IB Economics Extended Essay

Evaluation of the Düsseldorf government support of bicycles as a substitute for cars.

"How is the local government in Düsseldorf supporting the use of bicycles as a substitute for cars?"

Word Count: 3988

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1. Introduction

Düsseldorf is the sixth-largest city in Germany with 630 thousand inhabitants (*2021 World Population by Country*), yet it is placed 8th out of 14 in terms of bicycle friendliness within large German cities (ADFC, *Fahrrad-Klima-Test*). This feeling of lack of bike friendliness was also observed when inhabitants graded Düsseldorf on a scale of one to six in terms of bicycle friendliness (one being the best and six being the worst grade). After tallying the results from all 14 German cities with more than 500 thousand inhabitants, Düsseldorf got a grade of 4.1 (Kampe, Nicole, *Rheinische Post*). Now, with a new mayor, Düsseldorf has set its sights on becoming a bike-friendlier city.

The mayor, Stephan Keller, said that he wants to turn Düsseldorf into the most bike-friendly city in Germany. In an interview I conducted with him on the 14th of April 2021, I asked him if he thought this would be achievable within his four-year legislative period to which he answered that it was an achievable goal (Keller, Stephan, *Zoom Interview*). When asked about his method of improving bicycle friendliness he stated that he had three main methods for achieving his goal. First, he wants to decrease the number of cars used, since they are currently 33.6 percent of Düsseldorf's modal split (*ZIV*). Modal split is defined as the number of trips by each mode, usually expressed as a percentage. Second, he wants to increase infrastructure for electric-, load- and regular- bicycles by giving a 50 percent subsidy for any load bikes bought while imposing clear rules for people who benefitted from the subsidy like legally committing to using it for at least three years as their main way of transportation (Gasterland, Hendrik, *Rheinische Post*) and third, he wants to expand the bike lane network in Düsseldorf so that it will be 300 kilometres long (Keller, Stephan, *Zoom Interview*). Keller also stated public transport was an important factor in making more people use bicycles (Keller, Stephan, *Zoom Interview*). Not only Keller but also the previous mayor of Düsseldorf, Thomas Geisel, was a supporter of biking in Düsseldorf.

In 2017 he even went as far as to host the beginning stage of the Tour de France (Barfield, Tom, *The Local*). Another goal he had was to increase the bicycle modal split of Düsseldorf from 12.5 percent of all trips up to 25 percent by 2024 (*ZIV*).

To see how Stephan Keller will improve biking in Düsseldorf we will first need to see how biking in Düsseldorf is today. Although it will be impossible to fully see all the variables and factors that have led biking in Düsseldorf to what it is today, this essay will deal with the question, "**How is the local government in Düsseldorf supporting the use of bicycles as a substitute for cars and public transport?**". The essay is microeconomic in its nature and deals mainly with the concept of externalities and subsidies.

Originally, I thought that I would look at the impact of the corona-lockdown on bicycle sales but this topic soon proved fruitless since the topic was too new and there was not sufficient relevant data. That is why I moved on to my current topic.

1.1 Why I chose this topic:

Born in Düsseldorf, and having lived here the majority of my life, I have always relied on bicycles to get me from one place to another. I lived in the suburbs my entire life which means that biking somewhere was usually as fast (or faster) than taking public transport. During my life, I noticed the lack of infrastructure in Düsseldorf and saw how bad biking can be. I saw a range of issues throughout Düsseldorf like lack of bike paths, cars driving on bike paths and frequent accidents. However, since Stephan Keller was elected he has made it a point to think of biking in Düsseldorf as something important even going as far as stating that he bikes to work every day (Keller, Stephan, *Zoom Interview*).

Keller's enthusiasm for biking was inherited by me. I love biking which is reflected in the fact that I bike 25 km on average per day. Keller's talks about improving the biking system got me thinking about how the local government is supporting it right now. That is why I chose to research more into this topic and applied my economic knowledge to a

situation that will, hopefully, affect a lot of people living in Düsseldorf positively soon (Kowalewsky, Reinhard, *Rheinische Post*).

2. Methodology

This analysis will focus mainly on the subsidies which the Düsseldorf government has introduced. It will deal with their effectiveness and whether there even is an effect. This section is meant to showcase the methods I used to get to my evaluation.

2.1 Literature research:

I started this research by looking at secondary data like the newspapers of my hometown. Through these newspapers, I was able to find a lot of background information on the current biking situation in Düsseldorf from various sources. Specifically, the Rheinische Post had a lot of data on this topic. It is a Düsseldorf-focussed newspaper that has existed in Düsseldorf since 1946 (*Rheinische Post Mediengruppe)*. It often discussed the biking policies that were approved and whether they were effective or not. The Rheinische Post is also where I got the information about the subsidy from originally which I then further pursued by doing online research.

2.2 Online research:

I then did further research and found primary data of bicycles in Düsseldorf recorded with bike counters dispersed within the city of Düsseldorf (*eco-public*). These bike counters count every bike that passes by every day of the year. For simplicity's sake, I will only choose the counter on Mannesmann Ufer since this is the most passed-by counter in the entire city of Düsseldorf. I also restricted the time frame of the counted bicycles from October 19th, 2014 up to October 31, 2021. Originally I wanted to choose the 15th of June as my starting point as this would have been the exact time frame the previous mayor, Thomas Geisel, who was an

advocate of biking came into office. However, the bike counter I chose started counting in October of 2014. The reason I chose to use this specific timeframe and counter is that the entire data set of all counters in Düsseldorf is too vast. Many of these bike-counters are also newer so it would prove difficult to reduce the variables, like equipment used for these counters, that could influence the data-set. I extracted the data on a monthly basis and will analyze if there are visible trends. Furthermore this counter is located so that it looks at a narrow place so it is easy to count the bicycles that bike past.

