



Reputation in a simple online market

Are feedback systems reliable?

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Simulation models for economics

Summary

PREFACE.....	3
1. THE CODE.....	7
1.1 SETUP BUTTON.....	8
1.1.1. createBuyers.....	9
1.1.2. createSellers.....	10
1.1.3. colorPatches.....	12
1.2 GO BUTTON.....	12
1.2.1. negotiate.....	13
1.2.2. move.....	14
1.2.3. exitMarket.....	15
1.2.4. do_plots.....	15
2. EXPERIMENTING.....	16
2.1. Is honesty a good thing?.....	17
2.2. Being selfish is not good for you.....	19
2.3. The power of reputation systems.....	21
2.4. When is irrelevant being a good or a bad seller?.....	22
2.5. The failure of the reputation system.....	23
2.6. The opportunity cost of searching a counterpart.....	24

PREFACE

“Reputation systems are the worst way of building trust on the Internet, except for all those other ways that have been tried from time-to-time.”¹

Being interested in the role played by trust and reputation in economic interactions, we decided to focus our work on online markets. Even though internet services permit virtually anonymous interactions, reputations still play a major task.

A reputation system collects, distributes, and aggregates feedback about participants' past behaviour. Though few producers or consumers of the ratings know one another, these systems help people to decide who to trust, encourage trustworthy behaviour, and deter participation by those who are unskilled or dishonest.

For example, consider eBay, the largest person-to-person online auction site, with more than four million auctions active at a time: it provides limited insurance, and buyers and sellers both accept significant risks. There are problematic transactions to be sure. Nevertheless, the overall rate of successful transactions remains astonishingly high for a market as “ripe with the possibility of large scale fraud and deceit”² as eBay.

The high rate of successful transactions is attributed by eBay to its reputation system, called the Feedback Forum. After a transaction is complete, the buyer and seller have the opportunity to rate each other (1, 0, or -1) and leave comments (such as “good transaction”, “nice person to do business with”, “would highly recommend”). Participants have running totals of feedback points attached (visibly) to their screen names, which might be pseudonyms.



Amazon and other auction sites feature reputation systems like eBay's, with variations, including a rating scale of 1 to 5, several measures (such as friendliness, prompt response, quality product), and averaging instead of total feedback score.

¹ Anonymous

² Kollock, P. The production of trust in online markets. In Advances in Group Processes, vol. 16, E. Lawler, M. Macy, S. Thyne, and H. Walker, Eds. JAI Press, Greenwich, CT, 1999; see also www.sscnet.ucla.edu/soc/faculty/kollock/papers/online_trust.htm.

Reputation systems have also spread beyond auction sites. For example, Bizrate.com rates registered retailers by asking consumers to complete a survey form after each purchase. So-called “expert sites” (www.expertcentral.com and www.askme.com) provide Q&A forums in which self-proclaimed experts provide answers for questions posted by other users in exchange for reputation points and comments. Product review sites (such as www.epinions.com) offer rating services for product reviewers (the better the review, the more points the reviewer receives).

The question we want to answer is: why are these explicit reputation systems so important for fostering trust among strangers?

First of all, it helps to first examine how trust builds naturally in long-term relationships. When people interact with one another over time, the history of past interactions informs them about their abilities and dispositions. Moreover, the expectation of reciprocity or retaliation in future interactions creates an incentive for good behaviour: political scientist Robert Axelrod calls this the “shadow of the future”³.

An expectation that people will consider one another’s pasts in future interactions constrains behaviour in the present.

Among strangers, trust is understandably much more difficult to build. Strangers lack known past histories or the prospect of future interaction, and they are not subject to a network of informed individuals who would punish bad and reward good behavior. In some sense, a stranger’s good name is not at stake. Given these factors, the temptation to “hit and run” outweighs the incentive to cooperate, since the future casts no shadow.

Reputation systems seek to establish the shadow of the future to each transaction by creating

expectations that other people will look back on it.

Future buyers, lacking personal histories with particular sellers, may still base their buying decisions on a sufficiently extensive public history. If buyers do behave this way, the sellers’ reputations will affect their future sales. Hence, they seek to accumulate as many positive points and comments as possible and avoid negative feedback.

³ Axelrod, R. *The Evolution of Cooperation*. Basic Books, New York, 1984

The Internet can vastly accelerate and add structure to the process of capturing and distributing information. To post feedback, users need only fill out an online form; a mere mouse click is often enough.

Where interactions are mediated electronically, objective information about performance may be captured automatically (such as delay from question to response at an expertise site). The same technology facilitating market-style interaction among strangers also facilitates the sharing of reputations that maintain trust.

Despite this promise, significant challenges remain in the operating phases of such systems: eliciting, distributing and aggregating feedback.

Eliciting feedback encounters three related problems.

The first is that people may not bother to provide feedback at all. For example, when a trade is completed at eBay, there is little incentive to spend another few minutes filling out a form. That many people do so is a testament to their community spirit, or perhaps their gratitude or desire to exact revenge. People could be paid for providing feedback, but more refined schemes, such as paying on the basis of concurrence with future evaluations by others, would be required to assure that their evaluations are thorough.

