A simple model to study the Mobile Number Portability (MNP) impact on dynamic behavi of a two-competitor mobile market: Stability versus Oscillations

Hamed Shakouri G.

Assistant Professor, Department of Industrial Engineering, University of Tehran

Kargar Shomali St, Faculty of Engineering, Campus #2 , University of Tehran, Tehran, Iran, P.O. Box 14395-515

Email: hshakouri@ut.ac.ir

Nasim Gh. Tehrani

PhD candidate, Department of Industrial Engineering, Tarbiat modaress University

NASR Bridge, Jlal AleAhma Srteet,Engineering Campus, Tarit Modaress university,Tehran, Iran, P.O. Box 14115-111

Email:Nasim.Tehrani@modares.c.ir

Mohammad Hossein Taheri

Head of Mobile Committee, Teyf Sharif Consultants Company

No. 11, Avval St, Arab-ali St, Khoramshahr St, Sohrevardi-Shomali Ave, Tehran, Iran, P.O. Box 144497-3941

Email:Taheri@teyf.ir

Abstract

The mobile market in Iran is experimenting a transition period from monopoly by the incumbent service provider to a relatively competitive market by introducing the third operator. This paper describes the result of a research concerning the dynamisms of helping the churn in the mobile network by the Number Portability service. The feature adds to the attractiveness of the whole market and potentially stimulates the players to increase their individual attractiveness by either increasing their service quality or reducing prices or both. This dynamism is illustrated by a causal diagram, and a flow diagram has been constructed. The simple proposed model suffices to explore the consequences of different scenarios provided by the policy makers, and helps developing suitable policies to launch this new service. It is shown that improper settings for the service, including the costs, the time to port and the flexibility of porting can cause undamped oscillations in the system.

Keywords

Mobile Number Portability, Market attractiveness, Market dynamism, Regulatory role.

1 Introduction

The results of a survey done by Stefan Buehler et al. [1] have presented that consumers of telecommunications services in the European countries are more satisfied with their telephone numbers and require saving them switched between operators. This need causes uncertainty in deciding on which operator is the most suitable in providing services, while everyone shows tendency to specific competitive distinctions in the market.

Recently this uncertainty in selecting a service provider has been changed in some markets since Number Portability (NP) service has been implemented in many countries around the world and all of the European Union. By this service, subscribers can choose a new service provider while retaining their previous numbers to receive services from the new operators. This facility, which is now available for the both fixed and mobile phone numbers [2], has improved the attractiveness of the market, and so has increased the penetration level of the product in the corresponding societies.

MNP service is implemented in most of the mobile markets of different countries by regulation and feeling of need of regulatory and finally in collaboration with active operators of the market. The most important aim of service providers in provision of MNP is increasing facilitation of customer's selection and portability of subscribers from one operator to another which promote competition between market players in retaining their subscribers with taking advantages of strategies such as improving quality of service. Surveys show MNP service has important role in facilitating consumers' selection process of the best provided services in the market and also promoting competition between active market operators [1].

In Japan, since the introduction of MNP the intense competitive pressure has been created in the market and has forced operators to provide their services with lower prices and to develop stronger and more proactive acquisition and retention strategies. The impact of MNP on the Japan market was not immediate but as shown in Figure 1, it intensified the competition resulting in higher subscriber growth in the market [3].

Finland, where the service was introduced in 2003, experienced a huge rate of churn within a short period. Figure 2 shows a jump in the churn rate from 10% to about 50% after NP launch [4]. This case can be counted an extra-ordinary case regarding NP. The main reasons are summarized below.

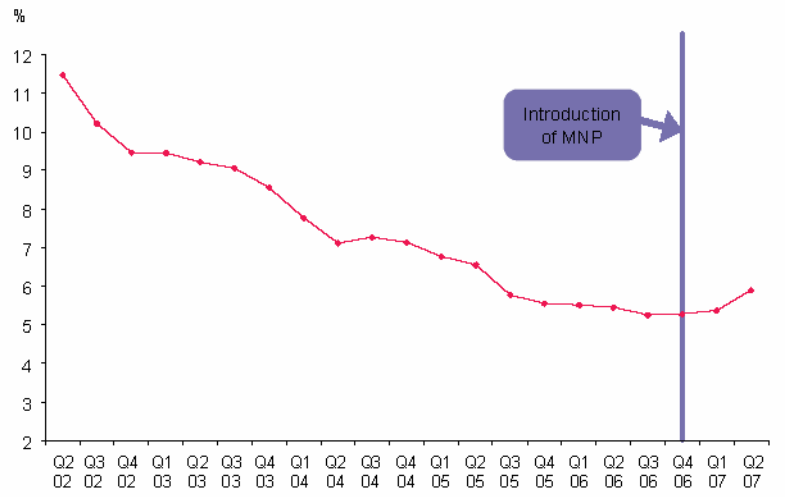
- Porting the number is very easy. When the customers sing up with a new service operator the new service operator informs the existing one and the automated porting takes place within two weeks.

