ENRICO URPIS

MPHIL IN ECONOMICS

SINGLE-HOMING AND MULTI-HOMING IN THE VIDEOGAME MARKET

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ABSTRACT

The object of this thesis is to analyse the main dynamics that can arise in a platform market characterized by the platform competition in a two sided market contest. After a brief review of the literature some definitions and examples are provided. Then, the basic model is introduced and the equilibriums are analysed. The main outcome is consistent with the related literature and shows that there are actual differences among goods sold in single homing and multi homing A database has been developed to investigate the dynamic evolution of prices in single-homing and multi-homing. It was found that there is a difference among the patterns of prices of videogames in time.

To Ching-Jung Chen

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INTRODUCTION

INTRODUCTION

Recently every one of us can experience the thrilling of sneaking inside a highly secured facility defended by several wardens trying not to be spotted. Instead, for the most sportive ones it is possible to shoot the final penalty kick in the final of a world championship, sitting in our softest armchair in the middle of our comfortable living room. Playing videogames each of us can experience once in a lifetime such emotions and decide to play it alone or sharing such experience with friends.

More than 30 years have passed since the first videogame appears but it is just recently that given on one side the progress in computer technology (such as more powerful microchips, bigger storage capacity of disks etc) and on the other side the possibility of having more sophisticated home equipments such as big screens, that the videogame market become a leading one in the media industry. From videogames that showed a very poor graphic we passed to videogames that astonish for their three dimension effects. Also the audio improved massively; from blip sounds we passed to surround effects. Given such improvements, it is not rare to have real expressions of real actors scanned to give life to digital characters or avatars.

A videogame is a game played by an electronic machine (hardware) which perform the instructions present in software (game) and with which a player can interact by using different devices. This definition tries to describe the minimal essence of a videogame but it is also very useful to highlight the fact that to play a videogame we need a system composed by hardware and software and that both of them are improving in time. Given the latest technological developments, videogames become more complex and less childish than what they use to be. Improvements in the technology stimulated game designers to develop more structured games, rich in graphic and special effects. Moreover, the developments in the technical quality of the videogames push to improve also the contents of them. At the beginning the task that was required to the player was easy and repetitive, if there was a plot, it was simple and repetitive. However, as the job was continuing, plots started to become more complex showing a real structure.

To fully appreciate the importance of videogames it is possible to have a walk inside a normal electronic shop to be amused by the extraordinary number of offers with which the videogame console is proposed. It is not the variety of different combinations of the same consoles that are present that starts to make us a little bit lost about the little peculiarities that make them different, it is also the presence of a lot of different accessories that immediately catch our attention. About videogame, we are directly in front of different shelters that amuse the consumer for the number and variety of videogames proposed. There are a lot of different genres of games that tried to fulfil all the tastes of consumers. Moreover for each genre there are a lot of different options. For instance, if we look carefully at the sport section in the same shop, we can see that almost all the professional sports have a videogame that represent those sports. Moreover, for the most popular sports there is such a broad choice of videogames that a non informed consumer could not distinguish the difference among them.

It has to be mentioned that it is possible to play videogames by different devices: computers, consoles, portable consoles, etc. However, the present work will focus just on the market of consoles that needs to be link to a television. Such consoles are produced by only three firms, however videogames are sold from an incredible number of software house. Moreover, if we look carefully in the same shop, we can notice that some videogames are sold for just one console (single homing) while some others are sold for more than one (multi homing). The most interesting thing is that, in the top ten of the most sold videogame of the week, we can observe that some videogames are sold in single homing and some other are sold in multi homing and this is true for all the consoles.

Starting from this observation, the author questions himself why this phenomenon was happening. Why some videogames are sold for only one console while some others are sold for more than one? Since videogames are sold from many years, how it is possible there are two different selling strategies coexisting at the same time for videogame of success? Since there is this conduct, what are the effects of these different strategies in the videogame industry?

Given such questions, the object of the present work is to highlight the main dynamics which can arise in this industry. To achieve this target, the author considered among all the two sided market as the one which can better represent the contest in object.

The two sided market is a market which was analysed in the past but cyclically capture the attentions of economists every time there is a new case that catches the attention of the economists. Stimulated by the developments of the technology and the managerial organization of economical activities, economists developed a new branch of their science. The invention of railways, telephones, dating clubs, etc pushed the academics to explain the main dynamics that could emerge in the new contests

To understand better the object of this work it is better to focus on the concrete contest that inspired it: the videogame industry. There are different ways to play videogame; it is possible by using a personal computer, by consoles which need to be linked to a television, by portable consoles, by mobiles, etc. The market of the consoles that need to be linked to a television was the chosen one by the author because the relationships between the subjects captured his attention. The market of videogames for personal computers and mobiles are characterised by the presence of so many competitors (perfect competition) producing the hardware and a lot of firms producing the software (again perfect competition). Whereas the portable console market consist mostly in just two firms producing the hardware sharing almost the totality of the market (duopoly) while the software is produced by a large number of firms.

Instead, the producers of the hardware in the market for the consoles that need a monitor is characterised by the presence of more than two firms and, at the same time, they are less than the personal computer ones. In fact this market is characterised by the presence of three large firms producing the hardware, while the software is, again, produced by a lot of different firms. Given that was considered very interesting to analyse the strategic interaction between these competitors, especially considering that this two sided market consist also of several software suppliers and a large pool of consumers.

If an observer takes a look on the videogame industry, she will find that the main characteristic is the presence of few firms producing the hardware required to play. However, videogames are produced by these firms and also by different enterprises that can choose to sell their videogames just to one console, to some or all of them, to one console in a first moment and later to all of them. At the same time, to play videogames, consumers need a console and at least one videogame. It is possible to observe that the two goods represent a bundle since the possession of just one of the two elements is useless for the final user. However, it is possible to notice that last generations of consoles available in the market are able to perform different tasks in addition to playing videogame. With some of them it is possible to access internet, with some others it is possible to play a DVD or a BLU-Ray DVD, etc. The author is aware of this fact, but it is unquestionable that a videogame console is primary designed and bought because of the fact that it plays videogames. The other entire technical characteristics can increase the value of a console but it is very important to keep in mind that the first and most important duty for a videogame console is to play videogames.

Because of this market structure, it is important to analyse the dynamics of this market. First of all, it is possible to observe that the market object of analysis is a two sided market. As Rochet J.C. & Tirole Jean[1] show, the two sided market is a market where a platform intermediate between the others two parts of the market.

This work tries to investigate some of the dynamics that can arise in this particular market condition. Chapter 1 is dedicated to the literature review where it is described what a two-sided market is and what are the main effects that arise. In this part the author will try to expose the most relevant topics that are involved in the analysis of a two sided markets. Even though some features will not be

[1] Rochet J.C. & Tirole Jean (2004) "Two-Sided Markets : An Overview", Institut d'Economie Industrielle

analysed later on in the model, the author reported them because his intention was to give first a complete and wide view of the literature to help the reader to familiarise with the topic. For this reason it will be described the possibility to switch, the occurrence of wars about standards, the option to join more than one platform are analysed throughout the recent economics literature. In this way it will be easier to understand the actions that consumers and producers will make.

In the second chapter the model is developed and different equilibrium are showed. This model will be focused on the possibility of having a two sided market characterised by single homing or multi homing. The main focus will be the possibility that a consumer has to enjoy in more than one platform, or instead if this is not feasible and the consumer has the constraint to join just one platform. The analysis will be focused on the equilibriums that will arise and on the differences in the utilities of the agents that are involved.

Previews works, such as Armstrong (2006)[2], highlighted that a two sided market is very different if agents single home or multi homes. This work will try to investigate if the same results will arise with different assumptions.

The biggest difference between the present work and the one written by Armstrong is that in the Armstrong one the platform has got to make two participants of two wider cohort of consumer match each others. In this work instead, there is a different relationship among participant since there are no consumers trying to meet each others but there are consumers and producers who needs to meet. Moreover, if in the Armstrong model each consumer has got to match another consumer, in this work the consumer can buy much more than one product and can purchase from different sellers.

Given these differences, starting from a very simple model some little changes are introduced to find the equilibrium that arise in a two sided market characterised by different characteristics. In particular the author decided to use this approach because the reader could become confident with the peculiarity of the model if

[2] Armstrong Mark (2006) “Competition in Two-Sided Markets”, RAND journal of Economics , Vol. 37, No 3, Autumn 2006, pp 668 - 691

they are introduced step by step. Starting from a very simple representation, the reader will be aware of the monetary and the physical transactions. In each new stage it will be described what is the little feature that is added and what is the effect of this feature in the agent involved. Moreover some interesting results will be given by the intermediate stages that were analysed.

The main difference with the precedent literature was the assumption that the utility of consumers was not constant. It was assumed that the utility is decreasing in the good that is purchased.

However, although the assumption was different respect to the previous works, the equilibriums were consistent with the previous literature. In particular it appear that when a good is sold in multi-homing the agent that multi-home will be worse off respect to the equilibrium that arise in a single homing context. At the same time for the consumer who does not multi home in a multi homing context will be better off respect to the equilibrium that would arise in a single homing context. Also for the platform there are some differences, an environment characterised by multi homing will harm its profits respect to an environment characterised by single homing.

In the third chapter, a database is analysed to investigate if in the real world there are some differences between single-homing and multi-homing goods and if this differences are consistent with the model that was developed in chapter 2. The choice of developing this dataset was due to the fact that there are actually videogames sold for just one console or in more than one. In this way It would have been possible to have confirmation from the real world that the results predict by the model actually occur. If instead the database does not provide the same results predicted by the model, it may suggest new way to investigate starting from the assumptions and to try to understand better the dynamics that characterise the market.

This database was built taking the prices of different videogame of different consoles on a weekly base for more than one year from three different UK websites that sell videogames. This choice was taken because the author wanted to build a database were prices of videogames were collected for a long period of time. Data collections from shops would be affected by inventory problems such as availability of the stocks etc. Instead, considering videogames sold by websites, it was possible to have a more homogeneous product (not affected by locations of shops, different opening time, etc) that could just highlight the difference concerning the fact that some videogames were sold in single homing while others in multi homing. At the end of the present work, all the prices are represented in diagrams showing their evolution in the period of analysis.

The most important outcome from this research was the fact that an actual difference in the pattern of the prices of the videogames sold in single homing and multi homing. In particular, it was expected that prices would decrease in time but the fact that the pattern could be different among this goods was not predicted. From the dataset it was possible to observe that the price of videogames sold in single-homing was decreasing in time. However, the price of videogames sold in multi-homing showed a deceasing pattern but different from the previous one. In this second case prices were decreasing in time in a pattern that was much more close to a cubic function.

The author reported the graphs of all the prices of the videogames that were observed in the second appendix. However the most important results and graphs were presented in the third chapter too. This was done to help the reader in understanding the main findings.

Finally, in the last chapter, the conclusions are drawn.

CHAPTER 1

LITERATURE REVIEW

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LITERATURE REVIEW

Introduction

In this first chapter there will be an attempt by the author to describe the most important works that have been written on the topics that are relevant to the present research. Among all the possible ways of developing such a chapter, the author has preferred to present the contents in a linear way.

The exposition will start with a definition of the market that is the context in which the participants perform their actions; in this case the context will be a two-sided market.

After the definition of the market, there will be descriptions of the possible events that can arise. For example, there will be an analysis of what happens when a consumer decides to choose one agent among several. Secondly, there will be an analysis of what happens when a consumer switches to another agent and how much it will cost if the cost is high. Finally there will be a description of the possible case where a consumer is be served by many more than one agent (multi-homing).

By discussing the topics in this order, this chapter attempts to make reader aware of the context and to make it clear how each topic is related to the other topics.

The author has also provided a selection of the various examples that have been proposed by the papers that have been consulted. They play a useful role in making this work more valuable to the reader.

Two-sided markets

When we go shopping we can hardly avoid bringing our credit card; indeed it is quite difficult to observe someone doing such an activity without one. Moreover it is frequently the case that current customers have more than one. Credit cards are not differentiated just by the institutions which provide them; sometimes the same institution offers a wide range of credit and debit cards to satisfy the needs of buyers and of sellers. At the same time, when we use our computer we can see that some of the programs and hardware we are using exhibit special labels showing that the software and devices are fully compatible with our operating system. In this way we know that the products we are purchasing will work on our personal computer and the sellers will be able to signal the quality of their products, avoiding the development of market of lemons problems.

At the same time, if we want to play a videogame on our videogame console, we need to posses not just a console but also a videogame which is especially designed by a software house for our device. Moreover, if we would like to play different videogames we probably have to buy more than one console; sometimes this is the only way to enjoy a broader catalogue of software.

The three examples provided above show us the importance of a remarkable part of the present economy. Indeed in recent years economists have started to investigate this topic, trying to highlight the main characteristics and the dynamics which can arise. The name given to this literature is platform competition, and is focused on the characteristics of a market where two different pools of economic subjects can interact thanks to the services provided by a platform. To be honest about this, this topic has already been studied in the past.

The classical example is that of a dating club (Rochet and Tirole 2004). The function of a dating club is to help two different cohorts of customers to meet. In fact, men and women have a complementary desire to meet people of the opposite sex. The role of the club is to help these two groups to interact and to provide a service that both are willing to pay for. It could be said that since both the groups want to meet, they could avoid making use of the service provided by a club and organise themselves without a third party. However, another fact must be considered: organising this service is not so easy and requires a high level of coordination. Moreover, the club can also help in selecting the participants. For example, each club tries to differentiate itself to attract particular subjects (subjects of a particular age, with particular interests or tastes, etc.). It is for this reason that clubs sometimes differentiate themselves by focusing on individuals with different interests or by charging different prices; in different clubs the price of the same good can be very different. Finally, one of the two customer groups may have a higher willingness to meet the other group. This is the reason why it is possible to observe that frequently a platform charges more to one group and less to another; frequently, one group is even subsidised. As an example, it is common practice among clubs and wedding agencies to charge a high price to men while women receive discounts or are even allowed to join for free.

This literature in a sense developed another branch which was already established: the switching costs literature. This field was focused on the reason why some subjects do not switch from one standard and continue to adopt solutions which do not seem optimal. The classical example is the QWERTY system on computer keyboards (Liebowitz and Margolis 1994). The QWERTY system is the standard way of organising the keys, and it is a crucial system, since when we learn to type we use the QWERTY system, as do typists being taught to type. The reason why this system arose and is still the standard one today has interested economists over the years. It seemed strange that a standard could survive so long without another one, a newer and more efficient one, being developed and becoming dominant. It was suggested that the main reason was that it was quite difficult to switch from one standard to another, since it would be costly. To establish a new standard would require investment in research and development on a new way to organise the keys, investment to produce new typing machines and, finally all typists, who would have to become efficient using the new standard. However, who should pay for these investments? If in the end the equilibrium would be a higher level of efficiency, who should internalise such improvement? If it is not possible to internalise such gains, who should coordinate the subjects involved? Since another standard called Dvorak was developed, why did it not become the new standard?

A good discussion of this topic is provided by S.J. Liebowitz and S.E. Margolis (1995). Against the common knowledge, in this paper the authors asserted that the reason why the Dvorak standard lost the battle was not because of the lack of coordination among consumers and producers, as was reported in most papers. After the Second World War an officer of the US Navy proposed another standard for typing machines which would, it was claimed, increase typing speed by 25%, and this predicted rate was actually achieved in a test run by the same individual. Such a huge improvement was due to the fact that the QWERTY system, it was thought, was developed to slow down the typist. This was done to avoid the possibility of the typing machine being damaged when different levers contacted each other. The only question to be answered was how the switch should happen.

One possible solution was to retrain all typists to the new standard. In this way all the factories would be forced to produce only typing machines conforming to the new standard, since all the typists would now be trained with the Dvorak standard.

Another possible way of solving the problem was to force all the factories to produce typing machines conforming to the Dvorak standard. In this way all the typists would be forced to learn how to type using the new standard, since, from that moment on, the only machines available would be Dvorak ones.

However, Liebowitz and Margolis stated that this was a false explanation; in fact the QWERTY system was not designed for the purpose of slowing the typist’s speed. Moreover, when the same experiment, examining the supposed higher efficiency of the Dvorak standard, was run by other researchers, the same performances were not achieved. Since the efficiencies of the two standards were similar, why should the subjects have to pay huge investments for an uneconomic switch? Even thought the two standards were equal in performance, economists reported this case for years to show the advantages of an incumbent standard over a new and supposedly better one and the difficulties that a new standard would face in becoming dominant. The literature refers to these problems as “chicken and egg” problems.

A possible solution is provided by a third subject who tries to resolve this stacking situation. In the dating club example, the main function of the dating club is to coordinate the two cohorts of subjects. It is possible for men and women to go to a public place to meet each other. However, it is evident that if a third subject acts as a coordinator and avoids market failure, then this can be profitable for all. The dating club can start to select subjects, helping them to maximise their resources, such as time, money, and so on.

Other examples where a coordinator was required

This problem can also occur in the credit card market. Why should consumers purchase a credit card if they have to wait for the sellers to buy the machine terminals? However, at the same time, why should sellers buy the terminals and wait for customers to obtain a credit card? At this early stage it is important to note the role of enterprises which support different standards, such as Visa and MasterCard. Investments in both R&D and promotion helped establish the market. By subsidising both sides, by providing terminals at a cost which was less than the marginal cost and by providing the service to customers for a very low price, these enterprises made the development of this market possible.

In a lot of other cases it is easy to see that a third party is required. One service that should be mentioned here is the service provided by the Yellow Pages. The main purpose of Yellow Pages is to give information on commercial activities to consumers. In Yellow Pages directories customers can find the telephone numbers of shops, and so on. All customers have to do to find a category they are interested in is search in the index, and they will be able to make a list of telephone numbers and contacts. In the case of Yellow Pages, it is also possible to identify a particular pricing structure.

As we saw earlier, a pricing structure can differentiate among the different cohorts of the market and can subsidise one side. For example, we know that in some clubs men pay a higher price for membership than women do. As discussed earlier, this happens because one side is more willing to pay more to have the chance of choosing among a broader group of people. In the case of Yellow Pages, one side can even participate for free. The Yellow Pages are given to householders for free; the only revenue for the companies which produce them is revenue from the advertisements. Commercial companies are aware that every time a subject needs a service for the first time, it is highly probable that he or she will have a look at the advertisements. Now advertisements are everywhere in every media; they are printed in newspapers, broadcast on television, and so on. Since it is impossible to stare at the television and wait for the proper advertisement, when a customer would like to search for a commercial service, he or she will need a service that is precise, selective and systematic. This service is provided by the Yellow Pages, where the advertisements are represented in the simplest way. Since companies know that all customers behave in this way, they will do everything possible to be in this book. Therefore, the revenues coming from advertisements are enough to pay for all the books for householders and to make a profit for the third party which provides the service.

Another possible example is provided by the telephone industry. As everyone knows, the purpose of the telephone is to connect two or more persons by machines which can use electricity to transmit their voices. It is necessary that the machines adopt the same standard for facilitating interaction and exchanging information. This fact is very important, since at the beginning different standards were available. In the USA in particular there were various different companies providing telephone services. Since none of them was strong enough to become the only player in the market and impose its standard, consumers were obliged to have more than one contract to be able to reach a bigger group of subjects.

Since each firm needed to develop their infrastructures and the country was so large, clearly it was costly to maintain that structure. For this reason AT&T solved this problem, and consumers, by subscribing to just one contract, were able to contact all other customers who purchased a telephone contract.

However, it is also necessary to mention an example linked to the telephone industry which shows how government intervention in a market can be different in different contests. In fact, after a long period when AT&T was the monopolist of the telephone industry, the US government decided to open the market to competition. With different firms competing, the final result was that prices went down but without producing the confusion which was a feature of the first phase of the industry. This was due to the fact that in the meantime an international institute, the International Telecommunications Union (ITU), was created to develop the standard in the telecommunication sector and also to the fact that the US government was very keen to avoid any company foreclosing on any of its competitors; so all companies had to work to guarantee full compatibility.

The train industry is also characterised by the elements analysed above. The train is a transportation machine which needs a rail road to work. Given this, it is important that the rail road perfectly fits the technical characteristics of the train. The distance between the two rails needs to be the same as the distance between the wheels of the train, and the materials and shape of the rails have to be strong enough to allow a train to use them several times. It is clear that both the train and the rail road have to be built to precise standards.

In this industry a lot of different standards were developed for different reasons. At the beginning the lack of coordination meant that the railroads were built for specific trains with different standards.

However, even when later there was an agreement on the technical specifications that had to be followed, different standards were in use. Sometimes this was due to the shape of the land the rail road had to pass over. Consider the differences between building a rail road in a flat area and in a mountain area. In a flat area it is possible to build long curves where big trains could turn at high speed. The same is not possible if the rail road has to be built in a mountain area; here the train would have to make very short turns at lower speed, and for this reason a short distance between the rails would be required. It is possible to see that, for this reason, in some countries different standards are required and can exist at the same time.

A third reason why different systems are not compatible relates to politics. As an example it is possible to cite the fact that the Russian rail road was intentionally built with different technical parameters from rail roads in other European countries. This was done so that, in the event of an invasion, the army of the invading country could not make use of the infrastructures built by the Russians.

Switching costs

After considering the main characteristics and the dynamics which arise in a two-sided market it is possible to highlight one of the most interesting aspects. Since a two-sided market is a market where demand and supply meet given the presence of an intermediary, it is also possible for another intermediary to do the same work and take the place of the incumbent.

This idea, and particularly its strategic implications in different contests, has been analysed by economists. In fact, it is possible to find different results starting from different starting points.

If there is a cost for a consumer to switch from the seller this may push the seller to price its goods at a very low price to build an installed base which can be exploited later at a higher price. Since there are switching costs it would be very difficult for a new competitor to enter the market and so the incumbent would have a strategic interest in building a big installed base at an early stage. Usually in a market there are subjects who are interested in a product and subjects who are not interested at all. However, the ones who are interested are not characterised by the same willingness to pay. The main objective of an incumbent is to attract most of the interested customers in the first period by charging low prices and to exploit them later. This might be seen as the typical behaviour of the “top dog”. If a new firm enters this market, it will have to face competition from the incumbent for new customers entering the market. If the incumbent has an installed base, this installed base can be large enough to make the entrance of a competitor uneconomic, even in the case that this competitor succeeds in attracting all the new customers.

However, there is another kind of strategic behaviour. The incumbent prefers to price its goods at a high price, avoiding building an installed base to exploit later. This is consistent with “lean and hungry” behaviour. In this case the incumbent will start to price aggressively when a competitor enters its market.

The importance of switching costs has been highlighted in different works. Greenstein (1993) wrote a remarkable paper that analysed the market of a part of the information technology sector, the commission of computers for the US Federal Agencies during the 1970s. His work is very interesting because it shows the advantage that the first firm which enters a market has. The paper shows that very frequently the firm which is first to serve in a market will continue to do so in the following years. This is particularly evident in this market because this effect is very strong.

Producing goods for a big agency with a very specific need may help the incumbent to better understand the needs of its client and to set up a better product each time. Also, in the extreme case where learning-by-doing externalities are not involved, it is clear that the specialisation of the incumbent will make it difficult for a competitor to enter the market. Finally, it is also important to consider the fact that it is difficult for a big customer with very specific needs to change its supplier. Also, if the supplier charges a high price, the buyer knows that the good fits its requirement. For this reason, a change of supplier may not be convenient because the new supplier’s product may not be the optimal product for the customer's needs.

For a firm, it is important to have an installed base because it is possible to exploit this base in the future. However, the entrance of new aggressive competitors aiming to attract new consumers, leaving the old ones to the incumbent, may produce an apparent paradox: the position of the incumbent and the entrant can swap over. This effect was analysed by Farrel and Shapiro (1988). and was very interestingly, they showed how the entrant can increase its market share to the point where it equals the incumbent one. At this point the previous incumbent should stop pricing at a high level and sell at a low price to increase its market share again. The final result is that the incumbent and entrant will cyclically alternate in the market.

When switching costs are not endogenous in a market, firms will try to introduce them to relax the competition. The perfect example is provided by the frequent flyer programmes, which almost all airlines promote. Here, consumers are pushed to use the same company to accumulate points and win flights. If a customer switches firms, he or she will lose all accumulated points and will have to start again to collect points with the new company, if he or she wants to take advantage of the offer. It is clear that the biggest firms have the advantage since they have many more connections. It is also important to consider that if a firm has the monopoly over some routes, it can use this fact as a strategic tool to push customers to continue to use its aeroplanes for connecting flights where there is competition.

Strategies to react against switching costs

The previous part discussed the way companies, because they are interested in keeping their installed base, have developed promotions like the frequent flyer programmes. In a certain way, it is possible to consider these actions as a defence strategy against the risk that customers will switch to other competitors.

The following section will analyse the strategies an entrant firm can adopt to steal consumers from the incumbent firm.

First of all, it should be remembered that switching costs are costs a consumer has to pay to switch from one supplier to another. Since this cost can be evaluated, it is possible for a firm to discount the good by the same amount of money the consumer pays for switching. The customer would therefore be indifferent between purchasing the goods from the different suppliers, and the strategic position of the incumbent would not be maintained.

A less extreme version of this strategy could be used by a new company to steal some of the customers of the incumbent. If a firm has perfect information of the market, it is possible to imagine that the firm could price its good below the good of the incumbent; however, it would need to discount its good only by an amount equal to the switching cost the consumer has to pay.

This strategy can become a predatory pricing strategy. Predatory pricing refers to the action of selling below the marginal cost of the good. Selling at a price lower than the marginal cost implies that the price is even lower than the price of perfect competition. This means that the firm which practises predatory pricing will incur losses until it stops charging such low prices. The main insight is that by taking a long-period perspective, the firm which practises predatory pricing will be able to serve all the customers in the market and push out all the rivals. In this way it will be possible for the firm to become the monopolist and charge higher prices and gain higher profits than before.

Sometimes a firm will prefer to continue to price its good at the equilibrium price of the market and directly pay the switching costs. In this way it becomes possible to increase the installed base in a more direct way and try to reduce the gap between the firm and its competitors.

This possibility was analysed by Chen (1997), and this work is crucial, since it shows what can happen if customers are paid to switch. In his paper Chen described the differences between a situation where it is possible to pay consumers to switch and a situation where this is not allowed. Interestingly the work starts with a discussion of second period equilibrium. This is done because, the paper argues, second period consumers are influenced by first period choices. Since consumers are aware that in the second period they will be affected by first period choices, in the first period they will act strategically to maximise their welfare in both periods.

The results of the paper are quite interesting and original since they demystify some of the conclusions of other papers.

For example, considering the second period contest where paying consumers to switch is possible, the paper comes to some interesting conclusions. First of all, the market size of a firm does not have an effect on the price structure, and one-third of the population will switch seller. Conclusions consistent with the previous literature are found too: when the switching cost approaches zero, the price tends to the marginal cost (as in the perfect competition contest). Conversely, when the switching cost rises, the price for all the customers rises too. However, the switching cost is assumed to be a dead weight loss for society welfare.

When paying customers to switch is not allowed, the role of the market share is important. In this contest profits are maximised when the firms each supply half of the market and they are minimised when one firm has the totality of the market. The analysis of this contest shows that profits are higher when it is not possible to pay consumers to switch and that the dead weight loss for society is lower too.

As discussed before, in the first period contest, firms and consumers make strategic choices. When it is possible to pay consumers to switch, firms have to be aware of the fact that prices are the same for firms in the second period, given that the equilibrium price in the first period is below the marginal cost and it is shown that equilibriums are unique. It is also claimed that when switching costs increase both profits and consumer's surpluses decrease.

When analysing the situation where it is not possible to pay consumers to switch, it is very important to know the market share of the firms. After various calculations the writer arrives at the unique solution of the subgame-perfect Nash equilibrium. As discussed before the market share is important and the price strategy will depend on it; it is also possible that first period prices will be lower than the ones in the other scenario. The main reason is that in this case it is possible to exploit the installed base in the second period. Regarding the social implications, it is certain that firms will earn much higher profits, while the consequences for consumers are debatable. It is possible that consumers enjoy lower dead weight losses (when it is not possible to subsidise switching) or an increase in competition (in the other contest).

Some of these results are consistent with the work of Caminal and Matutes (1990): price discrimination can make firms worse off, and there will be the negative effect of dead weight losses due to transportation costs and switching costs. However there are some differences too: in Chen's model prices increase over time, and the role of the market share is not important in the contest where it is possible to pay consumers to switch.

To sum up, this paper showed the different strategies a firm can choose to increase its profits: exploit the installed base with high prices or attract new customers with low prices to exploit them later. However, given the assumptions, the author is aware of the difficulties in assessing the welfare implications. If it is possible to state that in this model firms are always better off when it is not possible to subsidise the customer who wants to switch, it is not so clear that the consumer is always better off. Sometimes customers would benefit more from the increase in market competition, and sometimes they would benefit more from the absence of dead weight losses.

All these cases show how long the list of options is for a firm wanting to steal consumers from the incumbent firm. It is also worth noting that sometimes it can be profitable for a firm to have a competitor in the market to increase its profits.

This is true in Chen (1997), as was reported discussed before. However, Economides (1995) arrived at almost the same conclusion: for a monopolist sometimes it is better to have another firm in the market. Moreover, if another firm is not present, the monopolist can find it convenient to sponsor a competitor to enter the market. Economides came to this conclusion because he focused on network externalities. For a monopolist it is very difficult to be credible when promising to increase production and reduce costs in the future. The presence of a competitor in the market can persuade consumers to trust the monopolist, since if it does not keep its promises customers will be able to switch to the competitor.

Standards Wars

The term “battle of standards” is usually used by economists to refer to a situation where two different systems enter into conflict. The first part of this chapter discussed one example of this conflict, the attempt made to replace the QWERTY typing system with the Dvorak standard.

Another important case which captured much attention was the war between the two different standards for the home video tape industry. This battle took place during the 1970s, and the players were the BETAMAX format and the VHS format. These two formats were competing for the same market at the same time, and there was a lot of uncertainty over which one would win in the end.

Each of them had pros and cons. BETAMAX tapes were smaller, meaning that they were very easy to carry. However, there was the drawback that to start with one tape was not enough to hold one movie, and so it was necessary to have two tapes for each film. VHS tapes were large enough to hold a movie but they were much bigger than the rival ones. Quite soon new developments in technology allowed BETAMAX to market a second generation of tapes that were able to hold a full movie. However, the VHS standard made similar improvements. Since VHS tapes were already able to hold a full movie, the technological progress made meant that definition could be increased, so increasing the tapes’ quality.

Given that VHS was able to present the market with a better product, the battle was won by the VHS standard and BETAMAX became one of the standards that, like Dvorak, never became universal.

The case of the QWERTY standard has also been analysed by Liebowitz and Margolis (1995). The two authors first focused on the importance of the case. It was long time before the public became interested in the battle of standards. The amounts of investments in technology, in marketing and in promotion were remarkable. Moreover, many important firms took part in this war, supporting one of the two standards.

It is also remarkable that when VHS won the war, suddenly a lot of analysts started to suggest that the war had been won by an inferior standard. However, Liebowitz and Margolis in their 1995 paper rejected all these analyses and showed that VHS finally won the battle because of its higher quality.

Cooperation

This last part will show how a standard can be established without the need for a war.

The first example is provided by the DVD industry. After the VHS format came to rule the videotape industry, technological progress started to make tapes old. First of all it should be mentioned that the music sector by the beginning of the 1980s had been revolutionised by the appearance of a new format: the CD. The advent of the compact disc started the revolution of the digitalisation of the media industry. Since the data was recorded with a digital technique instead of an analogue one, it was possible to achieve a higher level of definition and a longer physical life, and to make cost savings, since it was much easier to make cheaper and high quality copies. Secondly the diffusion of personal computers powerful enough to play multimedia content resulted in the creation of a lot of different digital formats to play this content. Given this, consumers were expecting the video industry to move into the new digital era.

Media firms too were willing to skip to the new digital devices, but firms were scared that by proposing different formats they would again start a battle of standards. Since they were aware of the possibility that their investment would involve large sunk costs that probably would never be recovered, multimedia firms preferred to start a common project and to avoid any conflict. At the end of this process, the DVD (digital versatile disc) format was established. The DVD could store an entire movie recorded in high quality with high definition sound, and has enough additional space for different languages or extra bonuses such as behind-the-scenes features, making-offs, and so on.

If this development showed that collaboration can be worthwhile and can be a way to avoid useless sunk costs, it has to be reported that such agreement was not a mark of the development of the second generation of DVD. When it was clear that the industry was ready to move on to the next level, firms divided themselves into two groups focusing on different formats: DVD+ and the Blue-ray disc. The first format was the natural evolution of the preceding standard, in the sense that the same technologies were used but were improved by the latest developments in the field. The Blue-ray format, on the other hand, was a revolutionary one, in the sense that it used new devices such as a new type of laser, new codecs, and so on. Since DVD+ had the advantage of being fully compatible with the preceding generation, DVD+ machines and discs were quite cheap, and machines and discs of this standard were the first ones to appear in the market. The Blue-ray DVD, in contrast, was not compatible with existing technologies and so significant investments had to be made by the firms supporting this format. Moreover it should be considered that machines were needed in the market that could support the old DVD format, since consumers wanted to be able to play their old DVDs. Machines supporting two different standards were much more costly since they had to contain two different systems.

All in all, the case of the development of the different DVD formats showed that it is possible for different firms to work together on a project to achieve a result that benefits all involved. However it is not guaranteed that such a spirit of cooperation will persist in the future, as the preceding example showed. This topic was analysed using different examples by Varian and Shapiro (1999). In this paper these standards wars are analysed in all their possible forms. In fact, in the economic history of the battle of standards, there have been not just battles or peace, but also truces and unexpected events that have served to resolve the fight in an unexpected way.

Multi-homing

The preceding sections described what can happen when a standard has to be chosen. Firms can agree to support a common standard or there can be a war, with the winner taking all the market. However, there is a third possibility. In the same market there can be more than one standard, and consumers can access more than one standard at the same time. This is made possible by multi-homing.

Multi-homing refers to the possibility of supporting more than one standard. This possibility can be realised in different ways. One way is the production of machines able to support more than one standard. An example is the Blue-ray DVD players, which are also able to support the preceding DVD format and audio CDs, as was reported above.

Multi-homing is not just enabled by producers; customers can also play a part, since they have the option of purchasing different machines to support different standards. It can be hard to imagine why a person would buy more than one tool to do the same thing.

This problem was analysed in different papers; for example Rochet and Tirole (2000) analysed the credit card market. In this market there are many more than one firm selling credit cards services. However, it is important to note that consumers usually have more than one credit card. The work of Rochet and Tirole tried to describe the different equilibriums that can arise in this case and what happens when consumers or service providers are in the stronger position.

Another market that has these features is the videogame industry. Videogame consoles were sold from the beginning of the 1980s. Since then different generations of consoles have been sold and it has to be said that in each generation there have been many more than one console for consumers to choose from. It is interesting to note that players with a high enthusiasm for gaming decided to multi-home to increase their gaming possibilities. The problem was that sometimes videogames were produced for different systems, but other times videogames were sold for just one console. If consumers wanted to play all the videogames in the market they had to buy more than one console, and by multi-homing they were able to maximise their utility.

This topic was analysed by Roson (2005). In his paper the author analysed the characteristics of multi-homing and the various ways it can be achieved. One of the most significant results related to the cost of switching and the effect on the conduct of the market. If other authors showed that the presence of switching costs relaxed competition, Roson showed that the degree of competition is different depending on whether the consumer or the producer multi-home.

The aim of this paper is to analyse such dynamics in a two-sided market and their effects on the conduct of the industry.

Armstrong (2006) analysed the competition in two-sided markets, considering the main differences between a single-homing equilibrium and a multi-homing equilibrium. In his paper he describes first a two-sided market with just one platform and two groups of consumers. In this contest the prices that maximise profits for the platform are given by the cost of providing the service minus the benefits that the consumers get by interacting with the other group plus a factor that indicates the elasticity of the group's participation. This first stage of the model highlights the possibility of having subsidies among a group of consumers.

In the following sections of the paper the author analyses the equilibrium that arises when there are two platforms in a single-homing contest. The main difference from a standard Hotelling model is the presence of a term that measures the opportunity cost for the platform to increase the price to one group, causing a participant of that group to leave. Given the equilibrium of the model, it is demonstrated that if there are differences among the two groups that are interacting, the side of greater importance for the platform will be the side where there is more competition and that has more benefits to the other group. One interesting difference from the monopolistic contest is that if a consumer does not join one platform, he or she will join the opposite one. However, this choice will also affect the decision of consumers in the other group to join the platform. With respect to the monopoly case, the external benefit of one group will be of more significance to the platform after the price has been set for the other group.

The multi-homing stage is analysed only when a single group of customers joins both platforms. The possibility of both groups of consumers multi-homing is not studied because this development would involve a redundancy, since both sides of the market would have to join both platforms. Since just one group of consumers multi-homes, this means that this group is characterised by a high willingness. Since the group that multi-homes has these characteristics, the surplus of the consumers of this group will be exploited by the platforms and the other group of consumers.

If one group in the market multi-homes, the role of intra-group externalities is crucial. In fact intra-group externalities can lead to consumers who multi-home being affected negatively by other multi-homing consumers. In this case it is possible to observe a market failure, since this situation means that among the participants of the multi-homing group are some participants who negatively affect their utility.

The videogame market

The videogame market is part of the broader culture industry market.[3] As mentioned in the introduction, the focus of this market is on videogames sold for consoles that need to be linked to a screen. The good which is purchased by consumers consists of a bundle of hardware, in this case the console, and software (at least one videogame). It is possible to describe these two elements (hardware and software) separately to gain a better understanding of the dynamics of this market.

To start with, it can be considered that this market is quite recent and is characterised by a rapid evolution in different generations. Starting with the Atari videogame "Pong", sold from 1975 (Dietl and Royer 2003), different firms have proposed consoles to play videogames. The different consoles are usually classified as belonging to different generations based on their characteristics, such as processor speed, quality of the video, quality of the audio, and so on. These generations are quite close to each other, each generation having lasted less than eight years.[4] Each generation also tended to last longer than the previous one.