2.3 Field research:

On Friday the 22nd of October, I manually counted the bicycles that biked past the counter at the Mannesmann Ufer. I went there at noon and stayed for an hour while counting the bicycles. I purposely chose this day since it was sunny and even though it was a bit windy it was still not too cold. That is why I thought that more people would bike which would make my measurement more accurate. The timing was also on purpose since I believed that most bicycles would be there during rush-hour as most people are either going to lunch or going home at this time.

2.4 Interviews:

Furthermore, I conducted multiple interviews. One of them was with the mayor of Düsseldorf, Stephan Keller, and the other one was with a committee member of the ADFC (Allgemeiner Deutscher Fahrrad Club/General German Bicycle Club) Düsseldorf, Jan-Phillip Holthoff. Through these interviews, I gained valuable information on current issues, future plans and also gained contacts with people who could help me understand this topic further.

After doing this research I had an in-depth understanding and broader perspective about biking in Düsseldorf which allowed me to view the issues in Düsseldorf more clearly.

3. Analysis:

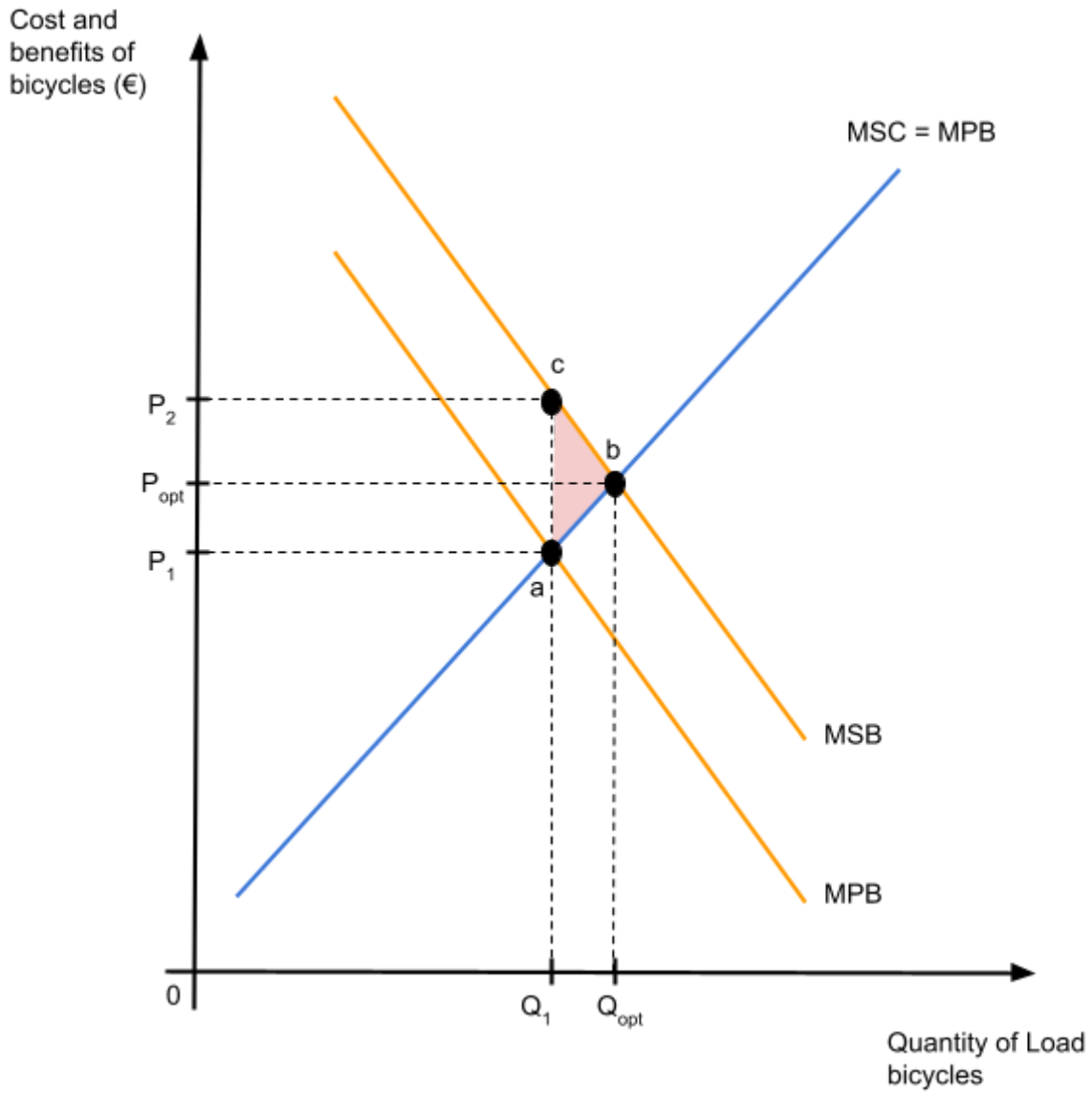
Using bicycles can be inconvenient. They have multiple disadvantages like getting to the wanted destination sweaty or suffering from exhaustion. The main disadvantage of bicycles is not these problems though. It is that most of the time, a bicycle cannot get someone from point A to point B as fast as a car. This is the main factor that caused the positive externality of bicycle consumption in Düsseldorf.