- Simultaneously with NP service introduction in 2004, the two major operators, MVNOs and SPs, heavily discounted the tariffs, so Finnish consumers were used of the price competition

- Network operators have launch their own no-frills service providers providing basic service on low prices.

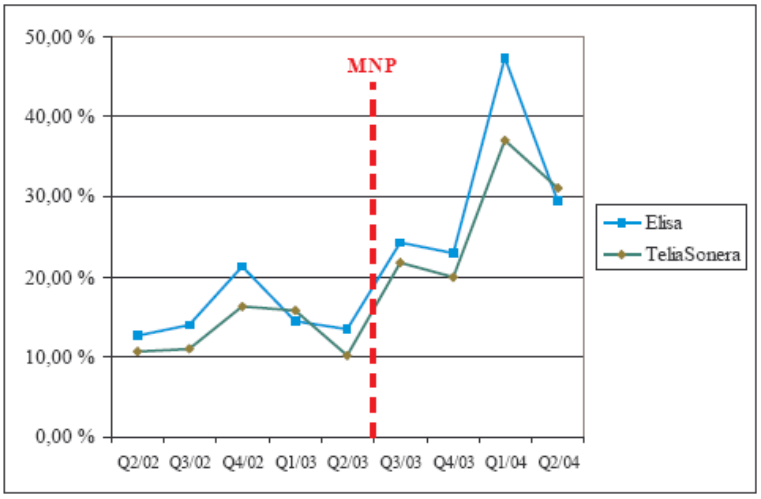
- The role of the regulator in planning and strongly guiding the operators in the preparatory work for NP was another important matter. The regulator led the work until a consensus on the system and business model for the NP between the operators could be reached. The system is owned and operated by a separate company, Numpac, which in turn is owned by all the mobile operators. As the system is state-of-the-art, it can support the fast number porting mentioned above. The regulator is also keen to measure the porting time.

Figure 1: Year-on-year subscriber growth in Japan by quarter, 2002-2007.



Source: TCA

Figure 2: Churn evolution among the largest Finnish mobile operators



Rogerson et al. have collected a valuable benchmark on the countries that recently offered MNP [5]. Except a few exceptions, most of the markets have shown more or less similar dynamic and static behaviors: a jump in the churn rate from an average of about 4–5 % up to more than 10% and then return to approximately the initial state after a short period of few months.

The market growth dynamics is deeply studied by J. D. Sterman [6], where he has discussed about 40 loops in the system, from advertisement and awareness effects to monopoly power and/or the price war. There are not so many works studying MNP effect and dynamism. However, particularly Jiayin Qi et al. have analyzed competition strategies of the two major Chinese mobile telecom carriers based by system dynamics (SD) modeling. They have implemented a large model, including the regulatory role, which is used to show how investment efficiency and product innovation can help the carriers to improve their competitiveness [7].

In this paper, a simple two-competitor model is implemented to show how MNP can cause the competitors to change their behavior in order to prevent customer loss. Moreover, the model is adequate to prove that inappropriate adjustment of system parameters, either set by the regulator or by the service providers, can lead to oscillation of the customers between the two (or more) competitors.

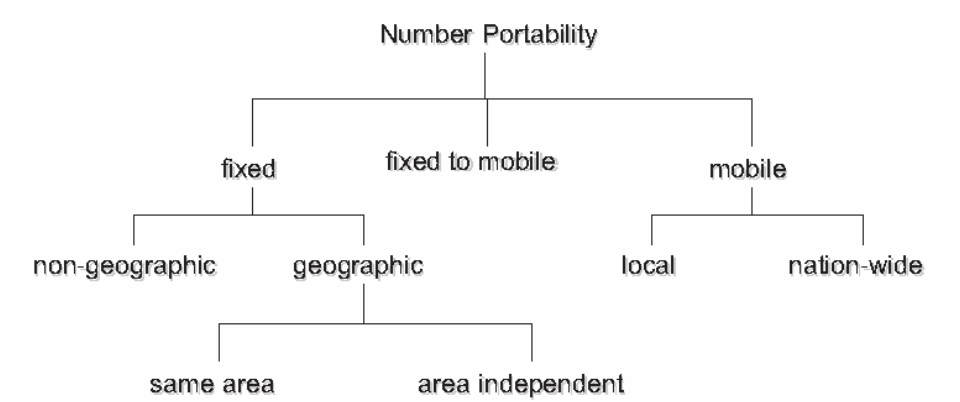
2 Different Models of NP Offering

NP could be considered in three different approaches: change of the consumer's physical location, change of the type of service and change of the service provider (operator), but replacement and change of operators is the main approach in offering this service .Thus, with respect to this approach, NP can be subdivided into three main categories [2]:

1. Fixed NP: the number is moved between two fixed operators.

2. Mobile or wireless NP: the number can be moved between mobile service providers.
3. Fixed to Mobile NP: the number that belongs to a fixed operator can be moved to a mobile operator and thus be used as a mobile number and vice versa.

