents that, even though the size of the EU+12 markets in terms of population is shrinking, and even though the car renewal time (which directly influences the new cars sales) is higher than in the EU15[29], the increasing levels of GDP per capita stimulate the demand for new cars enough to reach higher levels of growth than in the EU15.

[29] The high renewal time may serve as the future market growth driver, as it offers a high potential for decrease. Further research of this phenomenon is needed.

Graph 5: Automotive markets and their development in the EU countries[30]

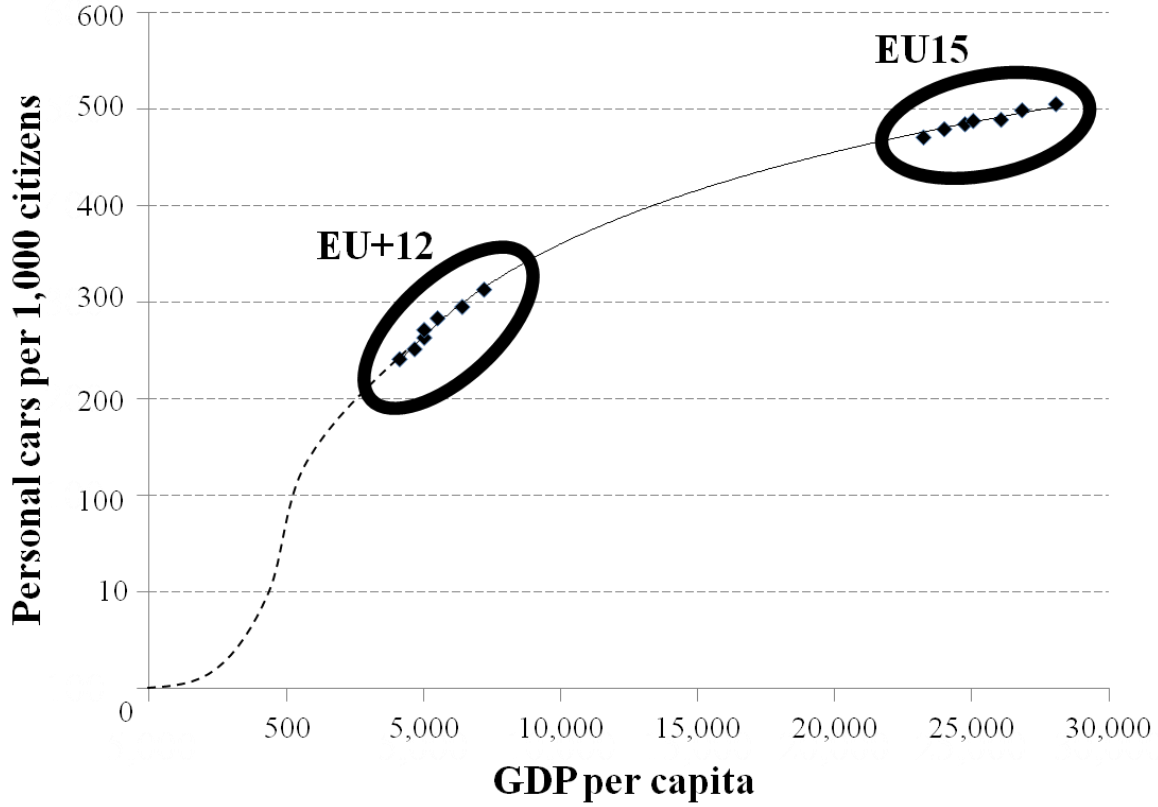


Gompertz curve and the recent development

If the above stated figures are plotted into the charts representing the main approach discussed in the beginning, a trend representing the upper part of the S-curve (Gompertz function) can be seen. However, there are not enough observations to produce relevant statistical outputs, therefore the presented Gompertz curve is only a theoretical estimation (even though the data are accurate).

[30] The x axis represents the market size (new passenger cars registration) in 2008 and the y axis represents the compound annual growth rate from 2003 to 2008. Cyprus and Malta are excluded due to lack of data. The CAGRs of Bulgaria and Romania are calculated for the 2006-2008 period due to lack of previous data. The EU+12 exclude Bulgaria, Cyprus, Malta and Romania. The position of the EU15 in only approximate due to the scale of the x axis.