3.1 Externalities

Externalities occur when there is an effect on a third party when producing or consuming a good. They result in welfare loss, otherwise known as deadweight loss which is an inefficiency in the market which society has to pay for. Externalities can occur on the producing or consuming side and can be negative or positive. Negative externalities represent an overproduction or overconsumption of a good. This means that too much is either produced or consumed. However, positive externalities also exist. Positive externalities are an underproduction or underconsumption. Biking and bicycles, in general, are a positive externality of consumption in Düsseldorf. This means that in Düsseldorf not enough bicycles are used which creates a negative effect on third parties. This negative effect can occur in a multitude of ways. It can occur in healthcare due to poor health from the citizens lack of exercise or even in traffic since fewer people biking means more people on the road in either public transportation or cars which causes traffic congestion. Road congestion is a big issue in Düsseldorf. In 2020 Düsseldorf was ranked as the 229th worst world city in terms of road congestion. Interesting is the fact that Düsseldorf was still ranked so badly even though traffic congestion went down by five percent from 2019 (*TomTom*). TomTom stated that the time lost by driving during rush hour, both in the morning and in the evening, in Düsseldorf would be 19 minutes assuming that both the trip there and back were 30-minutes long

(*TomTom*). This may not sound like a lot but it is a time loss that could be avoided by consumers switching to bicycles.

Figure 1. Positive externality of bicycles in Düsseldorf.



3.2 Positive externality of consumption for Bicycle infrastructure

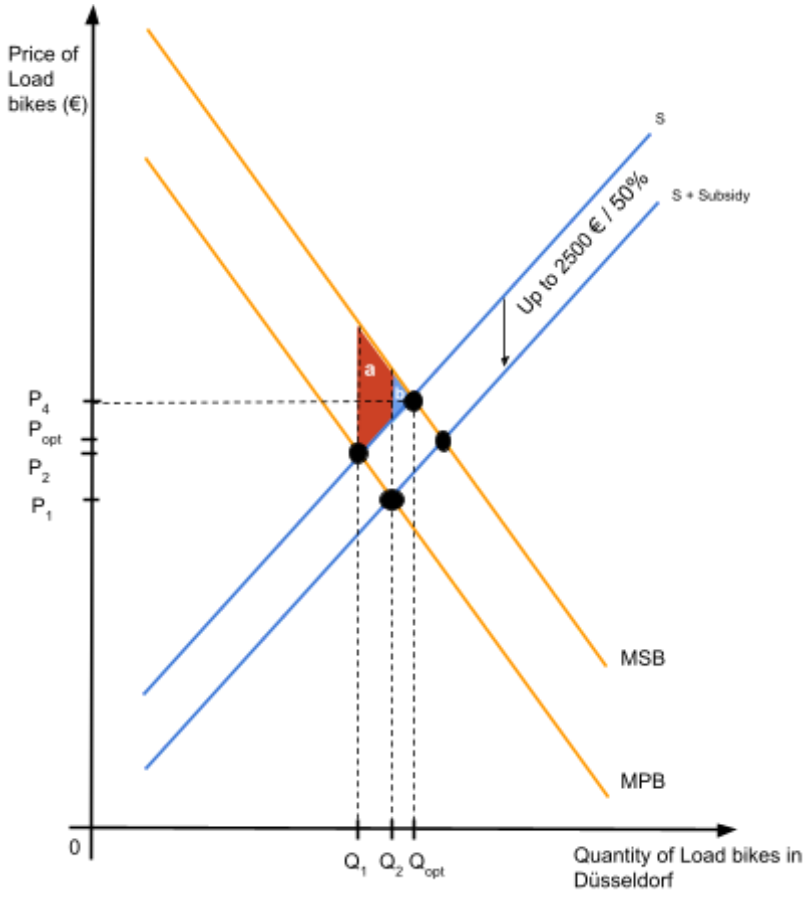
Bicycle infrastructure is a public good. This means that it is both non-excludable and non-rivalrous. Non-excludability means that consumers cannot be barred from using these goods and services. Non-rivalry means that if one consumer were to use said good and/or service it would not prevent simultaneous consumption of said good and/or service by other consumers.

Since the infrastructure of bicycles is a public good there exists a positive externality of consumption for it. This is shown in figure 1. Positive externalities of consumption occur due to the marginal private benefit (MPB) being lower than the marginal social benefit (MSB) at the point of consumption Q_1 (a < c). At point Q_1, the marginal private benefit is equal to marginal social cost (MSC = MPB). Hence, the quantity of bikes used is lower than the social optimum of bicycles used which occurs when the marginal social benefit is equal to the marginal social cost (MSB = MSC) at the equilibrium point (b). The externality leads to welfare loss, which is represented by the red triangle to the left of the equilibrium point in figure 1. In order to minimize the welfare loss, the government in Düsseldorf mainly uses subsidies. The incentives the subsidies give the consumer, artificially raise the marginal private benefit to be closer to the marginal social benefit which in turn decreases welfare loss.

3.3 Subsidies for bicycles in Düsseldorf

Subsidies are direct or indirect monetary assistance to individuals or firms provided by the government. They are used to reduce welfare loss and thus minimize market inefficiencies. They can occur in multiple forms. A form of direct monetary assistance is a transfer payment. Transfer payments can occur either when the government gives monetary assistance to producers so that the price of production will go down or when the government reduces the price for consumers by agreeing to pay part of the original price. Indirect monetary assistance can occur in the form of tax cuts. This part of monetary assistance affects firms more than individuals since firms often need to pay a variety of taxes like import taxes, green taxes, etc.

Fig 2. Subsidy and reduction of welfare loss.