Second, it is especially difficult to elicit negative feedback. For example, at eBay, it is common practice to negotiate first before resorting to negative feedback. Therefore, only really bad performance is reported. Even then, fear of retaliatory negative feedback or simply a desire to avoid further unpleasant interactions may keep a dissatisfied buyer quiet. In the end, because information about patterns of moderate discontent may remain invisible, buyers cannot shun the sellers who foster such discontent.

Third is the difficulty of ensuring honest reports. One party could blackmail another, threatening to post negative feedback unrelated to actual performance. At the other extreme, in order to accumulate positive feedback, a group of sellers might collaborate and rate one another positively, artificially inflating their individual reputations.

Distributing feedback, the second phase, poses its own challenges.

One is identity changes: in many sites, people choose pseudonyms when registering. If they register again, they might choose another pseudonym, effectively erasing prior feedback.

Reputations can still have effects, since newcomers want to accrue positive feedback, and those with established reputations want to avoid negative feedback. Game-theory analysis demonstrates that there are inherent limitations to the effectiveness of reputation systems when participants are allowed to start over with new names⁴. In particular, newcomers (those with no feedback) should always be distrusted until they have somehow paid their dues, either through an entry fee or by accepting more risk or worse prices while developing their reputations. Another alternative is to prevent name changes either by using real names or preventing people from acquiring multiple pseudonyms, a technique called “once-in-a-lifetime pseudonyms”⁵.

A second difficulty in distributing feedback stems from the lack of portability from system to system. Amazon.com initially allowed users to import their ratings from eBay. But when eBay protested vigorously, claiming its user ratings were proprietary, Amazon discontinued its rating-import service. Limited distribution of feedback limits its effectiveness; the future casts a shadow on only a single online arena, not on many. Efforts are under way to construct a more universal framework. For example, virtualfeedback.com provides a rating service for users across different systems, but it has yet to gain wide public acceptance.

Finally, there is also potential difficulty in aggregating and displaying feedback, so it is useful in influencing future decisions about whom to trust. Net feedback (positives minus negatives) is displayed at eBay; other sites, including Amazon.com, display an average. These simple numerical ratings fail to convey important subtleties of online interactions; for example, did the feedback come from low-value transactions? What were the reputations of the people providing the feedback?

As a solution to the ubiquitous problem of trust in new short-term relationships on the Internet, reputation systems have immediate appeal; the participants themselves create a safe community. Unfortunately, these systems face complex challenges, many of which yield no easy solutions. Efforts are under way to address these problems: for example, the Reputations

⁴ Friedman, E. and Resnick, P. *The social cost of cheap pseudonyms*; see www.si.umich.edu/~presnick/papers/identifiers/index.html.

⁵ See note 4

Research Network (see databases.si.umich.edu/reputations) represents a first step toward recognizing reputation systems as a subject of study and as a vital asset for the safety of online interaction environments.

Despite their theoretical and practical difficulties, it is reassuring that reputation systems appear to perform reasonably well. Systems that rely on the participation of large numbers of individuals accumulate trust simply by operating effectively over time.

Finally, after having highlighted the main features and limits of reputation systems in online markets, we built our model in order to test and verify their reliability. Much of our effort has been addressed to a realistic representation of the interaction among agents characterized by different behavioural attitudes. In order to do so we built up a model which can be used to infer on many of the issues related with online markets based on feedback systems: an example are the possibility of changing identity (and its relative cost), the problem of aggregation of feedbacks and the effect of different selection mechanisms of the counterpart.

1. THE CODE

The agent-based model “Reputation in a simple online market” is made up of two kinds of turtles: buyers and sellers. For this reason, we have introduced two classes with their relative variables. In addition there is a set of variables that are in common and so they are defined by the command “turtles-own”.

```
turtles-own [randomNumber attitude]
breed [buyers buyer]
breed [sellers seller]
buyers-own [ChosenSellers]
sellers-own [price pricePlot reputation ReputationSum feedbackNumber salesNumber lifeTime ]
```

In particular, the buyers' variables are the following:

- attitude: after every negotiation with a seller each buyer gives a feedback in the right way if she is honest (a high feedback equal to 25 for an high quality good and a low feedback equal to 5 for low quality good) or in the opposite way if she is misleading (a feedback of 25 for a low quality good and a feedback of 5 for high quality good). If buyer's attitude is selfish she doesn't give a feedback at all.
- ChosenSellers: a set of sellers which the buyer takes in consideration for the negotiation. It contains only sellers that have not sold all their goods yet. How many sellers are taken into account is chosen by the user with the slider “amongHowManySellers”.

On the other hand, the sellers' variables are the following:

- attitude: sellers could have different probabilities of selling high quality goods. If she is a “good” seller she has a probability of 80 per cent, otherwise if she is a “bad” seller she has a probability of 20 per cent.
- price: it is relatively higher for good sellers (between 0.34 and 1) than for bad sellers (between 0.01 and 0.66). In our model, the price of each seller doesn't change along the negotiations. We change this variable only when the chooser “purchasingPropensity” is altered.