Figure 3: Categories of number portability techniques.



Moreover, each category can be subdivided based on its relatedness to region; if the subscriber replaces his operator with one that provides services just in the same region as the previous operator this kind of NP is called Local NP, and if the number ported to another operator irrespective of subscriber it is called Nation Wide NP.

3 The State of NP Offering in Different Countries

In 1997, Singapore was the first country which implemented Mobile Number Portability (MNP) in the world. In 1999 the United Kingdom and Netherlands implemented this service before other European countries. Following these two countries other countries utilized this facility, the list of which is narrated from [1] in Table 1 in company with other Non-European countries. Only a few EU member states have not implemented this service yet.

Table 1: List of the countries that offer the MNP service [1].

Year	Countries
1997	Singapore
1999	UK, Netherlands, Hong Kong
2000	Spain, Switzerland
2001	Sweden, Denmark, Norway, Australia
2002	Belgium, Italy, Germany, Portugal
2003	Finland, Luxembourg, Ireland, France
2004	Greece, Austria, Slovenia, Cyprus, Lithuania, Poland, Hungary, USA, South Korea
2005	Estonia, Latvia (planned) , Malta (31 July 2005)
Not clear	Czech Republic, Slovakia, New Zealand, Japan, Mexico

The widespread implementation and rollout of MNP service took about six years in Europe. Some European countries delayed the implementation of MNP for various reasons. For example Germany postponed the work because of the lack of appropriate technical solution. Also, Austria delayed the introduction of this service several times while smaller Austrian operators like Tele.ring and Tele2 were agreed on MNP, the larger operators including Mobilkom and T-Mobile were uncertain about introduction of MNP. MNP offerings in some of Non-European countries such as Australia were done with more than 50 months delay.

4 The Effective Factors in MNP Offering in the Market

The effective factors in choosing MNP service by consumers have key role in the success of the service provision. Some of these impressive factors are:

- Number porting costs
- The required period for porting number
- Competitive environment of the market that is affected by quantitative specifications such as the tariffs and also by quality of offered services

The surveys were done in the European countries have shown that porting charges and pricing for this service are the most impressive factors among the others [1].

4.1 Number Porting Costs

High porting costs is an obstacle in adoption of this solution while low costs (lower than 20 % of operator's monthly revenue) can be effective in increasing adoption of that [4].

Given to the special effect of this factor in the churn rate of MNP in the market European union's universal service directive has obliged the member states to provide the service with cost oriented prices. Thus most of the member states have to implement regulations that should prevent porting charges to exceed costs. In Finland MNP service is provided free due to the high competitive

situation of the market. But in countries such as Ireland and Spain operators are not allowed to set charges for this service and it is an obstacle in developing porting numbers service [1].

4.2 Speed of porting (the time-to-port)

If the time to port be too long, consumers will put-off using the service. For consumers 2 days time-to-port is too long. In fact, for some consumers porting the number within an hour or two is very important .although there isn't any evidence from international experience to show that reducing a time-to-port will improve MNP take-up. Yet, on the one hand by reducing porting time, the cost of MNP implementation would increase. For instance, the cost of porting a number in Irish system (that has the shortest porting time) is far more than other implementations and almost five times more expensive than porting cost in Hong Kong [4].

Speeds of porting and porting time depend on two factors: technical porting systems and the willingness of networks to speed up the porting process. As a matter of fact, none of the donor or receiver network tends to resolve technical problems of porting systems quickly and try to neglect to find adequate cost solution for this service [1]. One of the other obstacles to rapid porting is the notice period that has been mentioned in the contract with the donor operator; in this period the donor operator must be notified before porting a number. Hence subscriber should wait to end this period for releasing the number by the donor operator [1].

Although, many countries have utilized manually operated porting process in the beginning of MNP implementation, nowadays most countries have been using automatic porting systems. While the speed of porting has been reduced considerably, there are still some problems in the way of rapid porting [1].

4.3 Competitive Environment in the Market and Quality of Offered Services

Given that the main purpose of MNP offering is promoting competition between market players [1], more undesirable competitive situation of market would have more effect on increasing subscribers' take-up of porting number from an operator with undesirable service quality to one that provides highly desirable service quality. Notwithstanding that the factor has an evident role in the system; more explanations will be given on this factor in the following sections.