To counter the effect of the positive externality of consumption for bicycles in Düsseldorf, the Düsseldorf government has set up subsidies for Lastenräder (Load bikes). The subsidy was set up in June of 2021 and covers 50 percent of the original cost for bicycles up to 5.000€ meaning that the government is willing to pay up to 2.500€ per person who applied for this government aid program (*WDR*). We can see the effect of the subsidy in figure 1. The introduction of the subsidy which artificially lowered the price from P_2 to P_1 raises the Quantity bought from Q_1 to Q_2. Even though this is not the desired equilibrium point (Q_{opt}). It is closer than the original Quantity of Q_1 by Q_2-Q_1 amount of bicycles. This in turn causes the welfare loss to shrink. Before the introduction of the subsidy, the area of the positive externality was "a+b" (red triangle + blue triangle) but after the introduction of the subsidy, it is only area "b" (blue triangle). Although the government strategy to introduce subsidies does not eliminate the welfare loss it is still an effective way of minimizing it.

Figure 3. Subsidy and stakeholder surplus.

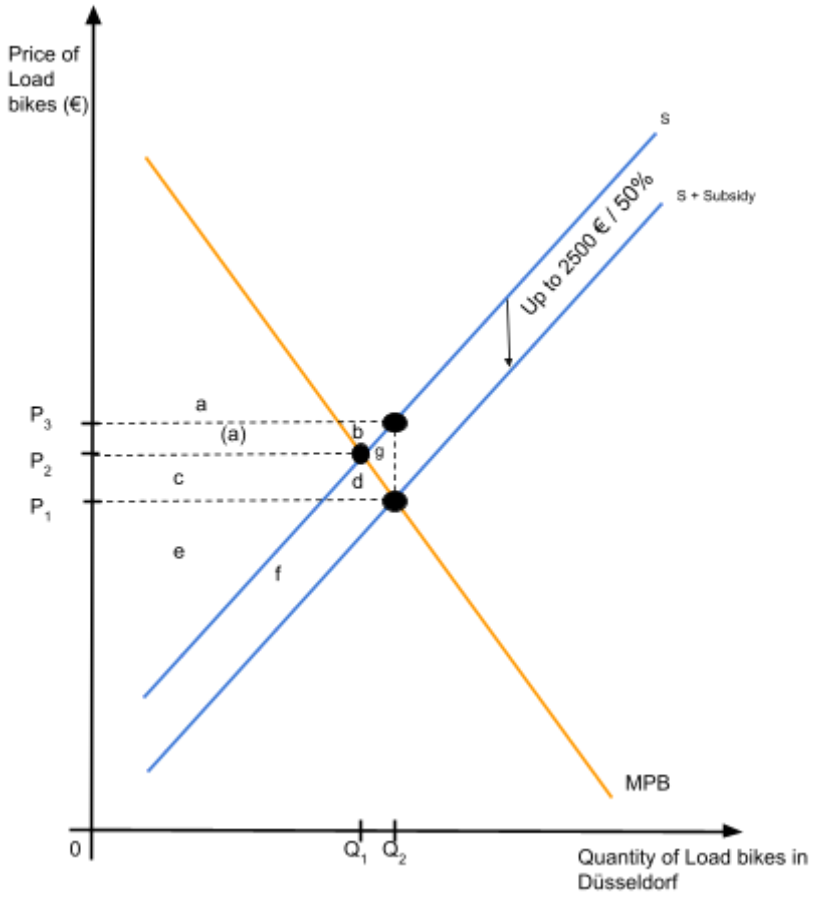


Figure 2 shows the effect of the subsidy on different stakeholders. Consumer surplus before the introduction of the bicycle subsidy was area “a”. After the introduction of the subsidy, the area grows to “a+c+d”. Since the consumer surplus grows with the introduction of the subsidy we can conclude that the bicycle users in Düsseldorf are better off. This refers to the fact that now bikes, a scarce good, are cheaper and thus more people can afford them. Overall, consumer net benefit grows. The same can be said for producer benefit as well.

Originally producers had a producer surplus of areas “c+e”. When the subsidy was introduced producers lost the surplus of area “c” since the price was decreased from P_2 to P_1. However, producers gained the surplus of area “f” since more bikes were being sold and bought (Q_1 to Q_2). Through the subsidy, bike sales increase by the difference between the post-subsidy quantity and the pre-subsidy quantity of bikes (Q_2-Q_1). Overall, the net producer benefit increases by “f-c” to become “e+f”.

The government in Düsseldorf both gains and loses by introducing this subsidy. The loss the government incurs comes from the fact that they have to pay for the subsidy. The amount they have to pay refers to areas “a+b+c+d+g” which is 2 million Euro. Originally the subsidy had an allocated budget of 1 million Euro but the budget was expanded by another 1 million Euro due to the high demand (Gasterland, Hendrik, *Rheinische Post*). This is also where the gain the government gets comes from. Since the demand for this subsidy is so high the government gains valuable information about the consumer mentality and the consumers enthusiasm about biking in Düsseldorf and also moves closer to fulfilling their goal of making Düsseldorf a more bike-friendly city.