The hardware side of the industry can be characterised as an oligopoly. Since the 8-bit generation, the market has been characterised by the presence of two or three major firms. This characteristic of the market derives from the high investment costs required to design, manufacture and produce each console. Such costs are so significant that they can be considered as a barrier to entry, and only a few firms can survive in this market.[5] Moreover, when the 32-bit generation started, there were eight different formats that were not compatible with each

[3] In 2002 the total industry sales amounted to about US $10 billion (Dietl and Royer 2003).
[4] Analysing the market, it can be noted that the first 8-bit console was the Nintendo NES in 1986. In 1990 Sega lunched the Mega Drive, a 16-bit console. In 1994 there was the launch of the Atari Jaguar and the 3DO, characterised by 32-bit technology. In 1999 Sega put the Saturn console (128-bit technology) on the market. Finally, in the most recent generation of consoles, Microsoft launched the Xbox 360 in 2005.
[5] When Microsoft entered this market in 2003, the cost to enter the market was US $500 million (Dietl and Royer 2003: 161).

other; however, after two years, just three firms (Nintendo, Sega and Sony) survived.[6]

The software side of this industry is characterised by two kinds of products. Videogames can be produced by console producers or by independent firms. Given the high number of firms, their size and the high frequency with which firms alternate as market leaders, Peltoniemi (2008) states that the videogame software market is far from mature. By comparing the Herfindahl index of the videogame market and the index of the car market, Peltoniemi (2008) arrived at the conclusion that the videogame market is not mature and that a consolidation in market shares among the software houses is some time away.

At the same time Nieborg (2011) highlights the fact that the costs involved in developing videogames are increasing, and now huge investments are required to produce a blockbuster title. For example, to develop a successful videogame such as “Grand Theft Auto IV”, the software house Rockstar North invested a hundred million dollars, while to develop the videogame “Halo 3”, Microsoft had to invest thirty million dollars.

It can be noted that videogames are sold both for just one console and for more than one: respectively single-homing and multi-homing. The decision of whether to develop a videogame for just one console is informed by different circumstances.

First of all, some videogames are produced by the same firm that produces the console; for this reason these games are called in-house videogames. In-house videogames are usually developed at the beginning of the lifecycle of a console to build an installed base of consumers. This installed base is necessary to push other independent firms to enter the market and solve the “chicken and egg problem” that usually arises in these kinds of markets.

[6] From 1994 onwards different consoles and console upgrades were sold. The upgrades of previous 16-bit consoles where produced by Sega; they were the 32CD and the 32X, and they were not successful. Totally new consoles were the Panasonic 3DO, Atari Jaguar, Philips CD-I, Sony PlayStation, Sega Saturn and Nintendo N64. Only the last three were still on the market in 1996.

Videogames can also be produced by independent firms. Independent firms endeavour to produce videogames, but they have some constraints. First of all some agreements with console manufacturers don't allow producers to develop games for other consoles. Secondly, producing a videogame can be quite a complex process; for this reason software houses use particular tools called game engines to avoid programming a videogame from the beginning.[7] If the engine is not compatible with different systems, producing a videogame for more than one console necessitates that the programming work starts from the beginning, and this can be particularly costly.

Dietl and Royer (2003) describe the decision that firms have to make when choosing the system(s) on which the videogame will be played. Whether a firm decides to produce a videogame for just one console or more than one console depends on the agreements between the console producer and the software house and on costs. Regarding the agreements, it is important to emphasise that among the present generation of consoles there are two different strategies. Nintendo opted for a very strict policy: it tends to produce several videogames for its own console and generally does not allow other software houses to sell the videogames to other systems. Sony and Microsoft, meanwhile, do not develop many videogames in-house and prefer to give much more freedom to the software houses.

Nintendo opted for this strict policy to solve the chicken and egg problem. The other platforms, in contrast, preferred to increase intra-system competition to increase the total value of the system in respect to other systems. This strategy was also adopted owing to the installed base of consumers. Sony and Microsoft aim to have an installed base and to lock as many mature consumers as possible. Nintendo focuses instead on 6- to 15-year-old boys; since the turnover is much faster and there is no lock-in effect to exploit, the strategy must be different.

[7] A videogame has to simulate a world with physics laws, but software already exists containing these laws and artificial intelligence. So software houses do not have to start from the beginning every time, and they can focus on other parts of the game such as design, plot, etc.

Finally, it should be remarked that profits can arise from the hardware side, the software side or both. It is important to remark that in this industry revenue comes from software royalties. Consoles are usually sold at a very low price compared with the industrial costs, and in the early stages of their life-cycle they are sold at a loss price to build an installed base of consumers. Profits from the hardware side are possible only in the last part of the life-cycle of a console. In this moment investments are recovered and the relatively high cost of a console is compensated by a broad catalogue of videogames which increases the willingness to pay of potential customers.[8]

Since profits come from the software side, platform producers are keen to have as many titles as possible for their system; at the same time, they need some videogames that differentiate their system form the others. Software houses want to sell the highest possible number of each videogame, and selling the game on more than one console can help. However, to release a videogame on more than one console is costly, and for this reason not all videogames developed by independent software houses are sold for more than one console.

The above discussion illustrates why some videogames are sold for just one console while others are sold for more than one.

Possible extensions

The cited works were analysed to build a consistent literature of the main dynamics that arise when there are different agents facing two-sided markets. Among all the papers cited, the work that was considered crucial by the author was the one written by Armstrong (2006).. The model presented in the next chapter is strongly influenced by Armstrong in intuition and approach. However there are some significant differences.

[8] It is worth remarking that just one console, the 3DO, has tried a different strategy. In 1994 this console was sold at a high price and revenues were expected from the hardware side. However this strategy was a fiasco and since then no firms have ever tried it again.

In the Armstrong model the two sides of the market are in a symmetric position. The role of the platform is to allow consumers in the two groups to meet and earn profits from this intermediation. However, if the two groups are characterised by different utilities, it is possible that the platform will charge more to the group with the higher utility to subsidise the second group of consumers.

However, what would happen if the platform did not help the two groups of consumers to interact but instead made a group of firms interact with consumers? Moreover, what would happen if the group of consumers were characterised by decreasing utility?

The model that is developed in the next section will try to investigate these questions.

CHAPTER 2

THE MODEL

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THE MODEL

The development of the model

The proposed model is intended to investigate a market where a platform is at the centre of an interaction between a group of consumers and different firms. However, there are some particular features that differentiate it from the models that were analysed in the first chapter. A discussion of the videogame industry will help develop a clearer picture of the model.

In this industry there are consumers aiming to use a good that comes in a bundle: one console and, at least, one videogame. Since it is impossible to play a videogame without a console, it is compulsory for a consumer to purchase hardware that allows her to play videogames. At the same time, videogame producers have to develop their software for a specific platform. Since both sides of the market are aiming to interact, the platform will be able to profit from both sides in a symmetric or asymmetric way, as described by Armstrong (2006).

Drawing on Armstrong's discussion, this work will focus on the same kind of market, where there are asymmetries among agents. In Armstrong a platform is used to link two different pools of consumers. In this dissertation, however, the two sides are differentiated because on one side there are consumers and on the other side there are firms willing to sell them goods that are a part of a bigger system.

In this market consoles are initially treated as a homogeneous good. This assumption is justified because, as can be seen by looking at the market, it is possible to play some videogames in more than one console. However, as the next stages are developed, a differentiation between the different platforms will be considered, and for this reason an element of differentiation will be included to analyse the possible effects.

The previous chapter described the main characteristics of videogames as a good. However, now a more detailed discussion is required to explain the possible dynamics that can arise in this market. First of all, it can be noted that console manufacturers sell videogames subject to copyright in two different ways: they either produce videogames by themselves or they let other firms produce the software for their machines. It is important to report that in the real world both these strategies are adopted at the same time. For all the consoles in the market there are videogames sold for one console and videogames sold for more than one. A good representation of the pros and cons of selling the product to just one seller or to more than one is provided by Marvel (1982), Rasmusen, Ramseyer, & Wile (1991), Douglas & Whinston (1998) and Dietl and Royer (2003). All these papers analyse the possibility for firms to have exclusive dealings with other but there are some peculiarities that require a further investigations.

Some videogames are developed by the producers of the console on which the games are played. This strategy in this contest is not chosen because of the usual advantages associated with vertical integration of production, such as avoiding double marginalisation, exploiting profits in the downstream market, and so on. This strategy is chosen because, especially when a new console enters the market, the manufacturer has to persuade consumers to purchase the console. Since a console has utility only when it is used together with at least one videogame, console producers have an incentive to provide different videogames to attract consumers and to lock them in to their system.

This strategy is the best strategy to solve the indirect holdup problem: the unwillingness of software producers to invest in a specific console because they are not sure what the reactions of the other participants in the market will be. As a matter of fact, all consoles in the market have at least one videogame produced by the console manufacturer. However, it is important to highlight that in no case are all the videogames for a console produced by the console manufacturer. Farrell and Gallini (1988) discuss this situation, showing that a firm selling a long-lasting hardware will not be credible when promising to continue to provide short-lived software. The console producer will have an obvious incentive not to support the software once the customer is locked in, so, clearly, totally adopting this strategy would not be optimal.

There is another possible strategy that console producers can adopt. They can allow software firms to produce videogames for their machine. In the real market, console producers sign agreements with third parties to develop videogames for their platform. These agreements can take a range of forms. They can be quite restrictive (the videogame cannot be sold for other consoles) or not restrictive (videogames can also be developed for other platforms), and they can refer to a single videogame or can explicitly refer to potential future editions, and so on.

What is important to note is that producers will increase the competition in the software market by having different software. This is important for two reasons. First, an increase in competition means that monopolistic pricing for consumers who are locked in will not be possible. Second, if the competition among software houses increases, consumers will be able to choose among a broader pool of firms willing to gain profits just from the software side.

There are different generations of consoles in the market. It can be noted that the interval among generations is increasing (Dietl & Royer 2003). However, the focus of this work is on the main dynamics that emerge in a single generation. Different papers such as Fudenberg & Tirole (1998) and Ellison and Drew Fudenberg (2000) analyzed the problem of different generation of products in a dynamics contest and especially they focus on the possibility to use different generations of products and the use of upgrades to force the early consumers to upgrade their product or to buy a new version of the one they already have. However, this work is focused just on a single period and possible strategic choices that console producers can play to increase their profits focusing on more than one generation are not studied here.

At this point it is introduced a two-sided market. In this setting there are three agents: platform suppliers, software suppliers and consumers.

To begin with, we can analyse the utility functions that are going to be applied. Given that the context is a two-sided market, there are at least three kinds of agents:

S: the software suppliers

P: the platform producers

C: the consumers

The interactions among the agents are shown in the figure below. The dashed line represents monetary interactions and the solid one represents material interactions.

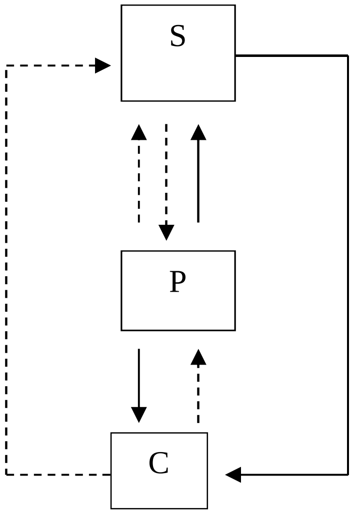

Fig 2.1: In this scheme it is possible to see the basic interactions among agents. The fitted lines represent the material interactions while the dashed lines are the monetary interactions

In Fig 2.1, S represents the software suppliers, P the platform producers and C the consumers. The relations among the agents can be summarised in this way:

The consumers have a direct relationship with the other two agents since they buy the platform and the software.

The platform suppliers provide the hardware to consumers. However, platform producers also have a direct relationship with software suppliers, since they can charge royalties or provide subsidies. Moreover, platform suppliers can provide software suppliers with the codes which are necessary to program a videogame for a given console (product interaction).

Finally the software suppliers have a direct connection with the platform suppliers and the consumers, as illustrated above.

Consumers are interested in the whole system. The overall system costs will depend on the overall system chosen, so it is important to consider not just the cost of the platform and the cost of the software, but also the technical characteristics of a platform and the variety of the software proposed. It will be possible for those consumers who evaluate the good very highly to multi-home to increase their level of satisfaction (see Case 3).

It is possible for the platform producer to have two margins. They will earn from both sides of the market, and eventually they will be able to subsidise one side to earn more in the other.

It is important to describe the main characteristics of the good. As we saw before this market is characterised by the presence of firms selling software that will be used for some consoles. In this context, exclusive arrangements are a possibility. Regarding this possibility, it is important to highlight that consoles are involved in a competition focused on prices and also on quality. The opportunity to sell a console with better videogames than other firms is a very important asset for producers.

This chapter is divided into four parts. Initially, a very simple version of the model is proposed, but little by little features are added. Each part will begin with a description of what the differences are between this and previous models and what the new variables are. Furthermore, at the end of each part, there will be a short summary that will show what the main economic meanings of the equilibriums are.

Model one: several videogames produced by one supplier

In this part we analyse what happens in the market when one software developer is present and is able to produce more than one videogame. In this contest the platform producer will charge a royalty f_s that maximises their profits.

The three equations that are going to be used in this part are

[1] $$U_i = \alpha y - \beta y^2 - yp_s - p_p$$

[2] $$\Pi_p = p_p + yf_s - c_p$$

[3] $$\Pi_s = y(p_s - f_s - c_s)$$

- p_s = price of the software,
- p_p = price of the console,
- f_s = royalties on the software suppliers (positive or negative)
- C_p = cost of producing a console
- C_s = cost of developing the software
- β = is a parameter between zero and one
- α = is a parameter and is bigger than one
- y = number of software items

From this point on, the utility of the consumer will be in the form of [4]. It can be noted that, given the parameters α and β, utility increases as the number of software items increases. In fact, it is assumed that the utility of enjoying a system derives from the number of software items a consumer can have. However, utility will decrease after a certain level. This happens because it is assumed that consumers will buy the software they appreciate the most first, and will only later buy software in which they are less interested.

It is important to state that in this work the videogames are not perfect substitutes. Consumers are concerned about diversity and they will purchase the product that will satisfy them most first and will continue to purchase until their utility is positive. In a way similar to that discussed by Dixit and Siglitz (1977) and Krugman (1979), the total amount of software bought will be the sum of the choices of the consumers in the market. In the present work the equation which describes the utility can be thought as a partial equilibrium specialization of the Dixit and Siglitz (1977) utility function with fixed quantities and endogenous variety (in this model the number of videogames y). The quadratic in y is a second order approximation of the general function u= u (y)'.

In more in detail, we use the following function:

$U = \left(\sum x^{a}\right)^{\beta}$ and since β < 1 we will have $U = \left(\sum x^{a}\right)^{\beta} = y^{\beta}$

The simplification just performed was possible since the quantity of each game bought by a representative consumer is fixed, so x is either zero or one. What matters is the number of games available ('variety'), y, and utility is concave in this. The quadratic form in y is a second order approximation of an arbitrary concave utility function

In the current model we are searching for a partial equilibrium where the number of videogames bought *y* is equal to the number present in the market. Moreover, to simplify, we used a cubed version of this formula. Given this dynamic, we will arrive at a point where there is no more software which consumers are interested in, and so utility will start to decrease.

Since equation [3] gives the price of the software and equation [2] provides the price of the platform and the royalty, one more equation is required. Equation [1] will provide the number of videogames in the market and the first condition for the platform to be bought is that the utility for the consumer is bigger or equal to zero, so if $U_i \geq 0$.

$$U_i = \alpha y - \beta y^2 - y p_s - p_p$$

Since we assume that the utility is given by the number of software consumer purchases, utility is maximised through the purchase of videogames.

$$\frac{\partial U_i}{\partial y} = [\alpha y - \beta y^2 - y p_s]' \quad \Rightarrow \quad y = \frac{\alpha - p_s}{2\beta}$$

Looking at the previous result, one restriction needs to be clarified. It is impossible for the consumer to increase their budget. This condition means that

$$y \succ \frac{\alpha}{2\beta}$$

In fact, when videogames are extremely cheap or even present in the market for free, the number of videogames has to satisfy the previous condition.

Now it is possible to move on to the equation of the software producer [3]:

$$\Pi_s = y(p_s - f_s - c_s)$$

Now for the first time we allow the software house to set the price independently from the platform producer.

We have to consider that the firm producing the software has to maximise its profits; therefore we have to maximise its utility function through the price of the software it sells.

$$\frac{\partial \Pi_s}{\partial p_s} = \left[\frac{\alpha - p_s}{2\beta}(p_s - f_s - c_s) \right]' \quad \Rightarrow \quad p_s = \frac{\alpha + f_s + c_s}{2}$$

At this point, we have to focus on the equation of the platform producer profit function. We also have to find the point where the platform producer maximises revenue; the solution is to look at the prices it is possible to charge on the software side. In fact it will be possible to maximise profit by charging the maximum royalty on the price of the software. However, it should be pointed out that the platform producer will set the royalty before the software house sets the price. Starting from equation [5], we can substitute the values we found before for the number of videogames and for the price of the software. We can then maximise the profit function through the royalties charged to find the optimal royalty level. Finally, we can rearrange the other terms and find the prices and the quantities in equilibrium:

$$p_s = \frac{1+f_s}{2} = \frac{3\alpha - c_s}{4} \quad \text{and} \quad y = \frac{\alpha - p_s}{2\beta} = \frac{\alpha - c_s}{8\beta}$$

We can note that this price involves double marginalisation. In fact, since the software house and the platform producer will set the prices so as to maximise their own utility and will not consider the total price the consumer will have to pay for the complete system, the price will be higher than in the case of the maximisation of the price of the overall system.

By substitution it is possible to analyse the utility for the consumer:

$$\boldsymbol{U_i = \alpha y - \beta y^2 - y p_s - p_p = \frac{\alpha - c_s}{32\beta}[14\alpha + 2c_s] - p_p}$$

The previous result suggests that if the platform producer could calculate the price of the platform as below, all the utility for the consumer would be extracted.

$$p_p = \frac{\alpha - c_s}{32\beta}[14\alpha + 2c_s]$$

It is also possible to find the profits:

$$\Pi_s = \frac{\alpha - c_s}{32\beta}(\alpha - 3c_s) \qquad \Pi_p = p_p - c_p + \frac{(\alpha - c_s)}{16\beta}$$

Main results from model one

It can be noted that the utility for the consumer is decreasing for the prices charged for the software and the hardware increases. At the same time, the profit of the software supplier is increasing in the utility of playing for the consumer (α) and decreasing in the cost to produce the software. Regarding the profit of the platform producer, it is possible to state that it is increasing in the selling price of the hardware but decreasing in the cost of production of both the hardware and the software. This happens because the revenues of the platform producer come from two sides: the sale of the hardware and the royalties charged on the software. Any increase in the cost of production of the hardware or the software will result in a decrease in the profits of the hardware producer.

However, as reported before, in this model double marginalisation will occur due to the behaviour of the platform producer and the software developer. Some of the solutions present in the economic literature (like exclusive territorial clauses, vertical integration, and so on) are not feasible given the characteristics of this model. However, to avoid the occurrence of the double marginalization, the hardware manufacturer can impose a two-part tariff and thereby increasing its profits.

Model two: several suppliers producing one videogame and several consumers

This model is an evolution of the previous one; however, here a complication is added: there are several consumers and several suppliers of videogames. The characteristics of these new features are as follows: consumers are homogeneous and the good provided by the software suppliers is uniform too. Moreover, the software market is characterised by free entry and every firm can enter to sell their product.

It is important to note that although equation [1] gives the number of videogames bought, it is not possible to quantify the number of subjects aiming to join the market. Given this restrain, we assume that the number of consumers is given and so there is no reason to change the structure of the previous system. All that is required is to adapt the model to the new scenario. As before, adapting the system we have that equation [4] provides the number of software purchased, [6] gives the price of the software and equation [5] provides the price of the platform and of the royalty. The equations that are going to be used in this part are

[4] $$U_i = \alpha y - \beta y^2 - y p_s - p_p$$

[5] $$\Pi_p = n_c p_p + n_c y f_s - n_c c_p$$

[6] $$\Pi_s = n_c (p_s - f_s) - c_s$$

- n_c = number of consumers in the market (it is supposed to be positive)

As before, each consumer's utility derives from the number of videogames she can purchase, so her utility function has to be differentiated by the quantity of the software. From [7]

$$\frac{\partial U_i}{\partial y} = [\alpha y - \beta y^2 - y p_s]' \quad \Rightarrow \quad y = \frac{\alpha - p_s}{2\beta}$$

As in the previous case, *y* represents the number of videogames in the market. Since each firm produces only one videogame, this also represents the number of firms which are present in equilibrium.

Since (by the assumptions) each software house produces just one videogame, *y* will represent the maximum number of software firms in the market. Considering also that the software market is in perfect competition and firms can enter the market freely, [6] should be equal to zero.

$$\Pi_s = n_c(p_s - f_s) - c_s = 0$$

It is possible to evaluate the price that can allow a firm to stay in the market; the price must satisfy the following condition:

$\boldsymbol{n_c(p_s - f_s) - c_s} = 0$ which can be rewritten $\boldsymbol{n_c p_s - n_c f_s - c_s} = 0$

So, the price of the software will be $p_s = f_s + \frac{c_s}{n_c}$

It is possible to note that the price of the software is equal to the average cost. In fact the cost of the software is divided by the number of all the customers in the market. If we compare this result to the one that was found in the previous model, we can note that here the cost of the software, which is fixed, is divided by the total number of the consumers present in the market.

Now it is possible to focus on the profit function of the platform producer [5], since before we evaluated the number of software *y*, and now we can substitute it so that we will have:

$$\Pi_p = n_c p_p + n_c \frac{\alpha - p_s}{2\beta} f_s - n_c c_p$$

Now it is possible to substitute the price of the software p_S:

$$\Pi_p = n_c p_p + n_c \frac{\alpha - \left(f_s + \frac{c_s}{n_c} \right)}{2\beta} f_s - n_c c_p$$

Now, as in the preceding case, it is possible to maximise the profit of the platform producer for the royalties charged:

$$\frac{\partial \Pi_p}{\partial f_s} = \left[\frac{n_c}{2\beta} \left(2\beta p_p + \left(\alpha - \left(f_s + \frac{c_s}{n_c} \right) \right) f_s - 2\beta c_p \right) \right]' = \alpha - 2 f_s + \frac{c_s}{n_c} = 0$$

If we bring the royalties to the left side and rearrange the signs we get

$$2 \boldsymbol{f_s} = \boldsymbol{\alpha} + \frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \qquad \text{which can be rewritten} \qquad f_s = \frac{1}{2}\left(\alpha + \frac{c_s}{n_c} \right)$$

Given the differentiation of the profit function, it is possible to note that this point is a maximum. It is important also to see the main relationships among the different variables. As expected, the royalties increase in the cost of production of the console and decrease in the number of consumers. If the number of consumers approaches infinity, royalties will tend to the parameter α, which describes the evaluation for the market software. It is also now possible to evaluate the values of the other variables of the system:

$$\boldsymbol{p_s} = \boldsymbol{f_s} + \frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} = \frac{1}{2}\boldsymbol{\alpha} + \frac{3}{2}\frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \qquad \boldsymbol{y} = \frac{\boldsymbol{\alpha} - \boldsymbol{p_s}}{2\boldsymbol{\beta}} = \frac{1}{4\boldsymbol{\beta}}\left(\boldsymbol{\alpha} - 3\frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \right)$$

Also, the price of the software decreases in the number of consumers. This is to be expected, since the cost of developing the software is assumed to be just a fixed cost; the more consumers are in the market, the less each consumer will have to pay for it. This same pattern is observed in the number of software items bought, represented by *y*. The dynamics here are also the same as the ones observed before. If the number of consumers increases, it will cause the fixed cost to develop the software to decrease, since the cost will be shared among a bigger pool of customers.

It is also possible to evaluate the utility of consumers. From [4]

$$\boldsymbol{U_i} = \frac{1}{4\boldsymbol{\beta}}\left(\boldsymbol{\alpha} - 3\frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \right)\left(\boldsymbol{\alpha} - \frac{1}{4\boldsymbol{\beta}}\boldsymbol{\beta}\left(\boldsymbol{\alpha} - 3\frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \right) - \frac{1}{2}\boldsymbol{\alpha} - \frac{3}{2}\frac{\boldsymbol{c_s}}{\boldsymbol{n_c}} \right) - \boldsymbol{p_p} =$$

$$U_i = \frac{1}{16\beta}\left(\alpha - 3\frac{c_s}{n_c}\right)^2 - p_p$$

And the price of the platform will be

$$p_p = \frac{1}{16\beta}\left(\alpha - 3\frac{c_s}{n_c}\right)^2$$

Main results from model two

Since the software firms are in competition among themselves and do not make any profits, the platform producer is able to extract all the surplus rents from consumers.

It is also possible to compare the utility of consumers in model one and model two. First of all, we note that the positive part in model one is divided by 32, and in model two it is divided by 16. Moreover, the utility in model two increases in the number of consumers. Given in model one there was just one consumer, the utility of consumers in equilibrium two (model 2) tends to be higher as the number of consumers increases to share fixed costs.

Model three: two platforms, Hotelling differentiation

In this case the focus is on what happens when there is more than one platform supplier. In particular, we will look at what happens when there are two platforms in the market.

The main difference to the previous models is that in model three there are two platforms competing in the same market. Now the contest of the competition is a single-homing one. In fact, in this market, consumers are allowed to choose one platform and, after the purchase, can only buy the software that is available for that platform. Once the consumer chooses, it is not possible for him to purchase the other platform or to buy the software which is available for the platform he did not choose. Summing up, in the previous model there are different software suppliers and several consumers. Here one complication is added: now there are two differentiated platform producers.

The dynamics observed require an adaptation to the model that has been developed. Model three is the first of two versions, as in Armstrong (2006). As in the cited paper, the single-homing case and the multi-homing case are analysed. The present model analyses what can happen in a market when the conditions allow first single-homing and later multi-homing. In the single-homing case, both software suppliers and consumers can only join one market. In the multi-homing case, the analysis will show what happens when consumers or software producers are allowed to join both markets.

To avoid extreme results, for example a small increase in price causing the loss of all the customers, a differentiation between software and consumers was introduced. In the model t represents the transportation cost for each consumer and software house in this market. As in the Hotelling model, t can be interpreted as the cost of a given quality of the goods in the market.

In the present model, it will be assumed that the number of videogames in the market y is equal to the number of companies. Each company is supposed to produce just one videogame, and this condition holds in reality, since software houses usually sell one videogame in a period of several months. We can also consider the fact that videogames are different from each other. Each game has at least one feature which distinguishes it from another game. This difference can be used to understand the role of the parameter *t*. It is possible to imagine that the characteristics of games are in a [0,1] interval and that the extremes are associated with one console. As an example, we can imagine that at 0 there are features like interactivity which are associated with console A, and at 1 there are features like graphic quality which are associated with console B. Each software house can decide which kind of videogame is better to produce: a very interactive one, a very graphically advanced one, or a combination of both. Since consoles are different (as are consumers' tastes), software houses can also decide which platform to produce for.

Another critical feature is the fact that the market is characterised by free entry, and so there are no supernormal profits for the firms producing the software. It is assumed that consumers' tastes are uniformly distributed in a [0,1] interval, the same interval which characterises the systems.

In the single-homing and the multi-homing case, it is assumed that the complete systems, consoles and videogames, are very close substitutes. It is assumed that the systems are very similar but not identical. In this sense, the parameter *t* refers to the distance of a given system from the tastes of a consumer. Then, as in the classical Hotelling model, it is possible to adopt the parameter *t* to represent the transportation cost each consumer has when he has to choose which console to buy. For example, if we consider that two different consoles can focus on different kinds of videogames, for instance sport and action videogames, we can put these two qualities at the two extremes of the line of characteristics. The parameter *t* will help us to quantify the disutility cost the consumer has to face.

In the two-sided market, the utility functions of the subjects involved are the following:

[7] $$U_i^A = \alpha y_A - \beta y_A^2 - y_A p_{sA} - p_{pA} - \theta_A t$$

[8] $$\Pi_p = n_A p_{pA} + n_A y_A f_{SA} - n_A c_p$$

[9] $$\Pi_s = n_A(p_{sA} - f_{SA}) - c_s = 0$$

In the utility function of consumers [7] the utility is represented by the formula that was used until the previous case minus a term which expresses the disutility a consumer faces when she has to choose one platform. If she is perfectly satisfied by system A, this term will be zero. But if she has to choose the system which is closer to her tastes, this parameter represents the cost she incurs in not having perfectly matched her tastes with the characteristics of the system she chose. The parameter θ indicates which part of the total number of consumers uniformly distributed in the [0,1] interval will chose to join system A.

As in the previous stage, in this stage we assume that the software market is in perfect competition and is characterised by free entry. Since there are no feasible supernormal profits we can equate the profit function of the software house to zero.

We can start by evaluating the number of consumers in platform A. As in the Hotelling model, we have to equate the utility functions of a consumer when she is indifferent to joining platform A or B

$$\alpha y_A - \beta y_A^2 - y_A p_{sA} - p_{pA} - \theta_A t = \alpha y_B - \beta y_B^2 - y_B p_{sB} - p_{pB} - \theta_B t$$

At this point we have to consider the fact that the consumers present in the market are split into two groups, the ones joining system A and the ones joining system B.

We can normalise the total number of consumers to one and say that the proportion of the consumers joining platform A and B is equal to one.

$\boldsymbol{\theta_B} + \boldsymbol{\theta_A} = 1$ which can be rewritten as $1 - \boldsymbol{\theta_A} = \boldsymbol{\theta_B} 0$

With this result, it is possible to modify the equation we evaluated before and find the total proportion of the consumers that decide to join platform A. If we substitute and add to each other the terms containing θ_A and move them to the left side

$$2\theta_A t = \alpha y_A - \beta y_A^2 - y_A p_{sA} - p_{pA} - \alpha y_B + \beta y_B^2 + y_B p_{sB} + p_{pB} + t$$

and then regroup everything, we will have the total proportion of consumers purchasing platform A:

$$\theta_A = \frac{\alpha(y_A - y_B) - \beta(y_A^2 + y_B^2) - y_A p_{sA} + y_B p_{sB} - p_{pA} + p_{pB} + t}{2t}$$

However, we have to consider that now it is important to focus on the number of consumers joining one platform, since the number of consumers joining platform A is given by the total number of consumers by the proportion of consumers who join platform A. So we have:

$$n_a = n\theta_A$$

Each consumer will maximise her utility by purchasing the optimal y_A number of videogames. Since the utility of a consumer is given by the number of videogames she purchases, we have to differentiate the utility function by the number of videogames to find the maximum.

$$\frac{\partial U_i^A}{\partial y} = \left(\alpha y_A - \beta y_A^2 - y_A p_{sA} - p_{pA} - n_A t\right)' = \alpha - 2\beta y_A - p_{sA} = 0$$

The results for consumers joining platforms A and B will then be:

$$y_A = \frac{\alpha - p_{sA}}{2\beta} \qquad \text{and so} \qquad y_B = \frac{\alpha - p_{sB}}{2\beta}$$

Now it is possible to use the number of videogames each consumer will purchase to evaluate the total number of consumers who join system A.

All the calculations that have been done to evaluate the number of the consumers joining a platform are presented in Appendix 1. The final result is

$$n_A = n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]$$

The number of consumers joining console A is equal to half of the market plus the difference between prices of the consoles by twice the transportation parameter plus a term which expresses the effects the role of the differences in the price of the software.

Now we can move on to the profit function of the software houses. We can start with the equation for the profits of the software developers [9]:

$$\Pi_s = n_A(p_{sA} - f_{SA}) - c_s = 0$$

First of all, it should be considered that, owing to the structure of the market, each firm present in the market can develop just one product. This means that the total number of videogames that are in the market represents the total number of firms. However, since the market structure is characterised by free entry and perfect competition among the firms, there are no supernormal profits from the software developer side. For this reason the profit function of the software houses is equal to zero.

It is possible to find the basic relationship that links the price of the software with the royalties, the cost necessary to develop the software and the number of consumers:

$$p_{sA} = f_{SA} + \frac{c_s}{n_A} \quad \text{but also} \quad p_{sB} = f_{SB} + \frac{c_s}{n_B}$$

Since the software market is in perfect competition and there are no barriers to entry, the console producers can choose the royalty values which give zero profits to the software houses. Given this, we can now move on to the equation of the profits of the console producer [8] to find the optimal prices for the console and the software.

The profits of the platform producers derive from the total number of hardware units sold by its price and by the total amount of royalties charged on the software side minus the costs that are necessary to produce the hardware. It is important to remember that the cost of the hardware is supposed to be a variable cost. This is in contrast to the software side, where the costs are assumed to be fixed.

$$\Pi_{pA} = n_A p_{pA} + n_A y_A f_{SA} - n_A c_p$$

After substituting the number of software *y* that each consumer purchases and the value of the royalties, it is possible to rewrite the preceding formula in the following way:

$$\Pi_{pA} = n_A \left[p_{pA} + \frac{\alpha - p_{sA}}{2\beta} p_{sA} - c_p \right] - c_s \frac{\alpha - p_{sA}}{2\beta}$$

In the previous formula the profit of a platform producer is equal to the revenues minus the costs it has from the hardware side and the software side. It is important to emphasise that the second term inside the square brackets is the revenue the platform producer gets from the software supplier in terms of royalties. It is also possible to see, given this, that the profits are influenced in two ways by the number of consumers. From the hardware side, they are influenced directly, since the difference between the price charged for the hardware and its costs is multiplied by the number of consumers. However, it is also possible to note that there are economies of scale in the software side, since the revenues from the software are influenced by the number of consumers, but the cost of the software is not influenced by the number of consumers.

Now we can substitute for the number of consumers we evaluated before and find the optimal price of the console by deriving an equation incorporating the price of the console and the price of the software to find the optimums which can provide the platform producers with the highest profits. The profits of the platform producer are maximised by the price of the hardware, and after the differentiation and considering that *n* is a fixed number, we have:

$$-\frac{1}{2t}\left[p_{pA}+\frac{\alpha-p_{sA}}{2\beta}p_{sA}-c_p\right]+\left[\frac{1}{2}+\frac{p_{pB}-p_{pA}}{2t}+\frac{(p_{sB}-p_{sA})(2\alpha-p_{sB}-p_{sA})}{8\beta t}\right]=0$$

Since the first equilibrium condition is satisfied, we can assume that the equilibrium is symmetric for both platforms, so we can simplify and consider that the prices of both platforms and software are equal. This assumption will simplify the preceding equation, and we will have:

$$-\frac{1}{2t}\left[p_{pA}+\frac{\alpha-p_{sA}}{2\beta}p_{sA}-c_p\right]+\left[\frac{1}{2}\right]=0$$

Which allows us to evaluate the optimal price for both platforms:

$$p_{pA}=c_p+t-\frac{\alpha-p_{sA}}{2\beta}p_{sA} \quad \text{and} \quad p_{pB}=c_p+t-\frac{\alpha-p_{sB}}{2\beta}p_{sB}$$

We can note that the software platform figure is multiplied by the number of software units sold in the market. In fact we can rewrite the optimal prices of the hardware in the following way:

$$p_{pA}=c_p+t-y_A p_{sA} \quad \text{and} \quad p_{pB}=c_p+t-y_B p_{sB}$$

If we compare these results to the standard Hotelling model, which is: $p = c + t$

It is possible to see that the model brings us to: $p_p + y * p_S = c + t$

In fact we have to consider that for consumers what is important is the system platform plus videogames. Usually in the standard Hotelling model there is just one kind of good. However, in this model consumers need at least one platform and one videogame to enter the market.

We can see that for the platform producer the price is increasing with respect to the cost of producing every platform. The price is also increasing with respect to the *t* parameter. This effect was expected, since *t* is a measure of the difference between one platform and the other. An increase in the difference between platforms will strengthen the position of the platform producers, meaning they can charge higher prices. There is also a negative relationship between the price of the hardware and the price of the software. This reminds us of the fact that since hardware and software are a bundle, increases in the hardware price will have a negative effect on the software side and vice versa. Given this result it is possible to speculate on compensations between the price of the hardware and the price of the software.

We also need to stress that all the revenues of the platform producers come from the consumer side. This is due to the characteristics of the software market. The software market is characterised by free entry, and supernormal profits are not possible for software firms. Since there are no profits, it is impossible for the platform to exploit them. However, for the platform producers it will be possible to exploit the consumer side from both the hardware and the software side.

Now we can focus on the optimal price of the software. Since the calculations are quite long, they are reported in the second part of Appendix 1. The final prices of the software are:

$$p_{sA} = \frac{2c_s}{n} \quad \text{and also} \quad p_{sB} = \frac{2c_s}{n}$$

Since it is known that $n_A = n_B = \frac{n}{2}$ and given that royalties are:

$$f_{SA} = p_{sA} - \frac{c_s}{n_A} \qquad f_{SB} = p_{sB} - \frac{c_s}{n_B}$$

The latest results imply that the royalties are zero:

$$f_{SA} = f_{SB} = 0$$

The last result means that platform producers are not willing to distort the software market. This means that for platform producers it will be better not to have earnings from royalties but to recover the profits from the price of the hardware.

Given these results, it appears that platform producers secure earnings only from the hardware side. It is possible to use these values to obtain the price of the hardware by substitution. Since the price of the hardware was

$$p_{pA} = c_p + t - \frac{\alpha - p_{sA}}{2\beta} p_{sA}$$

Also in this part it is possible to work on the market of system A and later to appeal to the symmetry. If at first the values of the price of the software are substituted then it is possible to simplify the last term by the number of consumers in the market by 2, which is present in the numerator and in the denominator:

$$p_{pA} = c_p + t - \frac{\alpha n - 2c_s}{\beta n} \frac{c_s}{n}$$ and for the symmetry $$p_{pB} = c_p + t - \frac{\alpha n - 2c_s}{\beta n} \frac{c_s}{n}$$

It is possible to note that the equilibrium is symmetrical and the price of the hardware, given the previous condition, will be the same for both consoles.

However, it is possible to rewrite the preceding results, considering that the last term is the number of software items multiplied by the average cost of the software:

$$p_{pA} = p_{pB} = c_p + t - y\frac{c_s}{n}$$

Regarding the number of consumers, it is possible to substitute the values that have just been found and use them to evaluate the formula that was stated previously:

$$n_A = n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]$$

Since the prices of the software and of the hardware in equilibrium are the same, it will be the case that in equilibrium consumers will split exactly in half.

$n_A = n\left[\frac{1}{2}\right]$ and for the symmetry $n_B = n\left[\frac{1}{2}\right]$

These results imply that in equilibrium consumers will split exactly in half between the two platforms and that the two groups will be characterised by the same number of consumers.