5 MNP Implementation in Iran Mobile Market

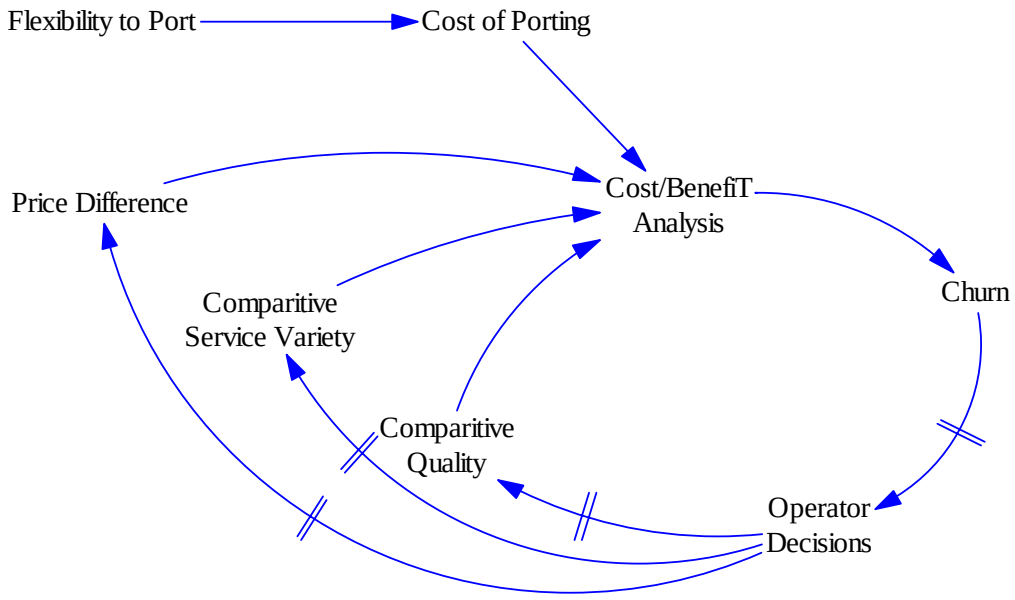
Most of the surveys on MNP provision have been done after offering the service in the target market. Examining the effect of MNP provision on the

target market and effective factors in customer take-up of MNP service have been the main purposes of the surveys. But we have been modeling and examining the effects of MNP provision while this service has not been offered in Iran yet. Iranian CRA is in the decision making stage on offering this service, considering technical and legal requirements of it. In other words there is not any visible behavior and information about market of the service; hence to facilitate deciding process of Iranian CRA on this service provision, we have applied system dynamic modeling by examining the surveys and considering effective factors in the provision of this service and to show dynamic results of this service on the market offering. Considering natural benefits of system dynamic modeling, Iranian authorities could deciding more appropriate on technical and legal framework of the service through changing different input factors and examining various outputs.

5.1 Overall dynamism

Exploring the dynamism of market and the customer reaction, the overall dynamism is illustrated in the figure 3. This figure shows the casual loop responsible for customer decision making about choosing different operators, and churn. This decision is made as a result of a cost-benefit analysis. As shown in the diagram, three factors – cost, quality and the variety of the provided service – in comparison with other operators form this analysis. As customers decide based on their perceptions and mentality about the real value of these factors, delay is unavoidable in these loops, illustrated by double lines on the links. What makes customer decision making meaningful, is the main purpose of this model, which is churn.

Figure 4: The causal diagram of the main dynamism.



5.2 Flow diagram

We added some assumptions to make it possible to model, and quantify the described loops in Figure 4. As all 3 loops have the same dynamic, and also because data gathering about the price is simpler than conceptualization and quantification of other variables (no index has been defined for the overall quality of service provided by the operators, and also there is no consensus on the service variety) we are going to model price factor. If we want to consider the rest, we should define a weighting method to combine all 3 factors in one index (for the cost-benefit analysis) we also assume that there are only 2 competitors in the market.

As described in the above loop, the price of one operator (tariffs level) ,or in the more general term, the overall costs and benefits of using a service is compared with the second service, and the gap is calculated by the costumer. These costs also include the porting costs. If the gap is considerably positive, then customer is willing to change the operator and the overall churn rate increases. It means that one operator is providing the lower quality service, or with the higher price, or the less variety, and is losing customers. A nonlinear relation can be considered that describes this fact which is depicted in Figure 5.

Suppose that a percentage of customers decide to leave operator 1, because of lower overall service. Decision making and implementing this decision is in company with a predictable delay, which can differ for customers of the two operators. According to the benchmarks, the delay varies from 1 week to 2 weeks.

There is also another delay associated with the detection of loosing customer for the operator, and then for the appropriate decision making and the related policy. In order to show importance of the other parameters, the reaction of the operators is assumed to be fast enough. Hence the delays are considered to be about 1 week. This delay is much more for the intangible factors such as service quality and service variety, which leads to more stability. We have used “Change Speed *k*” variables, to show this behavior. We have also added the effect of market price by assuming a maximum tariff to the price setting formula, which is controlled by the regulatory. When an operator attracts more subscribers, it can increase its price up to this ceiling tariff to attain more revenue.