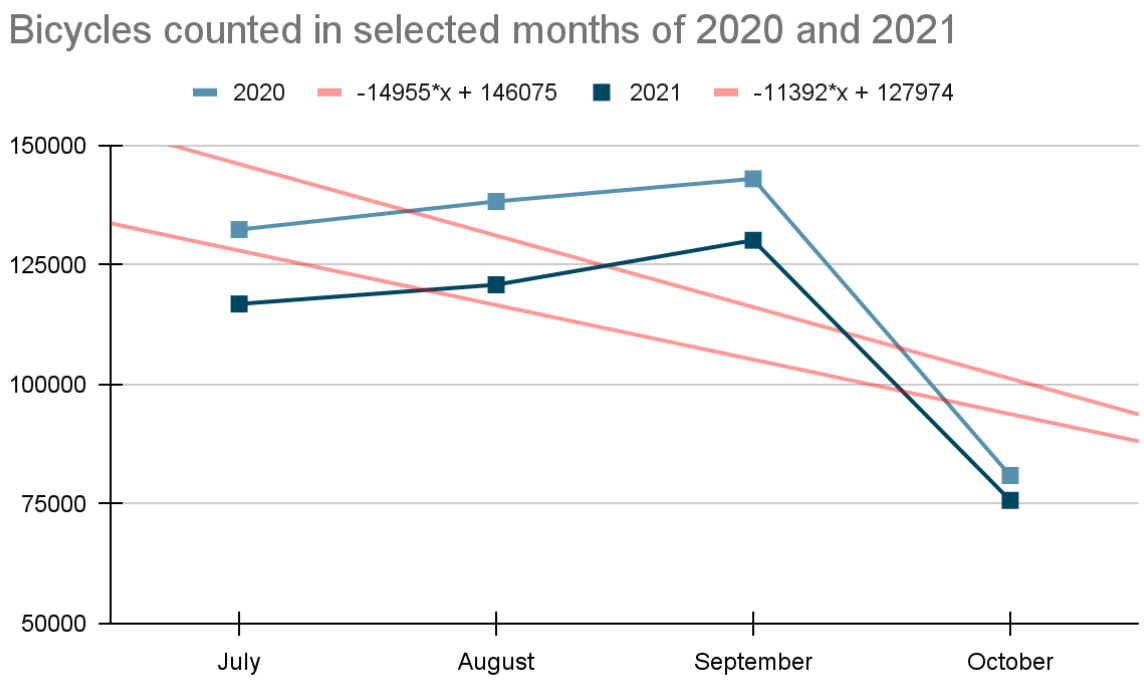
To analyze the effectiveness of the subsidy I looked at the counted bicycle numbers of July, August, September and October of the years 2020 and 2021.

Figure 4. Bicycles counted at the Mannesmann Ufer in July,August,September and October of 2020 and 2021.

	2020	2021
July	132.371	116.821
August	138.260	120.839
September	142.995	130.137
October	80.942	75.750

In this table, we can see that the bicycle count has decreased between the years 2020 and 2021. However, we assumed that this data had the same conditions as the year before. In 2020, many people had more free time due to the Covid-19 lockdown and thus were able to bike more. People also may have felt locked in and used bicycles as a way to get outside. Weather conditions like temperature, rain and wind are also not included in this data. Since there are many outside factors we cannot just take this data at face value. Therefore, the trend line is more interesting than the actual data. If the trend is increasing then the subsidy will be effective.

Figure 5. Trend of Bicycles counted at the Mannesmann Ufer in selected months of 2020 and 2021.



Even though the trend line used in figure 5 above is not accurate it still shows a general trend. The trend shown here is that 2020 had a steeper curve downwards than 2021 meaning that more bikes are used in 2021. The reason why the steepness of the line matters is because it shows that in the winter months (October), where bicycle usage always goes down due to lower temperatures and other external factors, there were more bicycles still riding. If one were to normalize the trends of 2020 and 2021, 2021 would have a more positive trend line indicating faster growth for bicycles than in the previous year.

An important piece of information to note is that the trend lines in figure 5 are not a correct model since they should be formed similar to a sine-curve with 12-month cycles, however, there is a lack of data that prohibits this. If there was more data, using a model based on one-year cycles would be the correct approach.

3.4 Overall trend of bicycles in Düsseldorf

In Figure 7 (included in the appendix below) is all the data recovered from eco-public which is a website that specializes in recovering data from bike counters in cities throughout the world. Eco-public is also the provider of the bicycle counter at Mannesmann Ufer in Düsseldorf. A prominent example of the bicycle data they collect is Hannover. In ADFC's 2020 bicycle friendliness ranking of German cities, Hannover ranked second.

Fig 6: Data of bicycles at the Mannesmann Ufer in Graph form.

Fig 6.1: Data of bicycles in Januarys.

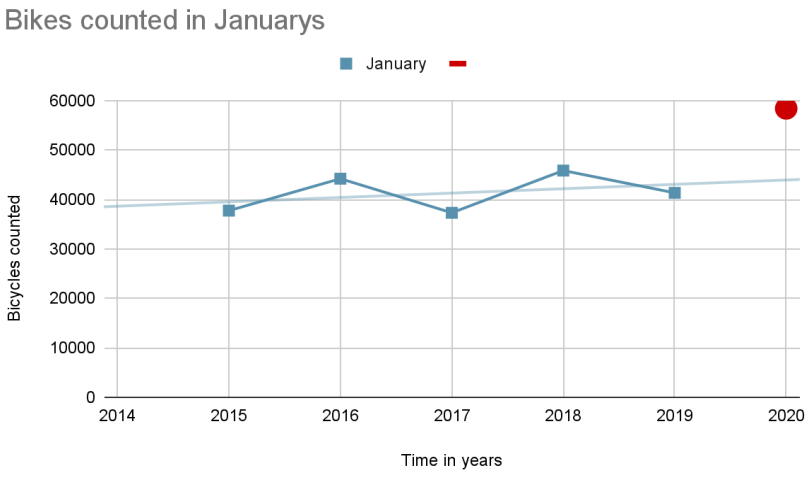
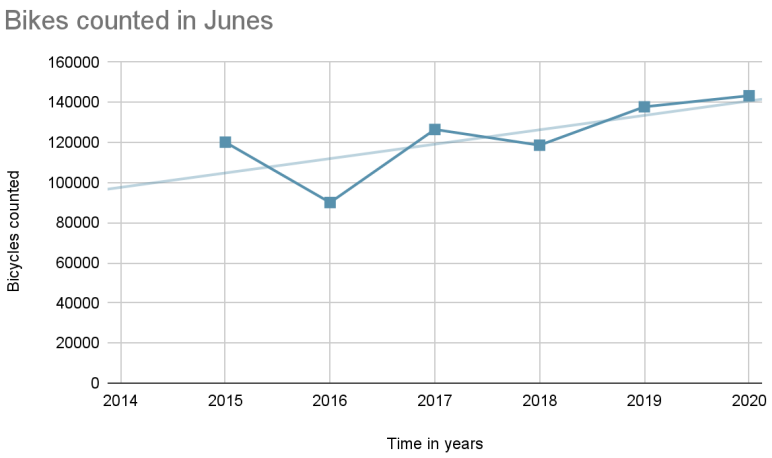