The total number of software units and software firms present in the market will be given by the formula of *y* that was found previously:

$y_A = \frac{\alpha - p_{sA}}{2\beta}$ For platform A and for platform B $y_B = \frac{\alpha - p_{sB}}{2\beta}$

Since the price of the software was the same in both markets, it is possible to work just on the number of platform A software units to also find the equilibrium in market B. If the price of the software is substituted with what was found

$$\boldsymbol{y_A = \frac{\alpha n - 2c_s}{2\beta n}}$$

It is also possible to evaluate the platform producers' profits by substituting the terms just found in the platform producer profit function. By substituting these values in the starting equation of the platform's profits formula, it is clear that the revenues for the hardware producers come just from the hardware side, since the revenues from the software side are going to simplify to zero. In the end, after the simplifications we will have:

$$\Pi_{pA} = \frac{n}{2}t - \frac{n\alpha - 2c_s}{2\beta}\frac{c_s}{n} \quad \text{and for the symmetry} \quad \Pi_{pB} = \frac{n}{2}t - \frac{n\alpha - 2c_s}{2\beta}\frac{c_s}{n}$$

At this point, it is possible to investigate the relationship among the variables. It is easy to see that the profits of the platform are increasing for the parameter *t* that individuates the degree of difference between the two platforms. However, to understand the role of the number of consumers, it is necessary to perform some comparative statics. If we differentiate the profit of a platform producer by the number of consumers, it will be possible to highlight this relationship.

$$\frac{\partial \Pi_{pA}}{\partial n} = \left[\frac{n}{2}t - \frac{(n\alpha - 2c_s)c_s}{2\beta n}\right]' = \frac{1}{2}t - \frac{4\beta c_s^2}{(2\beta n)^2} = 0$$

Given this result it is possible to evaluate the relationship between the number of consumers and the other parameters:

$$n = \frac{c_s}{\sqrt{\beta}\sqrt{\frac{1}{2}t}}$$

It is also possible to evaluate the total utility of consumers in this market contest. Starting from equation [7] we can substitute the values we discovered to find:

$$U_i^A = \left(\frac{\alpha n - 2c_s}{2\beta n}\right)\left[\alpha - \beta\left(\frac{\alpha n - 2c_s}{2\beta n}\right) - \left(\frac{2c_s}{n}\right) + \frac{c_s}{n}\right] - (c_p + t) - \frac{n_a}{n}t$$

Main results from model three

We can see that prices in equilibrium are equal. Since it was assumed that the fixed costs were equal for all the software producers, the final price will be the average price of producing the software. Given this result, the size of the market is very important. In fact, as the number of consumers increases, the number of software units will increase, and as the price of the software and hardware decreases, the profits of the hardware producers and the utility of consumers will increase. Moreover, if the differentiation increases between systems (which means if the t parameter increases), there will be an increase in the profits of the hardware producers, but the utility of the consumers will decrease.

It appears that in equilibrium there are no royalties charged to software producers. The hardware producer's revenues come only from the hardware side. It appears that the total profits of the platform producers are positively influenced not only by the utility of playing of consumers but also by the number of consumers, and are negatively influenced by the cost of the software. Due to the fact there are no royalties charged on the software and the price in equilibrium is equal to the average cost of producing each copy of the software; it is possible to analyse what will happen if there is the opportunity for firms to collude and set the price of the software higher than the equilibrium price.

If firms collude to set the price of the software, the price of the software will become exogenous and firms will gain fixed revenues from that. However, because of the consumer utility, the number of videogames purchased will decrease. Given the condition of zero profits for the software suppliers, this will cause the hardware producers' profits to increase, since they can profit from the loss of utility to consumers, and the part of the profits that derive from the hardware side will not be affected by any change. Though, this equilibrium is not stable. The incentive to deviate from fixed royalties would lead to firms charging lower royalties to decrease the final price for the consumer and gain more of the market. Provided both firms know this incentive to cheat, firms will continue to charge the equilibrium prices.

Model four: multi-homing

In this section we analyse what happens when the previous case conditions do not hold any longer. The main characteristic of the single-homing equilibrium was the fact that each consumer had a choice between two different systems, each characterised by different qualities and different videogames. At the same time, it was possible for the software suppliers to operate in just one market, so software produced for platform A would not have been available for platform B.

This section, however, will analyse how it is possible to avoid choosing between producing software for one market or the other. It considers the equilibrium where videogames are sold on both platforms. The reason why software houses would want a videogame to be available on both platforms is that in this way they would be able to reach a bigger pool of consumers. Moreover, it is a fact that in the real world, some videogames are developed and sold for more than one console.

Given the market structure, the equilibrium is going to be quite different from the preceding one, where the videogames were sold for just one platform. The fact that the utility consumers gain comes only from the videogames they play, the fact that the videogame market is characterised by perfect competition and the fact that there is no constraint on quantities all contribute to a bottleneck case very close to a competition *à la* Bertrand.

One of the main differences to the single-homing case is the absence of the parameter *t*, which indicates the difference between platforms. Since all utility for consumers comes from playing videogames, the possibility of playing the same videogame on the two consoles that are present in the market makes consumers indifferent between the two platforms. Since there is not a qualitative difference between playing the two consoles, the *t* parameter is equal to zero.

In this model the author is aware of the fact that firms are willing to differentiate themselves to introduce a certain kind of friction in the market that can justify a difference in prices. Such difference can be introduced in the market by investing in advertisement, in the final design of the product, in special agreements with sellers, and so on. However, since in this model the utility of consumers derives from the number of videogames they can play, such strategies have no influence on the choices of consumers.

Given the assumptions that the cost of a console is equal for both platforms and that there are no supernormal profits for the software houses, it can be easily verified that the platforms will be sold in the market for zero profits. Any other strategy would be a losing one. In fact, if one platform producer sells the platform for a different price than the average one, this would not be a winning strategy. If the price were lower, the platform producer would incur losses. If the price were higher, it would be possible for the opponent to sell the platform at a slightly lower price and gain all the market.

As in the previous cases, it will be possible to maximise consumers' utility by maximising the number of videogames they can buy. In this setting, the choice of the consumer is driven by the number of videogames that are sold in multi-homing contexts and by the prices of the hardware and software, which are the same. The equations that are used are the following ones:

[10] $$U_i = \alpha y - \beta y^2 - y p_s - p_p$$

[11] $$\Pi_{pA} = n_A p_{pA} + n_A y \ f_S - n_A c_p = 0$$

[12] $$\Pi_s = n(p_s - f_S) - c_s = 0$$

It is possible to observe that equation [11], expressing the profits of a platform (in this case platform A), depends on the way consumers split between different platforms. However, given the assumptions, it is possible to state that consumers will split perfectly in half between the two platforms that are present in the market:

$$n_a = n_b = \frac{n}{2}$$

Since customers are willing to maximise their utility, we have to derive equation [10] using the number of videogames and find the maximum.

$$\frac{\partial U_i}{\partial y} = \left(\alpha y \;-\beta y^2 - yp_s - p_p - nt\right)' \qquad y = \frac{\alpha - p_s}{2\beta}$$

At this stage we can focus on the profit function of the software producers [12]. Since their profits are zero, it is possible to find the equilibrium price at which the software is sold in the market, and so the price of the software will be

$$p_s = f_s + \frac{c_s}{n_c}$$

Using these results we can move on to the equation of the profits of the platform producers, also remembering that in this case there are no supernormal profits.

Remembering that the number of consumers joining platform A is equal to half of the consumers that are present in the market, and performing an easy substitution of the other variables and considering that the number of consumers is exogenous and present in all the terms, it is possible to simplify the equation:

$$p_p = c_p - \frac{\alpha - f_s - \frac{c_s}{n_c}}{2\beta} f_S$$

However, if we evaluate the royalties by substituting the value of the price of the platform in the profit function of the platform producer, the solution will indicate that the platform did not earn anything from the software side and that the royalties are zero. So in the end

$$\boldsymbol{p_s = \frac{c_s}{n_c}}$$

As expected, the results show that, given zero profits, royalties will be zero and the price of the hardware will be equal to the fixed cost necessary to produce the hardware.

$$p_p = c_p$$

Given these results, we can come back to the equation of the number of videogames that are purchased by consumers *y*, substituting the results obtained:

$$y = \frac{\alpha - p_s}{2\beta} = \frac{\alpha - \frac{c_s}{n_c}}{2\beta} = \frac{\alpha n_c - c_s}{2\beta n_c}$$

Finally, it is possible to evaluate the utility of each consumer in the market by substituting all the results obtained in equation [10]:

$$U_i = \alpha \frac{\alpha n_c - c_s}{2\beta n_c}\left[\alpha - \beta\left(\frac{\alpha n_c - c_s}{2\beta n_c}\right) - \frac{c_s}{n_c}\right] - c_p$$

Main results from model four

Here it is possible analyse this result by investigating the relationships among the different variables. First of all, the number of consumers present in the market has a positive effect on the utility of each consumer. As expected, there is a negative relationship between the utility of consumers on one hand and the cost of developing the software together with the cost of producing a platform on the other.

In the end what we can see in this market structure is that the opportunity for software houses to multi-home allows consumers to maximise their utility, while the profits of the platform producers are driven to zero.

It is also possible to make a comparison between this model, which allows multi-homing, and the previous one, which was characterised by single-homing. Table 2.1 is a report of the three most important variables: number of videogames, the price of the platform and price of the software.

Table 2.1 Analysis of the difference in sales		
	Single-homing	Multi-homing
Number of videogames	$y_A = \frac{\alpha n - 2c_s}{2\beta n}$	$\boldsymbol{y = \frac{\alpha n - c_s}{2\beta n}}$
Price of the hardware	$p_{pA} = c_p + t - y\frac{c_s}{n}$	$p_p = c_p$
Price of the software	$\boldsymbol{p_{sA} = \frac{2c_s}{n}}$	$\boldsymbol{p_s = \frac{c_s}{n}}$

Table 2.1: This table reports the different values of the most important variables that were evaluated for the single-homing and multi-homing contests.

Here, we can note that consumers are better off in the multi-homing contest. In fact, this situation is characterised by a higher number of videogames present in the market combined with lower prices for platforms and videogames.

However, it should to be pointed out that these conclusions are influenced by the assumptions that there is no differentiation between platforms in the multi-homing model. As reported previously, it is the opinion of the author that in this contest, the possibility of multi-homing determines the ability to play different videogames with the same machine. Given that the utility of the consumer derives from the number of videogames she can play, there is no difference between the two consoles that allow the player to play the same videogames.

Firms can certainly do something to differentiate their console from the others present in the market, such as invest in advertisements, develop different designs, and so on. However, these strategies are not relevant to the equilibrium that was analysed.

CHAPTER 3

EMPIRICAL EVIDENCE

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EMPIRICAL EVIDENCE

Introduction

While working on the theoretical model, the author started to think about the possibility of building a database.

The main aim was to investigate the most important dynamics that characterise the evolution of prices. While reading the articles that were reported in the literature review, it emerged that although a lot of papers were written on two-sided markets and on single-homing and multi-homing, the most significant emphasis was on the setting of the market and prices. However, the pricing strategies were never considered in a dynamic way. A good example is provided by Rysman (2009), who in his paper summarised the most recent development of the literature in this field. It is evident that most of the existing literature, when focused on pricing, investigated the conduct of a market, such as in Argentesi and Filistrucchi (2007), or attempted to describe the behaviour of consumers, such as in Rysman (2007). However, the videogames market offers the possibility of comparing goods that are sold in a single-homing and in a multi-homing way, and allows for the adoption of a dynamic point of view.

The dataset was developed to investigate a reality that is dynamic. The research here tries to highlight the differences between a good differentiated by the fact that it is sold in a single-homing way and one sold in a multi-homing way. To do so, a database was developed to investigate such peculiarities.

The database was built considering the evolution of the price of videogames over time. For some videogames, the price charged when the game entered the market was known, but there were not so many observations as the ones obtained by filling the database on a regular basis for a long period of time.

A second problem lies in the fact that in the proposed model, single-homing and multi-homing industries are separate. However, in the observed market, single-homing videogames coexist together with multi-homing videogames. Moreover, both strategies, single-homing and multi-homing, were present in the top ten best-selling videogames for all the three consoles.

The dataset was very useful because it highlighted that there are actually differences in the evolution of prices during the observation period. The results are reported in the following part of the chapter.

Hypothesis

While working on the previous chapter, the writer was curious to investigate whether there was a difference in the pricing of videogames. Was the starting price different? Would the price behave differently for videogames sold through single-homing and multi-homing strategies? Were there examples that could stimulate more theoretical works? Were the two sales options so important?

In the first chapter there was a discussion about the studies that have been conducted relating to two-sided markets, such as the credit card market (Rochet and Tirole 2003). In these studies the author was searching out the possible strategies that a platform could use to gain higher profits.

This work analysed the videogames market. The videogames market is a two-sided one because there are firms producing a platform, and on one side there are firms developing videogames and on the other side there are consumers. However, videogames have some peculiarities that needed to be considered. First of all, in the market there are videogames sold in a single-homing way and videogames sold in a multi-homing way. This characteristic turned out to be very useful; it was possible to make a direct comparison in this market between goods sold in single-homing and multi-homing.

Secondly, when a videogame enters the market there can be a launch effect. In the author's opinion, videogames have some characteristics of durable goods (Tirole 1988; Stole 2007).

As the economics literature points out, durable goods are products with particular characteristics that mean they are priced in a different way from other products. The fact that their utility lasts over a long period of time makes their pricing interesting. When producers sell their product at a high price to consumers that are characterised by a high level of utility, there are still consumers aiming to purchase their good but at a lower price. Then, to increase their sales, producers decrease the price to satisfy this group with an unsatisfied demand. This process can continue until the price reaches the marginal cost and no more profits are feasible for sellers.

Videogames too can be considered durable goods. A firm would like to sell the videogame at first at a high price to the consumers who show high valuation for the videogame. After this group of consumers is satisfied, the firm can lower the price to satisfy consumers showing a lower valuation. This process will end when it is not possible to satisfy any customer without losses for the firm. However, in the case of videogames, this process is accelerated by the fact that new videogames continuously enter the market. The fact that new and different videogames enter the market will speed up the normal process of aging, because if old videogames are still in the market they need to be cheaper than the new ones.

The author, before setting the database, was expecting the price of videogames to decrease over time. However, a difference between single-homing videogames and multi-homing videogames was expected too. It was the writer's idea that prices could decrease in a linear way until the price reached a certain threshold level, when it would be stable. It was thought that this process in single-homing videogames and multi-homing videogames would differ only in the decrease rate. It was supposed that prices of videogames sold in a multi-homing way would decrease faster than prices of videogames sold in a single-homing way. The reason is that videogames sold in multi-homing would face harsher competition than the ones in single-homing. This higher level of competition should push the firms present in the market to lower the prices more quickly to stay competitive against rivals.

However, the database analysis showed something different.

Methodology

The database, which shows videogame prices, was built on a weekly basis. The analysis was based on UK data, and prices were taken from different websites from the end of May 2008 to the beginning of September 2009. The websites were all British; this was to ensure a high level of comparability. The prices were recorded every weekend, and every week the cache of the computer was cleared. In total three websites were monitored: Amazon UK, Game Play and Game. The decision to observe three different online shops was made due to the fact that it was possible to increase the number of observations, check if the results were common for all of them, so as to reach a high level of significance, and to avoid particular promotions or contingencies (such as difficulties in selling a particular game on just one website, etc.).

This approach was chosen after the author initially tried to collect prices by physically visiting different stores. However, this methodology was too time-demanding and difficult to pursue. The main difficulty was that videogames are usually present in a shop in large volumes at the point of their release. However, as time passes by, it can become quite difficult to find them. Since this research was focused on the long-term analysis of videogame prices, this approach was not considered successful. The solution was to refer to different websites selling videogames. The biggest advantage was that websites usually stock a greater number of videogames than do small shops. It was assumed by the author that for a consumer there is no difference in the utility given by playing a videogame bought on a website and playing one bought in a traditional shop. Moreover, it has to be considered that videogame consumers are individuals who are quite interested in new technologies, and so the author assumed that websites were a good substitution for traditional shops.

It should be mentioned that the pricing strategies of the different websites were analysed too. If this research was expected to highlight differences in the pricing of videogames, it also showed that the pricing strategy of one the three websites, Amazon, was consistent with Varian (1980), Baye-Morgan (2004) and Ellison &Ellison (2005). More in detail it appear that the two websites Game Play and Game where using the same strategy pricing the videogames. in the third appendix there is a representation of the price evolution of the entire dataset and it is possible to observe that the price patterns are almost the same for this two websites. Instead, it appear that the Amazon UK strategy is not just different. It seems that Amazon UK is pricing for two different pools of consumers: the informed ones and the uninformed ones. When the price of a given videogame was the lowest, Amazon could sell to informed and uninformed players gaining very low profits per game. However, when the price was the highest, Amazon UK could sell just to uninformed players but gaining higher profit for each videogame sold.

The videogames considered were chosen because they were the best-selling videogames during the week the database collection was started. In this way the possibility of any involuntary data manipulation was avoided from the beginning. The sample chosen was considered big enough to avoid any particular dynamic skewing the sample, such as an increasing interest for sport games when a big sport event is close (European football championship, etc.), a new version of the same game (successful videogames are sometimes developed and continued in sagas), and so on. To increase the sample size, a few videogames were added later in the same week, but this operation was done in the same way: the best-selling videogames of that week were added.

Finally it has to be mentioned that the top ten videogames were for all the three consoles that were present in the market and that needed a television to work.

Moreover, the analysis was focused on the latest console technology that appeared in the market in the second half of the preceding decade. This was done because the videogames that sold the most were all for these machines and because it was easy to compare videogames of different consoles that from a technological point of view were quite similar.

The videogames are representative of all three videogame consoles that require a television for the consumer to interact with them. The three consoles were Wii, Playstation 3 and Xbox 360. All of them are characterised by different features. For example Playstation 3 can play blu-ray DVDs, while Xbox 360 cannot; Wii cannot play DVDs at all. However, when this research was started Wii presented a revolutionary technology to interact with the machine, by using devices that could catch the actions of the body; the machine could interpret these movements and use them to let the gamer interact with the videogame. The other two consoles instead presented a traditional device made of levers and buttons that the players had to push to play. Also, the processors that were present in all the three machines were quite different and consequently so were the graphical performances.

Consoles were different in performance, appearance and price; moreover, the costumer target group was quite different. If Playstation 3 was the third generation of a very successful family of consoles and Xbox was also quite successful in its preceding generation, Wii was oriented to less mature players and to consumers that had never played videogames before.

Despite all these differences, shops proposed these consoles as alternatives to each other. The consoles are close to each other to allow multi-homing games. The main reason for this approach is that there are several videogames that are proposed for all of them and they are quite comparable. The possibility of playing the same videogame using different consoles suggests that the console must be quite similar. Secondly, all the consoles were launched almost at the same time. Finally, the console manufacturer considers the others as competitors in the same market.

Given all these conditions, the research tried to highlight the main dynamics that are present in this particular market and to find some empirical evidence in relation to the model that was proposed in the previous chapter.

Statistical Analysis

Summary

Monitoring the three websites, it was possible to build a database of 70 videogames of three different games consoles sold on different retail websites. The representations of all the prices of these videogames are fully available in an appendix at the end of the present work.

Videogames were identified according to whether they were sold in a multi-homing way (for different consoles) or in a single-homing way (just for one console). It was hoped that this would reveal whether these two approaches have different real-world effects. Since the decision of single-homing would imply that not all of the market of consumers could be reached, it was expected that there would be a difference in the pricing strategy in respect to the price of the videogames sold in multi-homing.

This collection work took quite a long time, but after a few months it was clear that there was an actual difference in the pricing strategy between the videogames sold in single-homing in respect to the ones present on more platforms. It appeared that the price of videogames sold for just one console was more constant, and also the variance was much less than that characterising the videogames sold on more consoles.

TABLE 3.1 AVERAGE PRICES CHARGED BY SHOPS	
AMAZON	20.59
GAME PLAY	24.05
GAME	21.37

Table 3.1. In this table the average of the prices of the videogames that were collected is evaluated; in this case prices are differentiated by the online shops that were observed.

TABLE 3.2 AVERAGE PRICES CHARGED BY CONSOLES	
WII	22.62
PLAYSTATION 3	24.19
XBOX 360	22.76

Table 3.2. In this table the average of the prices of the videogames that were collected is evaluated; in this case prices are differentiated by the different consoles that were examined.

TABLE 3.3 AVERAGE PRICES CHARGED BY AGE	
AFTER 4 WEEKS	31.99
AFTER 8 WEEKS	30.89
AFTER 16 WEEKS	27.95
AFTER 64 WEEKS	25.25
AFTER 74 WEEKS	15.33

Table 3.3. In this table the average of the prices of the videogames that were collected is evaluated; in this case prices are differentiated by the age in the market.

TABLE 3.4 AVERAGE PRICES CHARGED	
SINGLE-HOMING	22.68
MULTI-HOMING	20.47

Table 3.4. In this table the average of the prices of the videogames that were collected is evaluated; in this case prices are differentiated by the way the videogame was sold: single-homing or multi-homing.

TABLE 3.5 AVERAGE PRICES DURING DIFFERENT PERIODS	
NORMAL PERIOD	21.31
CHRISTMAS PERIOD	20.72

Table 3.5. In this table the average of the prices of the videogames that were collected is evaluated; in this case the possibility is investigated of a special occurrence such as Christmas having an influence on the price of videogames.

TABLE 3.6 AVERAGE QUALITY OF VIDEOGAMES					
CONSOLE	Single Homing	Multi Homing	INHOUSE	EXTERNAL	Average
WII	72.329	71.523	79.907	70.210	72.001
PLAYSTATION 3	87.741	74.999	84.390	76.059	76.733
XBOX 360	84.507	75.327	88.443	75.583	78.314
Average	78.682	74.484	84.981	74.168	

Table 3.6. In this table the average quality of the videogames that were collected is evaluated. In this case prices are differentiated by the way the videogame was sold: either developed by the same firm manufacturing the console or not, and sold either in single-homing or multi-homing. Marks go from 0 (the worst) to 100 (the maximum). The averages are provided by the website "gameranking.com".

It is possible to comment on these results. First of all it is possible to observe that there is a difference in the quality of videogames. It appears that the quality of videogames sold in single-homing is higher than the quality of videogames sold in multi-homing. Moreover, this difference is usually more pronounced when the single-homing videogame is developed by the firm which also does produce the console.

This shows that actually there is a difference between videogames sold in single-homing and those sold in multi-homing. To build their installed base of consumers, console manufacturers aim to provide the most high quality videogames to persuade consumers to purchase their console.

Examples

The following graphs show the most relevant cases that the author highlights as examples that better illustrate the differences in the paths of videogames. While looking at the graphs, it is important to note that the time in the graphs refers to the observation week. However, when the prices are regressed, the author considered the age of videogames in the market. The main problem is that usually videogames are sold at a certain price; however, after a few months, the price decreases. Since this decrease can also be quite significant, comparing prices of videogames without considering this effect would be misleading.

The next six graphs represent videogames sold both in single-homing and in multi-homing for the three different consoles, and are reported to highlight the differences in the price evolution over time. It is important to stress that the following graphs are the most extremes cases that came out after the dataset was completed. The author reported them in this part because in this way it is possible to start to get an idea of the main dynamics that are going to be discussed later. The graphs of the complete database are in the third appendix.

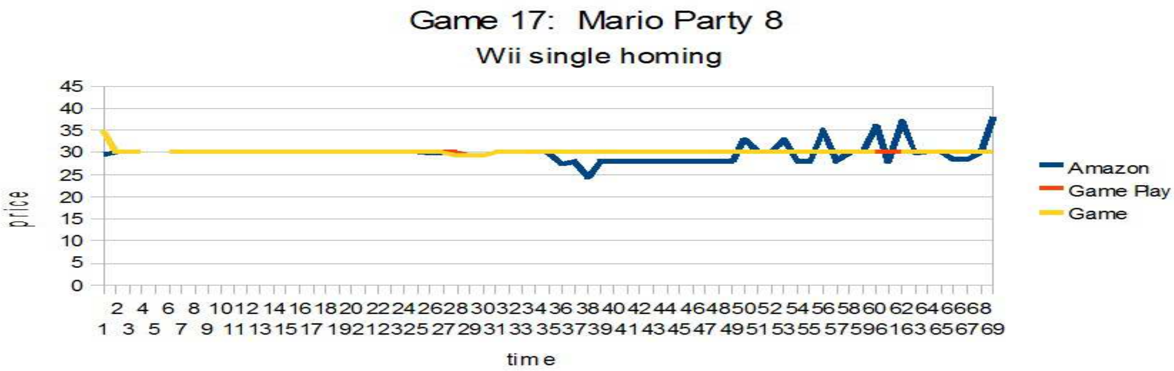

Fig 3.1. Evolution of the flattest price pattern for a single-home videogame sold for the console Wii; the three colours refer to the three different websites observed.

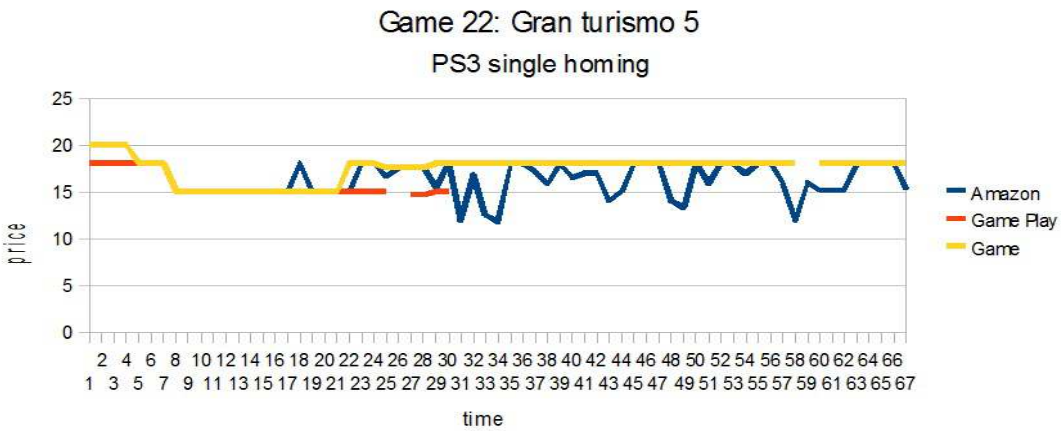

Fig 3.2. Evolution of the flattest price pattern for a single-home videogame sold for the console PS3; the three colours refer to the three different websites observed.

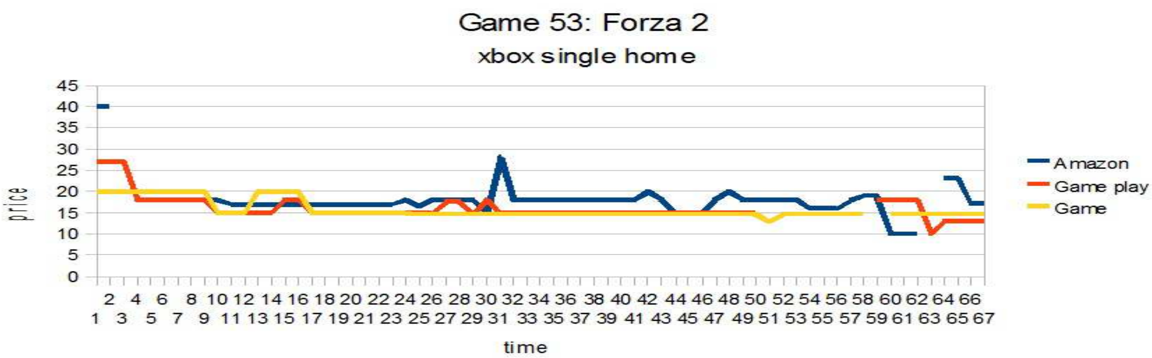

Fig 3.3. Evolution of the flattest price pattern for a single-home videogame sold for the console Xbox 360; the three colours refer to the three different websites observed.

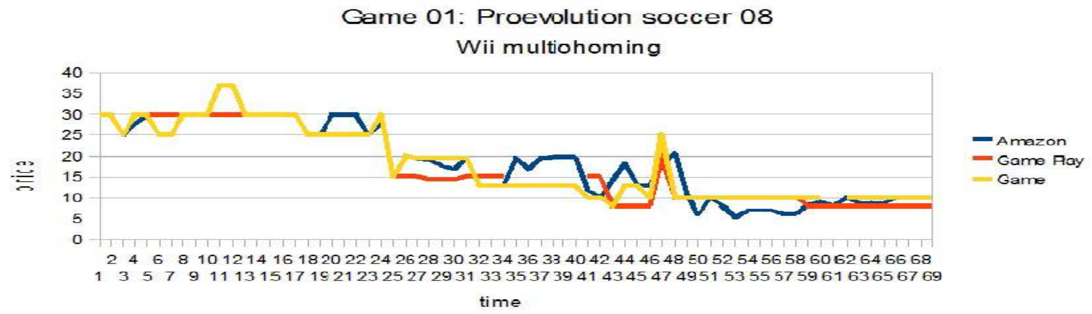

Fig 3.4. Evolution of the price pattern for a multi-home videogame sold for the console Wii; the three colours refer to the three different websites observed.

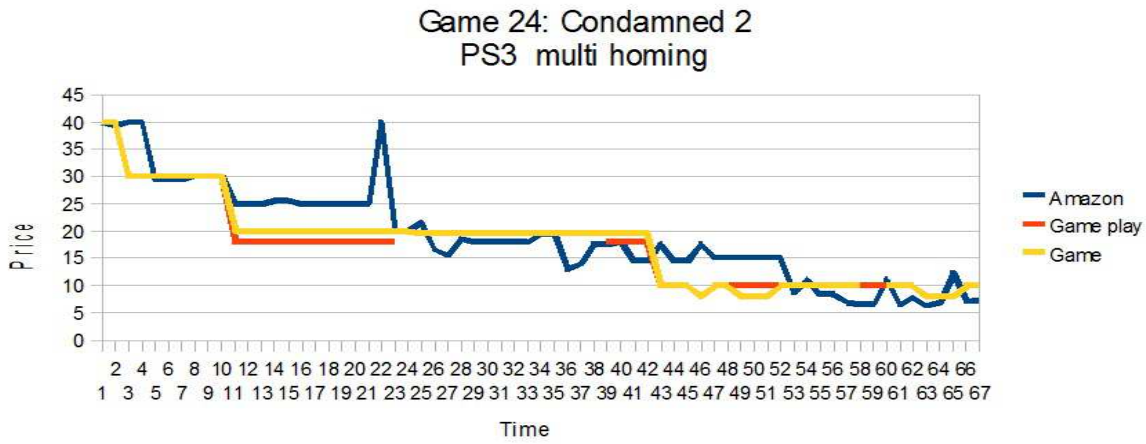

Fig 3.5. Evolution of the most extreme price pattern for a multi-home videogame sold for the console PS3; the three colours refer to the three different websites observed.

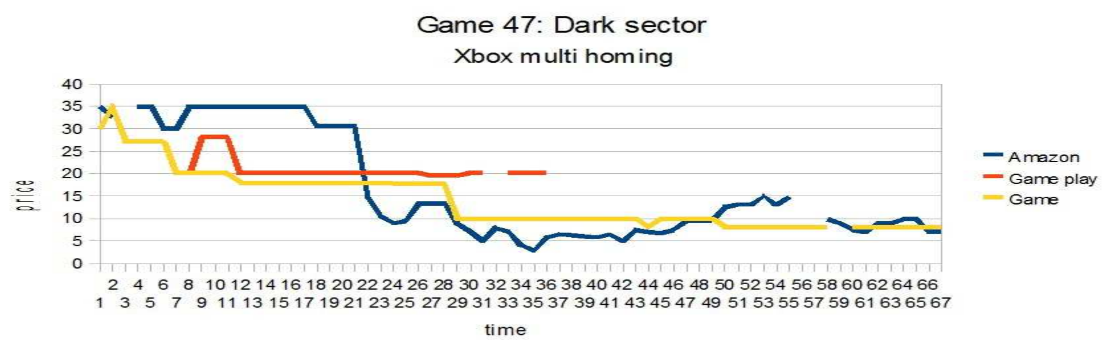

Fig 3.6. Evolution of the most extreme price pattern for a multi-home videogame sold for the console Xbox 360; the three colours refer to the three different websites observed.

As stated earlier, the aim of the author was to find any difference in the pattern of the videogame prices during a particular period. The author expected to find that prices were decreasing over time; however the big question was if there was a difference between videogames sold just for one console and ones sold for two or three consoles. Since the period was longer than a year, it was the opinion of the author that such a difference could emerge. The author was conscious of the possibility that the resulting time series might not be perfectly continuous, since some videogames might be out of stock for a while. Unfortunately this was the case, but the general analysis was not compromised by this event. Looking at all the graphs that are present in the third appendix, it is possible to note some interruptions; however, the price pattern can always be guessed easily.

Comparing the differences in the paths of videogames, it is evident that the most stable prices during the observation were all for videogames sold just for one platform. As the graphs reported, this is true for all the three consoles.

The three graphs represent the videogames that for each one of the three consoles exhibit the most stable prices during the study. Analysing all the possible interpretations, the most logical conclusion is that there is an actual difference in the price of videogames depending on whether they are sold just for one platform or for different platforms.

The results show that the price of videogames sold in single-homing is decreasing over time. However, the price of videogames sold in multi-homing is decreasing in a different pattern. Initially the price is relatively high and continues to be high for a few weeks. Later on the price decreases steeply until it reaches a level that will become the definitive price for the rest of the observed period. This is clearly evident from the images reported above; however, similar results are presents in the graphs reported in the third appendix.

Given the observations reported before, it is possible to specify the equations that the author was looking for. The equation that best describes the pattern is the following cubic one:

Equation 3.1 $P_{SS} = c - \alpha x + \beta x^2 - \gamma x^3$

This equation was chosen because it would be the most flexible in highlighting the dynamic patterns that arise in pricing single-homing videogames and multi-homing videogames.

In fact the cubic formula allows different forms. By changing the different parameters, many possible combinations are created that represent a broad range of possibilities for describing the evolution of prices.

However, a clarification is required. Since the prices that are collected refer to prices charged by online shops, pricing is in the power of the retailers, who have their own strategies. These strategies should emerge in an analysis of the prices charged over time. If a panel data analysis is made we can see that:

TABLE 3.7 Panel data analysis on the three websites						
	Amazon		Game Play		Game	
	Coefficient	P>|z|	Coefficient	P>|z|	Coefficient	P>|z|
t	-0.30	0.00	-0.09	0.08	-0.33	0.00
td	-0.44	0.00	-0.26	0.00	-0.30	0.00
t2	0.002	0.03	-0.003	0.00	0.00	0.32
t2d	0.005	0.00	-0.004	0.02	0.00	0.00
t3	-5.12e-06	0.30	0.00	0.00	3.97e-06	0.35
t3d	0.00	0.04	-0.00	0.03	0.00	0.00
dummy	7.81	0.00	3.49	0.07	4.34	0.02
constant	32.21	0.00	32.63	0.00	36.17	0.00

Table 3.7. This table reports the values that describe the pricing strategies of the three websites that were monitored.

The above table presents the analysis that has been done on the prices that were collected in the database by using the equation 3.1. It is possible to observe that although the prices refer to the same videogames sold in the same period of time, the coefficient of the parameters are quite different. In the next section a more accurate work will be presented.

Econometric analysis

To analyse all the collected data, the statistical software “Stata” was used. All the prices collected were rearranged and ordered by videogame, console, age in the market, website and presence in just one console or in more than one. After these preliminary works, a model was run that could fit the evolution of the prices. The author tried to regress the prices through time and to test whether the prices were decreasing linearly or if they were decreasing following another pattern. In particular, as reported in the previous paragraph, the author, by looking at the data that were collected and the relevant graphs, started to get an idea of the possible equations that could describe the patterns. By analysing the graphs reported in the appendix at the end of the present work, the author tested an “s” pattern where prices were at first constant, then decreased and then finally returned to being constant. It was assumed that the prices of videogames sold for more than one console would fit such a pattern. At the same time it was expected that videogames sold just for one console would not have the same pattern and that the same pattern would be rejected.

The following tables summarise the most important results. The tables are divided by console; this is due to the fact that the author wanted to test if the results were common to all the consoles or if they were different.

In regard to the tables, it should be mentioned that the dummy parameter is set to 1 for multi-homing videogames while it is zero for videogames sold in single-homing. The other parameters represent the constant factor plus the other parameters that influence the price over time: time (T), time squared (T2) and time cubed (T3). The value of the dummy for all the parameters is also expressed, and the third column reports the significance of the single parameters that were evaluated.

Table 3.8 Wii videogames								
	General		Amazon		Game Play		Game	
Parameters	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|
Constant	31.39432	0.000	30.24866	0.00	29.4436	0.00	33.9309	0.00
Dummy	11.06089	0.000	7.23393	0.04	15.4218	0.00	13.5241	0.00
T	-0.236704	0.000	-0.23661	0.00	-0.0991	0.12	-0.3551	0.00
TD	-0.754817	0.000	-0.30876	0.02	-1.1285	0.00	-1.0570	0.00
T2	0.000605	0.435	0.00093	0.38	-0.0019	0.09	0.0024	0.03
t2d	0.013843	0.000	0.00229	0.39	0.0229	0.00	0.0216	0.00
t3	2.32e-06	0.545	0.00000	0.85	0.0000	0.01	0.0000	0.27
t3d	-0.000081	0.000	0.00001	0.75	-0.0001	0.00	-0.0001	0.00

Table 3.8. Results of the tested model for the prices collected for the single-homing and multi-homing videogames sold for the console Wii.