Graph 6: The Gompertz curve and the recent development in the EU[31]



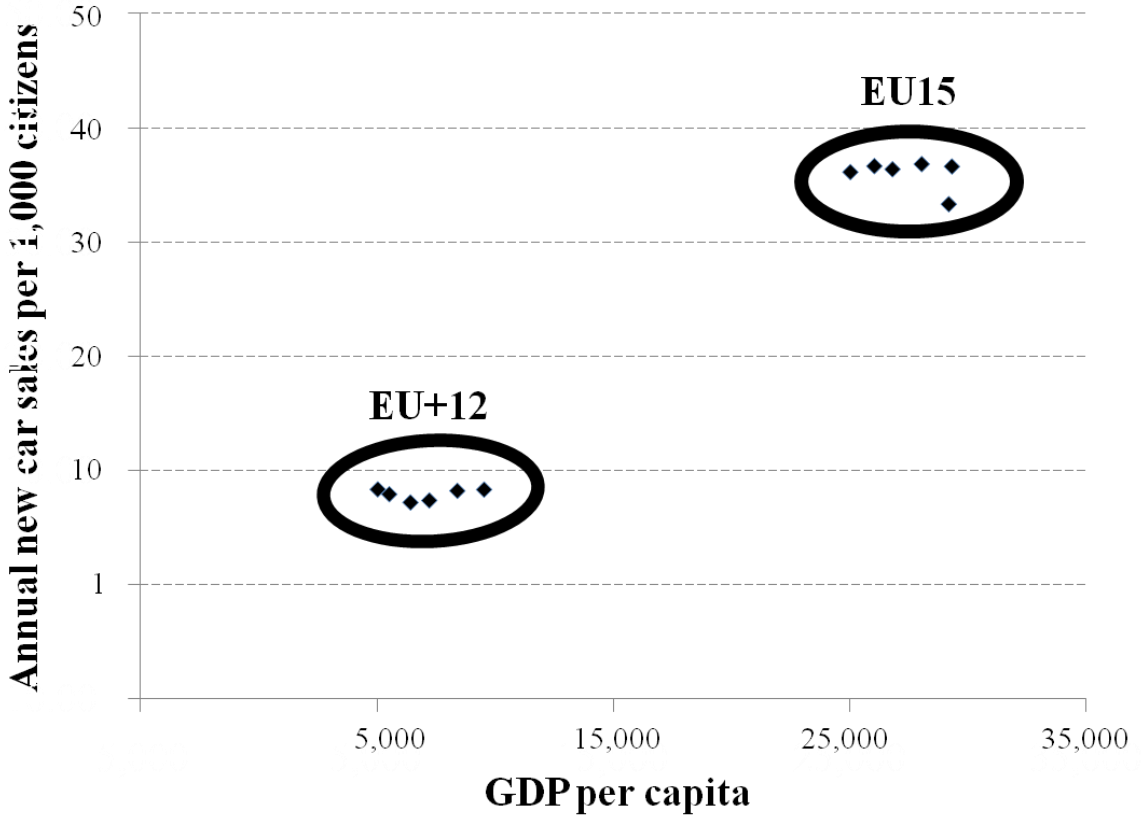
On the other hand, the S-shape pattern is not obvious, if data of the new car registrations (sales) are plotted in the graph.

The new car registrations per capita are stable/stagnant in the EU15, which can suggest that the saturation level has been reached (or is soon to be reached), and corresponds with the development of the motorization rates in the Graph 6. Surprisingly, the new car sales in the EU+12[32] are also stable/stagnant, even though their level is significantly lower. What is more, the sales are stagnant, even though the motorization rates rise. The possible explanation of such a development is the important role of used cars sales in the EU+12 countries. The used cars sales are not included in the new registrations, nevertheless they raise the car density. If the lower purchasing power of the EU+12 region is considered, the higher sales proportion of used cars, which are generally more affordable, is understandable.

[31] The chart includes figures from 2000 to 2006. The axes are logarithmical in the proximity of the coordinate origin.

[32] Bulgaria, Cyprus, Malta and Romania are excluded due to lack of data.

Graph 7: The new cars sales and the GDP per capita[33]



Shifting gears – possible stages of development in the EU+12

The presented model of the car consumption relies on the motorization rates, the car ownership level and the GDP per capita. The stage of the automotive market development is determined by the level (and development) of these variables. However, such a determination doesn't seem to work properly for the recent shifts of the automotive industry in the EU+12 countries.