- pricePlot: instrumental variable used in order to plot the graph called “revenues”. It equals the initial value of the variable “price”.
- reputation: it is constructed as the average reputation received (sum of all feedback over the number of feedback received). Its range is from 5 to 25, starting at 15 by default.
- reputationSum: sum of all feedback received by honest and misleading buyers.
- feedbackNumber: how many times the sellers have received a feedback (it doesn't count the negotiation with selfish buyers).
- salesNumber: this variable represents how many goods are sold. For ease, the increment is of 0.1 for each sale. The maximum value that this variable could reach is 49, which means that the maximum goods available are 490 per seller.
- lifeTime: this variable increments of one every time all buyers have done their purchases. It is useful in the procedure “exitMarket”.

In addition there is a common variable:

- randomNumber: this is an instrumental variable that helps us to share out the agent among the different attitude and, during the negotiation, to decide the quality of the book sold.

1.1 SETUP BUTTON

Now, we start with the first button that we encounter: “setup”. In this part of our model we clear all what we have created before, reset ticks and recreate a new setting in order to start a new experiment.

```
to setup
  __clear-all-and-reset-ticks
  createBuyers
  createSellers
  colorPatches
end
```

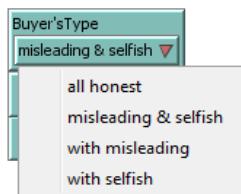
1.1.1. createBuyers

The first procedure creates all the buyers. The number of this kind of agents is selected by the user through the slider “howManyBuyers”. Its range is between 0 and 100. In order to be more realistic, we set the shape of the turtles on “person”. All these kinds of agents are placed on the upper line of the world. Moreover, they are divided in three sectors and they have different colors: honest on the left hand side are yellow, selfish in the center are green and misleading on the right are light blue.

In order to separate buyers into the different attitudes, we assign to each turtle a random number less than 100.

```
to createBuyers
  create-buyers howManyBuyers
    [set shape "person"
     set color 45
     set attitude "honest"
     setxy random-float 16 30
     set randomNumber random 100
```

Now the procedure continues depending on the following chooser:



If “all honest” is selected, nothing changes. If “misleading & selfish” is chosen, the percentage of each typology of agent is decided by the user thanks to the appropriate sliders. Obviously, the sum of the two percentages cannot be more than 100. Effectively, we use the random number assigned before and, using a combination of `ifelse` and `if` instructions, we decide the attitude of each buyer.

If “with misleading” or “with selfish” is selected, the procedure takes into account only the respective slider and, through an `if` instruction, the buyers are split in the two categories (honest and either misleading or selfish).

```

if Buyer'sType = "misleading & selfish"
[ifelse randomNumber < %selfish
 [set color 65
  set attitude "selfish"
  setxy 16 + random-float 16 30 ]
 [if randomNumber < %selfish + %misleading
  [set color 85
   set attitude "misleading"
   setxy 32 + random-float 16 30]]]
if Buyer'sType = "with misleading"
[if randomNumber < %misleading
 [set color 85
  set attitude "misleading"
  setxy 32 + random-float 16 30]]
if Buyer'sType = "with selfish"
[if randomNumber < %selfish
 [set color 65
  set attitude "selfish"
  setxy 16 + random-float 16 30]]]
end

```

1.1.2. createSellers

The second procedure presents in the setup button is “createSellers”. Its range is between 0 and 100. First at all, it creates a number of sellers according to the slider “howManySellers”. Also in this case, we set the shape of the sellers on “person”. A distinguishing mark of this model is how and why sellers move themselves in the world. In fact, they use the world as a graph. They change their position according to the number of sales and reputation which are respectively represented in the x axis and in the y axis.

```

to createSellers
  create-sellers howManySellers
    [set shape "person"
     set ReputationSum 15
     set feedbackNumber 1
     set reputation reputationSum / feedbackNumber
     set color 9.9
     set attitude "good"
     set price 1 - random-float 0.66
     set pricePlot price
     setxy salesNumber reputation

```

For all the sellers, the initial reputation is set at 15¹. Now, we assign to every seller the attitude “good”. This implies that the turtles' color is white and the price is relatively high (this is generated randomly on the range 0.34 – 1).

¹ In order to obtain that, each seller starts with a number of feedback equal to 1 and a reputationSum equal to 15.



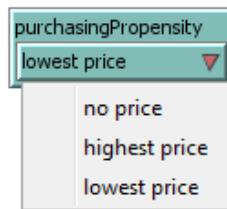
Looking at the chooser “Seller’sType”, the user decides if create a world with only good sellers or with a percentage of bad sellers. In this last case, we generate a randomNumber for each sellers and, using an if instruction, we change the attitude and the price (as before, generated randomly on the range 0.01 – 0.66).

```

if seller'sType = "% of bad sellers"
[ set randomNumber random 100
  if randomNumber < %badSellers
    [set color 15
     set attitude "bad"
     set price 0.67 - random-float 0.65
     set pricePlot price]]]

```

In the economy we could have agents which prefer mostly to buy products which have higher prices, because they think that higher prices represent also good quality items, or differently we could deal with buyers who prefer to buy products with lower prices, ceteris paribus the other variables of relevance, i.e. reputation. In order to capture this different purchasing propensity, there is the following chooser:



For commodity, when “no price” is selected the variable price is set equal to 1 for all sellers. If “lowest price” is chosen, the variable is let unchanged. In the case of “highest price” preferences, we use the inverse function. Sellers’ price become the inverse of the initial price. This mechanism will be useful when the buyer will choose among the sellers the best one.

```

ask sellers
[if purchasingPropensity = "no price"
 [set price 1]
 if purchasingPropensity = "highest price"
 [set price price ^(-1)]
 if purchasingPropensity = "lowest price"
 [set price price ]]
end