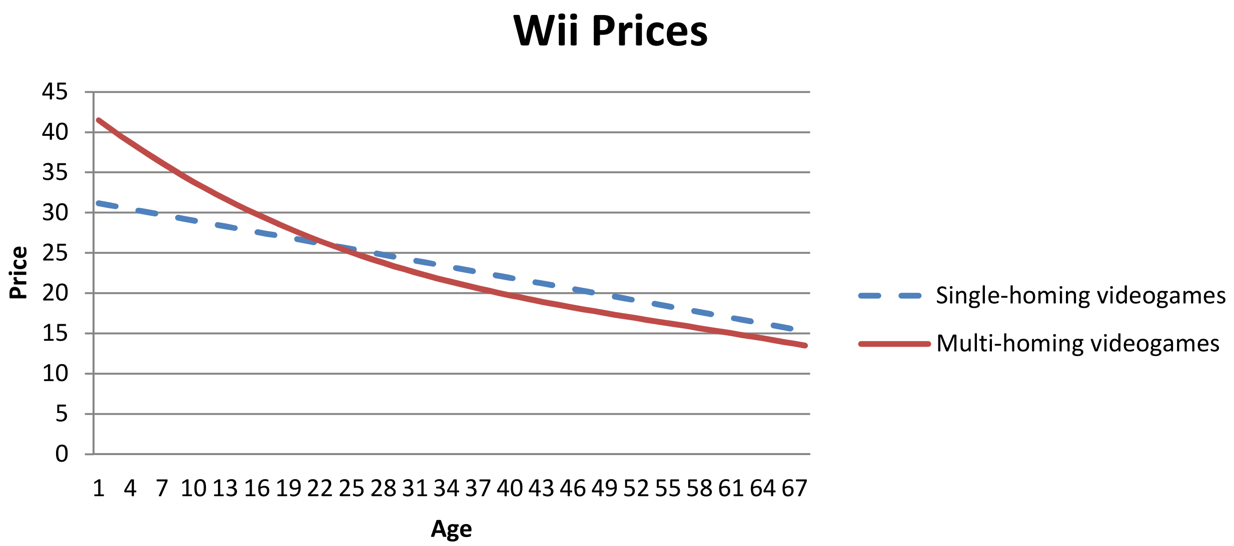

Fig 3.7. In this graph the prices of videogames sold for the console Wii in single-homing and multi-homing are scattered against the age in the market. It is possible to note the different patterns that characterise them.

Table 3.9 PS3 videogames								
	General		Amazon		Game Play		Game	
Parameters	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|
Constant	25.3703	0.00	31.9561	0.00	8.0803	0.12	25.0366	0.00
Dummy	11.6725	0.01	9.9311	0.04	23.3543	0.00	11.7986	0.01
T	0.5167	0.03	-0.3664	0.29	2.4665	0.00	0.8710	0.00
TD	-0.8177	0.00	-0.3992	0.27	-2.3014	0.00	-1.1068	0.00
T2	-0.0170	0.01	0.0067	0.45	-0.0781	0.00	-0.0278	0.00
t2d	0.0145	0.02	0.0008	0.93	0.0667	0.00	0.0233	0.00
t3	0.0001	0.01	-0.0001	0.44	0.0007	0.00	0.0002	0.00
t3d	-0.0001	0.06	0.0000	0.74	-0.0006	0.00	-0.0002	0.01

Table 3.9. Results of the tested model for the prices collected for the single-homing and multi-homing videogames sold for the console PS3.

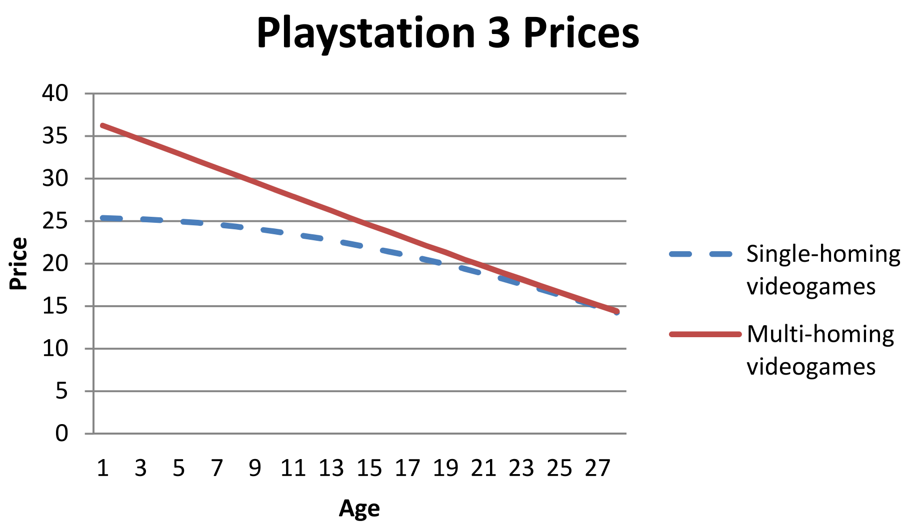

Fig 3.8. In this graph the prices of videogames sold for the console Playstation 3 in single-homing and multi-homing are scattered against the age in the market. It is possible to note here the different patterns that characterise them.

Table 3.10 Xbox videogames								
	General		Amazon		Game Play		Game	
Parameters	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|
Constant	39.1694	0.00	37.9470	0.00	38.8482	0.00	39.8253	0.00
Dummy	1.1615	0.67	2.3506	0.49	5.3279	0.19	0.1651	0.96
T	-0.4086	0.00	-0.5973	0.00	-0.1121	0.20	-0.3773	0.00
TD	-0.3886	0.00	-0.4288	0.02	-1.0952	0.00	-0.2053	0.16
T2	0.0015	0.22	0.0077	0.00	-0.0061	0.00	-0.0005	0.76
t2d	0.0086	0.00	0.0079	0.03	0.0293	0.00	0.0044	0.14
t3	0.0000	0.72	0.0000	0.00	0.0000	0.00	0.0000	0.05
t3d	-0.0001	0.00	-0.0001	0.02	-0.0002	0.00	0.0000	0.11

Table 3.10. Results of the tested model for the prices collected for the single-homing and multi-homing videogames sold for the console Xbox 360.

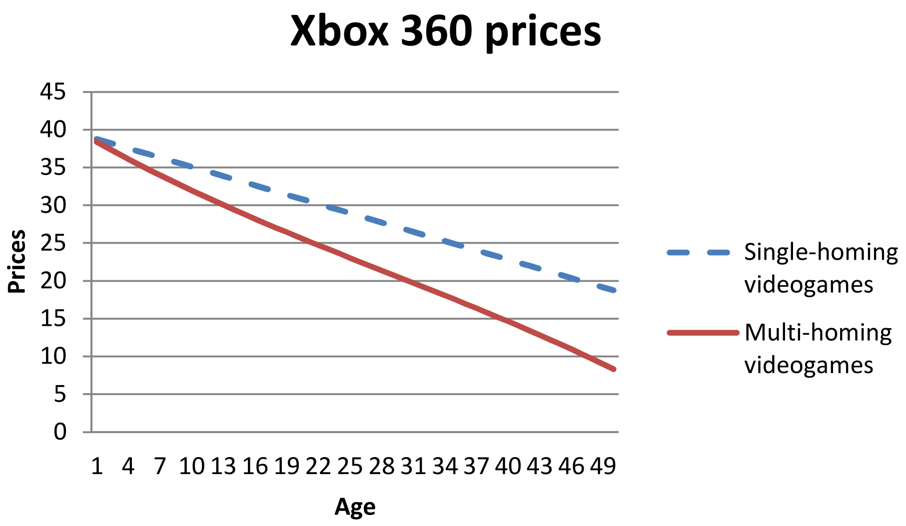

Fig 3.9. In this graph the prices of videogames sold for the console Xbox 360 in single-homing and multi-homing are scattered against the age in the market. Here the patterns are quite different from the previous ones; however there are still differences between single-homing videogames and multi-homing videogames.

Looking at the results, it appears that there are actually differences in the evolution of the prices of videogames sold in single-homing and videogames sold in multi-homing. This is particularly evident in respect to the videogames for the different consoles. The low significance of the parameters time squared and time cubed means that the pattern of the price in time is different, and videogames sold in single-homing tend to decrease in a linear way. Prices of videogames sold in a multi-homing way are characterised by a different pattern. In this case prices seem to start at a high level but the pattern of decrease is much stronger and the price falls at a higher rate than the one of videogames sold in a single-homing way. However, when the price arrives at a certain level, different for all videogames, the price stays stable and does not decrease any more – or, if it does decrease, it does so at a rate that is almost negligible.

Logit analysis

Finally a logit analysis of the videogames was also run, which tested if the probability of a videogame being sold in a single-homing or multi-homing way was influenced by the size of the developer or by the quality.[9] In the next two tables zero corresponds to single-homing while one corresponds to multi-homing.

In this analysis there are two variables: Developer and Quality. The variable Developer represents the size of the firm which developed the videogame (as a proxy of the size it is considered the total revenues each developer firm had in the period object of investigation). The variable Quality it is the quality of the videogame. As a proxy of the quality of a videogame, it was chosen a weighted average of the marks received. It was chosen to run a logit analysis given the

[9] It is worth highlighting that the proxy of the quality of the videogames was provided by the website http://www.gamerankings.com/, where the scores of different reviews are collected to give a unique mark. Marks are collected from both online and offline sources, collected marks are weighted by different parameters (number of reviews, variety of titles, etc) and consistency among scores are tested.

characteristics of the distributions and given that empirically there are no significant differences respect the probit one.

Table 3.11 Multi-homing choice general analysis				
	General			
Parameters	Coeff.	P>|z|	Std. Err.	z
Developer	-1.89e-07	0.000	1.29e-08	-14.64
Quality	-.050266	0.000	0.00377	-13.32
Constant	5.04392	0.000	0.30096	16.76

Table 3.11. Results of the Logit model for the probability of a videogame being sold in single-homing or multi-homing, given its quality and the size of the developer.

Table 3.12 Multi-homing choice by console						
	Wii		PS3		XBOX	
Parameters	Coeff.	P>|z|	Coeff.	P>|z|	Coeff.	P>|z|
Developer	-6.31e-07	0.000	-1.13e-07	0.000	6.46e-06	0.000
Quality	.098864	0.000	-.2503468	0.000	-.1416306	0.000
Constant	-5.4073	0.000	23.38755	0.000	9.583922	0.000

Table 3.12. Results of the Logit model for the probability of a videogame being sold in single-homing or multi-homing, given its quality and the size of the developer, Here the analysis is differentiated by console (the full results are provided in the Appendix).

It is important to describe these results. Firstly it is possible to note that the overall probability of a videogame being sold in a single-homing way is increasing in the quality of the videogame and in the size of the developer. It should be mentioned that given the size of the sample, the results are quite robust (given 4.118 observation the probability the result is bigger than Chi^2 is zero).

It is possible to think that console manufacturers are aiming to increase the purchasing willingness of the consumers by increasing the perceived difference among consoles and one possible way is to offer exclusive videogame. To increase the differentiation, the possibility to play the most successful videogames in one console and not in the other is a big advantage. So, firm face a fierce competition to have these high valued videogames for their machines and this explains why the most valued videogames are sold in single-homing way rather than multi-homing'

Moreover, usually to develop good videogames are needed huge resources and investments that not so many firms can afford (Chapter one paragraph “The videogame market”). This can explain why there is a positive effect between the probability for a single-homing videogame to be developed by a big firm.

However, a closer analysis of the results reveals some differentiations among consoles and an explanation is required.

Several videogames sold in single-homing were produced by the same big firms that produced the consoles or by small firms that did not have enough resources to develop the videogame for more than one console. Given this market structure the results are quite extreme. This point is crucial.

Moreover the Nintendo results are quite specific. This console was quite technologically different from the other two. The power of the console was low compared to that of the others present in the market and it was also characterised by a different way of playing videogames. The system required the player not to use joysticks, where one has to push buttons, but to play a videogame by moving a little remote control. Since only the Nintendo console uses this system and since it was difficult to use this gaming system with other videogames, it is possible to note that more single-homing videogames existed for this console. Moreover, Nintendo needed to increase the variety of the offer. This occurrence forced the manufacturer to produce different videogames by itself. This also affected the quality, since it was important to have a lot of videogames in stock, though all of them were not blockbusters.

Conclusions

These different patterns clearly show that there is an actual difference between videogames sold in multi-homing and videogames sold in single-homing. The author’s original curiosity led to an exploration of the evolution of prices in a given interval of time, which eventually resulted in results showing that there are significant differences in the pricing strategies between single-homing and multi-homing videogames.

The dataset was useful in answering some of the questions that were originally asked. The most important one is whether there is a difference in the pricing of videogames sold in a single-homing way and in a multi-homing way. What was really interesting was that these results were confirmed for all the three console markets that were analysed and for the three different websites that were used to build the database.

This work tried to explain how it is possible that two different strategies coexist at the same time in the same market. However, this fact brings us to another question: is this situation a stable one or it is going to change? Since the necessity to single-home is necessary to differentiate consoles among themselves and the data were collected at the early stages of this generation of consoles, it is possible that the proportion among single-homing and multi-homing videogame is going to change?

CONCLUSIONS

Conclusions

At present, two-sided markets are being investigated by different economists and a number of relevant papers have been published. This work has tried to improve this field of research by investigating how a market would behave under different assumptions.

The aim of this work was to explore what would happen in a two-sided market where there is an asymmetry between the two sides and the utility of consumers is not constant. All these questions were inspired by the Armstrong paper about this topic that was published in 2006[10]. After reading that paper, some questions arose. First of all, in the real world the utility of consumers, most of the time, is not constant. Each of us has to maximise our choices and deal with constraints every day. Moreover, as customers we know that in two-sided markets we are in a different position in respect to firms on the other side.

To investigate how the market would behave under these assumptions a model was developed. The different stages of the model in this work were created to investigate little by little these questions. The study illustrated what the main dynamics are in markets characterised by perfect competition in the software market but with only one platform, two-sided markets characterised by single-homing and two-sided market characterised by multi-homing. It is important to note that there is an actual difference between the founded equilibrium and that in the real world.

The results are consistent with the related literature. A two-sided market characterised by multi-homing increases the utility of the side that does not multi-home. This result was intuited at the beginning of this work and it was proved equilibrium after equilibrium.

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[10] Mark Armstrong (2006) “Competition in Two-Sided Markets”, RAND Journal of Economics , Vol. 37, No 3, Autumn 2006, pp 668-691.

However, the author also wanted to explore the characteristics of the pricing of videogames in the real world from a dynamic point of view. The database collection was a time-consuming work that took several months of patient and constant dedication, but it turned out to be crucial. Thanks to the dataset statistical analysis, the author found that in the real world there are differences in quality and in the evolution of the price between goods that are sold in multi-homing and those that are sold in single-homing. The results clearly showed differences in paths between single-homing videogames and multi-homing videogames. More precisely, the paths show that the prices of single-homing videogames are more stable over time. Moreover, the analysis also showed that there is a difference in the quality of single homing-videogames and multi-homing ones.

All this analysis showed that, as the theory predicted, two similar goods will exhibit different patterns if they are sold in different market contests. The theoretical part of the analysis showed that, when starting with different assumptions, the results of other authors are confirmed. The welfare of the side of the market that does not multi-home will be high in respect to the welfare that is possible for consumers in the single-homing contest. The dataset analysis also confirmed that in the real world there is a difference in the quality and price of goods sold in single-homing and in multi-homing.

Moreover, the analysis also showed differences in the pricing strategies of the online stores that were consulted to fill the database. It is possible, judging from the graphs present in the third appendix, that the prices are not the same. Some websites have more stable prices while others are characterised by a higher variance in prices of the same goods. Also for this reason, in the regressions that are presented, the values referred to are the prices charged by the different sellers. The differences in these patterns were consistent with Varian (1980) and Baye-Morgan (2004) and can be the object of further investigations.

However, as sometimes happens, new findings brought up new questions. First of all, it has to be mentioned that the fact that there are two different strategies in the same market is quite curious. Since there are differences in the evolution of the price and in the quality of videogames, is this differentiation going to persist in the long run?

Another possible question derives from the fact that the model that was developed was a static one, while the dataset described the evolution of prices over a long period of time. If the model included time and different generations of consoles, changing after a certain period of time maybe the behaviour of the different agents in the market would have been different.

BIBLIOGRAPHY

1. Argentesi E. and Filistrucchi L. (2007) “*Estimating market power in a two-sided market: the case of newspaper*”, Journal of Applied Econometrics.

2. Armstrong Mark (2006) “*Competition in Two-Sided Markets*”, RAND journal of Economics , Vol. 37, No 3, Autumn 2006, pp 668 – 691.

3. Michael R. Baye and John Morgan (2004) "Price *dispersion in the lab and on the Internet: theory and evidence*", RAND journal of Economics , Vol. 35, No 3, Autumn 2004, pp 449 – 466.

4. Caminal Ramon and Matutes Carmen(1990) “*Endogenous switching costs in a duopoly model*”, International Journal of Industrial Organization, 1990 – Elsevier.

5. Cabral, L.M.B. and M.H. Riordan (1997), “*The learning curve, predation, antitrust, and welfare*", Journal of Industrial Economics 45, pages 155-69.

6. Chen, Y. (1997), “*Paying customers to switch*", Journal of Economics and Management Strategy 6, pages 877-897.

7. Choi J. P. (2004) “*Tying and innovation: a dynamic analysis of tying arrangements*”, The Economics Journal, n. 114.

8. Choi J.P. (2010) “*Tying in Two-Sided Markets with Multi-Homing*”, The Journal of Industrial Economics, volume 58, issue 3.

9. Church Jeffrey and Gandal Neil (1992), “*Complementary network externalities and technological adoption*”, International Journal of Industrial Organization.

10. Church Jeffrey and Ware R. (2000) "*Industrial organization*", Mac Graw Hill, chapter 22 & pages 546-550.

11. Church Jeffrey, Gandal Neil and Krause David (2002), "*Indirect Network effects and Adoption Externalities*", Foerder Institute for Economic Research, Working Paper 02-30.

12. Church Jeffrey & Department of Economics University of Calgary (2004) "*The impact of Vertical and Conglomerate Mergers on Competition*", for Directorate General for Competition Directorate B Merger Task Force European Commission.

13. Clements M.T. & Ohashi H. (2005) "*Indirect Network Effects and the Product Cycle: Videogames in the U.S., 1994 - 2002*", The Journal of Industrial Economics, Vol 53, No. 4, pp. 515 - 542.

14. David, P. (1985), "*Clio and the Economics of QWERTY*", American Economic Review 75, pages 332-337.

15. Dietl Helmut M. & Royer Susanne (2003) "Intra-system competition and innovation in the international videogame industry", Content Management Pty Ltd. Innovation: management, policy & practice.

16. A. K. Dixit & J. E. Stiglitz (1977) "*Monopolistic Competition and Optimum Product Diversity*", The American Economic Review, Vol 67, No. 3, pp. 297 - 308.

17. Doganoglu Toker & Wright Julian (2003) "Multi-homing and compatibility" National University of Singapore Department of Economics Working Paper No. 0314.

18. Doganoglu Toker & Wright Julian (2006) “Exclusive dealing with network effects”, International Journal of Industrial Organization, Volume 24, Issue 1, Pages 45-67.

19. Douglas B.B. and Whinston M. D.. "*Exclusive Dealing*," Journal of Political Economy, 1998, v106(1,Feb), 64-103

20. Economides Nicholas (1995) “*Network Externalities, Complementarities, and Invitations to Enter*”, European Journal of Political Economy.

21. Economides Nicholas (1996) “*The Economics of Networks*”, International Journal of Industrial Organization.

22. Ellison Glenn and Fudenberg Drew (2000) “*The Neo-Luddite's Lament: Excessive Upgrades in the Software Industry*”, The RAND Journal of Economics , Vol. 31, No. 2, pp. 253-272

23. Evans D.S., Hagiu Andrei and Schmalensee Richard (2004) “A Survey of the Economic Role of Software Platforms in Computer – Based Industries”, CESifo Economic Studies, n. 51.

24. Evans D.S. & Schmalensee Richard (2005) “*The industrial organization of markets with two-sided platforms*”, Chapter for “Issues in Competition Law and Policy” (Wayne D. Collins).

25. Evans D.S. (2003) “Some empirical Aspects of Multisided Platform Industries”, Review of Network Economics, 2(3): 191-209. Page 1.

26. Evans D.S. & Schmalensee Richard (2007) “*The industrial organization of markets with two-sided platforms*”, Competition Policy International.

27. Farrell J & Gallini Nancy T. (1988) "Second-sourcing as a commitment: Monopoly incentives to attract competition", Quarterly Journal of Economics.

28. Farrell Joseph and Klemperer Paul (2007) “Coordination and lock-in: Competition with switching costs and network effects,” Handbook of industrial organization, Volume 3, Pages 1967-2072 - Elsevier.

29. Farrell Joseph and Saloner Garth (1986) *“Installed Base and Compatibility: Innovation, Product Preannouncement and Predation*”, The American Economic Review.

30. Farrell Joseph and Shapiro Carl (1988) “Dynamic competition with switching costs”, the RAND Journal of Economics.

31. Faulhaber G.R. (2000) *“Access and Network Effects in the “New Economy”: AOL –Time Warner*” in Kwoka J. E. & White L.J. (2004) “The Antitrust Revolution” Oxford University Press, case 18.

32. Fudenberg Drew and Tirole Jean (1998) “*Upgrades, Tradeins, and Buybacks*”, the RAND Journal of Economics, Vol. 29, No. 2, pp. 235-258.

33. Hagiu Andrei (2006) "*Pricing and commitment by two sided platforms*”, The Rand Journal of Economics.

34. Greenstein, S.M. (1993) “*Did installed base give an incumbent any (measurable) advantage in federal computer procurement?*” RAND Journal of Economics 24, pages19-39.

35. Katz M.L and Shapiro C. (1986) “*Technology adoption in the presence of Network Externalities*”, Journal of Political Economy, vol. 94 no.4.

36. Kai-Uwe Kuhn and Van Reenen John (2007) “I*nteroperability and Maket foreclosure in the European Microsoft case*”

37. Kim, M., D. Kliger and B. Vale (2003) “*Estimating switching costs: the case of banking*", The Journal of Financial Intermediation 12, pages 25-56.

38. Klemperer, P.D. (1987a) “*Markets with consumer switching costs*", Quarterly Journal of Economics 102, pages 375-394.

39. Klemperer, P.D. (1987b) “*The competitiveness of markets with switching costs*", RAND Journal of Economics 18, pages138-150.

40. Krugman Paul R. (1979) “*Increasing returns, monopolistic competition, and international trade*” Journal of International Economics, Volume 9, Issue 4, Pages 469–479

41. Mac Kie J.K. & Metzler John (1997) “*Links between Markets and Aftermarkets: Kodak*”, in Kwoka J. E. & White L.J. (2004) “The Antitrust Revolution” Oxford University Press, case 17.

42. Lee Sang-Yong T. & Fu W.W. (2006) “Software – Platform Integration, Incompatibility, and System-User Switching”, Journal of Media Economics.

43. Liebowitz S.J. and Margolis S.E. (1994) “*Network externality: An uncommon tragedy*”, The Journal of Economic Perspectives, Vol. 8, No.2.

44. Liebowitz S.J. and Margolis S.E. (1995) “*Path dependence, Lock-In, and History*”, JLEO, Vol. 11, n1.

45. Marvel Howard P. (1982) “*Exclusive Dealing*”, Journal of Law and Economics, Vol. 25, No. 1, pp. 1-25

46. Maruyama Masayoshi & Kenichi Ohkita (2007) “*Platform strategy of Videogame Software: Theory and Evidence*”, Anzmac 2007 (University of Otago).

47. Odlysko Andrew (2001) “*Internet pricing and the history of communications*”, Computer networks 36, Pages 493-517.

48. Ordover J. A. (2007) “*Comments on Evans & Schmalensee's “The industrial Organization of Markets with Two-Sided Platforms*””, Competition Policy International.

49. Osborne M.J & Rubinstein Ariel (1994) “*A Course in Game Theory*”, The MIT Press.

50. Peltoniemi M. (2008) *"Life-cycle of the games industry: the specificities of creative industries"*, MindTrek '08 Proceedings of the 12th international conference on Entertainment and media in the ubiquitous era

51. Rasmusen Eric Bennett, Ramseyer J. Mark and Wiley John (1991) "*Naked Exclusion*" The American Economic Review 81.5: pp. 1137-1145.

52. Rochet J.C. & Tirole Jean (2000) “*Cooperation among competitors: The Economics of Payment Card Associations*”, Rand Journal of Economics.

53. Rochet J.C. & Tirole Jean (2003) “Platform Competition in Two-Sided Markets”, Journal of the European Economic Association, volume 1.

54. Rochet J.C. & Tirole Jean (2004) “Two-Sided Markets : An Overview”, Institut d'Economie Industrielle.

55. Roson Roberto (2005) “*Two-sided markets: A tentative Survey*”, Review of Network Economics.

56. Rysman Marc (2007) “*An empirical analysis of Payment card usage*”, Boston University, Department of Economics, The Journal of Industrial Economics.

57. Rysman Marc (2009) “*The Economics of Two-Sided Markets*”, The Journal of Economics Perspective, Volume 23 n. 3, pages 125-143.

58. Shapiro C. and Varian H.R. (1999) “*Information Rules, A strategic guide to the network Economy*”, Harvard Business School Press.

59. Shapiro C. and Varian H.R. (1999) "The Art of Standards Wars", California Management Review, Vol. 41.

60. Stole Lars A. (2007) "Price discrimination and competition", Handbook of Industrial Organization, 2007 - Elsevier

61. Thomson William (1999), "The young person guide to writing economics theory", Journal of Economics Literature 1999.

62. Tirole Jean (1988) "*The Theory of Industrial Organization*", MIT Press, Cambridge, Massachusetts, chapter 1, chapter 2 & chapter 3.

63. Varian Hal R. (1980) "*A model of sales*", American Economic Review 70, pages 651-659.

64. Varian Hal R. (1997) "*How to build a model in your spare time*", essay for *Passion and Craft: Economists at Work*, edited by Michael Szenberg, University of Michigan Press, 1997.

65. Varian Hal R. (2001) "*Economics of Information Technology*", revised version of the Raffaele Mattioli Lecture, delivered at Bocconi University, Milan, Italy, on November 15-16-2001 .

66. Varian Hal R. and Shapiro C. (2003) "*Linux adoption in the Public Sector: An Economic Analysis*", University of Berkley.

67. Warsh David (2007) "*Knowledge and the Wealth of Nations – A Story of Economic Discovery*", W.W. Norton & Company.

68. Whinston, Michael D. (2001) "*Exclusivity and Tying in U.S. v. Microsoft: What we know, and don't know*", Journal of Economic Perspectives, 2, spring 2001.

Appendix 1

Part 1

In this first part of the appendix is reported what the author did to evaluate the number of the consumer in the market. First of all it is possible to start reminding what it is known such as the formula of the number of consumers, the parameter θ, and the number of videogames that are bought:

$$n_a = n\theta_A$$

$$\theta_A = \frac{\alpha(y_A - y_B) - \beta(y_A^2 + y_B^2) - y_A p_{sA} + y_B p_{sB} - p_{pA} + p_{pB} + t}{2t}$$

$$\boldsymbol{y_A} = \frac{\boldsymbol{\alpha - p_{sA}}}{2\boldsymbol{\beta}}$$

$$y_B = \frac{\alpha - p_{sB}}{2\beta}$$

By substitution we have

$$n_A = n\frac{\alpha\left(\frac{\alpha - p_{sA}}{2\beta} - \frac{\alpha - p_{sB}}{2\beta}\right) - \beta\left[\left(\frac{\alpha - p_{sA}}{2\beta}\right)^2 - \left(\frac{\alpha - p_{sB}}{2\beta}\right)^2\right] - \frac{\alpha - p_{sA}}{2\beta}p_{sA} + \frac{\alpha - p_{sB}}{2\beta}p_{sB} - p_{pA} + p_{pB} + t}{2t}$$

It is possible now to make some simplification among the terms containing α and β

$$n_A = n\frac{\frac{\alpha p_{sB} - \alpha p_{sA}}{2\beta} - \beta\left[\frac{\alpha^2 - 2\alpha p_{sA} + p_{sA}^2}{4\beta^2} - \frac{\alpha^2 - 2\alpha p_{sB} + p_{sB}^2}{4\beta^2}\right] - \frac{\alpha p_{sA} - p_{sA}^2}{2\beta} + \frac{\alpha p_{sB} - p_{sB}^2}{2\beta} - p_{pA} + p_{pB} + t}{2t}$$

If we regroup the terms containing the prices of the software and we sum the common terms

$$n_A = n\frac{-\left[\frac{\alpha^2 - 2\alpha p_{sA} + p_{sA}^2}{4\beta} - \frac{\alpha^2 - 2\alpha p_{sB} + p_{sB}^2}{4\beta}\right] - \frac{2\alpha p_{sA} - p_{sA}^2}{2\beta} + \frac{2\alpha p_{sB} - p_{sB}^2}{2\beta} - p_{pA} + p_{pB} + t}{2t}$$

We can work on the signs and multiply the denominators and the denominators of the central terms by 2

$$n_A = n\frac{\left[\frac{\alpha^2 - 2\alpha p_{sB} + p_{sB}^2}{4\beta} - \frac{\alpha^2 - 2\alpha p_{sA} + p_{sA}^2}{4\beta}\right] - \frac{4\alpha p_{sA} - 2p_{sA}^2}{4\beta} + \frac{4\alpha p_{sB} - 2p_{sB}^2}{4\beta} - p_{pA} + p_{pB} + t}{2t}$$

Summing all the terms containing the prices of the software, the result will bring to:

$$n_A = n\frac{\frac{\alpha^2 + 2\alpha p_{sB} - p_{sB}^2}{4\beta} - \frac{\alpha^2 + 2\alpha p_{sA} - p_{sA}^2}{4\beta} + p_{pB} - p_{pA} + t}{2t}$$

We can simplify the two squared α

$$n_A = n\frac{\frac{2\alpha p_{sB} - p_{sB}^2}{4\beta} - \frac{2\alpha p_{sA} - p_{sA}^2}{4\beta} + p_{pB} - p_{pA} + t}{2t}$$

Working on the first two terms

$$n_A = n \frac{\frac{2\alpha(p_{sB} - p_{sA})}{4\beta} - \frac{(p_{sB}^2 - p_{sA}^2)}{4\beta} + p_{pB} - p_{pA} + t}{2t}$$

It is possible to rearrange the terms in this way

$$n_A = n \frac{\frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{4\beta} + p_{pB} - p_{pA} + t}{2t}$$

Finally in a more elegant way

$$n_A = n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]$$

Part 2

In this second part of the appendix will be derived the price of the software of model four. First it is possible to start by focusing on the optimal price of the software; as before the starting equation is the profit of the platform producer one

$$\Pi_{pA} = n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]\left[p_{pA} + \frac{\alpha - p_{sA}}{2\beta} p_{sA} - c_p\right] - c_s \frac{\alpha - p_{sA}}{2\beta}$$

Now to find the when the profits are maximized by charging the optimal price of the software, we have to derive the profit function of the platform producer by the price of the software:

$$\frac{\partial \Pi_{pA}}{\partial p_{sA}} = \left\{ n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]\left[p_{pA} + \frac{\alpha - p_{sA}}{2\beta} p_{sA} - c_p\right] - c_s \frac{\alpha - p_{sA}}{2\beta}\right\}' = 0$$

So by differentiating we will find

$$n\left(\frac{-(2\alpha - p_{sB} - p_{sA}) - (p_{sB} - p_{sA})}{8\beta t}\right)\left[p_{pA} + \frac{\alpha - p_{sA}}{2\beta} p_{sA} - c_p\right] +$$

$$+ n\left[\frac{1}{2} + \frac{p_{pB} - p_{pA}}{2t} + \frac{(p_{sB} - p_{sA})(2\alpha - p_{sB} - p_{sA})}{8\beta t}\right]\left[-\frac{p_{sA}}{2\beta} + \frac{\alpha - p_{sA}}{2\beta}\right] + \frac{c_s}{2\beta} = 0$$

We can assume also at this point that the equilibrium is symmetric for both platforms and so we can simplify and consider that the prices of both platforms and software are equal. The result will be:

$$n\left(\frac{-(2\alpha-2p_{sA})}{8\beta t}\right)\left[p_{pA}+\frac{\alpha-p_{sA}}{2\beta}p_{sA}-c_p\right]+\frac{1}{2}n\left[-\frac{p_{sA}}{2\beta}+\frac{\alpha-p_{sA}}{2\beta}\right]+\frac{c_s}{2\beta}=0$$

In the second square brackets, it is possible to sum the two terms containing the price of the software:

$$n\left(\frac{-(2\alpha-2p_{sA})}{8\beta t}\right)\left[p_{pA}+\frac{\alpha-p_{sA}}{2\beta}p_{sA}-c_p\right]+n\left[\frac{\alpha-2p_{sA}}{4\beta}\right]+\frac{c_s}{2\beta}=0$$

However we can remember that when we maximized the profits of the platform we found the optimal price of the platform which was equal to

$$p_{pA}=+c_p+t-\frac{\alpha-p_{sA}}{2\beta}p_{sA}$$

We can now substitute the value of the optimal price of the platform into the optimal price of the software equation and have:

$$n\left(\frac{-(\alpha-p_{sA})}{4\beta t}\right)\left[+c_p+t-\frac{\alpha-p_{sA}}{2\beta}p_{sA}+\frac{\alpha-p_{sA}}{2\beta}p_{sA}-c_p\right]+n\left[\frac{\alpha-2p_{sA}}{4\beta}\right]+\frac{c_s}{2\beta}=0$$

Some simplifications are possible and the solution will be:

$$n\left(\frac{-(\alpha-p_{sA})}{4\beta t}\right)\left[c_p+t-c_p\right]+n\left[\frac{\alpha-2p_{sA}}{4\beta}\right]+\frac{c_s}{2\beta}=0$$

It is also possible to simplify the cost of the platform present in the first square brackets

$$n\left(\frac{-(\alpha-p_{sA})}{4\beta t}\right)[t]+n\left[\frac{\alpha-2p_{sA}}{4\beta}\right]+\frac{c_s}{2\beta}=0$$

Finally, we can see that now also the t term can be simplified

$$n\left(\frac{-(\alpha-p_{sA})}{4\beta}\right)+n\left[\frac{\alpha-2p_{sA}}{4\beta}\right]+\frac{c_s}{2\beta}=0$$

Since β is a parameter, it is possible to multiply everything by 2β

$$n\left(\frac{-(\alpha-p_{sA})}{2}\right)+n\left[\frac{\alpha-2p_{sA}}{2}\right]+c_s=0$$

Now we can observe that the parameter α is simplifying and that the price of the software can be easily evaluated

$$n\left(\frac{+p_{sA}}{2}\right)+n\left[\frac{-2p_{sA}}{2}\right]+c_s=0$$

By summing the price of the software, bringing the cost of the software on the right side and changing the signs

$$n\left[\frac{p_{sA}}{2}\right]=c_s$$

and so finally

$$\boldsymbol{p_{sA}=\frac{2c_s}{n}}$$

And for the symmetry

$$\boldsymbol{p_{sB}=\frac{2c_s}{n}}$$

It is important to highlight the fact that in the optimal prices of the software, the royalties are equal to zero. Given this result, it appears that platform producers earn just form the hardware side.

Appendix 2

In this part is reported what has been done using the statistical software “Stata”.

First the database was browsed in the software.