Fig 6.2: Data of bicycles in Junes.



Above is the data collected from eco-public organized in graph form. I chose two months to represent the trend line over the 6 years the data was collected. January and June. I chose these two months because I wanted to show the difference between the summer and winter months since the trend did not rise equally throughout the months of the year. This was visible in the summer months like June or July since these months had an especially steep curve compared to the winter months. Originally the January trend line in Figure 6.1 was as steep as the trend line of the summer months but that occurred due to the outlier of January 2020 which is marked in red. This was the month the corona crisis just started which is most likely the external reason for its uncharacteristic difference. To show the actual trend line I did not include this outlier and instead marked it as a non-included data-point.

Regardless of this outlier, we can still see a positive trend line in both graphs. This trend upwards is visible throughout all months, which is why I decided not to include other months since they would have shown the same trend.

4. Concerns

This analysis relies heavily on certain assumptions. There are two main assumptions throughout the analysis which are addressed below.

4.1 Ceteris Paribus

Ceteris Paribus literally translated means “other things equal”. It is an assumption which states that all other variables stay the same. By assuming Ceteris Paribus a very complex situation can become much simpler since it can “erase” random variables. It does not actually erase the variables however it takes these and assumes them to be part of the data-set. This assumption is addressed multiple times throughout the essay when I talked about the accuracy of my data and referenced weather conditions as reasons for the sometimes more randomized data.

4.2 Accuracy assumption

The second assumption in this essay is that the data collected by the eco-public counter at the Mannesmann Ufer is accurate. To check whether this was true I went to the Mannesmann Ufer and manually counted bicycles to compare my results to the automatically counted bicycles.

On Friday the 22nd October 2021, I manually counted the bicycles from noon to 1 pm. When I first got there I checked the bike counter which showed that there were already 595 counted bicycles that day. After an hour I checked the counter again and at this time 718 bicycles had been counted meaning that in that hour 123 bicycles were counted. My manual count got the answer of 149 bicycles. 143 of those were regular bicycles and E-bikes and 6 load bikes. By dividing the difference by the total I got that there is a 21 percent difference between the manually counted bicycles and automatically counted bicycles. The original results of my manual counting are in Figure 8 in the Appendix.

The fact that there was a 21 percent difference between the data assumed to be true and the actual data has a big impact on the accuracy of the analysis. That is why to gain a more detailed insight into the effectiveness of the subsidy one would have to wait longer and create a more detailed model with the data. That is also the reason why I added a section dealing with the overall trend of bicycles in Düsseldorf since I assumed that this 21 percent difference would even out if it included seven years of data. My assumption is that the 217 days for the Januarys and 210 days for Junes were enough data to even out the difference between the actual and automatically collected data and show that biking in Düsseldorf is in fact increasing.

5. Conclusion

This research has shown that there is a positive trend in bicycle growth in Düsseldorf. In a world which is continuously focussing on climate change and renewable energy this positive trend of more bicycle usage is nothing unusual. However, the research has shown that the positive trend of bicycle usage in Düsseldorf is accelerating. The trend is accelerating because the government intervened in the market by introducing subsidies to decrease the welfare loss which was caused by the positive externality of consumption of bicycles in Düsseldorf. This means that the end goal of the introduction of the subsidy is to reduce the welfare loss.

For a more complex analysis or to further the understanding of the biking culture in Düsseldorf, the next step would be to compare the weather results of the different years and to see how bicycle usage and weather conditions correlate. By accounting for weather conditions it would be possible to normalize the data so that this external factor would be excluded from the models. This would lead to a more accurate depiction of the biking trend.

It would also be possible to analyze the effect of the infrastructural improvements planned for the Radhauptnetz or to examine the consequences of the marketing strategies which the Düsseldorf government is implementing. These include but are not limited to raffles, events and posters (Düsseldorf, Landeshauptstadt, *Fahrrad Statt Auto*). Due to limitations of data, these variables which promote biking in Düsseldorf are beyond the scope of this analysis.

Also, it is important to realize that my research could be biased. I have lived in Düsseldorf most of my life and know where issues lie and where to look for sources of information. However, this does not mean that I know every single source which deals with biking in Düsseldorf. It is a very niche topic which is why the sources which I have chosen might have some bias for or against biking in Düsseldorf.