```

1.1.3. colorPatches

The third and last procedure of the setup button is “colorPatches”. It is useful to make the world more understandable. We color a grey strip in the middle that corresponds to the initial reputation of sellers and another grey strip on the right side which is reached when the sellers have sold all the goods available.

```

to colorPatches
ask patches
[if pxcor > 48
 [set pcolor 5]
 if pycor = 15
 [set pcolor 5]]
end

```

1.2 GO BUTTON

The other button present in our program is the “go” button. It contains four procedures and the ticks. Moreover, when all the sellers finish their goods² (490 sales) no negotiations will take place anymore, hence we have introduced an instruction that stops the program.

```

to go
if count sellers with [salesNumber < 49] = 0
[stop]
negotiate
move
exitMarket
do_plots
tick
end

```

² Go is a forever button

1.2.1. negotiate

In this procedure every buyer chooses a seller to negotiate with through a mechanism that does not depend on her attitude. In order to do so, we use local variables, if and ifelse instructions and n-of/max-one-of functions.

```
to negotiate

ask buyers with [attitude = "honest"]
[let sellersLeft sellers with [salesNumber < 49 ]
ifelse amongHowManySellers < count sellersLeft
[set ChosenSellers n-of amongHowManySellers sellersLeft]
[set ChosenSellers sellersLeft]

let TheSeller max-one-of ChosenSellers [reputation / price]
if TheSeller != nobody
[ask TheSeller
[set salesNumber salesNumber + 0.1
set feedbackNumber feedbackNumber + 1
set randomNumber random-float 1
ifelse attitude = "good"
[ifelse randomNumber < 0.8
[set ReputationSum ReputationSum + 25]
[set ReputationSum ReputationSum + 5]]
[ifelse randomNumber < 0.2
[set ReputationSum ReputationSum + 25]
[set ReputationSum ReputationSum + 5]]
set reputation reputationSum / feedbackNumber]]]
```

First at all, we start defining a local variable called “sellersLeft” that includes all the sellers with goods still available. Among all these sellers, the buyer compares only a limited number of agents³. We call ChosenSellers this set. The limited number is set by the user through the slider “amongHowManySellers” (its range is from 0 to the actual quantity of sellers).

Secondly we create another local variable called “TheSeller” that includes the seller definitely chosen. The function used in order to choose TheSeller is maximum of the ratio between reputation and price. Thanks to the mechanism used for setting the variable price in the setup, we can use just this function in order to include all the different criteria for choosing the counterpart.

At this point the negotiation takes place. The quality of the good sold is now discovered. If TheSeller is a “good” seller, there is 80 per cent of probability of high quality. On the other hand, if TheSeller is a “bad” seller, there is only 20 per cent of probability of high quality.

³ Because of cost, in term of time and energy spent in look up on the web

In the end the buyers give feedbacks, depending on their attitude.

```

ask buyers with [attitude = "misleading"]
[let sellersLeft sellers with [salesNumber < 49 ]
ifelse amongHowManySellers < count sellersLeft
[set ChosenSellers n-of amongHowManySellers sellersLeft]
[set ChosenSellers sellersLeft]

let TheSeller max-one-of ChosenSellers [reputation / price]
if TheSeller != nobody
[ask TheSeller
[set salesNumber salesNumber + 0.1
set feedbackNumber feedbackNumber + 1
set randomNumber random-float 1
ifelse attitude = "good"
[ifelse randomNumber < 0.8
[set ReputationSum ReputationSum + 5]
[set ReputationSum ReputationSum + 25]]
[ifelse randomNumber < 0.2
[set ReputationSum ReputationSum + 5]
[set ReputationSum ReputationSum + 25]]
set reputation reputationSum / feedbackNumber]]]

ask buyers with [attitude = "selfish"]
[let sellersLeft sellers with [salesNumber < 49 ]
ifelse amongHowManySellers < count sellersLeft
[set ChosenSellers n-of amongHowManySellers sellersLeft]
[set ChosenSellers sellersLeft]

let TheSeller max-one-of ChosenSellers [reputation / price]
if TheSeller != nobody
[ask TheSeller
[set salesNumber salesNumber + 0.1]]]
```

As shown in the definition of the variable “lifeTime”, now we increment it of one because all buyers have done their purchases. It is useful in the procedure “exitMarket”.

```

ask sellers
[set lifeTime lifeTime + 1]

end
```

1.2.2. move

This procedure guarantee that the world works as a graph.

```

to move
ask sellers
[setxy salesNumber reputation]

end
```

1.2.3. exitMarket

We introduce a rule which states that after four possibilities of negotiation, if a seller hasn't sold at least one time out of four leaves the market and restart the activity with the initial settings. This happens because she finds more profitable to change her identity (changing identity costs zero).

This mechanism works for all sellers with goods still available.

```
to exitMarket
  if exitFromMarket
    [ask sellers with [salesNumber < 49 ]
     [if salesNumber < (lifeTime / 4) and lifeTime > 3
      [set lifeTime 0
       set ReputationSum 15
       set feedbackNumber 1
       set reputation ReputationSum / feedbackNumber
       set salesNumber 0]]]
  end
```

1.2.4. do_plots

There are two plots: "revenues" shows over time the mean amount of revenues for bad and good sellers; the other plot "sales" represents the sum over each individual of the number of sales.