Note: multi-homing is characterised by dummy equal to 1 single homing is characterised by dummy equal to 0

After that the, time is set with the following command, however it has to be set also the panel variable. In the case of the database in object the time variable is T and represent the week the videogame was sold since lunch. Y instead represents the videogame which is analysed. Since prices were collected from different websites, the following variables were adopted:

```
pa : price form “Amazon”
pgp: price form “Game Play”
pg : price from “Game”
p  : is the mean of the prices of the three websites
y  : is the videogame
c  : console (1=Wii, 2= PS3, 3= Xbox)
dummy (0= single-homing, 1= multi-homing)
```

```
. xtset y  t
       panel variable:  y (unbalanced)
        time variable:  t, 1 to 132
                delta:  1 unit
```

Some variables have got to be generated to make the model to become squared and cubic

```
. gen t2=( t^2)
. gen t3=( t^3)
. gen td=( t* dummy)
. gen t2d=( t^2* dummy)
. gen t3d=( t^3* dummy)
```

```
gen pwii=p  if c==1
gen pps3=p  if c==2
gen pxbox=p if c==3
```

It is also possible to analyse the different variables

```
. summarize pa,detail
                             Pa
-------------------------------------------------------------
      Percentiles      Smallest
 1%         5.85           1.75
 5%         8.58              2
10%         9.99            2.9       Obs                4445
25%        13.65              3       Sum of Wgt.        4445

50%        17.99                      Mean           20.59005
                        Largest       Std. Dev.      9.143906
75%        27.96          56.95
90%        34.89          56.95       Variance       83.61101
95%        37.18           59.5       Skewness       .6229227
99%        42.48          59.99       Kurtosis       2.764635
```

```
. summarize  pgp,detail
                            Pgp
-------------------------------------------------------------
      Percentiles      Smallest
 1%         7.98           4.98
 5%         9.99           4.98
10%        12.99           4.98       Obs                3352
25%        16.99           4.98       Sum of Wgt.        3352

50%        24.99                      Mean           24.05031
                        Largest       Std. Dev.      9.139302
75%        29.99          39.99
90%        39.99          39.99       Variance       83.52685
95%        39.99          39.99       Skewness       .2089357
99%        39.99          44.99       Kurtosis       2.085007
```

```
. summarize   pg,detail
                            Pg
-------------------------------------------------------------
      Percentiles      Smallest
 1%         6.98           4.98
 5%         9.98           4.98
10%         9.99           4.98       Obs                4586
25%        14.98           4.98       Sum of Wgt.        4586

50%        19.56                      Mean           21.37495
                        Largest       Std. Dev.      9.332083
75%        29.99          39.99
90%        34.99          39.99       Variance       87.08778
95%        39.99          39.99       Skewness          .5554
99%        39.99          42.99       Kurtosis        2.30036
```

To analyse the different variables, the following commands had been used

```
sum p if dummy==0, detail
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         9.93           7.27
 5%        12.11           7.98
10%        13.08           7.98       Obs                1704
25%        16.14           8.99       Sum of Wgt.        1704

50%       21.315                      Mean           22.68087
                        Largest       Std. Dev.      7.737545
75%        29.65          39.99
90%        33.32          39.99       Variance       59.86961
95%        35.83          39.99       Skewness       .2649257
99%        38.99          39.99       Kurtosis       1.904812
```

```
sum p  if dummy==1, detail
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         7.02           1.75
 5%         8.77           4.99
10%         9.99           4.99       Obs                2959
25%        14.24           5.04       Sum of Wgt.        2959

50%        18.79                      Mean           20.46601
                        Largest       Std. Dev.       8.45965
75%        26.09          42.76
90%        33.32          42.77       Variance       71.56568
95%        36.65          44.46       Skewness       .5467875
99%        39.99          46.99       Kurtosis       2.485945
```

```
sum p  if c==1, detail

                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         8.22           7.24
 5%         9.99           7.24
10%        12.03           7.24       Obs                1421
25%        14.99           7.64       Sum of Wgt.        1421

50%        20.32                      Mean           20.90846
                        Largest       Std. Dev.       7.07408
75%        26.99          36.65
90%        29.99          36.65       Variance        50.0426
95%        30.99          36.65       Skewness       .0730283
99%        34.15          37.81       Kurtosis       1.847008
```

```
sum p  if c==2, detail

                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         6.94           4.99
 5%         8.97           5.04
10%        10.78           5.98       Obs                1798
25%        14.99           5.99       Sum of Wgt.        1798

50%        19.21                      Mean           21.88246
                        Largest       Std. Dev.       9.10969
75%        29.99          42.76
90%        35.66          42.77       Variance       82.98645
95%        37.29          44.46       Skewness       .4031432
99%        39.99          46.99       Kurtosis        2.06449
```

```
sum p if t==4, detail

                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%        19.99          19.99
 5%        19.99          37.66
10%        19.99          38.32       Obs                   3
25%        19.99              .       Sum of Wgt.           3

50%        37.66                      Mean              31.99
                        Largest       Std. Dev.      10.39754
75%        38.32              .
90%        38.32          19.99       Variance       108.1089
95%        38.32          37.66       Skewness      -.7039029
99%        38.32          38.32       Kurtosis            1.5
```

```
sum p  if  h==0, detail

                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%          7.4           1.75
 5%         9.45           4.99
10%        11.25           4.99       Obs                4383
25%        14.97           5.04       Sum of Wgt.        4383

50%        19.56                      Mean           21.31086
                        Largest       Std. Dev.      8.347343
75%        28.16          42.76
90%        33.32          42.77       Variance       69.67813
95%        36.32          44.46       Skewness       .4023392
99%        39.99          46.99       Kurtosis       2.235982
```

. sum p if h==1, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         8.92           8.47
 5%       12.005           8.47
10%        13.58           8.92       Obs                 280
25%        15.62           9.42       Sum of Wgt.         280

50%       18.395                      Mean           20.72007
                        Largest       Std. Dev.      6.964389
75%        24.99          37.97
90%        31.91          37.97       Variance       48.50272
95%       34.165          38.82       Skewness       .7632655
99%        37.97          39.42       Kurtosis       2.676189
```

sum p if t==4, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%        19.99          19.99
 5%        19.99          37.66
10%        19.99          38.32       Obs                   3
25%        19.99              .       Sum of Wgt.           3

50%        37.66                      Mean              31.99
                        Largest       Std. Dev.      10.39754
75%        38.32              .
90%        38.32          19.99       Variance       108.1089
95%        38.32          37.66       Skewness      -.7039029
99%        38.32          38.32       Kurtosis            1.5
```

sum p if t==8, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%        18.65          18.65
 5%        19.32          19.99
10%        22.49          24.99       Obs                  20
25%        26.05          24.99       Sum of Wgt.          20

50%       30.485                      Mean             30.893
                        Largest       Std. Dev.      6.373947
75%        35.57          38.99
90%       39.905          39.82       Variance        40.6272
95%        39.99          39.99       Skewness      -.1701988
99%        39.99          39.99       Kurtosis       2.216687
```

sum p if t==16, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%        14.49          14.49
 5%        15.65          14.99
10%        20.83          15.65       Obs                  47
25%        24.32          20.65       Sum of Wgt.          47

50%        28.15                      Mean            27.9534
                        Largest       Std. Dev.      6.066661
75%        33.32          36.65
90%        36.31          36.65       Variance       36.80437
95%        36.65          36.82       Skewness      -.2493437
99%        37.95          37.95       Kurtosis       2.411045
```

sum p if t==32, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%        12.69          12.69
 5%        14.32          13.32
10%        14.99          13.51       Obs                  63
25%        17.24          14.32       Sum of Wgt.          63

50%        23.72                      Mean           25.24794
                        Largest       Std. Dev.      8.066933
75%        33.32          37.37
90%        36.32          39.14       Variance        65.0754
95%        37.37          39.15       Skewness       .1898485
99%        39.99          39.99       Kurtosis       1.762723
```

sum p if t==64, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         7.02           7.02
 5%         8.84           8.67
10%         9.46           8.75       Obs                  67
25%        12.18           8.84       Sum of Wgt.          67

50%        16.46                      Mean            17.6894
                        Largest       Std. Dev.      7.228454
75%        21.32          30.66
90%        29.97          33.32       Variance       52.25054
95%        30.66          33.32       Skewness       .7828563
99%        35.11          35.11       Kurtosis       2.639779
```

sum p if t==74, detail

```
                              P
-------------------------------------------------------------
      Percentiles      Smallest
 1%         7.24           7.24
 5%         8.16           7.69
10%         8.72           7.98       Obs                  61
25%        10.62           8.16       Sum of Wgt.          61

50%        13.99                      Mean           15.33049
                        Largest       Std. Dev.      6.012358
75%        17.99          28.99
90%        24.99          29.66       Variance       36.14845
95%        28.99          29.99       Skewness       1.052831
99%        30.99          30.99       Kurtosis       3.538531
```

```
. sum av if  c==1, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%           57             57
 5%           57             57
10%        61.33             57       Obs                1354
25%        65.72             57       Sum of Wgt.        1354

50%        69.71                      Mean             72.001
                        Largest       Std. Dev.      9.307407
75%        76.95          97.46
90%        83.26          97.46       Variance       86.62782
95%        97.46          97.46       Skewness       .9583154
99%        97.46          97.46       Kurtosis       3.723794

. sum av if  c==2, detail

                             Av
```

```
-------------------------------------------------------------
      Percentiles      Smallest
 1%        50.15          50.15
 5%        56.27          50.15
10%        63.96          50.15       Obs                1396
25%        68.97          50.15       Sum of Wgt.        1396

50%        78.82                      Mean           76.73321
                        Largest       Std. Dev.      11.09028
75%        84.39          93.56
90%        87.93          93.56       Variance       122.9943
95%        93.54          93.56       Skewness      -.6720407
99%        93.56          93.56       Kurtosis       2.884412

. sum av if  c==3, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        53.26          53.26
 5%        58.88          53.26
10%        65.67          53.26       Obs                1780
25%        72.82          53.26       Sum of Wgt.        1780

50%         80.4                      Mean           78.31373
                        Largest       Std. Dev.      9.545496
75%       84.735          93.53
90%        89.85          93.53       Variance       91.11649
95%        93.32          93.53       Skewness      -.6984141
99%        93.53          93.53       Kurtosis       3.272695

. sum av if   inhouse==0, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        63.04          63.04
 5%        63.04          63.04
10%        76.95          63.04       Obs                 695
25%        79.79          63.04       Sum of Wgt.         695

50%        86.51                      Mean           84.98165
                        Largest       Std. Dev.      9.375777
75%        93.32          97.46
90%        93.53          97.46       Variance        87.9052
95%        97.46          97.46       Skewness      -.9627138
99%        97.46          97.46       Kurtosis       3.477863

. sum av if   inhouse==1, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        50.15          50.15
 5%        56.27          50.15
10%        61.33          50.15       Obs                3768
25%        67.72          50.15       Sum of Wgt.        3768

50%        73.87                      Mean           74.16822
                        Largest       Std. Dev.      9.650927
75%        82.51          93.56
90%        85.69          93.56       Variance       93.14039
95%         88.3          93.56       Skewness       -.277645
99%        93.56          93.56       Kurtosis       2.659334

.
sum av if    dummy==0, detail  For console Wii

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        61.33          61.33
 5%        61.33          61.33
10%        63.04          61.33       Obs                 802
25%        65.37          61.33       Sum of Wgt.         802
```

```
50%        67.72                        Mean           72.32948
                        Largest         Std. Dev.      10.11111
75%        76.95          97.46
90%        82.48          97.46         Variance       102.2346
95%        97.46          97.46         Skewness       1.223297
99%        97.46          97.46         Kurtosis       3.672081

. sum av if    dummy==1, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%           57             57
 5%           57             57
10%           57             57         Obs                 552
25%       68.255             57         Sum of Wgt.         552

50%        70.48                        Mean           71.52375
                        Largest         Std. Dev.      7.981972
75%        77.23          83.26
90%        83.26          83.26         Variance       63.71187
95%        83.26          83.26         Skewness       .0084908
99%        83.26          83.26         Kurtosis       2.530958

. sum av, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%           57             57
 5%           57             57
10%        61.33             57         Obs                1354
25%        65.72             57         Sum of Wgt.        1354

50%        69.71                        Mean             72.001
                        Largest         Std. Dev.      9.307407
75%        76.95          97.46
90%        83.26          97.46         Variance       86.62782
95%        97.46          97.46         Skewness       .9583154
99%        97.46          97.46         Kurtosis       3.723794


. sum av if    dummy==0, detail For console Playstation 3

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        84.39          84.39
 5%        84.39          84.39
10%        84.39          84.39         Obs                 190
25%        84.39          84.39         Sum of Wgt.         190

50%        86.23                        Mean           87.74158
                        Largest         Std. Dev.      3.850051
75%        93.56          93.56
90%        93.56          93.56         Variance       14.82289
95%        93.56          93.56         Skewness       .7693948
99%        93.56          93.56         Kurtosis       1.766847

. sum av if    dummy==1, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        50.15          50.15
 5%        50.15          50.15
10%        56.27          50.15         Obs                1206
25%        68.45          50.15         Sum of Wgt.        1206

50%       76.555                        Mean           74.99889
                        Largest         Std. Dev.      10.86022
75%         82.9          93.54
90%        87.93          93.54         Variance       117.9445
95%        93.54          93.54         Skewness      -.5748068
99%        93.54          93.54         Kurtosis       2.796233
```

```
. sum av , detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        50.15          50.15
 5%        56.27          50.15
10%        63.96          50.15       Obs                1396
25%        68.97          50.15       Sum of Wgt.        1396

50%        78.82                      Mean           76.73321
                        Largest       Std. Dev.      11.09028
75%        84.39          93.56
90%        87.93          93.56       Variance       122.9943
95%        93.54          93.56       Skewness      -.6720407
99%        93.56          93.56       Kurtosis       2.884412
```

After the generation of the previous variables, different models are tested

```
xtreg   pa t  td t2 t2d t3 t3d dummy

Random-effects GLS regression                   Number of obs      =      4445
Group variable: y                               Number of groups   =        70

R-sq:  within  = 0.3548                         Obs per group: min =        34
       between = 0.0270                                        avg =      63.5
       overall = 0.2051                                        max =        69

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   2396.91
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.2982253   .0526777    -5.66   0.000    -.4014718   -.1949789
          td |  -.4366032   .0871257    -5.01   0.000    -.6073665     -.26584
          t2 |   .0020631   .0009415     2.19   0.028     .0002178    .0039083
         t2d |   .0051879   .0017494     2.97   0.003     .0017591    .0086167
          t3 |  -5.12e-06   4.91e-06    -1.04   0.296    -.0000147    4.49e-06
         t3d |  -.0000217   .0000107    -2.03   0.043    -.0000427   -7.14e-07
       dummy |   7.807656   1.905281     4.10   0.000     4.073374    11.54194
       _cons |   32.21516   1.400703    23.00   0.000     29.46983    34.96049
-------------+----------------------------------------------------------------
     sigma_u |  5.6607278
     sigma_e |  5.8660701
         rho |  .48219131   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
xtreg    pgp t  td t2 t2d t3 t3d dummy

Random-effects GLS regression                   Number of obs      =      3352
Group variable: y                               Number of groups   =        70

R-sq:  within  = 0.4193                         Obs per group: min =        15
       between = 0.0000                                        avg =      47.9
       overall = 0.1445                                        max =        69

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   2330.73
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         pgp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.0934446   .0535959    -1.74   0.081    -.1984905    .0116014
          td |   -.264866   .0900376    -2.94   0.003    -.4413364   -.0883956
          t2 |  -.0032466   .0009983    -3.25   0.001    -.0052032   -.0012901
         t2d |   .0044513   .0019447     2.29   0.022     .0006398    .0082628
          t3 |   .0000238   5.40e-06     4.40   0.000     .0000132    .0000344
         t3d |  -.0000267   .0000129    -2.08   0.038    -.0000519   -1.51e-06
       dummy |   3.488721   1.961873     1.78   0.075    -.3564798    7.333922
       _cons |   32.62882   1.458527    22.37   0.000     29.77016    35.48748
-------------+----------------------------------------------------------------
     sigma_u |  6.1153942
     sigma_e |  5.0553629
         rho |  .59404655   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
xtreg     pg t  td t2 t2d t3 t3d dummy

Random-effects GLS regression                   Number of obs      =      4586
Group variable: y                               Number of groups   =        70

R-sq:  within  = 0.5288                         Obs per group: min =        54
       between = 0.0002                                        avg =      65.5
       overall = 0.2370                                        max =        68

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   5019.44
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pg |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.3299515   .0460153    -7.17   0.000    -.4201398   -.2397632
          td |  -.2957068   .0746952    -3.96   0.000    -.4421067   -.1493069
          t2 |   .0008202   .0008215     1.00   0.318    -.0007899    .0024302
         t2d |   .0042334   .0015016     2.82   0.005     .0012903    .0071766
          t3 |   3.97e-06   4.28e-06     0.93   0.355    -4.43e-06    .0000124
         t3d |  -.0000252   9.22e-06    -2.73   0.006    -.0000432   -7.10e-06
       dummy |   4.337052   1.828782     2.37   0.018     .7527054    7.921399
       _cons |   36.17538   1.374581    26.32   0.000     33.48125    38.86951
-------------+----------------------------------------------------------------
     sigma_u |  5.8683219
     sigma_e |  5.0930371
         rho |  .57037682   (fraction of variance due to u_i)
------------------------------------------------------------------------------

.
```

It is possible to run the same calculation but focusing on the prices charged by consoles. In the next analysis the regressions are done on the different console's videogame to try to highlight the main dynamics

First of all the Wii market is studied

xtreg   p t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1421
Group variable: y                               Number of groups   =        21

R-sq:  within  = 0.5264                         Obs per group: min =        56
       between = 0.0790                                        avg =      67.7
       overall = 0.0988                                        max =        69

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1532.18
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        pwii |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.2367041   .0448333    -5.28   0.000    -.3245757   -.1488325
          td |  -.7548172   .0972249    -7.76   0.000    -.9453744     -.56426
          t2 |   .0006046   .0007739     0.78   0.435    -.0009122    .0021213
         t2d |   .0138427   .0019469     7.11   0.000     .0100269    .0176586
          t3 |   2.32e-06   3.82e-06     0.61   0.545    -5.18e-06    9.81e-06
         t3d |  -.0000813   .0000118    -6.90   0.000    -.0001044   -.0000582
       dummy |   11.06089    2.88344     3.84   0.000      5.40945    16.71233
       _cons |   31.39432    1.71043    18.35   0.000     28.04194    34.74671
-------------+----------------------------------------------------------------
     sigma_u |  5.5499269
     sigma_e |  3.5398102
         rho |  .71083097   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg   pa t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1367
Group variable: y                               Number of groups   =        21

R-sq:  within  = 0.3133                         Obs per group: min =        53
       between = 0.0001                                        avg =      65.1
       overall = 0.1105                                        max =        69

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    610.38
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.2366092    .061119    -3.87   0.000    -.3564003   -.1168181
          td |  -.3087638   .1335291    -2.31   0.021    -.5704761   -.0470516
          t2 |   .0009317   .0010539     0.88   0.377    -.0011339    .0029973
         t2d |   .0022862   .0026811     0.85   0.394    -.0029686     .007541
          t3 |   1.02e-06   5.20e-06     0.20   0.845    -9.18e-06    .0000112
         t3d |   5.26e-06   .0000163     0.32   0.746    -.0000266    .0000371
       dummy |   7.233925   3.586235     2.02   0.044     .2050344    14.26282
       _cons |   30.24866   2.104945    14.37   0.000     26.12304    34.37427
-------------+----------------------------------------------------------------
     sigma_u |  6.6743111
     sigma_e |  4.8037357
         rho |  .65875348   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg pgp t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1022
Group variable: y                               Number of groups   =        21

R-sq:  within  = 0.4425                         Obs per group: min =        15
       between = 0.1913                                        avg =      48.7
       overall = 0.0262                                        max =        69

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    750.16
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         pgp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.0990561   .0628777    -1.58   0.115    -.2222943     .024182
          td |  -1.128492    .156646    -7.20   0.000    -1.435512   -.8214713
          t2 |  -.0018672   .0010996    -1.70   0.089    -.0040224     .000288
         t2d |   .0228761   .0036663     6.24   0.000     .0156903     .030062
          t3 |   .0000152   5.59e-06     2.72   0.007     4.25e-06    .0000261
         t3d |  -.0001484   .0000264    -5.63   0.000    -.0002001   -.0000968
       dummy |   15.42178   2.937883     5.25   0.000      9.66364    21.17993
       _cons |   29.44359   1.647865    17.87   0.000     26.21384    32.67335
-------------+----------------------------------------------------------------
     sigma_u |   4.702276
     sigma_e |  4.0426134
         rho |  .57500725   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg pg t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1397
Group variable: y                               Number of groups   =        21

R-sq:  within  = 0.4684                         Obs per group: min =        55
       between = 0.1054                                        avg =      66.5
       overall = 0.0848                                        max =        68

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1173.52
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pg |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.3551032    .061212    -5.80   0.000    -.4750765   -.2351299
          td |  -1.056992    .132177    -8.00   0.000    -1.316054   -.7979297
          t2 |    .002363   .0010585     2.23   0.026     .0002883    .0044377
         t2d |   .0216342    .002651     8.16   0.000     .0164383    .0268302
          t3 |  -5.84e-06   5.24e-06    -1.11   0.265    -.0000161    4.43e-06
         t3d |  -.0001415   .0000161    -8.81   0.000     -.000173     -.00011
       dummy |   13.52406   3.117804     4.34   0.000     7.413272    19.63484
       _cons |   33.93092   1.807209    18.78   0.000     30.38886    37.47299
-------------+----------------------------------------------------------------
     sigma_u |  5.3729092
     sigma_e |  4.7723489
         rho |  .55898944   (fraction of variance due to u_i)
------------------------------------------------------------------------------

sum av if    dummy==0, detail  For console Xbox

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        72.82          72.82
 5%        72.82          72.82
10%        72.82          72.82       Obs                 579
25%        79.79          72.82       Sum of Wgt.         579

50%        86.51                      Mean           84.50732
                        Largest       Std. Dev.      6.937552
```

```
75%        89.85          93.53
90%        93.53          93.53       Variance       48.12963
95%        93.53          93.53       Skewness      -.2253982
99%        93.53          93.53       Kurtosis       1.763645

. sum av if    dummy==1, detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        53.26          53.26
 5%        53.26          53.26
10%        58.88          53.26       Obs                1201
25%        70.25          53.26       Sum of Wgt.        1201

50%        75.88                      Mean           75.32781
                        Largest       Std. Dev.      9.190518
75%        82.82           88.3
90%        85.69           88.3       Variance       84.46562
95%         88.3           88.3       Skewness      -.8069829
99%         88.3           88.3       Kurtosis       2.955458

. sum av , detail

                             Av
-------------------------------------------------------------
      Percentiles      Smallest
 1%        53.26          53.26
 5%        58.88          53.26
10%        65.67          53.26       Obs                1780
25%        72.82          53.26       Sum of Wgt.        1780

50%         80.4                      Mean           78.31373
                        Largest       Std. Dev.      9.545496
75%       84.735          93.53
90%        89.85          93.53       Variance       91.11649
95%        93.32          93.53       Skewness      -.6984141
99%        93.53          93.53       Kurtosis       3.272695
```

Now it is studied the PS3 Market

xtreg p t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1798
Group variable: y                               Number of groups   =        27

R-sq:  within  = 0.6221                         Obs per group: min =        56
       between = 0.0047                                        avg =      66.6
       overall = 0.3438                                        max =        67

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   2898.08
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
           p |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |   .5167457   .2334558     2.21   0.027     .0591807    .9743106
          td |  -.8177035   .2436894    -3.36   0.001    -1.295326   -.3400811
          t2 |  -.0170223   .0060386    -2.82   0.005    -.0288578   -.0051868
         t2d |   .0145097   .0062308     2.33   0.020     .0022976    .0267217
          t3 |   .0001203    .000047     2.56   0.011     .0000281    .0002125
         t3d |  -.0000895   .0000481    -1.86   0.063    -.0001838    4.90e-06
       dummy |   11.67253   4.222868     2.76   0.006      3.39586     19.9492
       _cons |   25.37034   3.932267     6.45   0.000     17.66324    33.07744
```

```
-------------+----------------------------------------------------------------
     sigma_u |  5.8466474
     sigma_e |  4.5024229
         rho |  .62773344   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg pa t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1731
Group variable: y                               Number of groups   =        27

R-sq:  within  = 0.4041                         Obs per group: min =        55
       between = 0.0041                                        avg =      64.1
       overall = 0.2571                                        max =        67

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1134.09
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.3664489   .3470209    -1.06   0.291    -1.046597    .3136996
          td |  -.3991807   .3628137    -1.10   0.271    -1.110283    .3119212
          t2 |   .0067204   .0089808     0.75   0.454    -.0108817    .0243225
         t2d |   .0007796   .0092748     0.08   0.933    -.0173986    .0189579
          t3 |  -.0000537   .0000699    -0.77   0.443    -.0001908    .0000834
         t3d |   .0000239   .0000716     0.33   0.739    -.0001165    .0001642
       dummy |   9.931121   4.766221     2.08   0.037     .5894987    19.27274
       _cons |   31.95614   4.458021     7.17   0.000     23.21858     40.6937
-------------+----------------------------------------------------------------
     sigma_u |  4.3079629
     sigma_e |  6.6122829
         rho |  .29798165   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Finally it is analysed the Xbox market

xtreg p t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1444
Group variable: y                               Number of groups   =        22

R-sq:  within  = 0.6192                         Obs per group: min =        56
       between = 0.1730                                        avg =      65.6
       overall = 0.3916                                        max =        67

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   2297.59
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
           p |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.4086081   .0630669    -6.48   0.000     -.532217   -.2849992
          td |  -.3885854   .1189593    -3.27   0.001    -.6217413   -.1554295
          t2 |   .0015057   .0012364     1.22   0.223    -.0009176    .0039291
         t2d |    .008561   .0024428     3.50   0.000     .0037732    .0133488
          t3 |   2.64e-06   7.26e-06     0.36   0.716    -.0000116    .0000169
         t3d |  -.0000597   .0000153    -3.89   0.000    -.0000898   -.0000296
       dummy |   1.161503   2.737415     0.42   0.671    -4.203732    6.526737
       _cons |   39.16944   1.891641    20.71   0.000      35.4619    42.87699
-------------+----------------------------------------------------------------
     sigma_u |  4.8445808
     sigma_e |   3.844125
         rho |  .61363777   (fraction of variance due to u_i)
```

```
------------------------------------------------------------------------------
```

xtreg pa t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1347
Group variable: y                               Number of groups   =        22

R-sq:  within  = 0.3411                         Obs per group: min =        34
       between = 0.2187                                        avg =      61.2
       overall = 0.2646                                        max =        66

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    685.37
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |   -.597291   .0954842    -6.26   0.000    -.7844366   -.4101453
          td |  -.4288019   .1824237    -2.35   0.019    -.7863457   -.0712581
          t2 |   .0076776   .0018897     4.06   0.000      .003974    .0113813
         t2d |   .0079404   .0037278     2.13   0.033      .000634    .0152468
          t3 |  -.0000377   .0000111    -3.38   0.001    -.0000595   -.0000159
         t3d |  -.0000537   .0000233    -2.31   0.021    -.0000993   -8.05e-06
       dummy |   2.350567   3.403666     0.69   0.490    -4.320495    9.021629
       _cons |   37.94701   2.171566    17.47   0.000     33.69082     42.2032
-------------+----------------------------------------------------------------
     sigma_u |  4.7786539
     sigma_e |  5.6267795
         rho |  .41902997   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg pgp t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1039
Group variable: y                               Number of groups   =        22

R-sq:  within  = 0.4471                         Obs per group: min =        24
       between = 0.1318                                        avg =      47.2
       overall = 0.2732                                        max =        67

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    818.77
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         pgp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.1120994   .0874418    -1.28   0.200    -.2834822    .0592833
          td |  -1.095157   .2084841    -5.25   0.000    -1.503779    -.686536
          t2 |  -.0061305   .0018029    -3.40   0.001     -.009664   -.0025969
         t2d |   .0292699   .0049458     5.92   0.000     .0195764    .0389634
          t3 |   .0000457   .0000107     4.28   0.000     .0000248    .0000665
         t3d |   -.000207   .0000359    -5.77   0.000    -.0002773   -.0001367
       dummy |   5.327909   4.027964     1.32   0.186    -2.566755    13.22257
       _cons |   38.84815   2.652279    14.65   0.000     33.64978    44.04652
-------------+----------------------------------------------------------------
     sigma_u |   6.936211
     sigma_e |  4.6293081
         rho |  .69183166   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

xtreg pg t td t2 t2d t3 t3d dummy

```
Random-effects GLS regression                   Number of obs      =      1420
Group variable: y                               Number of groups   =        22

R-sq:  within  = 0.5758                         Obs per group: min =        54
       between = 0.1312                                        avg =      64.5
       overall = 0.3764                                        max =        66

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1882.50
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          pg |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
           t |  -.3772535   .0798192    -4.73   0.000    -.5336963   -.2208107
          td |  -.2052904   .1460701    -1.41   0.160    -.4915825    .0810018
          t2 |  -.0004671   .0015547    -0.30   0.764    -.0035143      .00258
         t2d |   .0044089   .0029944     1.47   0.141      -.00146    .0102778
          t3 |   .0000178   9.08e-06     1.96   0.050     2.47e-08    .0000356
         t3d |  -.0000298   .0000188    -1.59   0.112    -.0000667    6.98e-06
       dummy |   .1650997   3.004724     0.05   0.956    -5.724052    6.054251
       _cons |   39.82527   2.036137    19.56   0.000     35.83451    43.81602
-------------+----------------------------------------------------------------
     sigma_u |  4.8252707
     sigma_e |  4.6422545
         rho |  .51932373   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Logit analysis.

In the next part the logit calculus are presented. First the calculations refers to the whole dataset, later WII is c1, PS3 is C2 and Xbox is C3.

. logit dummy av developer

```
Iteration 0:   log likelihood =  -2615.117
Iteration 1:   log likelihood = -2332.7987
Iteration 2:   log likelihood = -2304.0604
Iteration 3:   log likelihood = -2303.7362
Iteration 4:   log likelihood = -2303.7361

Logistic regression                               Number of obs   =       4118
                                                  LR chi2(2)      =     622.76
                                                  Prob > chi2     =     0.0000
Log likelihood = -2303.7361                       Pseudo R2       =     0.1191

------------------------------------------------------------------------------
       dummy |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |   -.050266   .0037738   -13.32   0.000    -.0576626   -.0428694
   developer |  -1.89e-07   1.29e-08   -14.64   0.000    -2.14e-07   -1.63e-07
       _cons |    5.04392   .3009557    16.76   0.000     4.454058    5.633783
------------------------------------------------------------------------------
```

. logit inhouse av

```
Iteration 0:   log likelihood =  -1930.302
Iteration 1:   log likelihood = -1607.5935
Iteration 2:   log likelihood = -1558.5143
Iteration 3:   log likelihood = -1557.9789
Iteration 4:   log likelihood = -1557.9789

Logistic regression                               Number of obs   =       4463
                                                  LR chi2(1)      =     744.65
                                                  Prob > chi2     =     0.0000
Log likelihood = -1557.9789                       Pseudo R2       =     0.1929

------------------------------------------------------------------------------
     inhouse |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |  -.1353677   .0059487   -22.76   0.000     -.147027   -.1237084
       _cons |   12.52314   .4962387    25.24   0.000     11.55053    13.49575
------------------------------------------------------------------------------
```

. logit dummy av developer if c==1

```
Iteration 0:   log likelihood = -683.06291
Iteration 1:   log likelihood = -490.64755
Iteration 2:   log likelihood = -462.73695
Iteration 3:   log likelihood = -459.35271
Iteration 4:   log likelihood =  -459.2485
Iteration 5:   log likelihood = -459.24825
Iteration 6:   log likelihood = -459.24825

Logistic regression                               Number of obs   =       1009
                                                  LR chi2(2)      =     447.63
                                                  Prob > chi2     =     0.0000
```

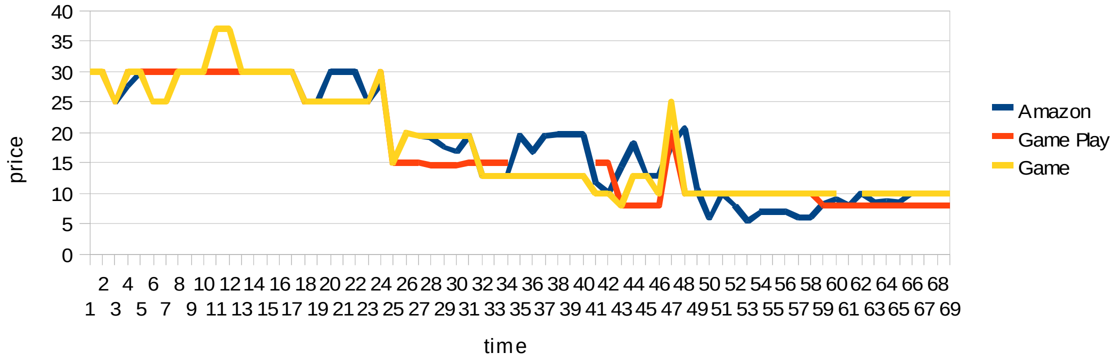
```
Log likelihood = -459.24825                       Pseudo R2       =     0.3277

------------------------------------------------------------------------------
       dummy |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |   .0988641   .0113097     8.74   0.000     .0766975    .1210307
   developer |  -6.31e-07   6.27e-08   -10.08   0.000    -7.54e-07   -5.09e-07
       _cons |  -5.407346   .7781176    -6.95   0.000    -6.932429   -3.882264
------------------------------------------------------------------------------

. logit  dummy av developer if c==2

Iteration 0:   log likelihood = -545.30049
Iteration 1:   log likelihood = -311.11433
Iteration 2:   log likelihood = -293.06469
Iteration 3:   log likelihood = -266.63149
Iteration 4:   log likelihood = -265.60523
Iteration 5:   log likelihood = -265.60235
Iteration 6:   log likelihood = -265.60235

Logistic regression                               Number of obs   =       1329
                                                  LR chi2(2)      =     559.40
                                                  Prob > chi2     =     0.0000
Log likelihood = -265.60235                       Pseudo R2       =     0.5129

------------------------------------------------------------------------------
       dummy |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |  -.2503468   .0207932   -12.04   0.000    -.2911006    -.209593
   developer |  -1.13e-07   1.66e-08    -6.84   0.000    -1.46e-07   -8.09e-08
       _cons |   23.38755    1.83069    12.78   0.000     19.79947    26.97564
------------------------------------------------------------------------------

. logit  dummy av developer if c==3

Iteration 0:   log likelihood = -1122.7994
Iteration 1:   log likelihood = -576.08802
Iteration 2:   log likelihood = -435.78733
Iteration 3:   log likelihood = -381.59408
Iteration 4:   log likelihood = -374.67801
Iteration 5:   log likelihood =  -374.5856
Iteration 6:   log likelihood = -374.58556
Iteration 7:   log likelihood = -374.58556
Logistic regression                               Number of obs   =       1780
                                                  LR chi2(2)      =    1496.43
                                                  Prob > chi2     =     0.0000
Log likelihood = -374.58556                       Pseudo R2       =     0.6664

------------------------------------------------------------------------------
       dummy |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |  -.1416306   .0111345   -12.72   0.000    -.1634539   -.1198073
   developer |   6.46e-06   4.60e-07    14.07   0.000     5.56e-06    7.37e-06
       _cons |   9.583922   .8719854    10.99   0.000     7.874862    11.29298
------------------------------------------------------------------------------

. logit  dummy av developer

Iteration 0:   log likelihood =  -2615.117
Iteration 1:   log likelihood = -2332.7987
Iteration 2:   log likelihood = -2304.0604
Iteration 3:   log likelihood = -2303.7362
Iteration 4:   log likelihood = -2303.7361

Logistic regression                               Number of obs   =       4118
                                                  LR chi2(2)      =     622.76
                                                  Prob > chi2     =     0.0000
Log likelihood = -2303.7361                       Pseudo R2       =     0.1191