5.3 Simulation and the results

Suppose that in time 0, (the service provision time) the number of customers for each operator is the same, and both operators have the same quality and variety. But the tariff level for the second operator is 20% higher than the other (as it is

currently allowed by the regulator in Iran). As a result, the customers of this operator will tend to leave the operator, considering the overall cost (cost of porting and tariffs and also the time needed for requesting churn and doing it technically)

For evaluating the number of customers we could use (1), which is also depicted in Figure 6.

Customers like to churn to 1 = Max(0, (1-EXP(Churn Speed 1*(1 - Total Benefit 1)))*Customers 2) (1)

Figure 5: The function for "Customers like to churn to *k*" [%] versus "Total Benefit *k*", based on the formula (1)

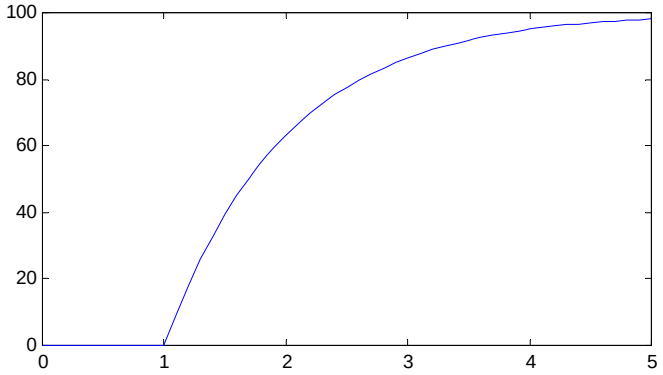
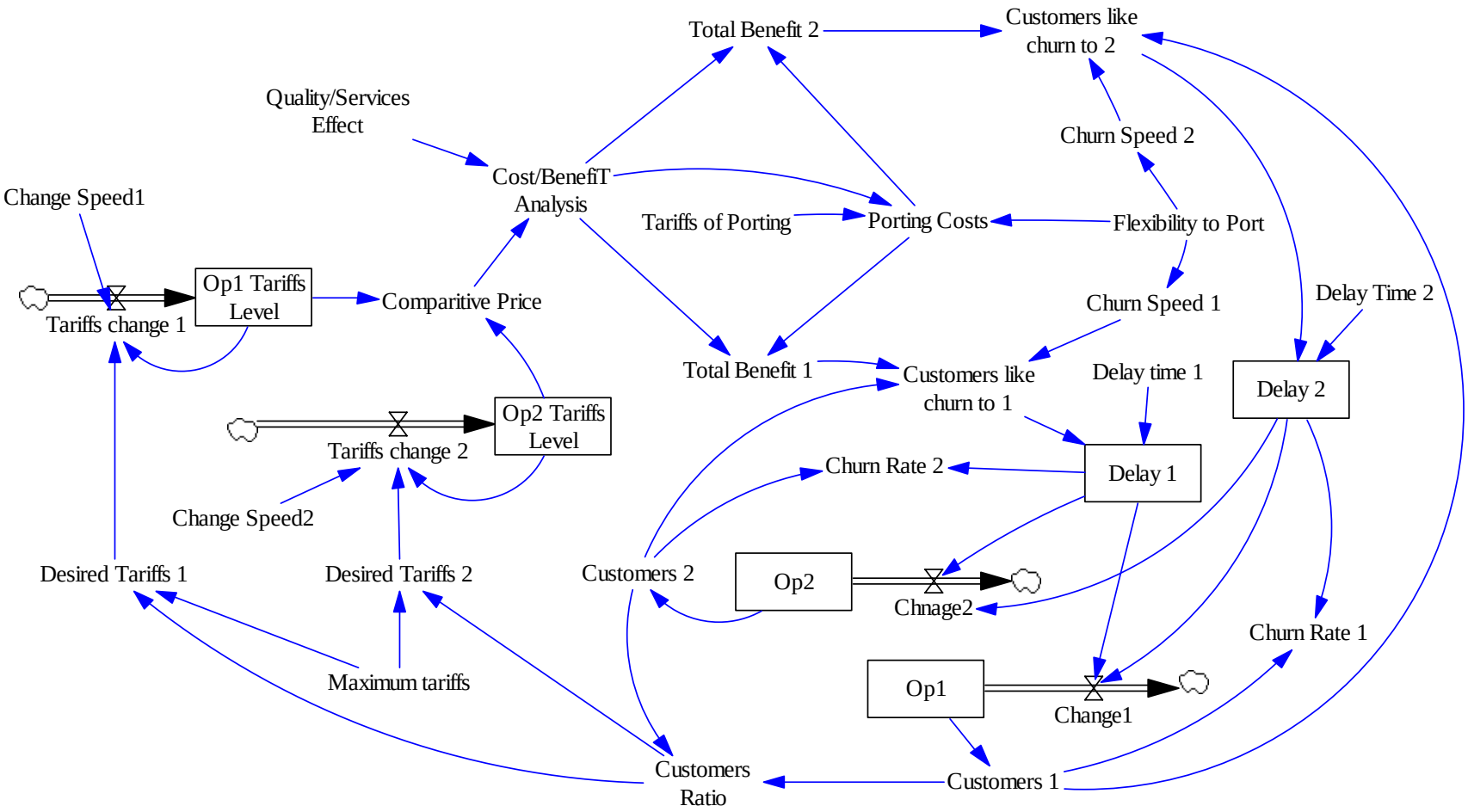