Finally, the answer to my research question, “How is the local government in Düsseldorf supporting the use of bicycles?” is that the government in Düsseldorf is doing a decent job in supporting the use of bicycles as a means to reduce the positive externality of consumption for bicycles. However, after analyzing the current trend I have found that it is very improbable to reach the goal of doubling the modal split to reach the targeted 25 percent by the year 2024. That is why I believe that Düsseldorf will need to invest more money into the biking scene and create more incentives for both consumers of bicycles and producers of bicycle infrastructure to create a friendly and lively bicycle community around Düsseldorf.

6. Appendix

Figure 7. Data of Bike-counter at the Mannesmann Ufer.

	2014	2015	2016	2017	2018	2019	2020	2021	Overall	Mean
January	N/A	37.733	44.192	37.304	45.836	41.329	58.384	46.083	310.863	44.409
February	N/A	38.308	38.629	43.147	38.673	68.696	48.134	60.920	336.504	48.072
March	N/A	64.713	50.727	85.811	53.343	64.038	71.840	81.831	472.304	67.472
April	N/A	95.807	85.643	79.338	106.971	97.831	125.367	81.631	672.588	96.084
May	N/A	94.886	104.568	106.632	128.815	80.770	146.811	95.138	757.620	108.231
June	N/A	120.147	90.046	126.494	118.637	137.785	142.326	138.060	873.495	124.785
July	N/A	103.231	115.974	113.324	144.796	131.439	132.371	116.821	857.956	122.565
August	N/A	89.721	117.555	77.890	88.107	92.359	138.260	120.839	724.731	103.533
September	N/A	78.751	123.460	83.081	104.026	103.319	142.995	130.137	635.632	105.938
October	34.260	76.471	71.970	80.435	101.697	79.241	80.942	75.750	525.016	75.002
November	67.532	62.937	50.477	54.805	67.769	64.262	83.728	N/A	451.510	64.501
December	37.169	54.864	46.736	33.239	43.963	49.158	51.861	N/A	316.990	45.284
Overall		917.569	939.977	921.500	1.042.633	1.010.227	1.223.019	741.323	N/A	N/A

Figure 8. Manually counted bicycles at the Mannesmann Ufer.

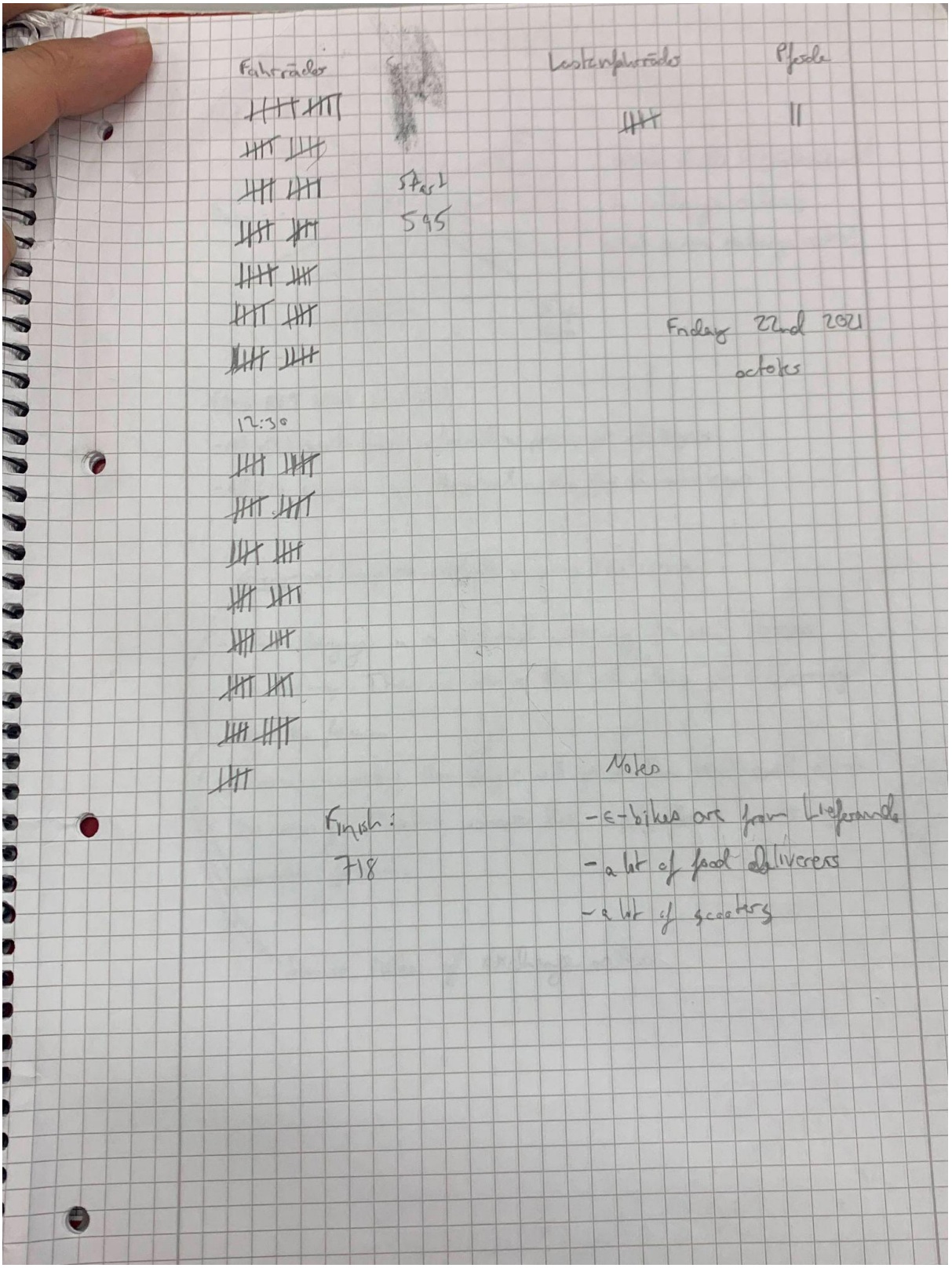


Figure 9. Overall bicycles counted in 6 years in each month.