------------------------------------------------------------------------------
       dummy |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          av |   -.050266   .0037738   -13.32   0.000    -.0576626   -.0428694
   developer |  -1.89e-07   1.29e-08   -14.64   0.000    -2.14e-07   -1.63e-07
       _cons |    5.04392   .3009557    16.76   0.000     4.454058    5.633783
------------------------------------------------------------------------------
```

Appendix 3

In this part all the prices collected are scattered by time

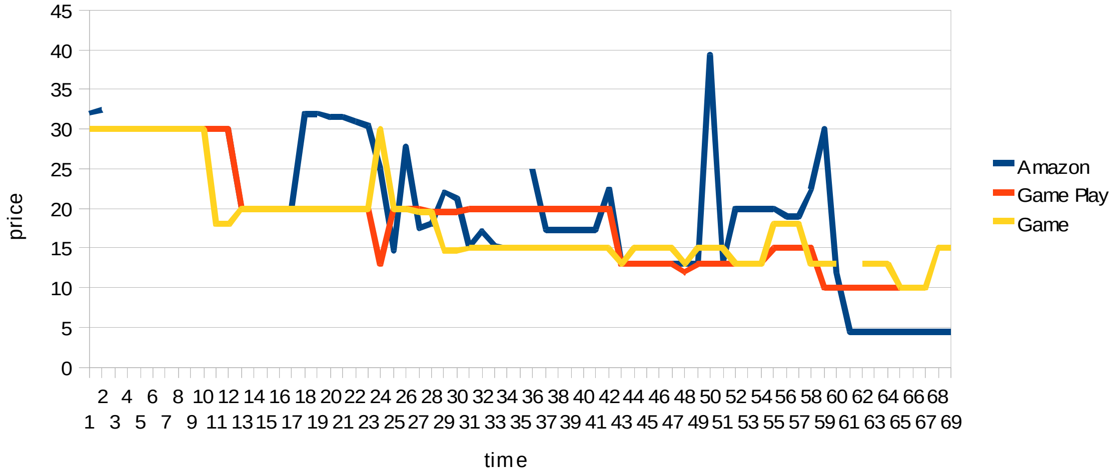
Game 01: Proevolution soccer 08

Wii multiohoming



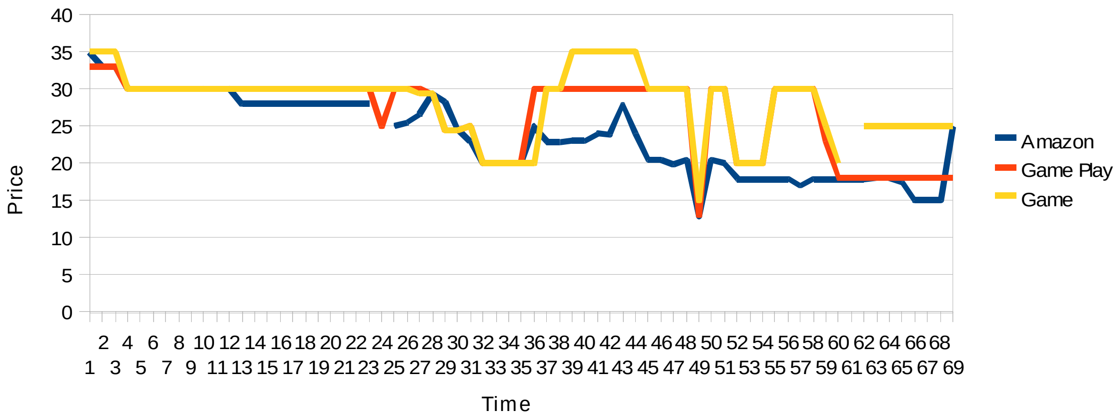
Game 02: Sega superstar tennis

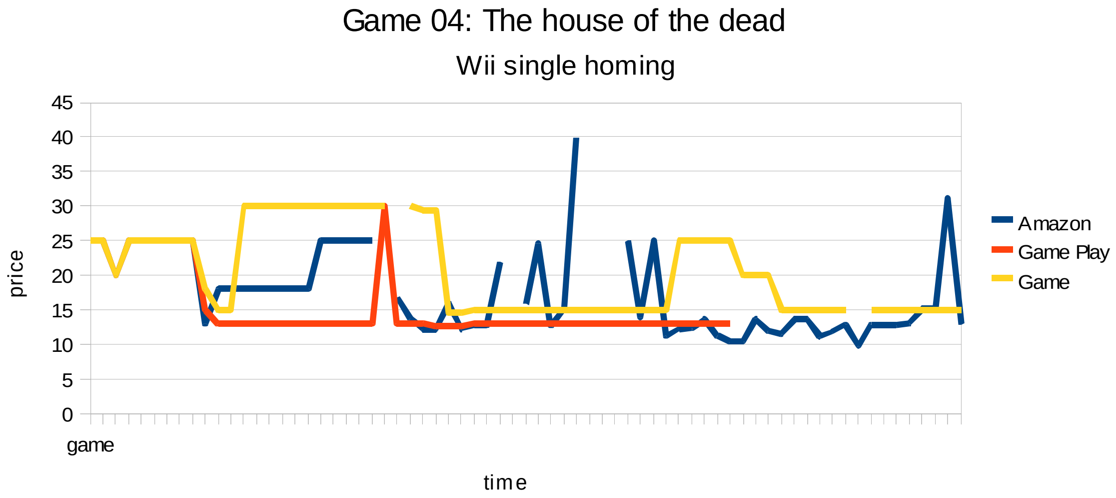
Wii single homing



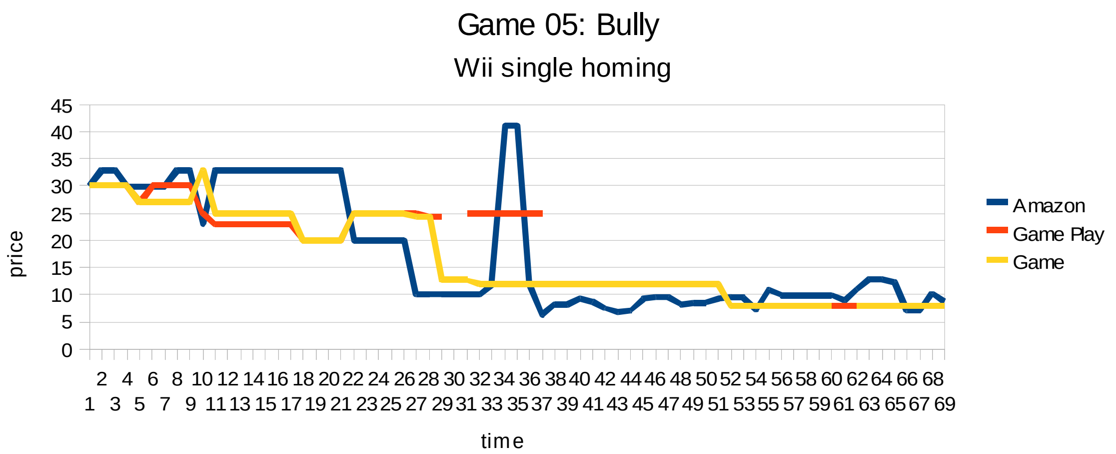
Game 03: Mario & Sonic at the Olympic games

Wii single homing

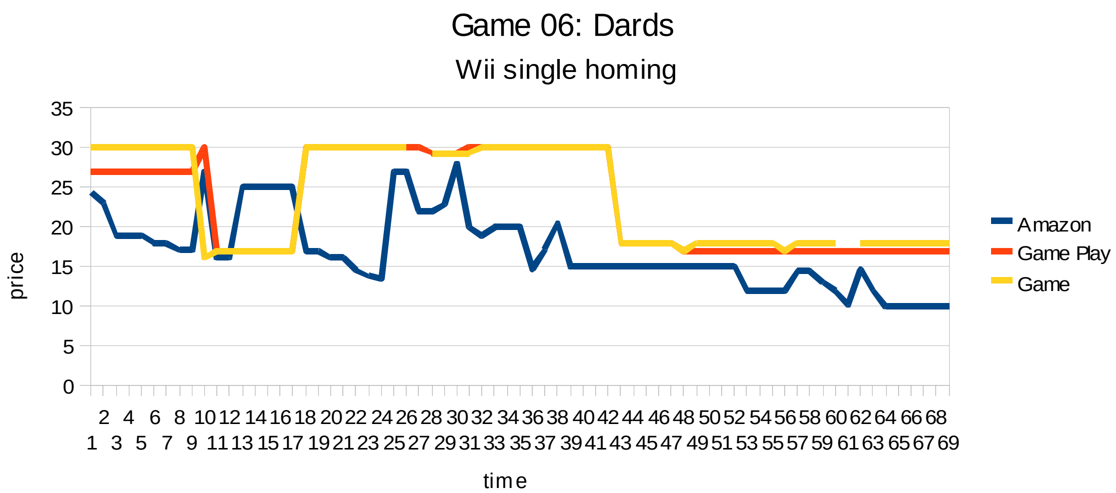




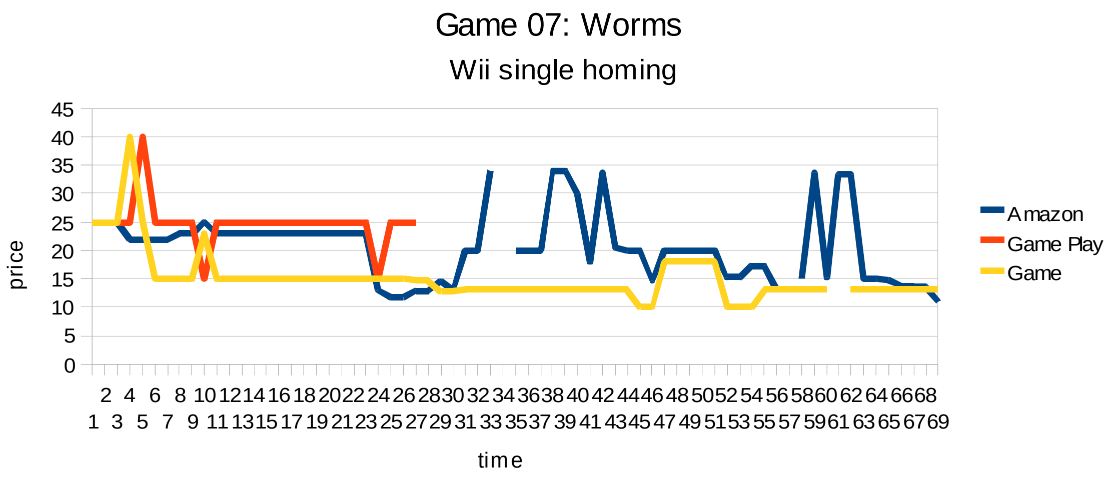
Game 04: The house of the dead
Wii single homing
price
45
40
35
30
25
20
15
10
5
0
game
time
Amazon
Game Play
Game

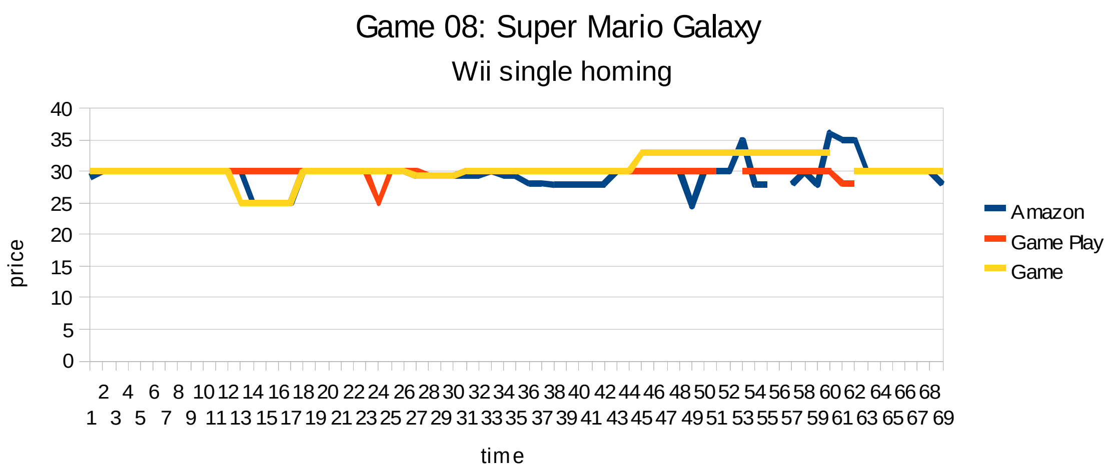


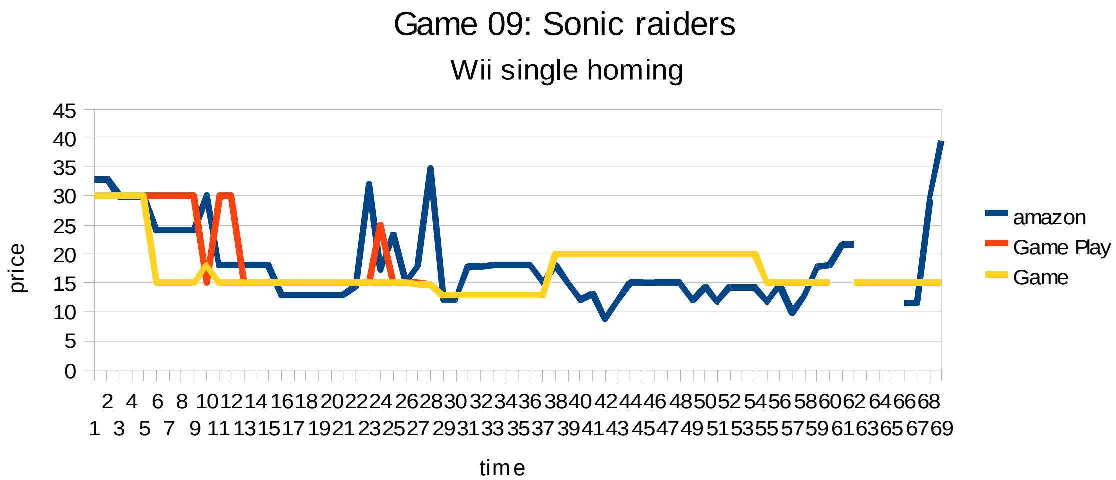
Game 05: Bully
Wii single homing
price
45
40
35
30
25
20
15
10
5
0
time
Amazon
Game Play
Game

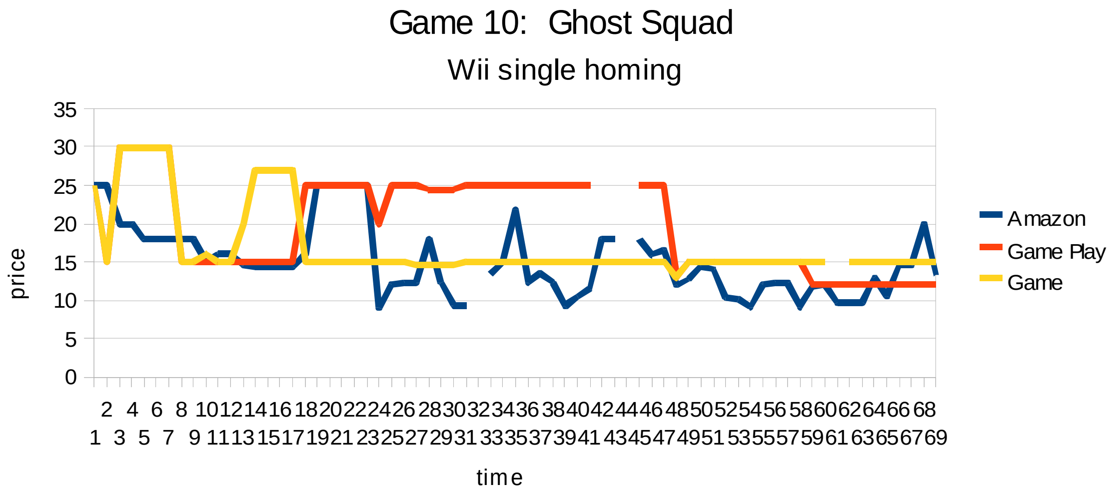


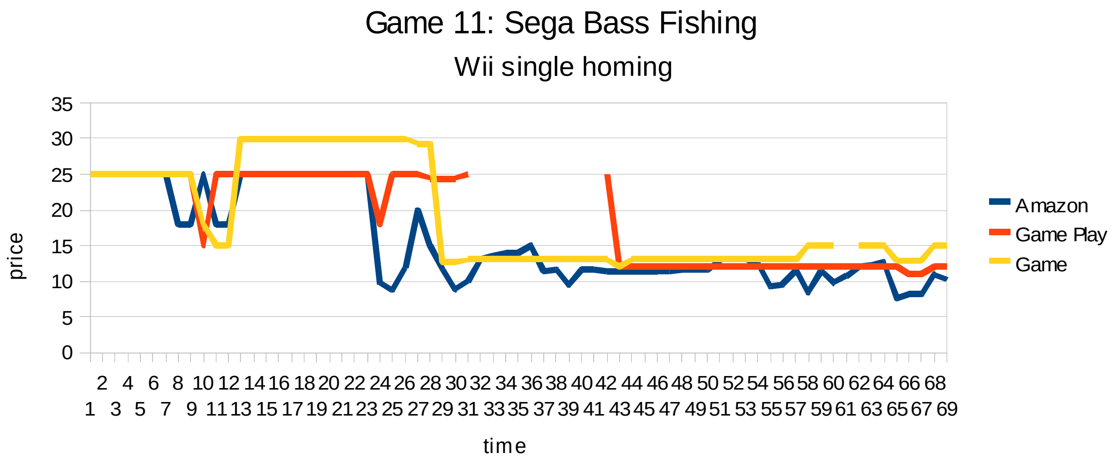
Game 06: Dards
Wii single homing
price
35
30
25
20
15
10
5
0
time
Amazon
Game Play
Game

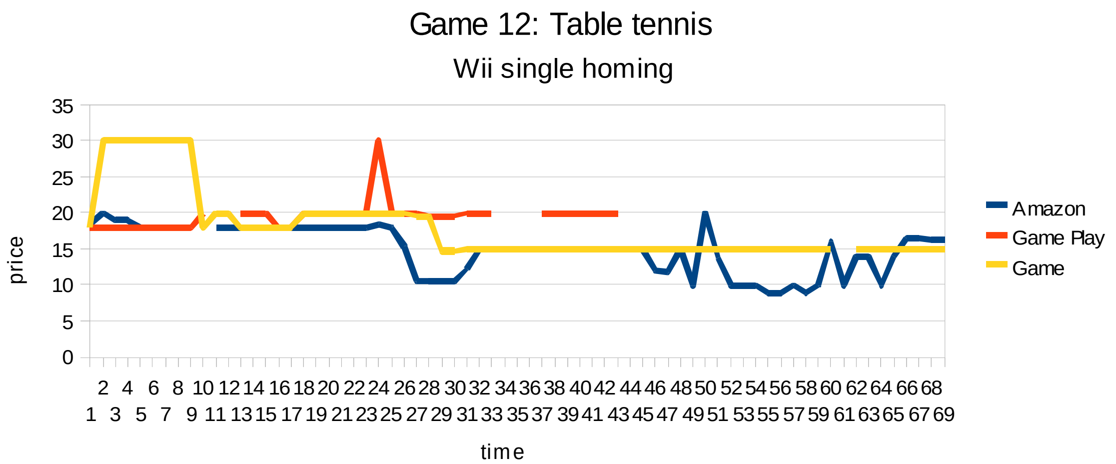

Game 07: Worms
Wii single homing
price
time
Amazon
Game Play
Game

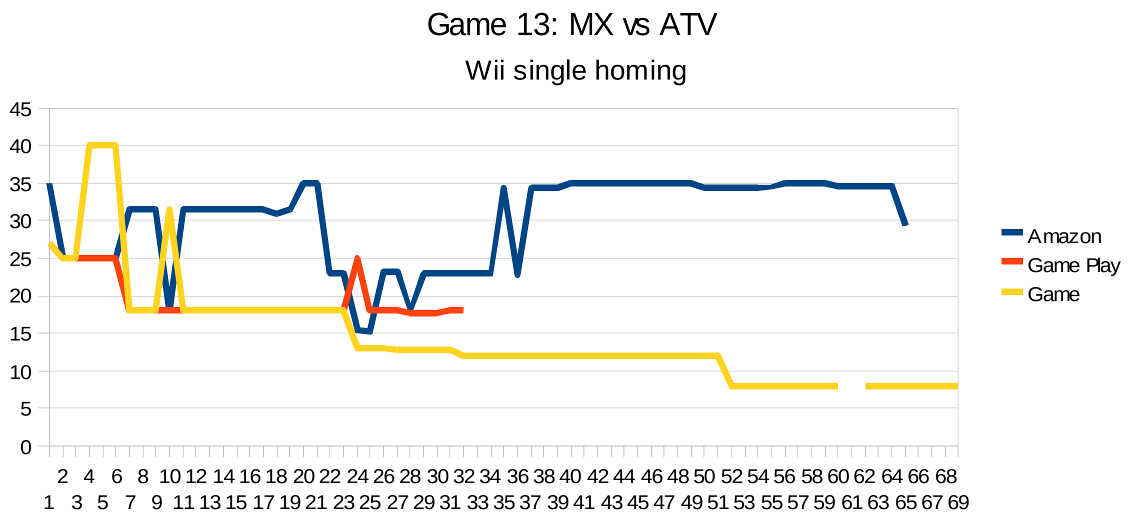

Game 08: Super Mario Galaxy
Wii single homing
price
time
Amazon
Game Play
Game

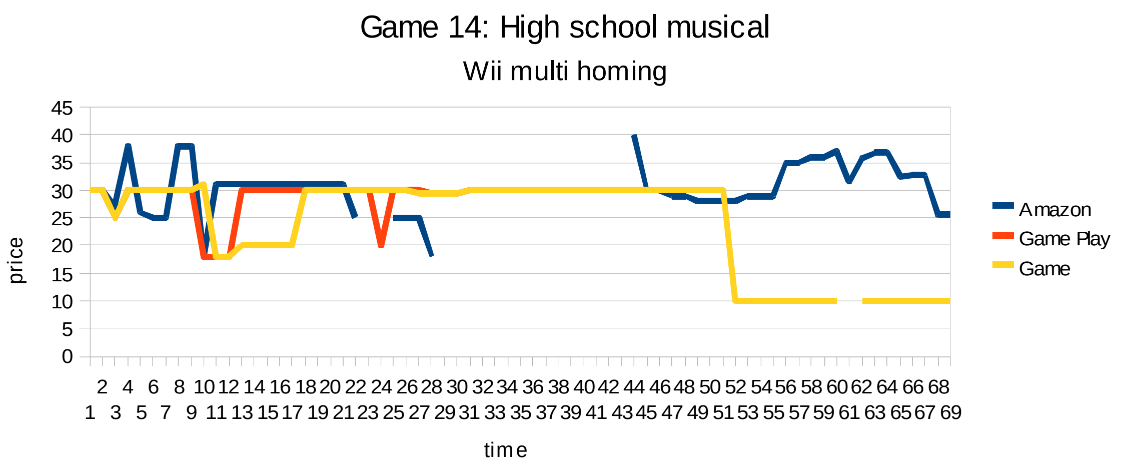

Game 09: Sonic raiders
Wii single homing
price
time
amazon
Game Play
Game

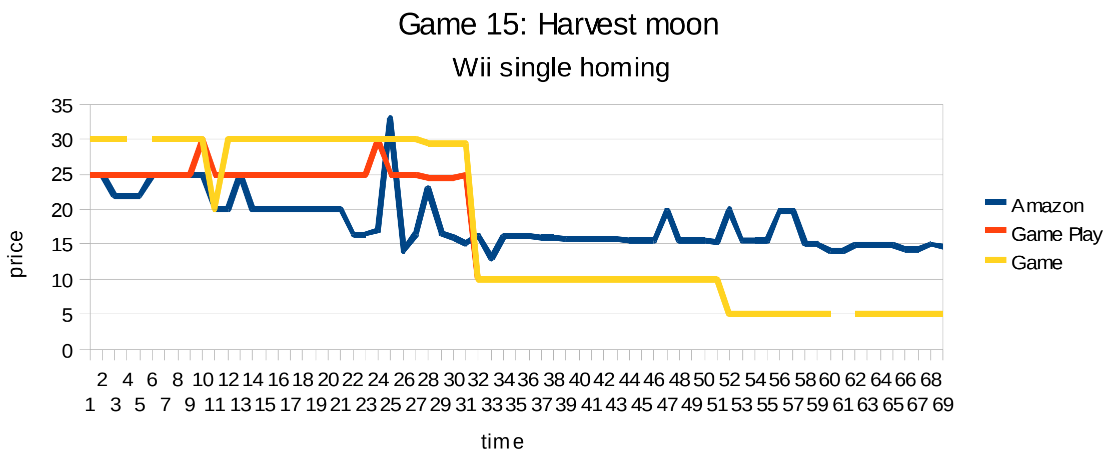

Game 10: Ghost Squad
Wii single homing
price
time
Amazon
Game Play
Game

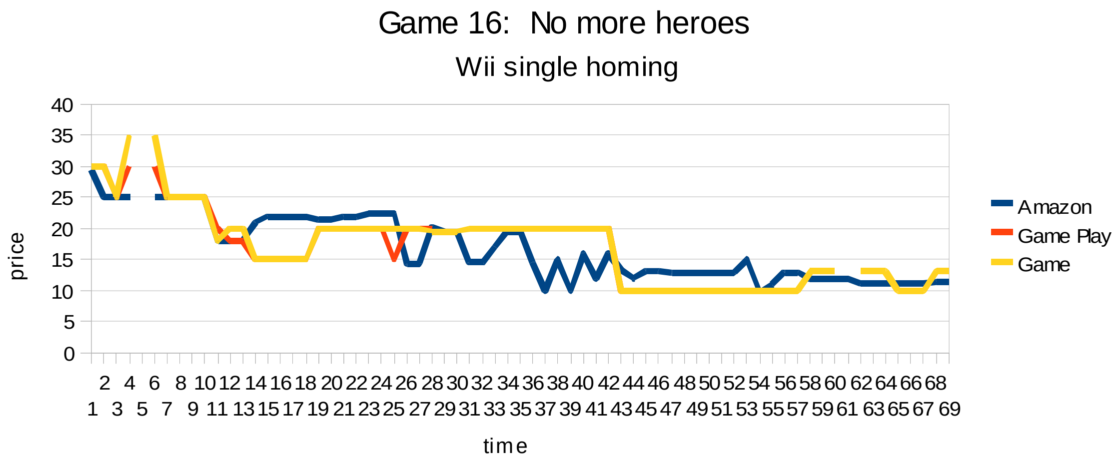

Game 11: Sega Bass Fishing
Wii single homing
price
time
Amazon
Game Play
Game


Game 12: Table tennis
Wii single homing
price
time
Amazon
Game Play
Game

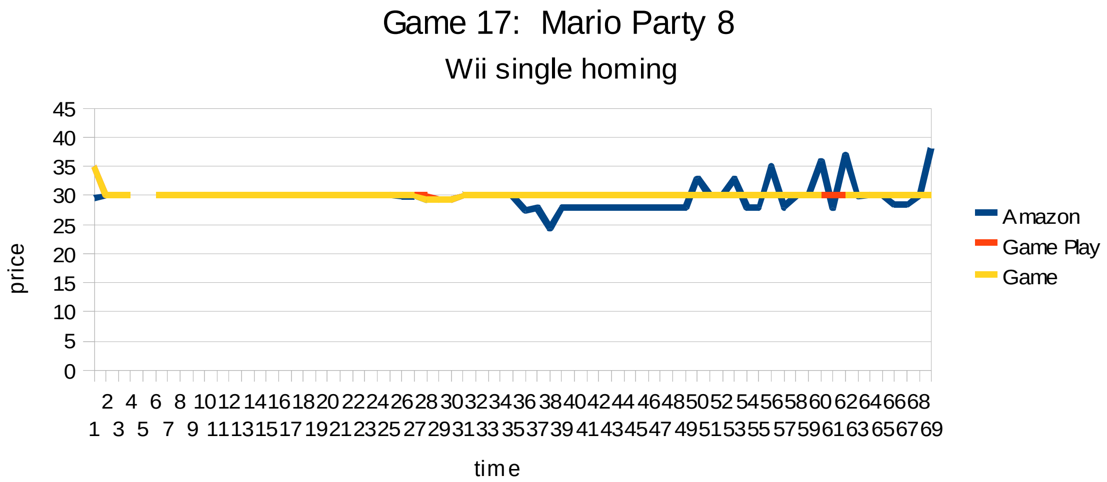

Game 13: MX vs ATV
Wii single homing
Amazon
Game Play
Game


Game 14: High school musical
Wii multi homing
price
time
Amazon
Game Play
Game

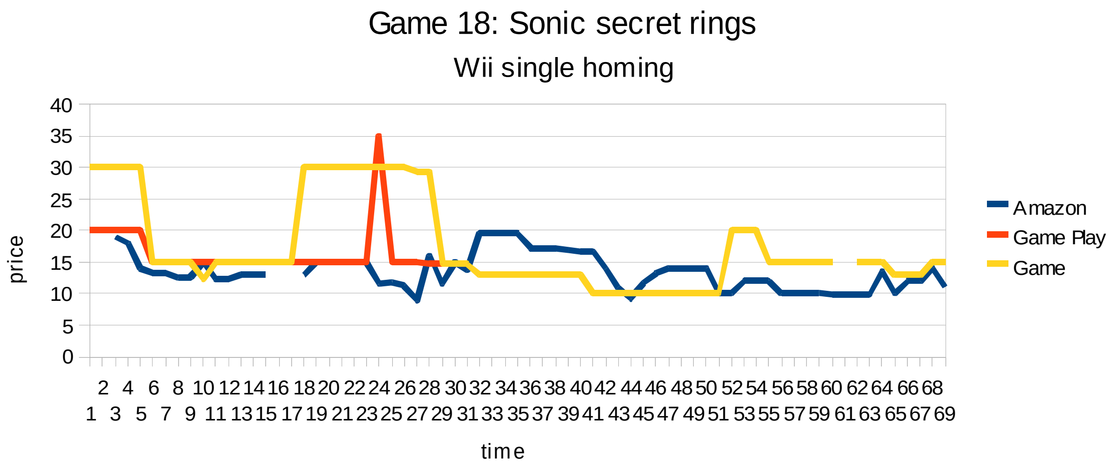

Game 15: Harvest moon
Wii single homing
price
time
Amazon
Game Play
Game



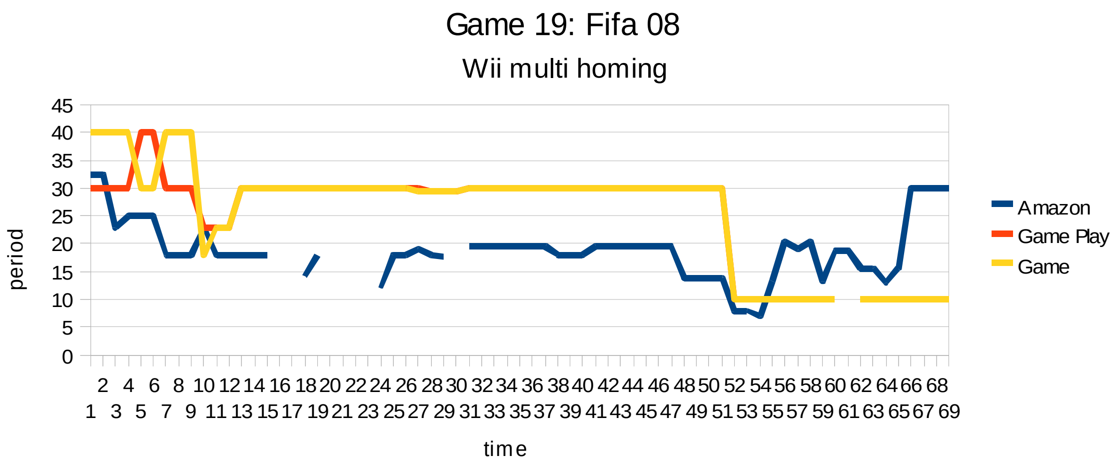
Game 16: No more heroes
Wii single homing
price
time
Amazon
Game Play
Game

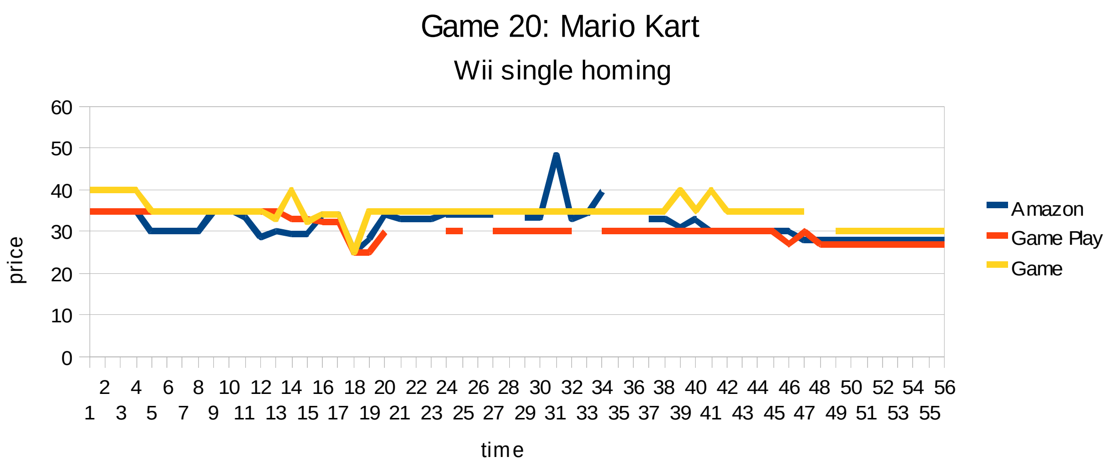


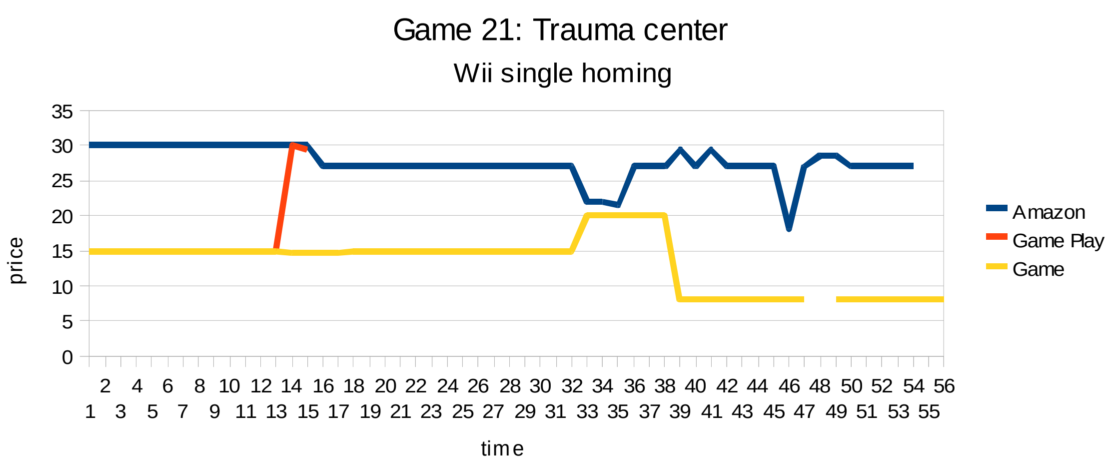
Game 17: Mario Party 8
Wii single homing
price
time
Amazon
Game Play
Game

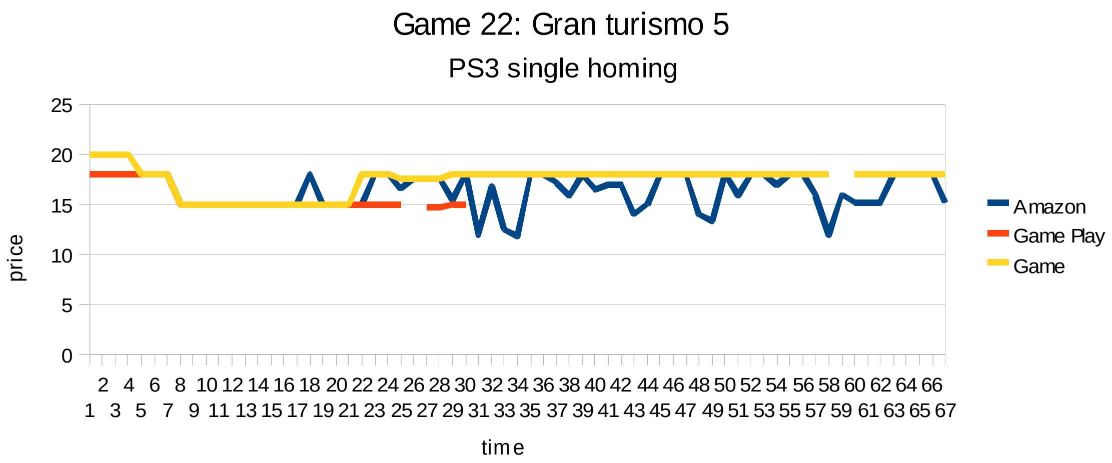


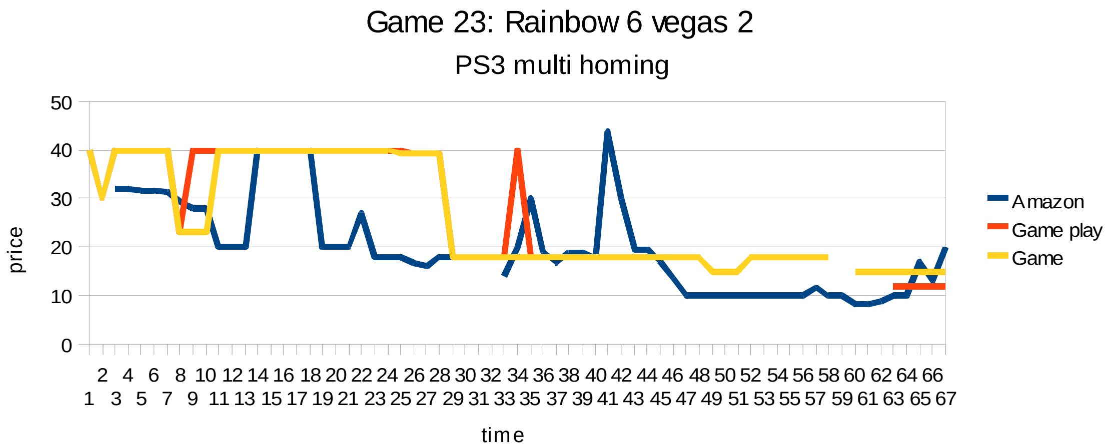
Game 18: Sonic secret rings
Wii single homing
price
time
Amazon
Game Play
Game

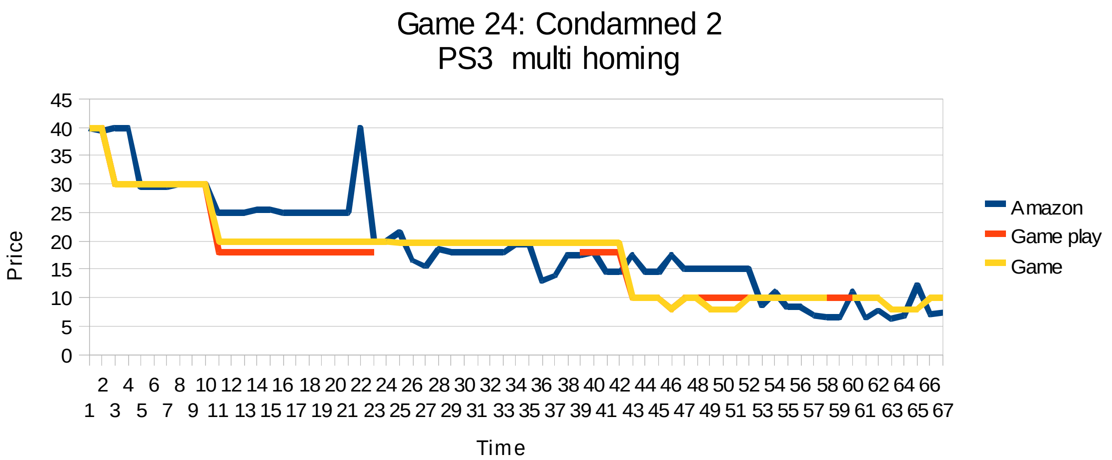

Game 19: Fifa 08
Wii multi homing
period
time
Amazon
Game Play
Game

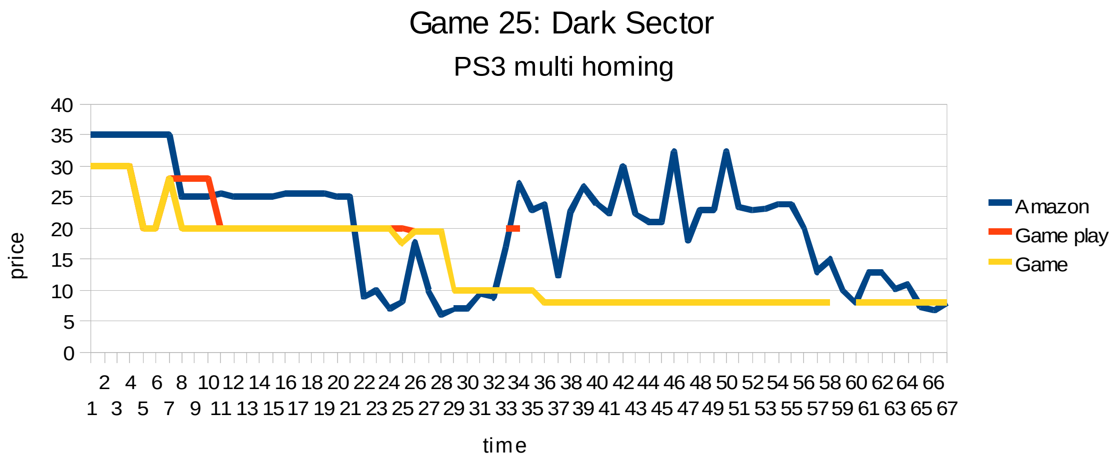

Game 20: Mario Kart
Wii single homing
price
time
Amazon
Game Play
Game

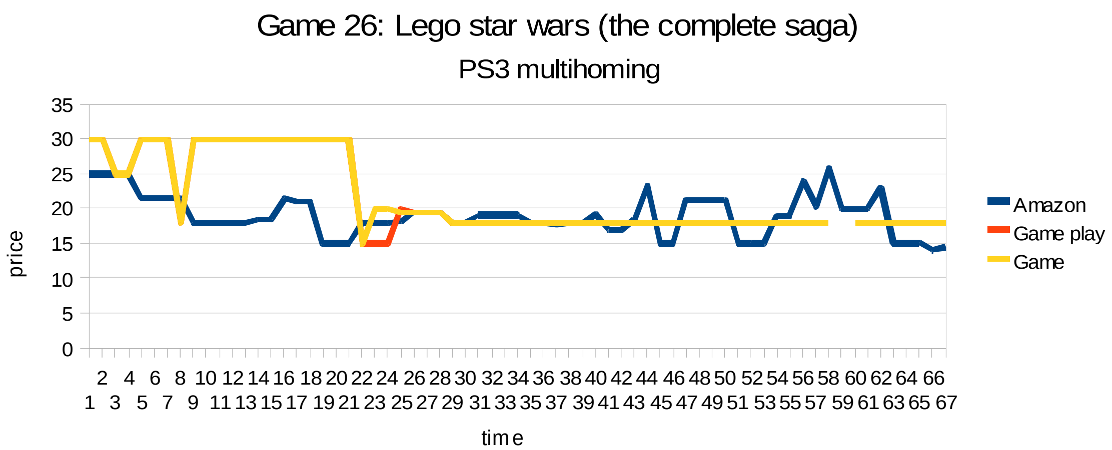

Game 21: Trauma center