Figure 6: The flow diagram for the two-competitor model



By assuming a specificied speed for changing the operator (which is characterized by the flexibility of the system due to the churn and the availability of service provision centers) the conclusion is that if the percepted value of churn is up to five times more for one operators, it would loose all of customers. “Total benefit”, as defined in the model, is the ratio of benefit (price gap between the two operators) to the churning tariff. This process would take place in an acceptable time frame (such as a few weeks). The “Churn speed” and “Time delay” are necessary for modifying the decision making speed and the action speed.

By changing the customers’ number, moving from the lower benefit operator to the higher one, another mechanism would be activated for the operators. The second operator tends to decrease the price to attract the customers (bridges the gap in market share) and the first operator would move toward the maximum acceptable tariff to increase the revenue. Based on this behavior, there could be a formula for defining the desired tariff, based on formula 2.

Desired Tariffs = Min(Maximum tariffs, Maximum tariffs/Customers Ratio) (2)

Because the number of operators in this model in assumed to be 2, “customer ratio” is simply defined by the ratio of number of customers. Changing tariffs is made upon the speed (agility of operators) to change their price, and is proportional to the desired tariff, as shown in formula 3.

Tariff Change = (Desired Tariffs – Op. Tariffs Level)*Change Speed (3)

If the prices for operator 1 were low, now it should be increased, and since the 2nd operator would decrease the prices, the situation could be vice-versa in a time period. If the parameter setting is inappropriate, this structure could cause an unrealistic fluctuation. However, as in the most markets, after 2-3 oscillations it would lead to some kind of equilibrium. By changing parameters, a parameter set, which is shown by (4)-(10), is found for the appropriate behavior of the system leading to a stable condition. This behavior, as the base case, is shown in Figure 7.

Change Speed1=0.4 (4)

Change Speed2=0.7 (5)

Delay time 1=1 (6)

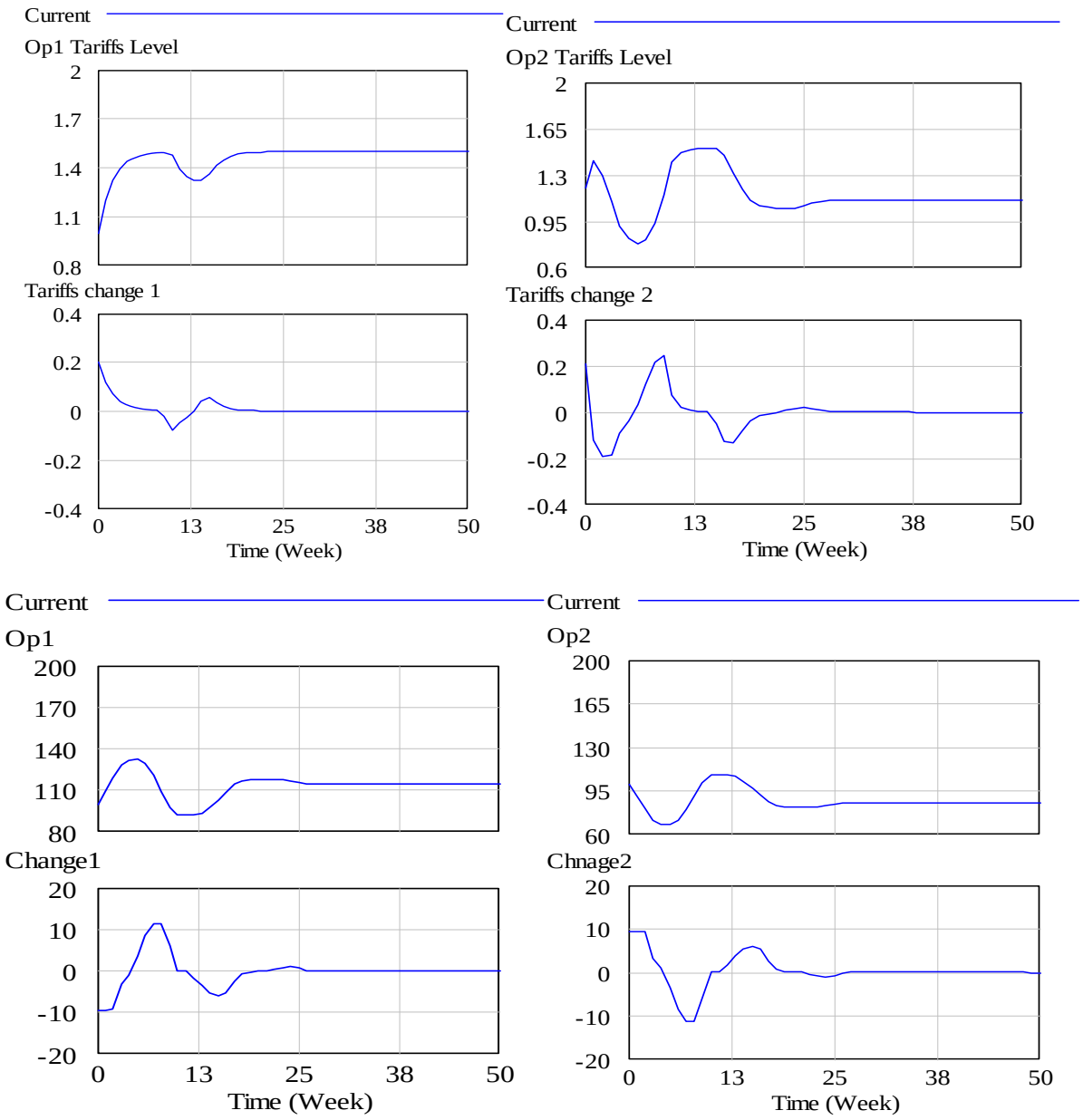
Delay Time 2=1.5 (7)