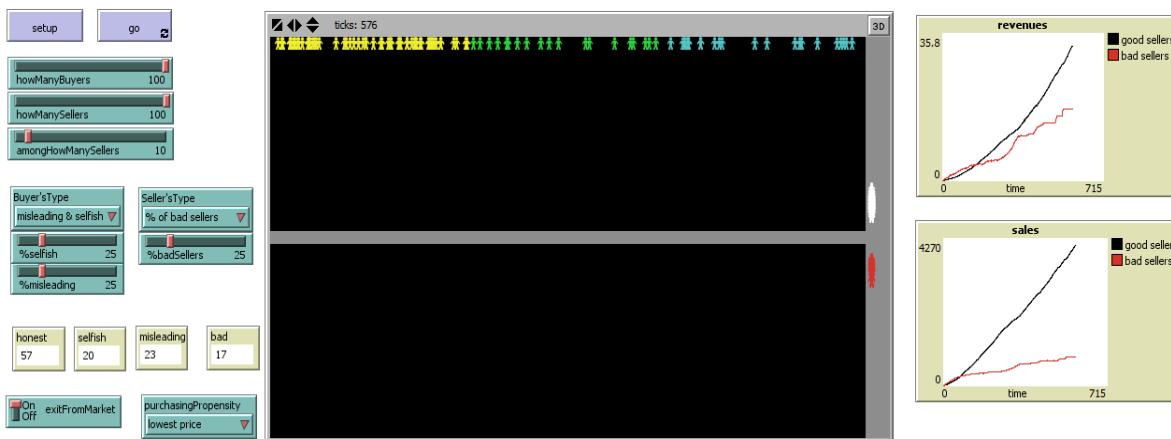
```
to do_plots
  set-current-plot "sales"
  set-current-plot-pen "good sellers"
  plot sum [salesNumber] of sellers with [ attitude = "good"]
  set-current-plot-pen "bad sellers"
  plot sum [salesNumber] of sellers with [ attitude = "bad"]

  set-current-plot "revenues"
  set-current-plot-pen "good sellers"
  plot mean [pricePlot * salesNumber] of sellers with [ attitude = "good"]
  set-current-plot-pen "bad sellers"
  plot mean [pricePlot * salesNumber] of sellers with [ attitude = "bad"]
end
```

2. EXPERIMENTING

The model aims to explain an on line market, and wants to underline the important role of reputation in this particular kind of markets. Reputation depends on the different kind of attitude that buyers have and depends also on the quality of goods that sellers sell in the market. Another important characteristic to take into account is represented by the preferences of consumers with reference to the level of the price. In the economy we could have agents which prefer mostly to buy products which have higher prices, because we think that higher prices represent also good quality items, or differently we could deal with buyers who prefer to buy products with lower prices ceteris paribus the other variables of relevance, i.e. reputation. At the end we could also have agents who do not care about price at all, and the only thing that they look at is the reputation which is given by previous feedbacks given in the previous transactions. Another thing to take into account in order to see whether the results are reliable and appropriate, is to see the way in which buyers give their feedbacks. In the real world we have different categories of people, someone likes to give her own opinion, someone does not care and someone else could found “funny” do destroy the market giving an opinion which is the opposite of her real one. In order to explain accurately the real world, another think that is important to explain is the existence or not of forces that makes sellers to find no more profitable to continue her activity of selling goods. Such forces can be interpreted as “external” forces that makes more profitable to leave the market and restart with another name the activity. According to this different features we can have different results which may also differ a lot among them. Our standard setting is represented by the presence of all the categories of sellers, more precisely we find a respectively higher percentage of “honest” sellers (50%) and an equal percentage for “selfish” and “misleading” sellers. We think that buyers when have to decide with who to do the transaction choose among a limited number of sellers (10) chosen randomly and once that we have decided the sellers among which we have to choose we think that in a normal world buyers, when the level of reputation is the same for two sellers, prefer to purchase at a lower price. In a standard market we think that if after some possible negotiation, the seller has not sell any good it means that his reputation will be the one set

at the starting point and that no one will interact with her in the future; so she will find more profitable to exit from the market. From the graph we can see that in the starting setting good sellers will have higher profits than bad sellers and we can see the same behavior for the number of sales. This result is straightforward and is the one that we expect. Initially bad sellers will sell more than good sellers because they will have lower prices and a level of reputation which is similar to the one of good sellers because we are at the beginning of the market; but once that the number of negotiation increases and buyers give their feedbacks we see that good sellers gain a lot of power in the market because they will have higher reputation than bad ones.