Wii single homing
price
time
Amazon
Game Play
Game

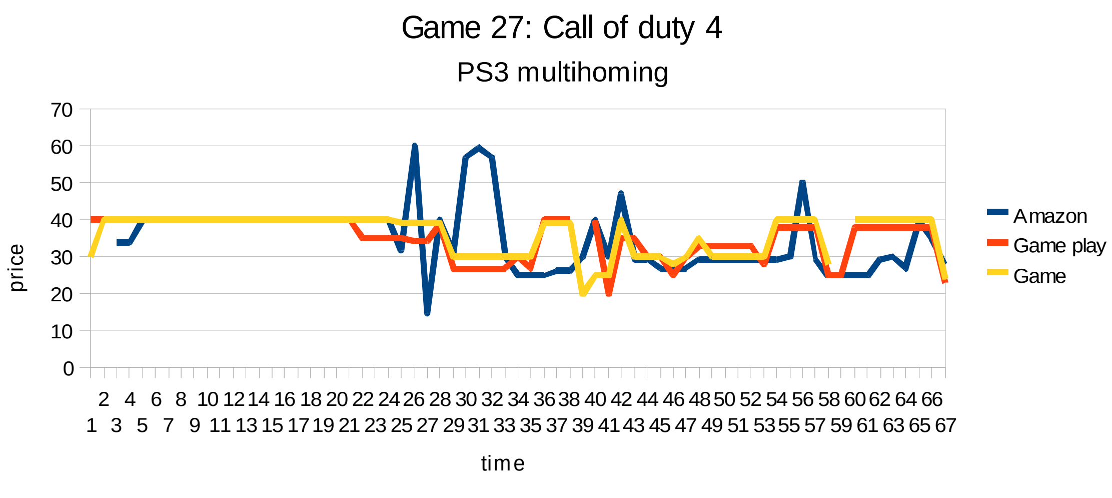

Game 22: Gran turismo 5
PS3 single homing
price
time
Amazon
Game Play
Game

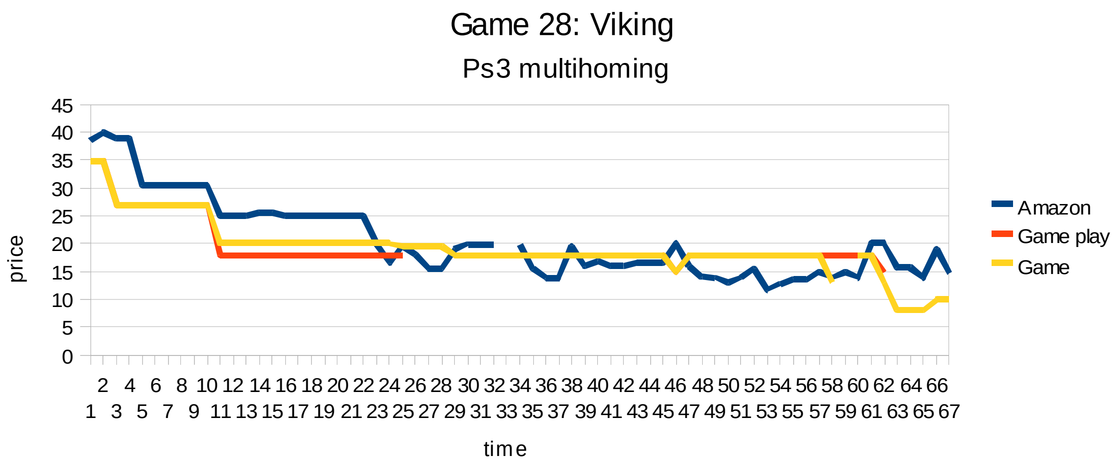

Game 23: Rainbow 6 vegas 2
PS3 multi homing
price
time
Amazon
Game play
Game

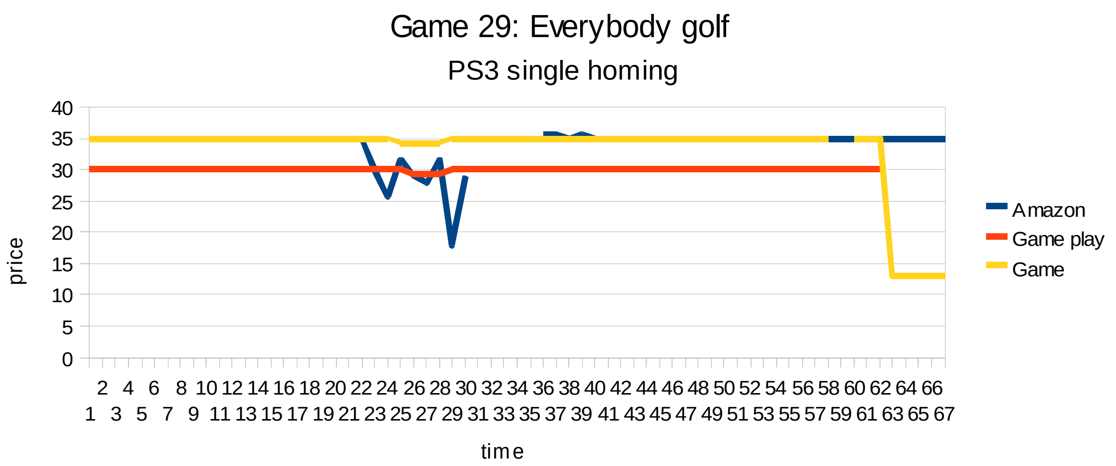

Game 24: Condamned 2
PS3 multi homing
Price
Time
Amazon
Game play
Game

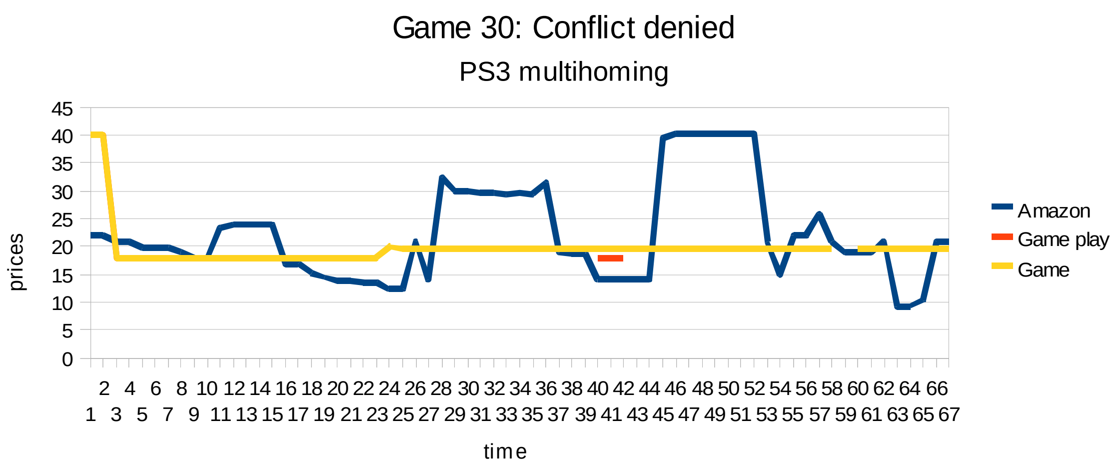

Game 25: Dark Sector
PS3 multi homing
price
time
Amazon
Game play
Game

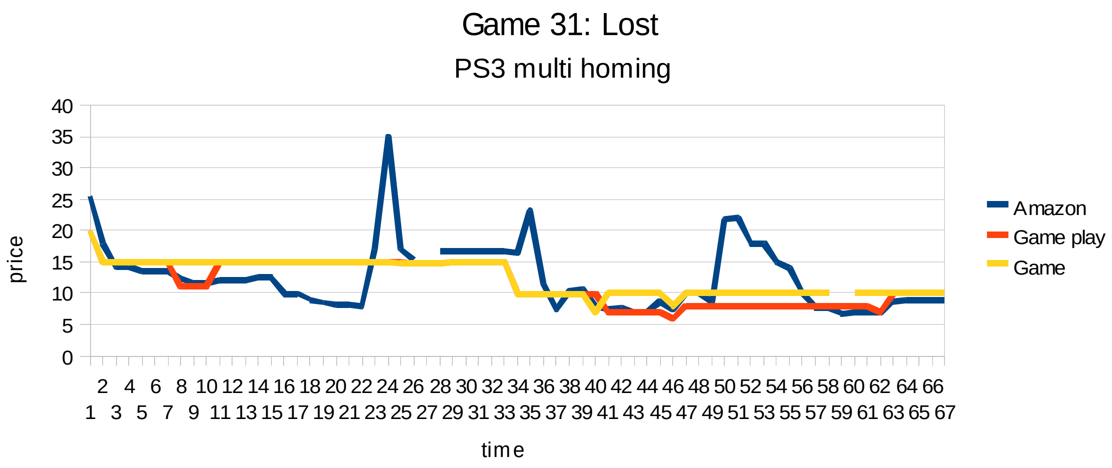

Game 26: Lego star wars (the complete saga)
PS3 multihoming
price
time
Amazon
Game play
Game

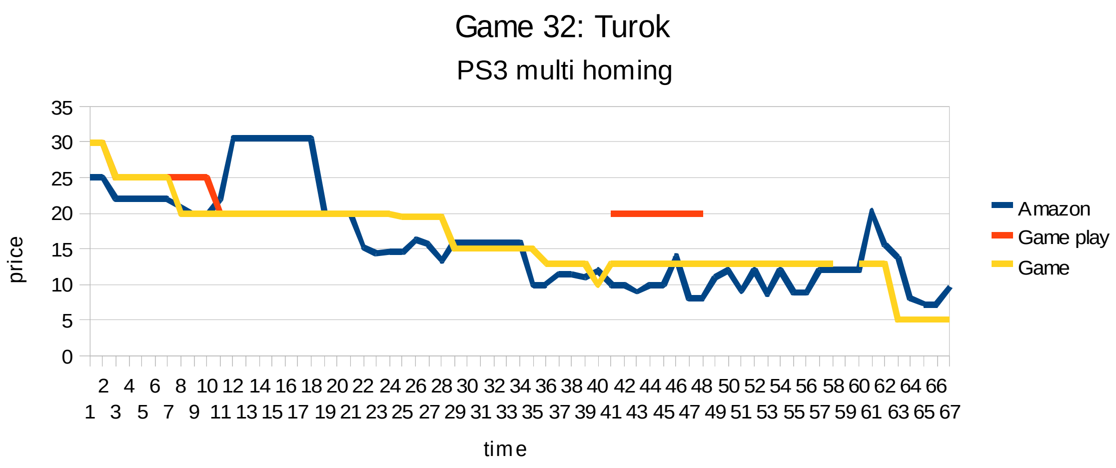

Game 27: Call of duty 4
PS3 multihoming
price
time
Amazon
Game play
Game

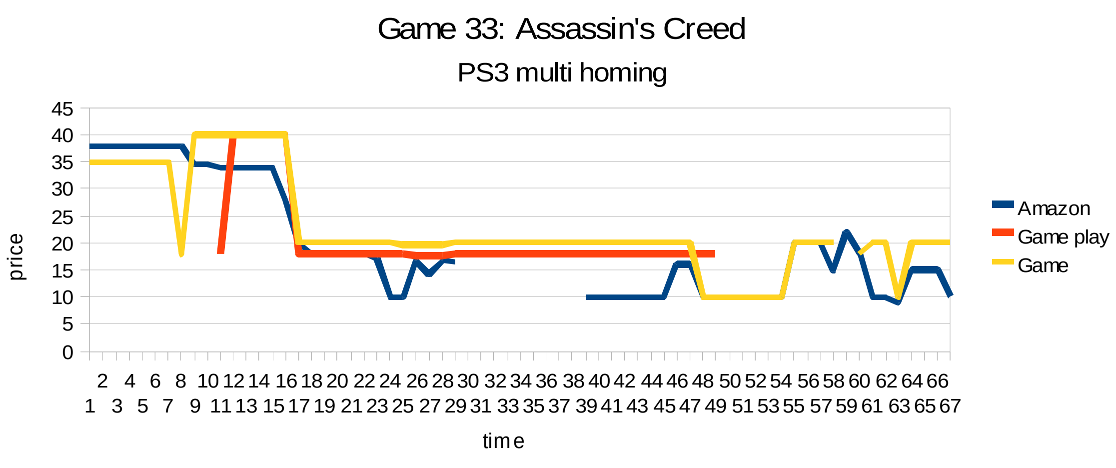

Game 28: Viking
Ps3 multihoming
price
time
Amazon
Game play
Game

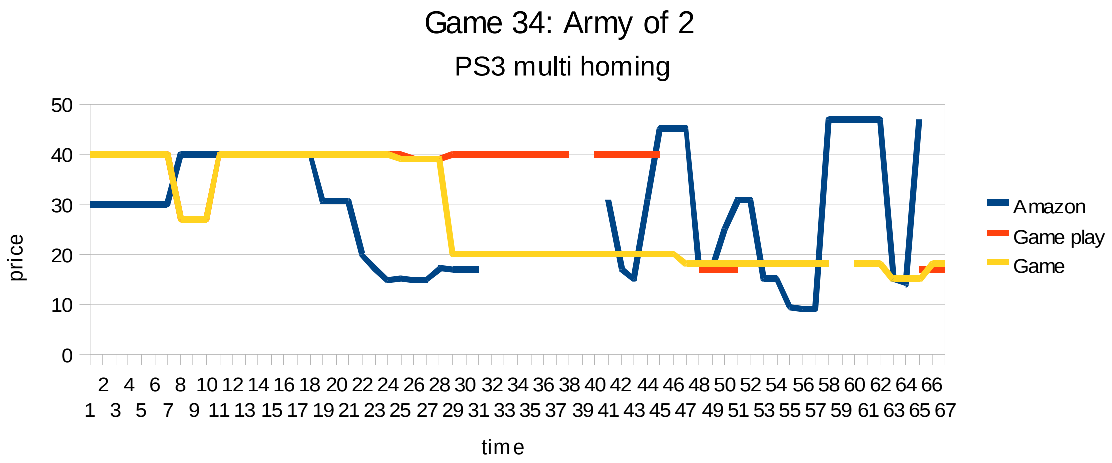

Game 29: Everybody golf
PS3 single homing
price
time
Amazon
Game play
Game

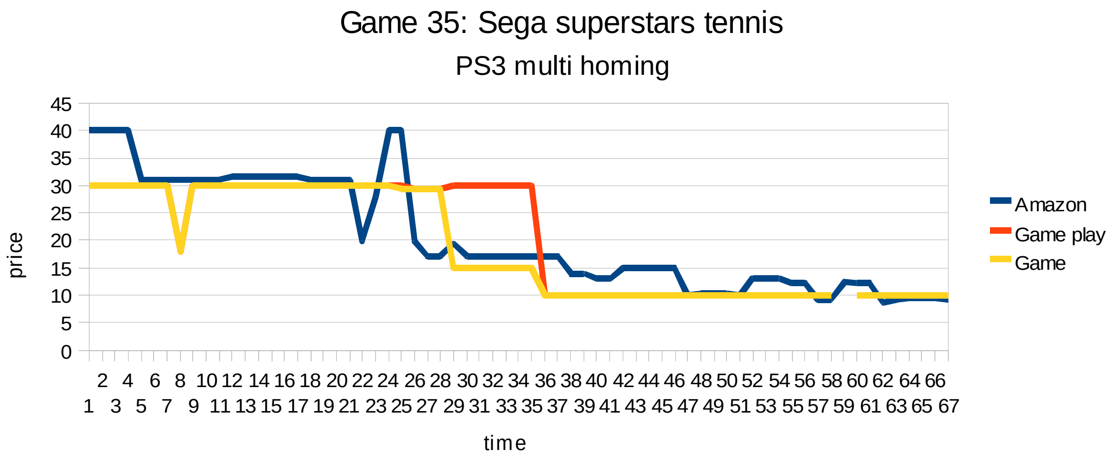

Game 30: Conflict denied
PS3 multihoming
prices
time
Amazon
Game play
Game

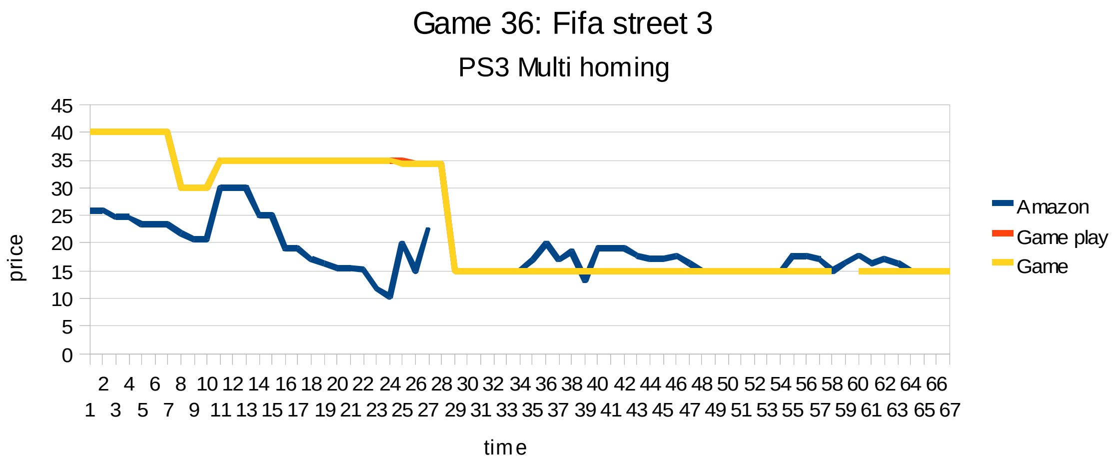

Game 31: Lost
PS3 multi homing
price
time
Amazon
Game play
Game

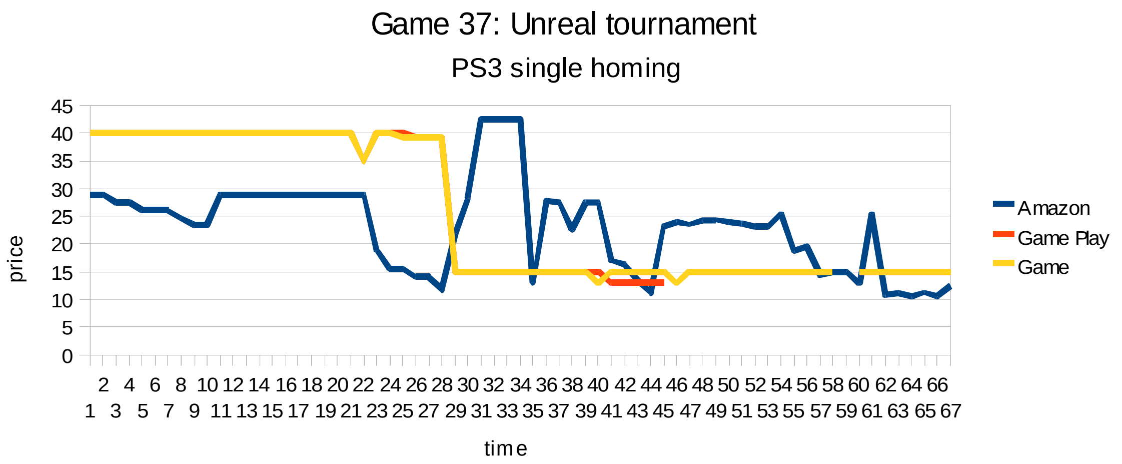

Game 32: Turok
PS3 multi homing
price
time
Amazon
Game play
Game


Game 33: Assassin's Creed
PS3 multi homing
price
time
Amazon
Game play
Game

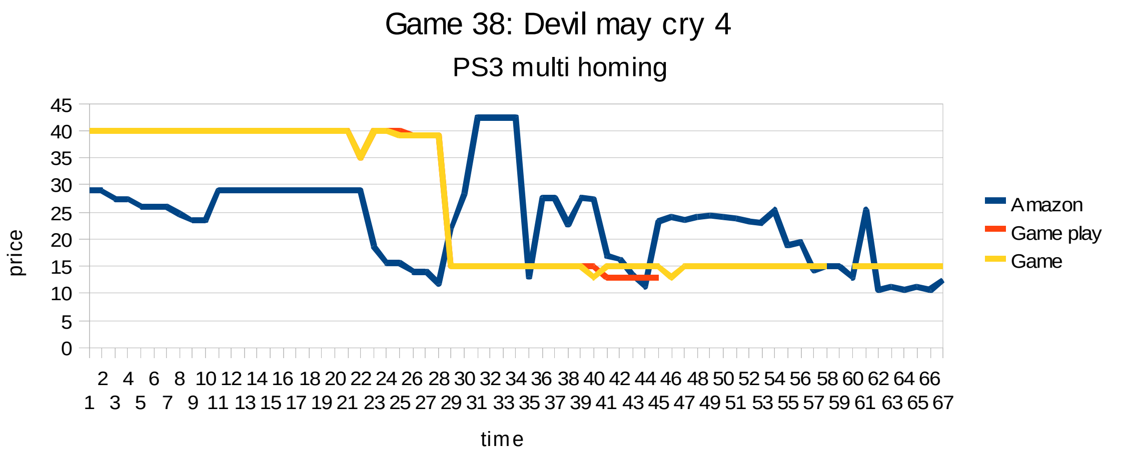

Game 34: Army of 2
PS3 multi homing
price
time
Amazon
Game play
Game


Game 35: Sega superstars tennis
PS3 multi homing
price
time
Amazon
Game play
Game

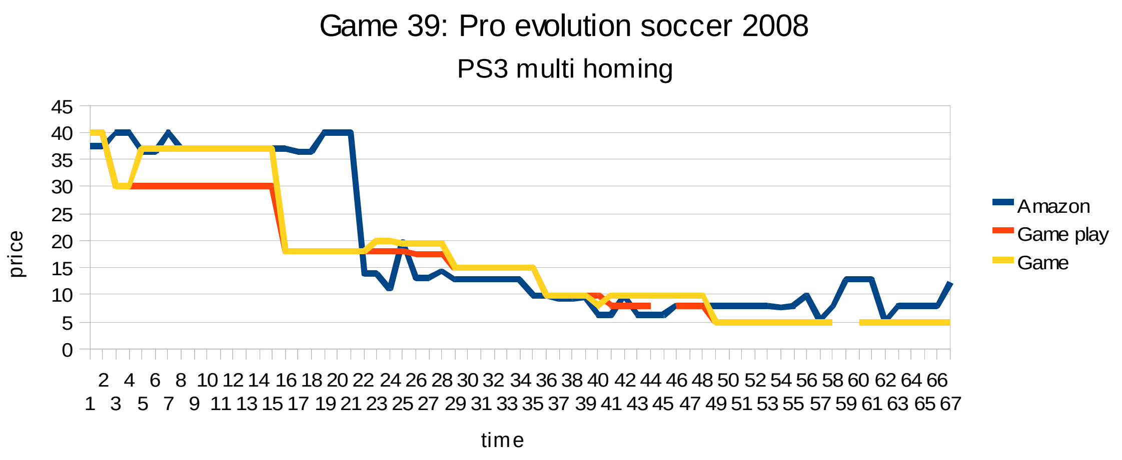

Game 36: Fifa street 3
PS3 Multi homing
price
time
Amazon
Game play
Game



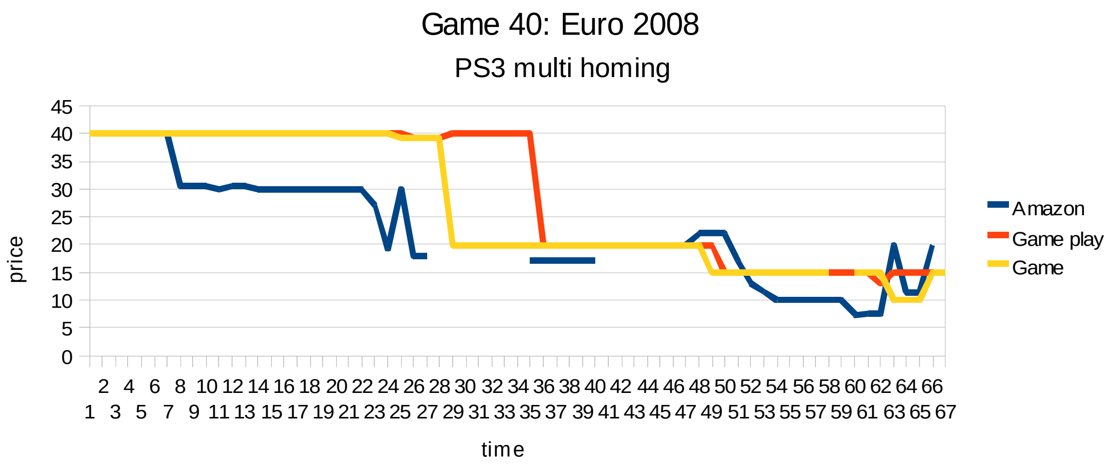
Game 37: Unreal tournament
PS3 single homing
price
time
Amazon
Game Play
Game

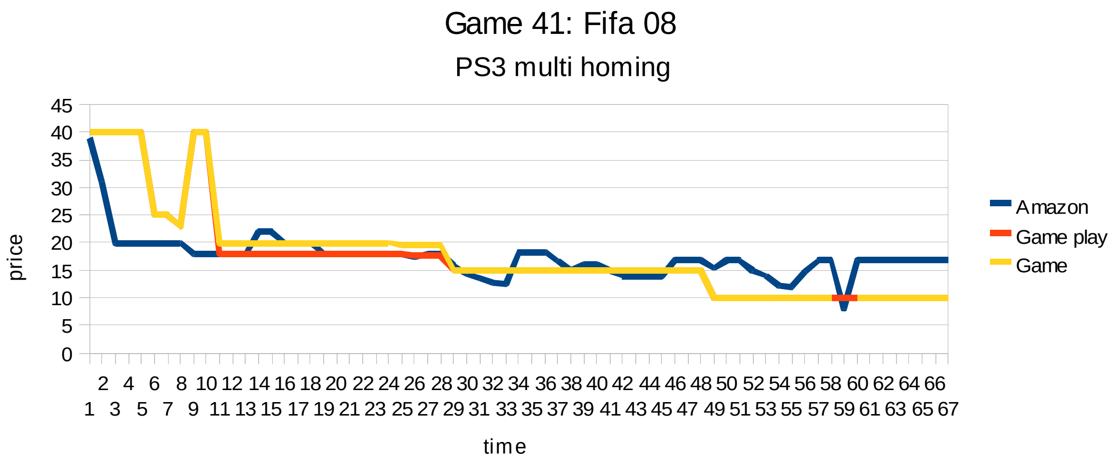


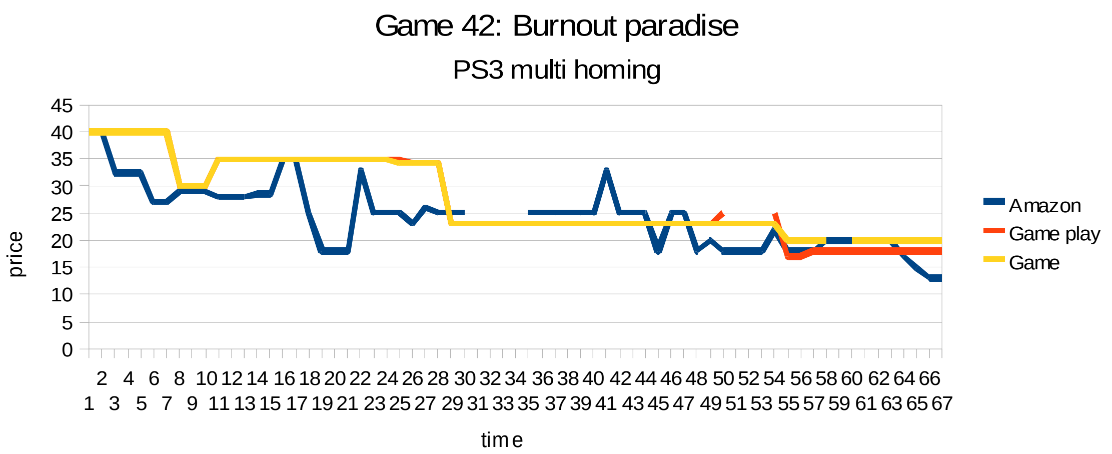
Game 38: Devil may cry 4
PS3 multi homing
price
time
Amazon
Game play
Game

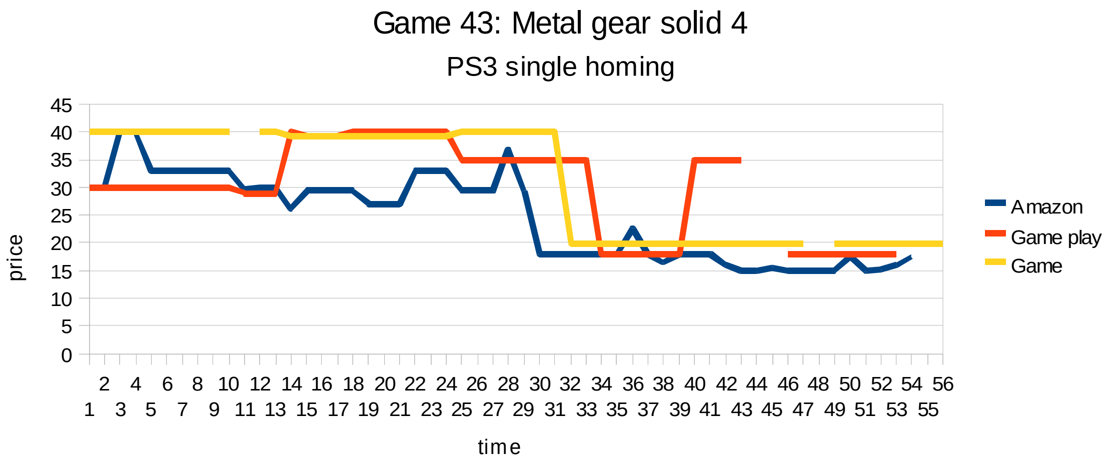


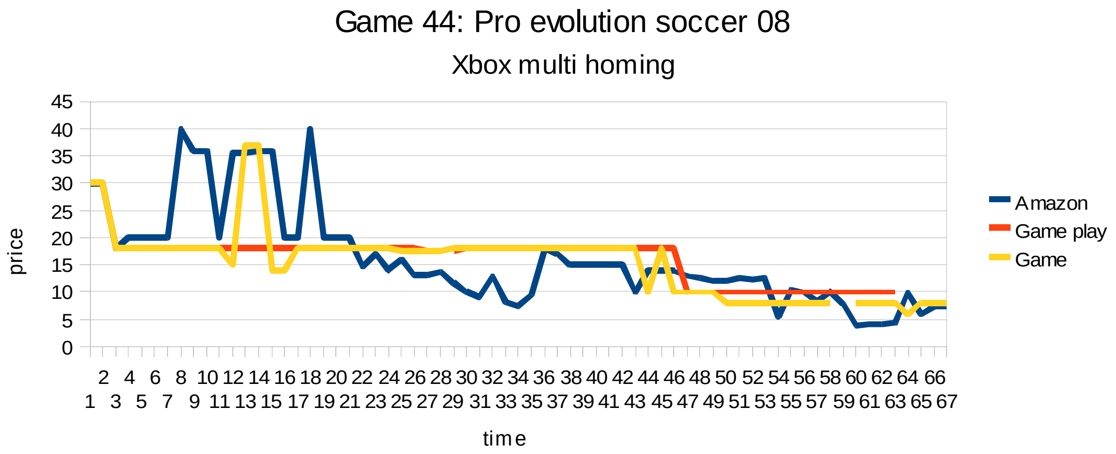
Game 39: Pro evolution soccer 2008
PS3 multi homing
price
time
Amazon
Game play
Game

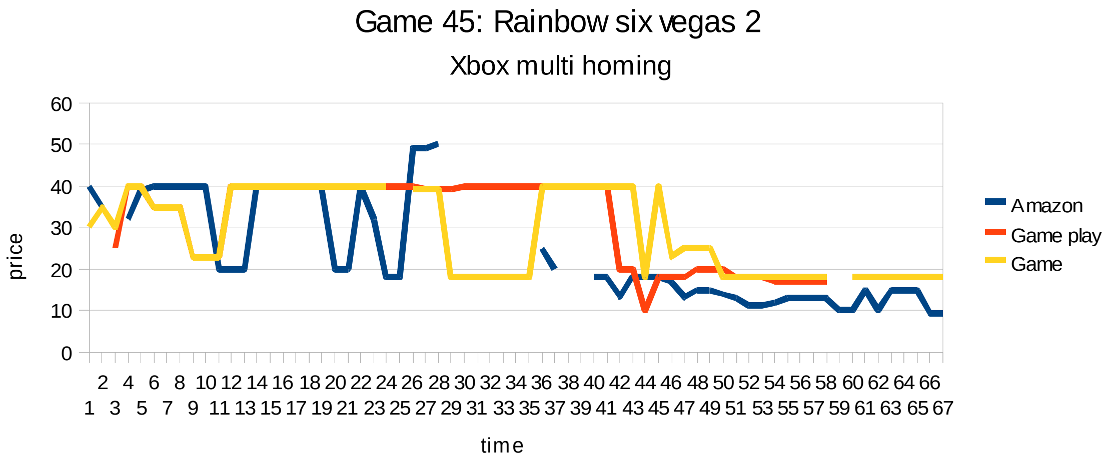

Game 40: Euro 2008
PS3 multi homing
price
time
Amazon
Game play
Game

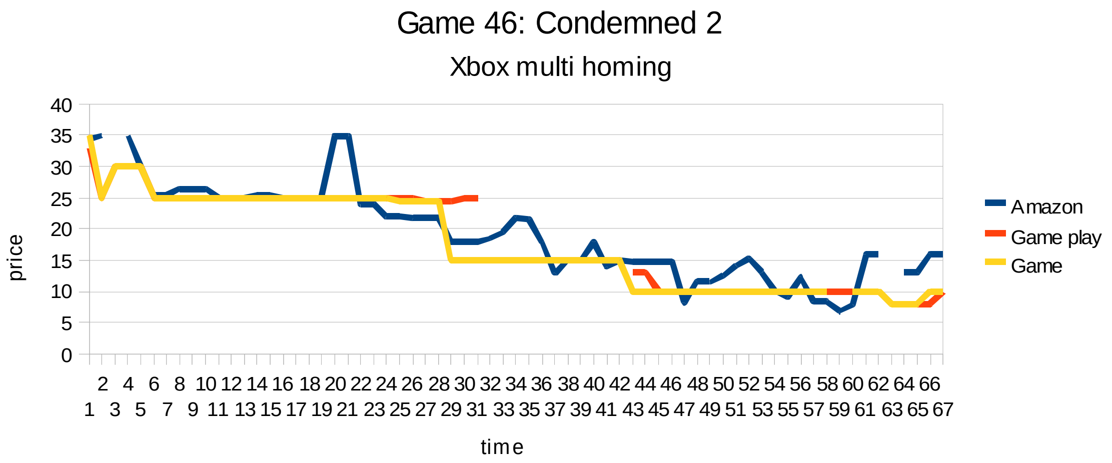

Game 41: Fifa 08
PS3 multi homing
price
time
Amazon
Game play
Game

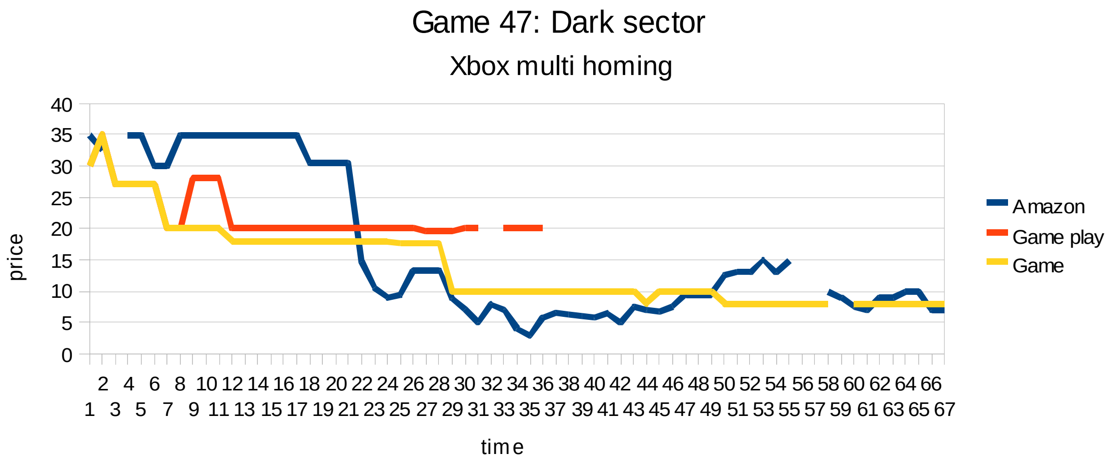

Game 42: Burnout paradise
PS3 multi homing
price
time
Amazon
Game play
Game

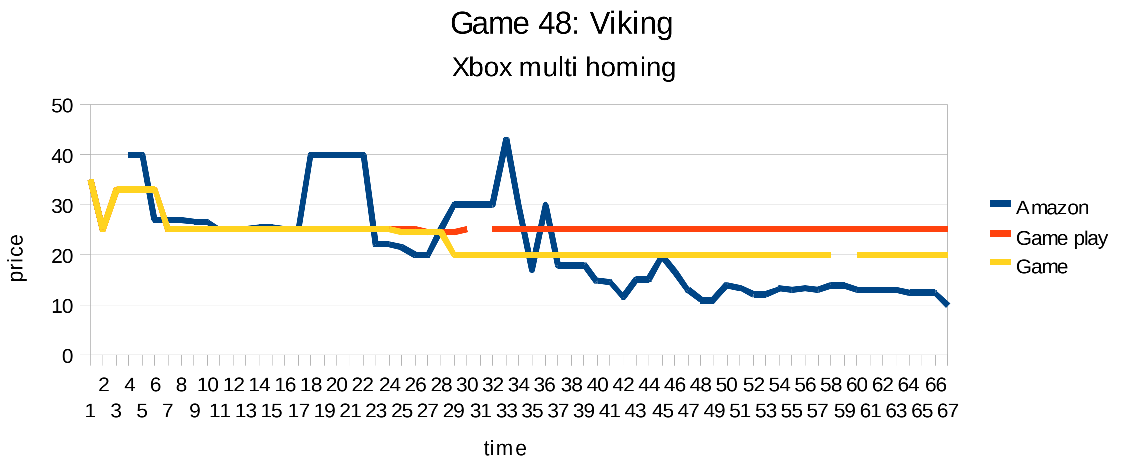

Game 43: Metal gear solid 4
PS3 single homing
price
time
Amazon
Game play
Game
0
5
10
15
20
25
30
35
40
45

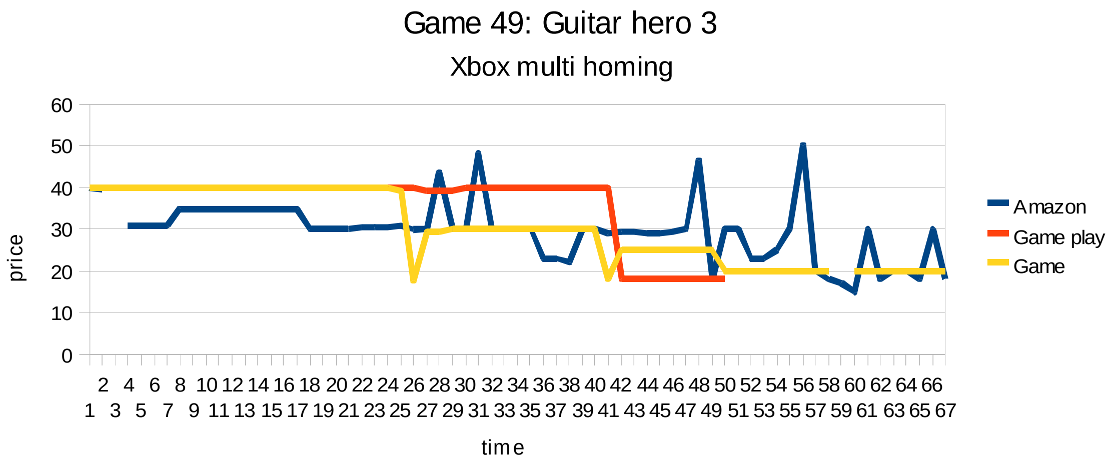

Game 44: Pro evolution soccer 08
Xbox multi homing
price
time
Amazon
Game play
Game
0
5
10
15
20
25
30
35
40
45

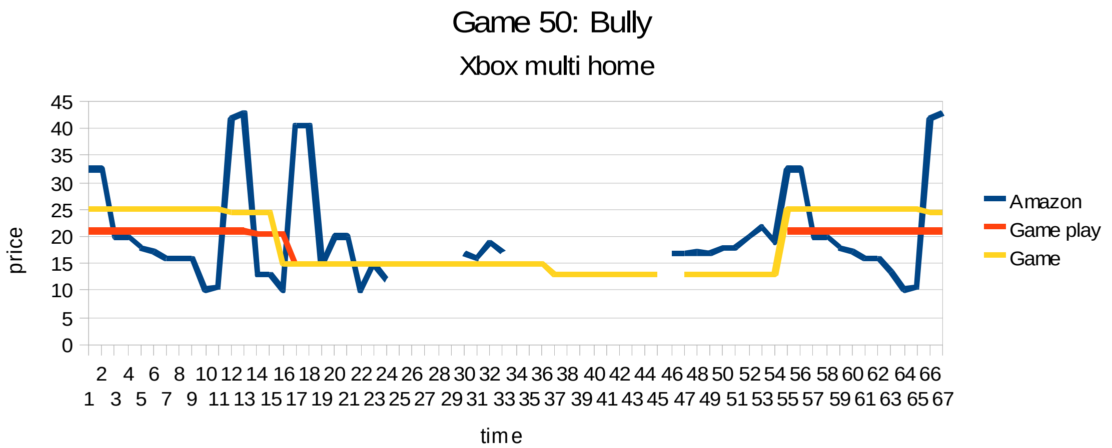

Game 45: Rainbow six vegas 2
Xbox multi homing
price
time
Amazon
Game play
Game
0
10
20
30
40
50
60

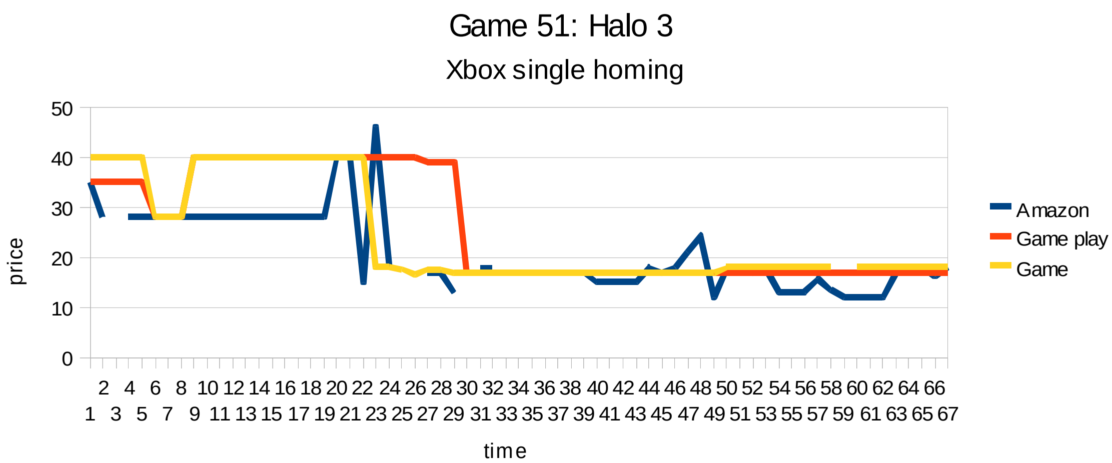

Game 46: Condemned 2
Xbox multi homing
price
time
Amazon
Game play
Game

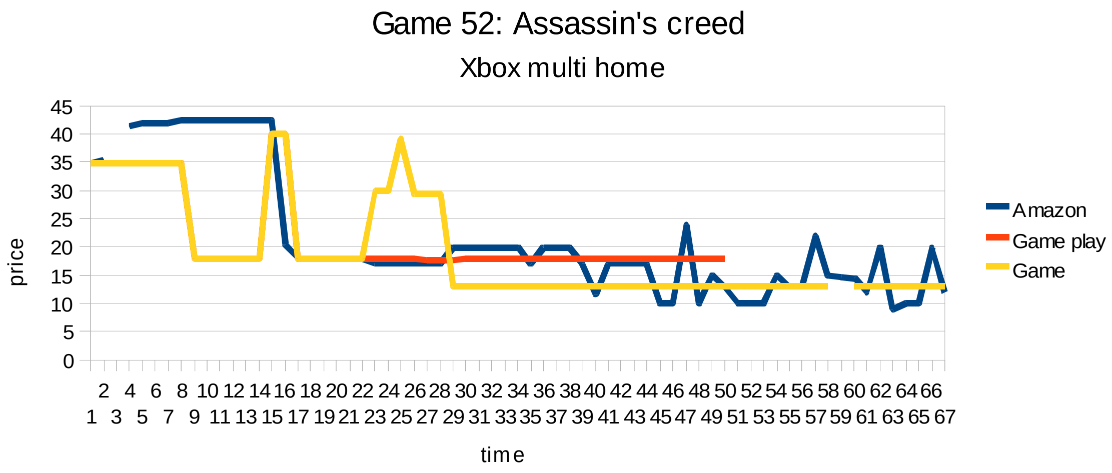