The motorization rates in the EU+12 have been steadily rising, whereas their EU15 counterparts have been significantly higher and more stable, thus confirming the theory of the S-shaped curve of the car density development. However, the data of the new cars sales do not fit the theory that well. The level of sales in the EU15 countries is rigid, which corresponds with the (relatively) stable advancement of the motorization rate. But the new cars sales levels in the EU+12 have been also stagnant, which is surprising if compared to the dynamically rising levels of the car density. The intuitive explanation behind is that the rising motorization rates are driven by the registrations of the used cars.

The first stage of development, which was characterized by the (relatively) low level of motorization and the low level of registrations (both new and used cars combined) can thus be claimed as overtaken in the whole European Union. The automotive industry in the EU+12 has now been

[33] The chart includes figures from 2003 to 2008. Bulgaria, Cyprus, Malta and Romania are excluded due to lack of data. The axes are logarithmical in the proximity of the origin.

experiencing the second stage – the motorization rates are dynamically rising, however the growth is (mainly) driven by the used cars sales. The new cars sales remain stagnant.

The following prognosis should be understood with the famous quotation that predictions are very difficult, especially predictions about future, in mind.[34] However, the advancement from the first level to the second level is too tempting to be left at this point.

The second gear, the EU+12 have just shifted in, will not be the last one. There are, at least, two more coming. During the third stage of development the motorisation rate will continue to grow, but at a significantly lower pace. The further rising level of income (GDP per capita) will trigger dynamic growth of the new car sales, which will replace the used cars as the main source of the car density increase. Finally in the fourth stage, the motorization rate will reach saturation (or its proximity), will become stable without any significant modifications, neither up nor down (under the circumstance of no external shocks). The new car sales will adjust to the stability of the motorization rates and will also become stagnant.[35]

I believe it was brave enough to give the prediction about the development stages and I will not dare go that far to forecast when these changes are about to happen. The prediction is subject to various external effects, which can‘t be covered in this article. The crucial issue of the motorization rates development, and especially of the new car sales, is the role of the used cars. Their preference seems to be significantly higher in the EU+12 compared to the EU15 and it is thus questionable what will happen to the demand for them as the citizens get richer.

Conclusion

The automotive industry is a long term pillar of the world economy, which has successfully managed to overcome all challenges of the previous decades. It is also one of the cornerstones of the European economies, both in the old EU countries (EU15) and among the new members (EU+12). The development of the automotive industry, and its determinants, are thus subject to numerous analyses. This one focused on the progress of the automotive industry from the perspective of the motorization rates (personal cars per capita) and the new cars sales in the EU+12 countries.

Thanks to the high attention the world scholars have been paying to the automotive industry, there are various papers and theoretical models dealing with the development of the motorization rates and cars sales. The main stream of the current theory puts emphasis on the model, which follows an S-shaped curve depending on the wealth of citizens, usually measured by the GDP per

[34] There is a discussion about who was the first to make such a quotation, but the most sources acknowledge the physicist Neils Bohr as the original author. See Patau (2006) for details.

[35] However, this may happen significantly later than the saturation level of the motorization rate is reached due to the high current influence of the used cars sales.

capita. This approach was also used in the article and its determinants were analyzed in the European Union, with particular focus on its new members.

The European Union in its current breadth covers a large portfolio of countries, which are on very different levels of development. The simple analysis of the GDP in market prices reveals that the citizens of the richest EU member (Luxembourg) are twenty times (!) richer than the inhabitants of the poorest one (Bulgaria). And even though the prices of new cars differ within the Union, the average Bulgarian has to save all his earnings ten times longer than an average Luxembourgian to buy the long-term EU bestseller among the new cars, Volkswagen Golf.

Based on the main approaches to the car density and car consumption models, the three key determinants of the development were identified and further analyzed – the population, the wealth (GDP per capita) and the car fleet renewal time. The results of the analysis revealed that the EU+12 countries experienced population decrease and high fleet renewal times, which should have negative impact on both the motorization rate and the car sales. However, the dynamic growth of the GDP per capita managed to reverse the negativity, and the EU+12 countries have been experiencing a steady increase of the motorization rate in the monitored period. As the EU15 region also experienced growth of the car density, however a significantly lower one at a significantly higher level, the S-shaped curve of the motorization rates and GDP per capita seems to be the likely pattern behind the development.

On the other hand, the analysis of the new car sales does not bring the same kind of evidence. The sales of new cars are stagnant both in the richer EU15 countries and in the significantly poorer EU+12 members. Due to the different values of the GDP per capita, and many other factors, the levels of the (relative) new car sales are much higher in the EU15 than in the EU+12.