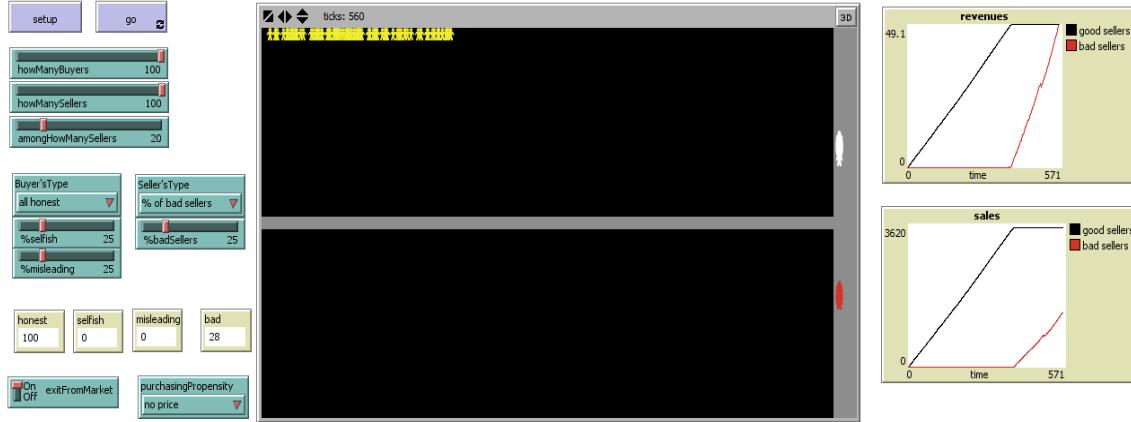


Different situation will be deeply explained in the following pages through different experiments.

2.1. Is honesty a good thing?

Let's start considering that in the market we have only honest buyers who gives their feedback according to the quality of the good that they have purchased. If we start from this point and we do not introduce the level of prices as a variable which influence the choice of the consumer, we can see that once that we run the program good sellers will always lie in the upper part of the "world" which means that their reputation will increase while bad sellers lie always in the lower part of the "world" since they sell mostly goods with low

quality. We notice that the first agents who finish their stock of goods are good sellers, because buyers will always prefer to purchase goods from the seller who has the highest reputation and the reputation will always be higher for good sellers since buyers gives a true feedback. Once that all good sellers have finished their product, bad sellers will start to sell goods because buyers have no other alternatives. Even if bad sellers make transactions and finish their goods, they will never lie in the upper part of the graph because buyers will always give an effective evaluation of the good; so after each transaction they will have a negative feedback from the buyer if the good sold was a low quality good, or otherwise will have a good feedback if the good sold was a high quality good. We have to notice that the same agent can sell high and low quality goods in different probabilities in fact they do not move always in the same direction but change their position without a well defined trend. Profits for good sellers will always be higher than profits for bad sellers. And we can see that bad sellers will start to have profits only once that good sellers have finished their products. The same trend is shared by the other variable “sales”.



When we have only honest people who cares only about the quality of goods, we have that good sellers will join their goal before bad sellers and will have on average higher profits because they have relatively higher prices since they sell a higher percentage of high quality goods and this thing allows them to set prices at a higher level with respect to bad sellers.

When we deal with a market like the one presented above, we can say that buyers are very lucky because they know that looking at the previous feedbacks they can be sure that they will not make mistakes when they will choose the seller with who they have to negotiate;

moreover also sellers will be happy to operate in a market like that because they know that they will sell all their product with no problems and they will have higher profits than the other sellers who sell bad quality goods. In a world like this we can say that being honest is a very good thing in order to make the market to function well.

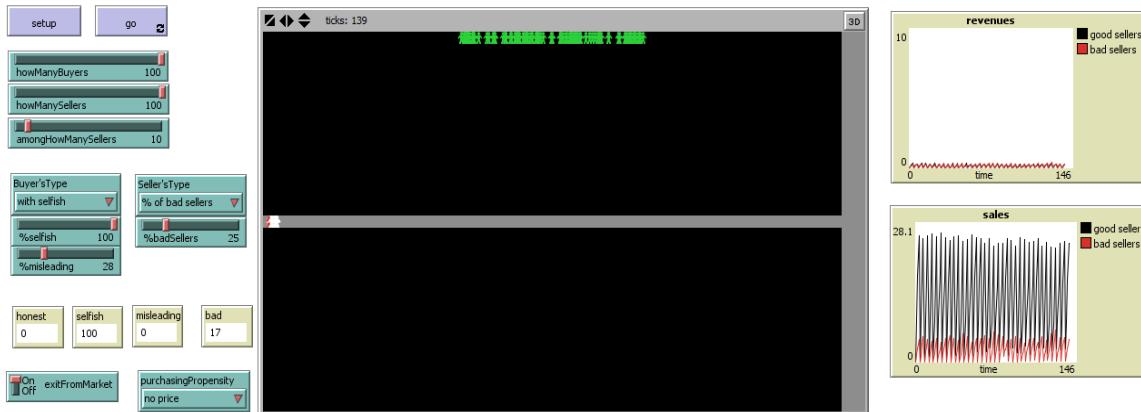
2.2. Being selfish is not good for you

Let's introduce the case of buyers being only selfish people, so they do not like to give feedbacks once that they have finished the transaction. In a situation like this, the reputation will not change over time and will be the one that we have set equal for everyone at the beginning of the simulation. If we do not introduce the possibility of leaving the market, the sales number will be equal for good and bad sellers if we think that preferences depend only on the reputation level. Since prices differ among sellers, revenues will be higher for good sellers because they sell at higher prices than bad sellers. If instead the level of prices influences the preferences of buyers we will have that in the case in which buyers prefer to purchase goods with higher prices, good sellers will negotiate with buyers before bad sellers. Initially the level of sales of bad sellers will be approximately zero, and only once that good sellers start to finish their stock of products we see that the sales of bad sellers increase at the end the number of sales will be approximately the same for good and bad sellers. Profits will be always higher for good sellers because they have high prices. In the opposite case, where buyers prefer to buy from sellers with lower prices we see that initially are bad sellers who sell more, and only after that bad sellers have finished their stock good sellers start to negotiate more. In a scenario like this, initially profits of bad sellers will be higher than the one of good sellers even if prices of the last ones are higher. This is due to the fact that good sellers initially sell very few quantity of goods. Once that they start to increase the number of negotiations with buyers, profits of good sellers explode and reach a very high level.