Game 47: Dark sector
Xbox multi homing
price
time
Amazon
Game play
Game


Game 48: Viking
Xbox multi homing
price
time
Amazon
Game play
Game

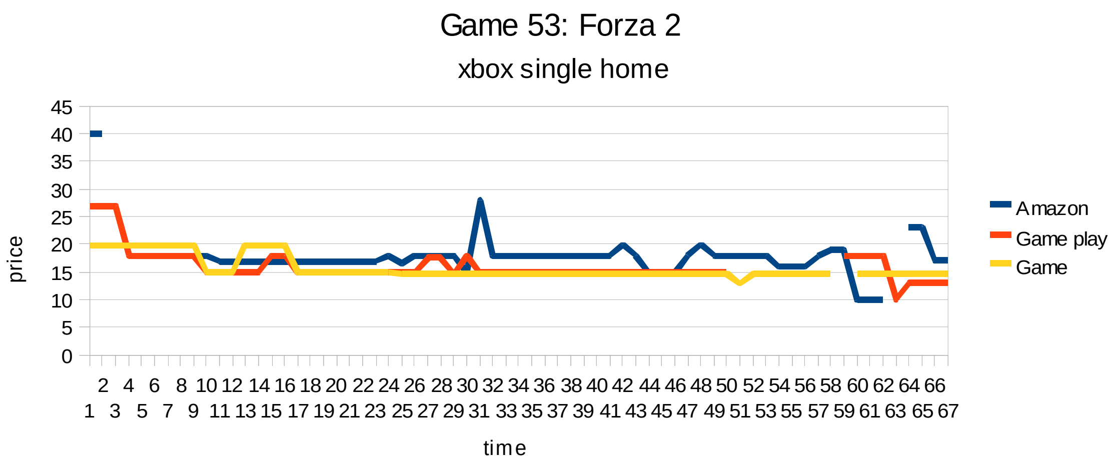

Game 49: Guitar hero 3
Xbox multi homing
60
50
40
30
20
10
0
price
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
time
Amazon
Game play
Game


Game 50: Bully
Xbox multi home
45
40
35
30
25
20
15
10
5
0
price
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
time
Amazon
Game play
Game

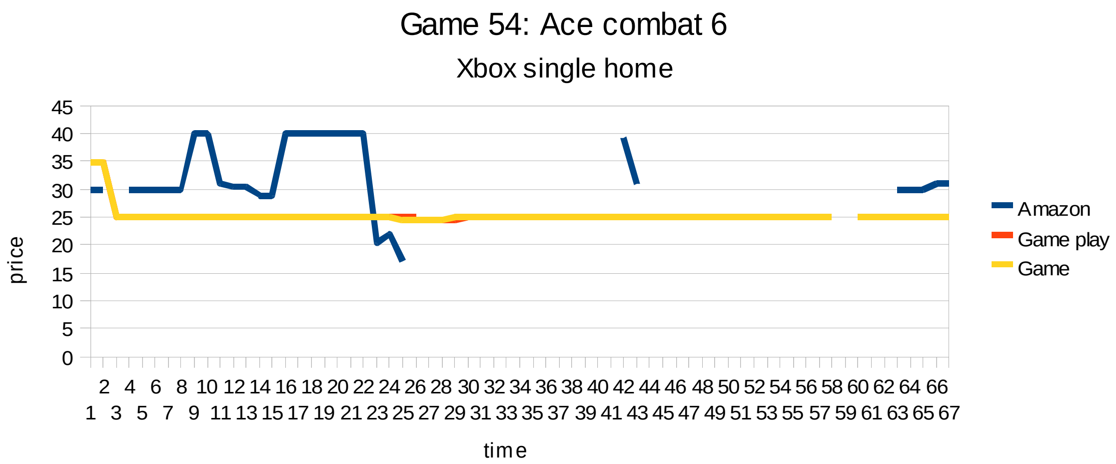

Game 51: Halo 3
Xbox single homing
50
40
30
20
10
0
price
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
time
Amazon
Game play
Game



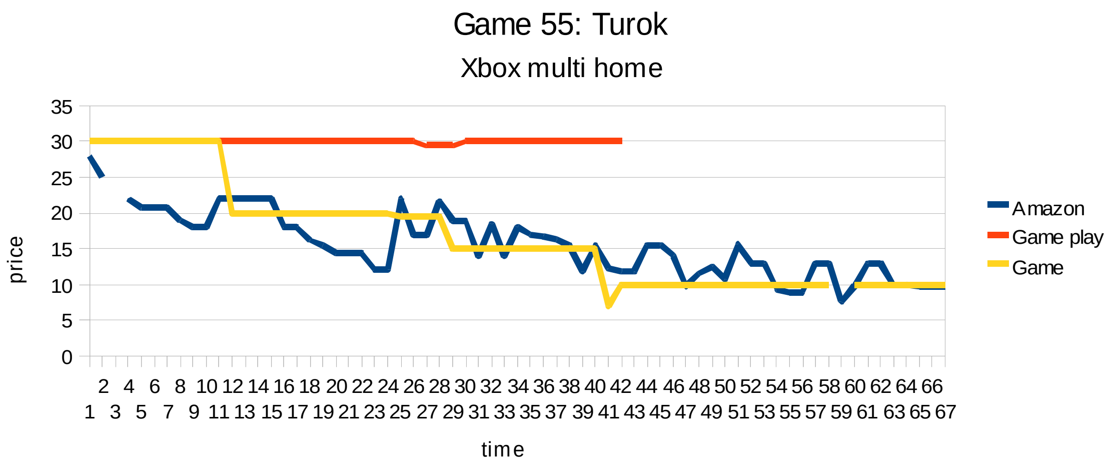
Game 52: Assassin's creed
Xbox multi home
price
45
40
35
30
25
20
15
10
5
0
time
Amazon
Game play
Game

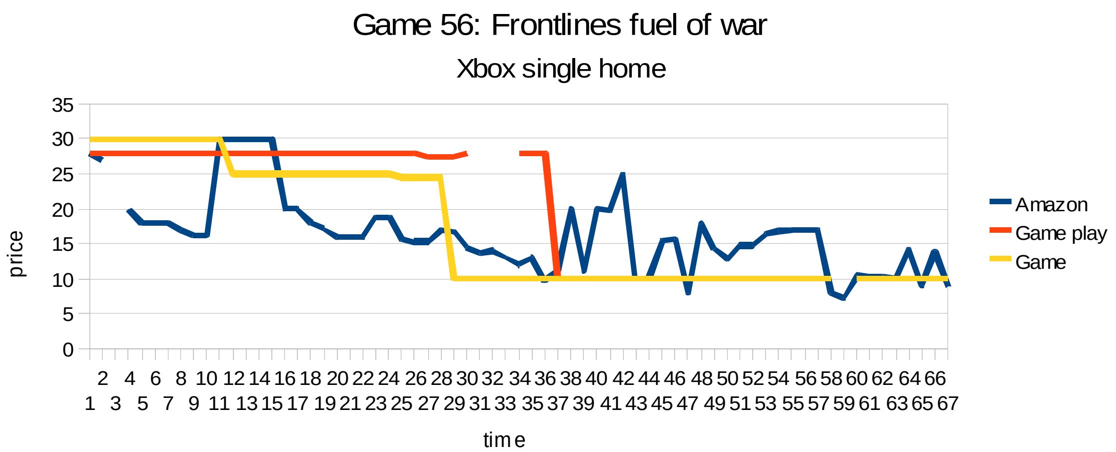


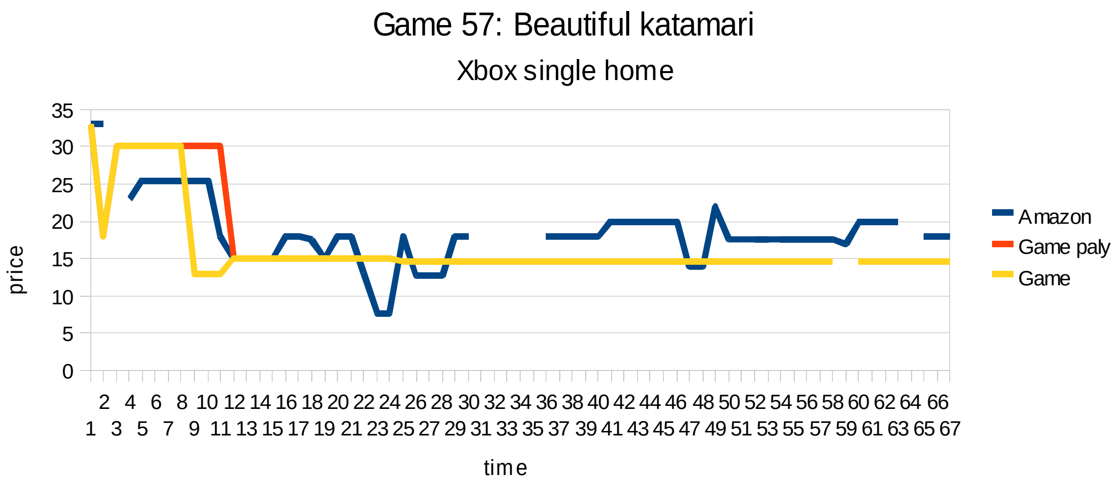
Game 53: Forza 2
xbox single home
price
45
40
35
30
25
20
15
10
5
0
time
Amazon
Game play
Game

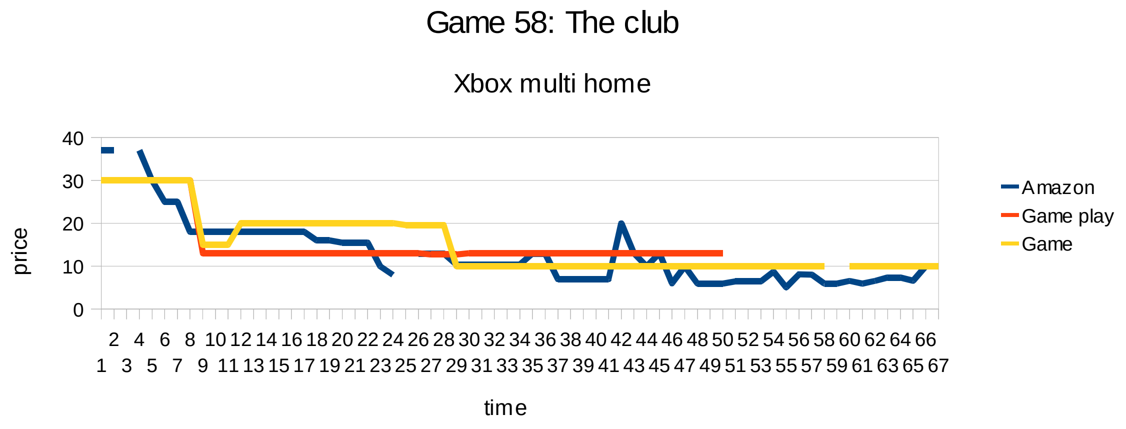


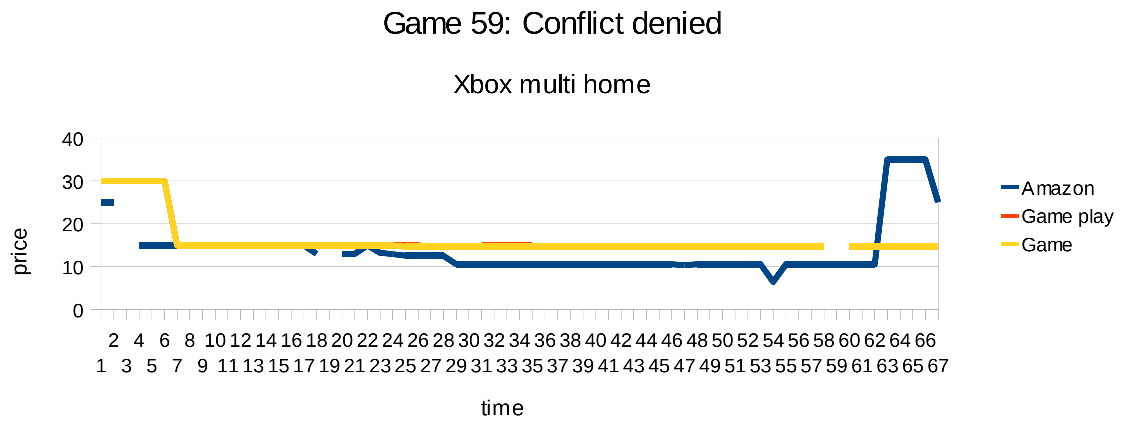
Game 54: Ace combat 6
Xbox single home
price
45
40
35
30
25
20
15
10
5
0
time
Amazon
Game play
Game

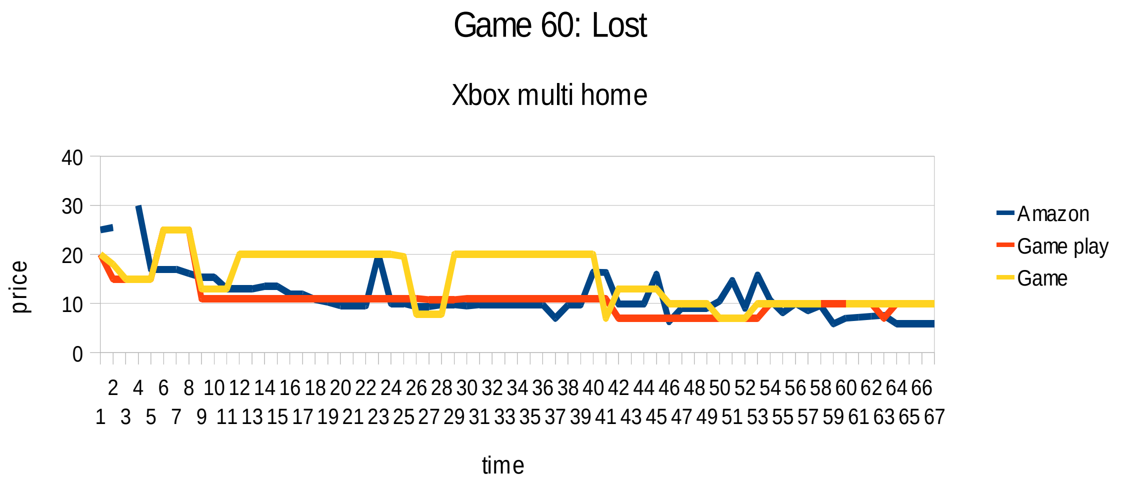

Game 55: Turok
Xbox multi home
price
0 5 10 15 20 25 30 35
time
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Amazon
Game play
Game

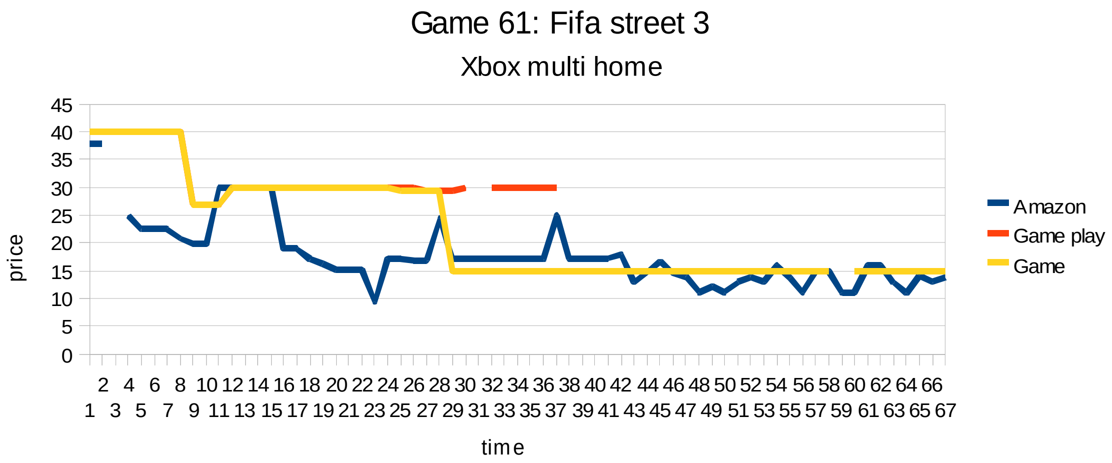

Game 56: Frontlines fuel of war
Xbox single home
price
0 5 10 15 20 25 30 35
time
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Amazon
Game play
Game

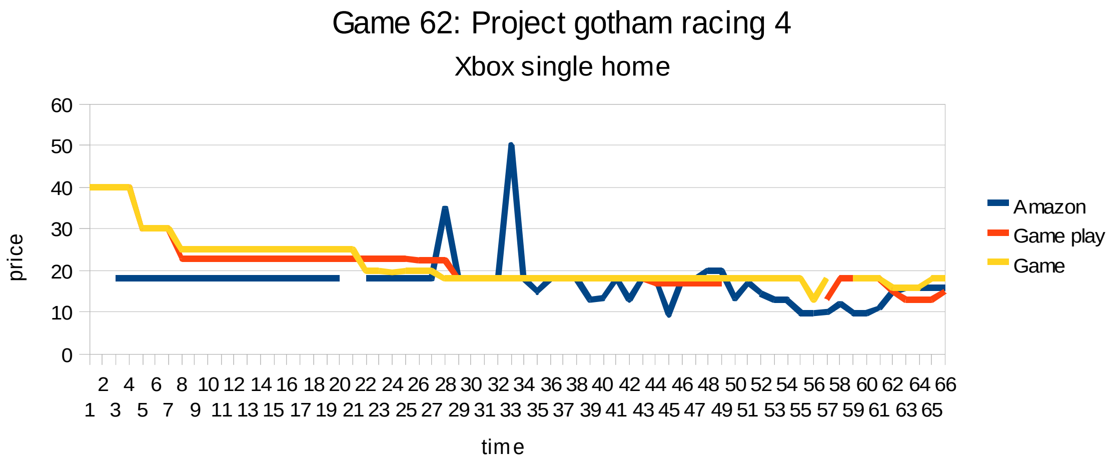

Game 57: Beautiful katamari
Xbox single home
price
0 5 10 15 20 25 30 35
time
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Amazon
Game paly
Game

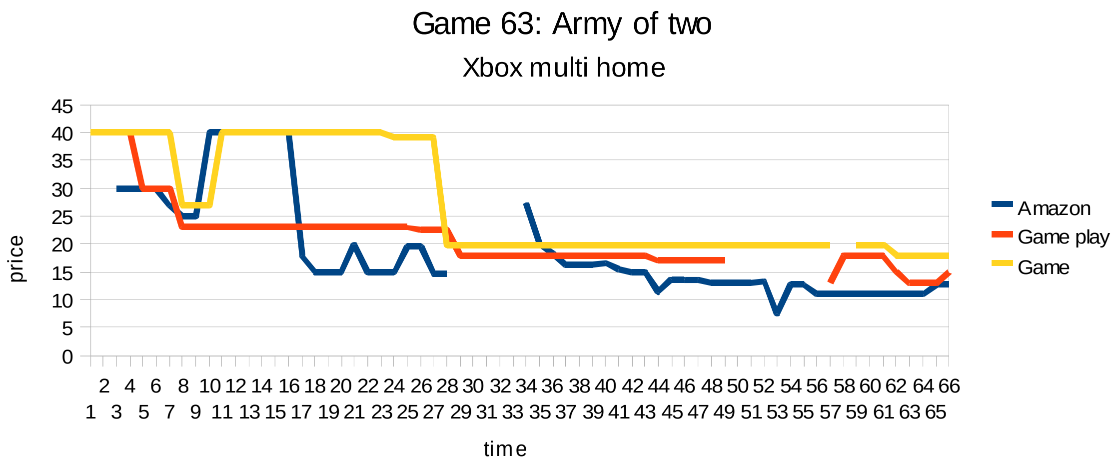

Game 58: The club
Xbox multi home
price
time
Amazon
Game play
Game

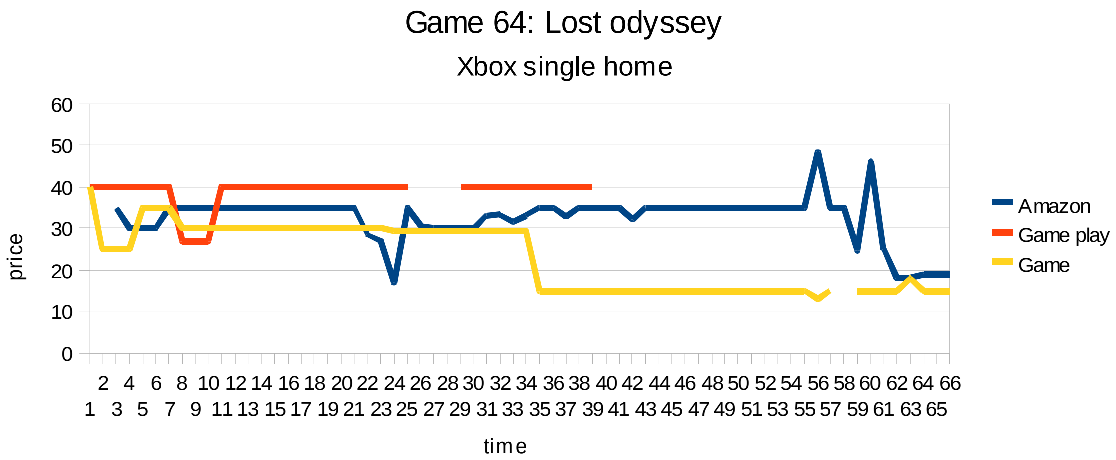

Game 59: Conflict denied
Xbox multi home
price
time
Amazon
Game play
Game

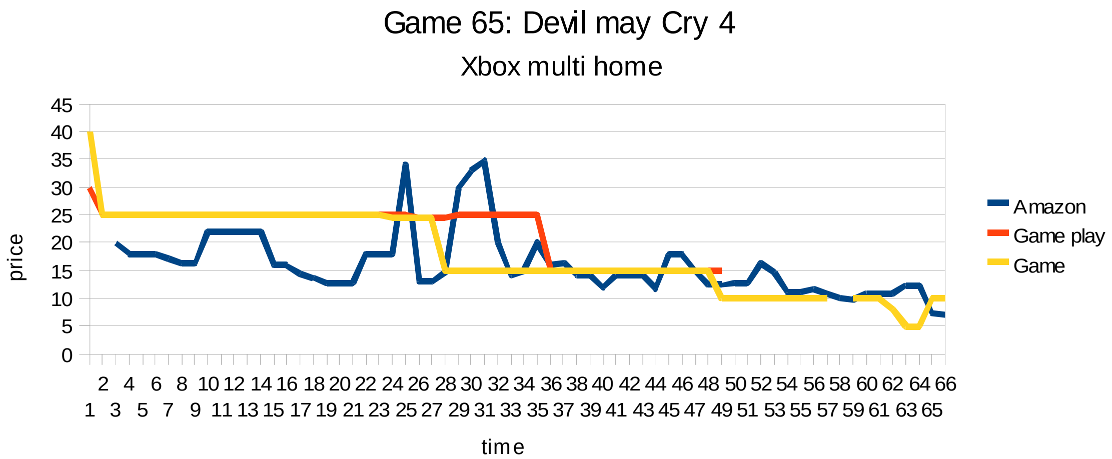

Game 60: Lost
Xbox multi home
price
time
Amazon
Game play
Game

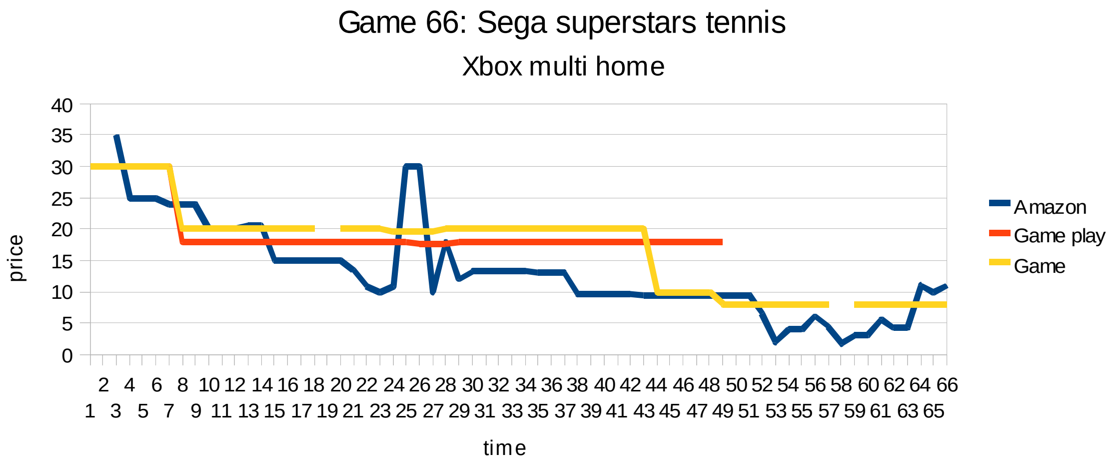

Game 61: Fifa street 3
Xbox multi home
price
time
Amazon
Game play
Game

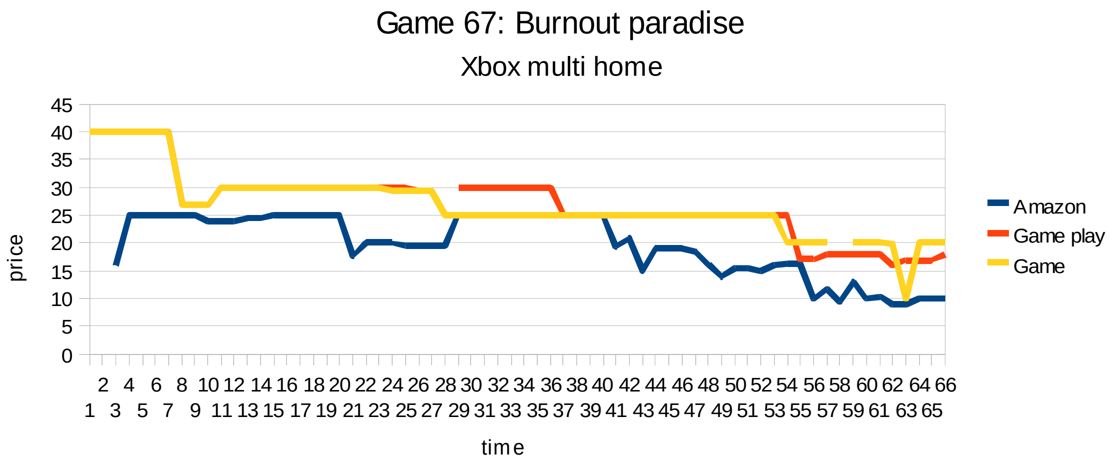

Game 62: Project gotham racing 4
Xbox single home
price
time
Amazon
Game play
Game

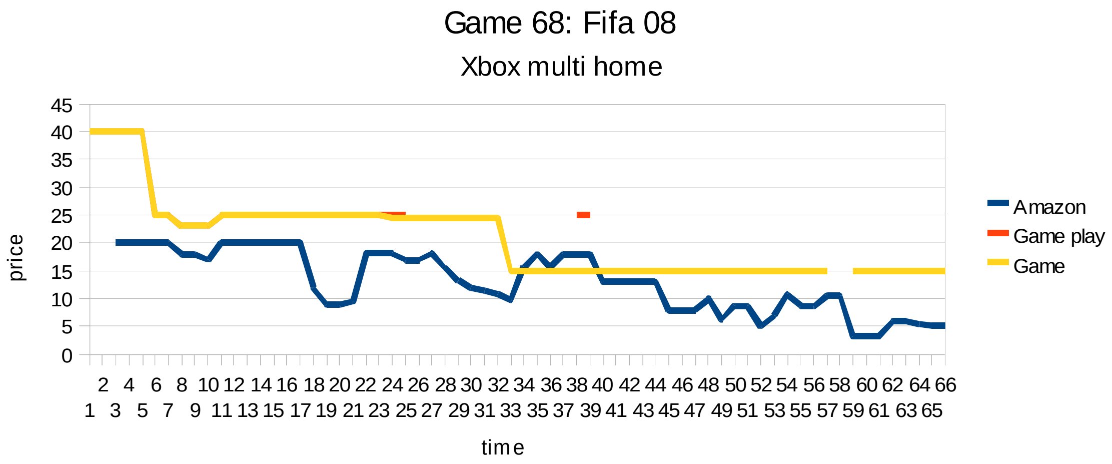

Game 63: Army of two
Xbox multi home
price
time
Amazon
Game play
Game

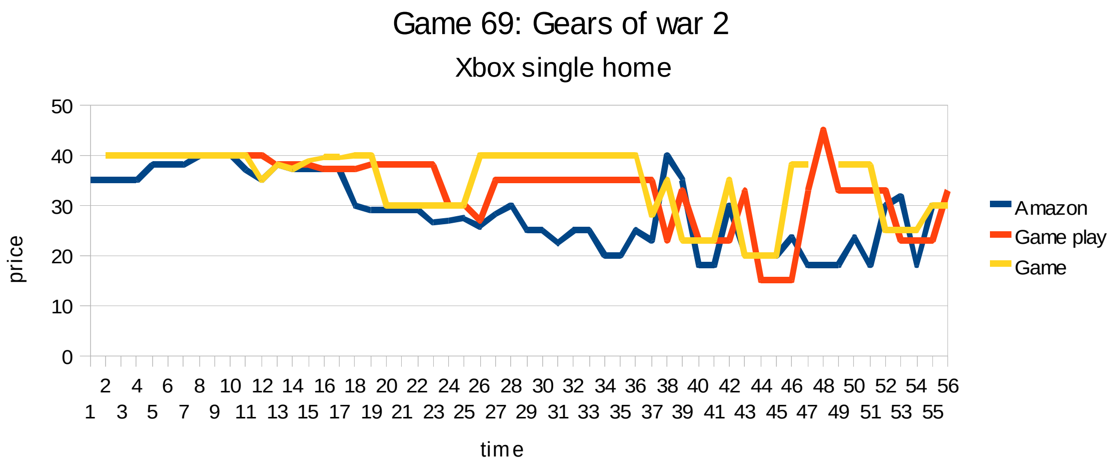

Game 64: Lost odyssey
Xbox single home
price
time
Amazon
Game play
Game

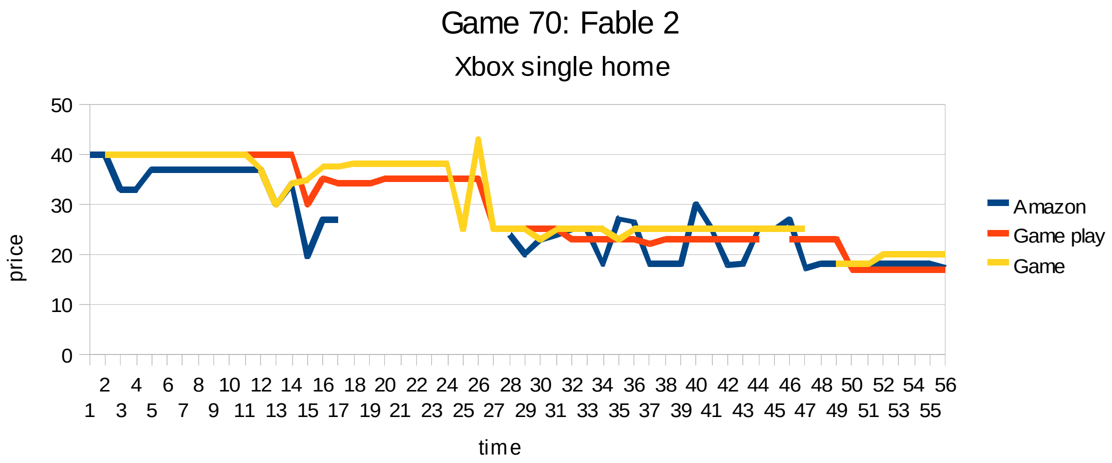

Game 65: Devil may Cry 4
Xbox multi home
price
time
Amazon
Game play
Game


Game 66: Sega superstars tennis
Xbox multi home
price
time
Amazon
Game play
Game


Game 67: Burnout paradise
Xbox multi home
price
time
Amazon
Game play
Game


Game 68: Fifa 08
Xbox multi home
price
time
Amazon
Game play
Game


Game 69: Gears of war 2
Xbox single home
price
time
Amazon
Game play
Game


Game 70: Fable 2
Xbox single home
price
50
40
30
20
10
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55
time
Amazon
Game play
Game