Flexibility to Port=0.5 (8)

Maximum tariffs=1.5 (9)

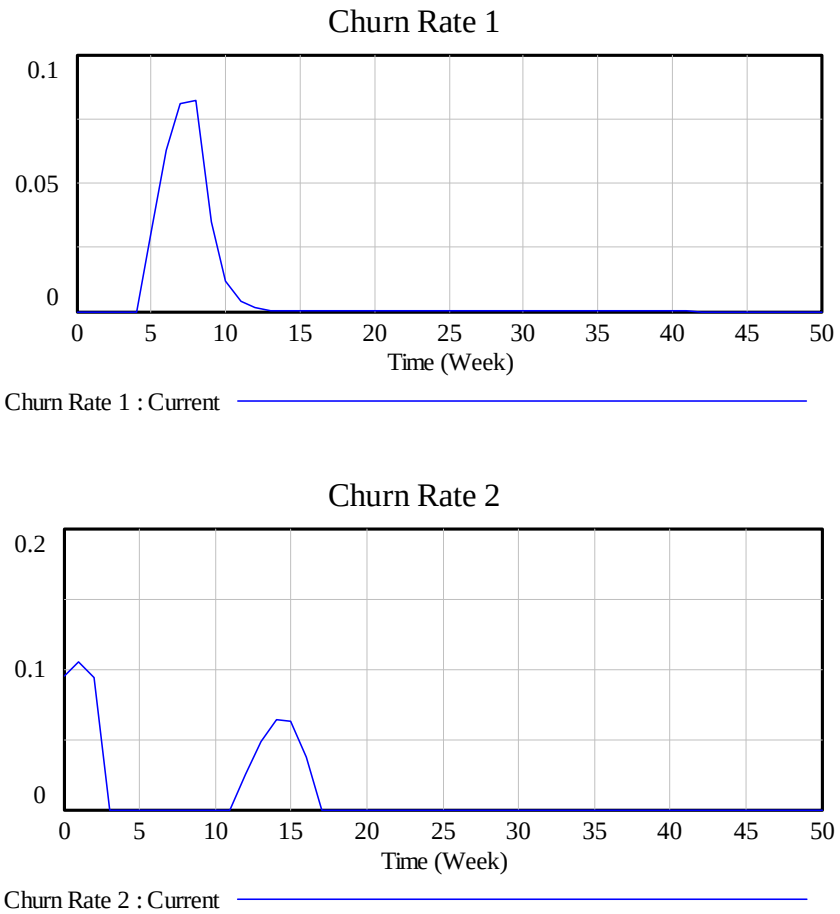
Tariffs of Porting=0.7 (10)

Figure 7: Behavior of the system, in equilibrium due to launching MNP at t=0, set by values shown in formula 4-10 (the base case)



In this run, the churn rate between operators is as shown in Figure 8. Note that the variable is indeed the absolute churn due to the NP. Normally there is a small churn rate which may be added to this value.