Let's now consider that selfish individuals do not care about the level of price, but they look only at the reputation level. In a situation like this we see that the result is a very un-happy result for buyers. Buyers, due to their attitude cannot choose in a good way the best counterpart of the transaction, so the possibility of dealing with a good or a bad seller

depends on the quantity of good and bad sellers in the market. In a situation like this we cannot make a rational choice because we do not have any variable that we can look at. Sales number is the same for good and bad sellers if we set that they share the same proportion in the market, and for what concern profits we can see that good sellers will have always a higher level of profits due to the fact that they have higher prices and sell the same quantity. If we allow sellers to exit from the market after a certain period that they do not negotiate, we can notice that the program will never finish to work. Due to the fact that a lot of sellers will choose to exit from the market and to restart the activity. If instead we do not allow sellers to exit from the market, we see that all agents will sell all their products. We notice that due to the fact that buyers are selfish, sellers do not move in the x-y axes because their reputation doesn't change over time, stays at the constant level set at the beginning. When they will finish their products, every seller will share the same position indifferently from the quality of the goods sold.

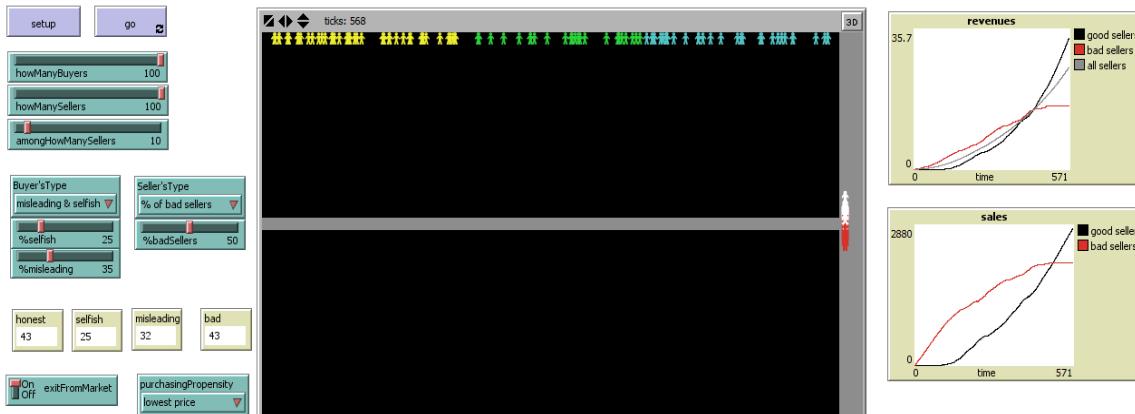
A situation like this doesn't allow buyers to make a rational choice because in this way she has not information available in order to make choice in a rational way, so she will choose randomly among buyers. In the graph we can notice that when the possibility of exit



from the market is allowed good sellers and bad sellers have the same random trend in sales and the random trend is the same also in profits. In the graph we see that good sellers sell more just because we put a higher percentage of good sellers in the market than bad sellers, but if we introduce an equal percentage we notice that the two plots are very similar; we have to notice that the amount of profits for good sellers lies above the amount of profits for bad sellers due to the difference in the level of prices.

2.3. The power of reputation systems

When we consider a world made of buyers who can be different in terms of attitude and all of them prefer lower prices we notice that initially the number of sales for bad sellers will be higher than the one performed by good sellers because buyers prefer cheaper goods to more expensive ones. When the number of negotiation starts to increase and also the number of feedbacks increases, the reputation for good sellers increases and for bad ones decreases. So after some negotiations, even if good sellers have higher prices and buyers prefer cheaper goods, good sellers will increase the number of sales more than bad sellers because their level of reputation over time will increase more than the one of bad sellers. So since our buyers are set in such a way that they prefer the buyer with lower price only when the level of reputation is the same, we see that at the end the reputation system reward the good sellers and their profits will be higher than the one performed by bad sellers.



This is a very powerful result for the reputation system because it underlines the fact that this kind of systems, if are well exploited, in the long run reword the good agents making the market to function in the best way. So in this case we can notice that is very important to give in a correct way feedbacks in order to make possible for the market to identify bad sellers and decrease their possibility of making transactions. In fact if we consider only "honest" buyers we see that good sellers always sell more than bad sellers and so they also have higher profits than bad sellers.

2.4. When is irrelevant being a good or a bad seller?

Let's consider a world made of an half with good sellers and an half with bad sellers and we consider that preferences of consumers look only at the level of reputation of sellers and we not look at the level of prices.