The surprising result that the motorization rates in the EU+12 countries have been dynamically rising, but the amount of the new cars sold have been stagnating, has a logical explanation – the car park growth has been driven by the sales of used cars. Such a situation represents the second stage of development the automotive markets of the EU+12 countries have entered. The motorization rate is quickly rising, but the sales are pillared by the used cars.

Based on the analysis, the prediction of the future development offers, at least, two more stages (the third and the fourth one) the automotive markets in the EU+12 should experience. In the third stage, the motorization rate growth will continue at a slower pace than recently, and will be mainly backed by the growth of the new cars sales. The fourth stage will then experience stagnant levels of the car density together with stagnant levels of the new cars sales, which will both adjust to the market saturation values.

The results of the analysis seem to be quite persuasive at the first sight, however high attention must be paid to the limitations of the research. First and foremost, the analysis covers a limited period of time, which is not long enough

to track the long-time trends of the automotive markets in the European Union. Second, the past development can never be understood as an accurate predictor of future, therefore the analysis of the last decade proves trends that happened only, and does not predict the advancement in the years to come. Third, both the motorization levels and the new cars sales are driven by many factors (consumers' preferences, public transport availability, or petrol prices can be mentioned as an example), therefore relying on the population size, citizens' wealth and the car fleet renewal time represents a significant simplification. Last but not least, the reliability of the data can also be questioned. The main data were extracted from the renowned European institutions (EUROSTAT and ACEA), but their reputation does not necessarily provide a seal of validity and reliability.

References

[1.] Adams, John: Transport planning – Vision and practice. Department of Geography, University College London. Routledge & Kegan Paul. ISBN-13 978-0710008442. 1981.

[2.] Bellis, Mary : Automobile history – The history of cars and engines. Available in May 2010 at http://inventors.about.com/od/cstartinventions/a/Car_History.htm

[3.] Button, Kenneth, Ngoe, Ndoh, and Hine, John: Modelling vehicle ownership and use in low income countries. Transport and Road Research Laboratory, Crowthorne. 1992.

[4.] Central Intelligence Agency: The World Factbook. Update from May 21, 2010. Available in May 2010 at https://www.cia.gov/library/publications/the-world-factbook/index.html

[5.] Dargay, Joyce, Gately, Dermot, and Sommer, Martin: Vehicle ownership and income growth, worldwide 1960-2030. Institute for Transportation Studies, University of Leeds, Department of Economics, New York University, and International Monetary Fund. 2007.

[6.] Dargay, Joyce, and Gately, Dermot: Income's effect on car and vehicle ownership, worldwide 1960-2015. Department of Economics, Faculty of Arts and Science, New York University. 1997.

[7.] Dargay, Joyce, and Vythoulkas, Petros C.: Estimation of dynamic transport demand models using pseudo-panel data. ESRC Transport Studies Unit, Centre for Transport Studies, University College London. 1998.

[8.] European Automobile Manufacturers Association (ACEA): Statistics. Available in May 2010 at http://www.acea.be/index.php/collection/statistics

[9.] EUROSTAT: Statistics database. Available in May 2010 at http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

[10.] International Organization of Motor Vehicle Manufacturers (OICA): Economic contributions and Production Statistics. Available in May 2010 at http://oica.net/category/economic-contributions/ and http://oica.net/category/production-statistics/
[11.] Patau, Peter: Bohr leads Berra, but Yogi closing the gap. 2006. Available in May 2010 at http://letterfromhere.blogspot.com/2006/12/bohr-leads-berra-but-yogi-closing-gap.html
[12.] Sivak, Michael, and Tsimhoni, Omer: Future demand for new cars in developing countries – Going beyond GDP and population size. Transportation Research Institute, University of Michigan. 2008.
[13.] Mogridge, Martin John Henry: The Car market: A study of the statistics and dynamics of supply-demand equilibrium. ISBN-13 978-0850860856. Routledge & Kegan Paul. 1983.
[14.] Volkswagen: Official websites of Volkswagen in Bulgaria and Luxembour. Available in May 2010 at http://www.volkswagen.bg/ and http://www.volkswagen.lu
[15.] Whelan, Gerard Andrew, Wardman, Mark, and Daly, Andrew: Is there a limit to car ownership growth? An exploration of household saturation levels using two novel approaches. Institute for Transport Studies, University of Leeds, and Hague Consulting Group. 2000.