Figure 8: Changes in the churn rates (the base case)



As shown in Figure 7 and Figure 8, at first 10% of customers are churning from the 2nd operator to the 1st. Then the mobility is reversed and reaches to 8% from the 2nd operator to the 1st. this rate oscillates until it diminishes .It is obvious that this churn facility benefits for the 1st operator, because of the lower prices. This operator not only has more customers, but also could increase the prices.

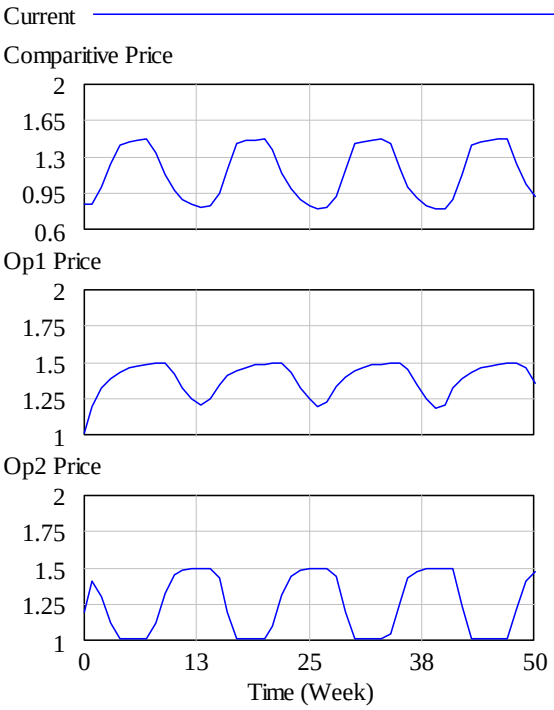
Another analysis at this stage concerns the change of tariff. If we decrease the porting tariff by about just 10%, we would see a dynamic oscillation behavior in the system, as shown in (11).

Tariffs of Porting=0.625 (11)

As shown in the Figure 9, in this situation a competition starts between operators. They try to attract customers by decreasing the costs, and when it is done, they start to increase the prices for gaining more income, that makes customers to move to the other one. This makes an unstable market that is not desirable from the regulatory point of view. Then a restricting rule could be proposed to improve this situation. This simulation shows how the market would be sensitive to parameter misalignment, although is somehow exaggerated in this case. We note that for existence of many other nonlinear saturating and/or tight factors, the oscillation will not happen so easily and the real frequency of oscillation cannot be that much fast. However, it is quite important to mention that

similar improper behavior (undamped oscillations) may happen if any of other parameters, like the speed or the flexibility of porting is set to improper values.

Figure 9: Behavior of the system by applying a misaligned parameter (inappropriate policy)



6 Conclusion and further research

As described in the previous sections, most surveys concerning the provision of MNP are done after launching service in the market. This model has been built for providing a perspective for investment and policy design about this service, before launch it in the market. As we have not found a similar model in the literature, we acclaim that this dynamic model is the first SD model concerning the customer behavior in this market due to the MNP facility, and could be a basis for future development. It is shown by the model how any false policy, which can be represented by a misaligned parameter in the model, can cause undesired dynamism for the system, no difference either the regulator has taken that weak policy or the operators.

This model is the output of a research project for the Iranian regulatory agency, which could act as a decision aiding tool. This model has been validated by simulating many scenarios provided by the managers, and then showing the predicted behavior. The parameters have been tested by extreme point tests, and then their behavior has been observed in the regular scenarios. After validation, some certain scenarios for launching this service in Iranian market has been designed by the authors, and presented to the agency. The policy makers had the opportunity to see the results of each scenario by changing the different parameters, and observing the outcomes, so the quality of their decisions improved (by their opinion).

Although this simple model suffices for the goal explained above, i.e. MNP role in the mobile market from the regulatory point of view, we mention the following

deficiencies to be improved in the next stages to better model and simulate the market behavior:

- Currently there is not any real proxy measuring quality of services (QoS) or index referring to customer experience, but consumers have effective ways of filing complaints towards the operators' business practices and QoS to both the Communications Regulatory Authority as well as the Consumer Agencies. Defining quantitative indices for quality and variety of services, and measuring these indices for every operator by a customer survey, in a time horizon can help better quantizing of the model.

- Defining weighting system for combining the variety and quality in the cost-benefit analysis, which by now just includes the price.

- Developing the model to contain all the active operators in the Iranian market.

- Focus more on the investment part, including the investment barriers and also the technological abilities of each operator.

- Considering the target market of each operator, where there is obvious difference between majority of each operator's customers, and considering the different customer behavior for each sector which would affect the policy making and revenue generating model of each operator.

We recently noticed that some of these are well done by Jiayin Qi et al. in [7].

7 Acknowledgments

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