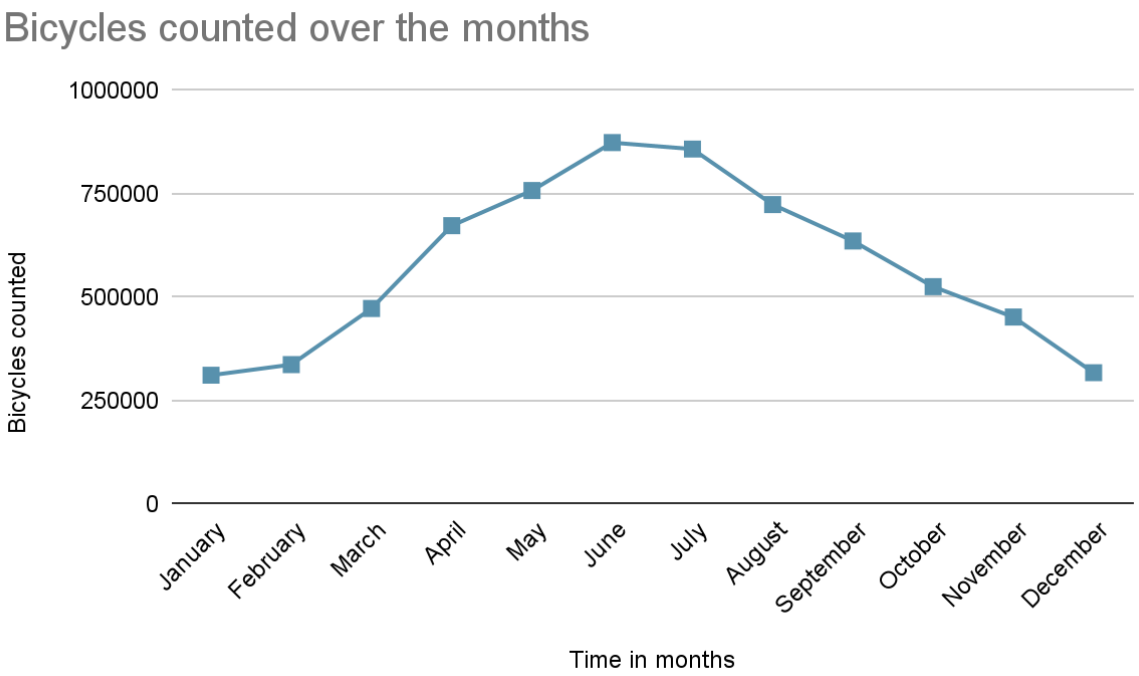
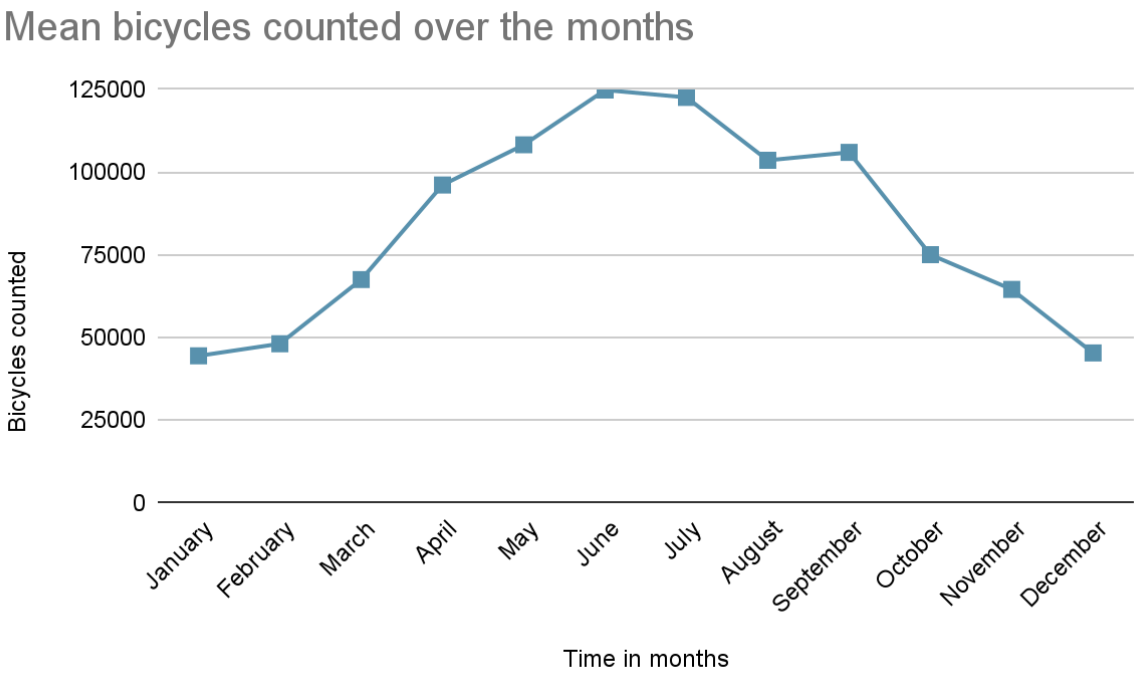


Figure 10. Mean bicycles counted in 6 years in each month.



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