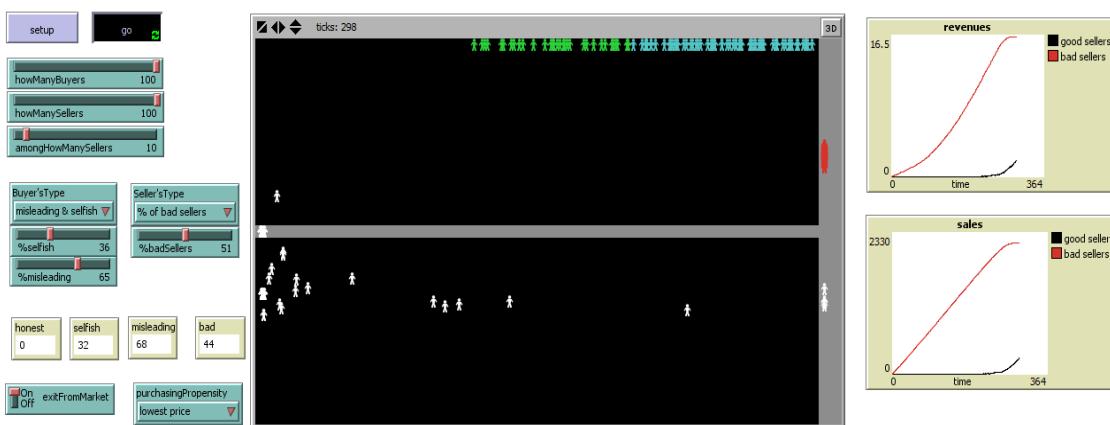


If we introduce a relatively high percentage of misleading buyers, we will have a situation in which bad sellers and good sellers sell more or less the same quantities and the difference in profits will be a consequence of the level of prices which is different across sellers since it is a variable which is set at the beginning.

At the end every buyer will join her goal, but we can see from the figure that the sellers lies at a level of reputation which is more or less the one set at the beginning. We can see that the high presence of misleading buyers causes that the level of reputation never reaches a high value because feedbacks will always be destroyed by misleading agents, but the presence of honest buyers ensure the fact that some feedbacks will be appropriate to reality so considering the two agents together we will have that the overall effect will be that of having a market who is unable to well select the agents and gives more or less the same level of reputation to buyers independently on the quality of the goods that they sell. In this case, being a good or a bad seller is irrelevant because the level of reputation will be destroyed by the feedbacks given by misleading consumers.

2.5. The failure of the reputation system

When we consider a market in which buyers are in high percentage misleading and selfish we have a situation in which the reputation is a completely mislead variable and we focus our attention in consumers who prefer goods with lower prices. In a situation like this one, we can see that misleading buyers destroy completely the market and initially only bad sellers will sell their products because they will have higher reputation than good sellers. The fact that buyers prefer lower prices prevents to good sellers to sell goods before bad

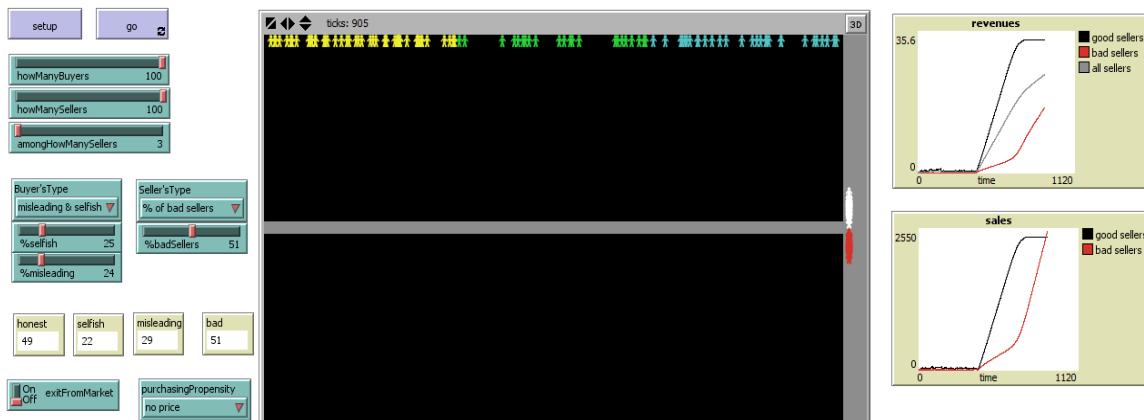


sellers have sold their entire amount of goods. Good sellers, will sell their good only once that bad sellers have finished their stock of goods. In the figure we can see that when the sales of good sellers start to increase the sales of bad sellers stay constant. For what concerns the profits, the reasoning is similar. Profits increases initially for bad sellers while profits for good sellers stay at zero level. When sales for good sellers start to increase also profits increase and at a certain point they will exceed profits of bad sellers. The overtaking in profits it's due to the difference in prices that good sellers and bad sellers have.

In the figure we can see that bad sellers (red) have already finished their stock of books and their level of reputation is higher than the one of the good ones that are still negotiating in the market. In this case the reputation system completely fails because we can see that good sellers lie in the lower part of the “world” and bad sellers lie in the upper part of the “world” where the upper part of the world represents the space in which the reputation is high and the lower part represents the space in which reputation is low.

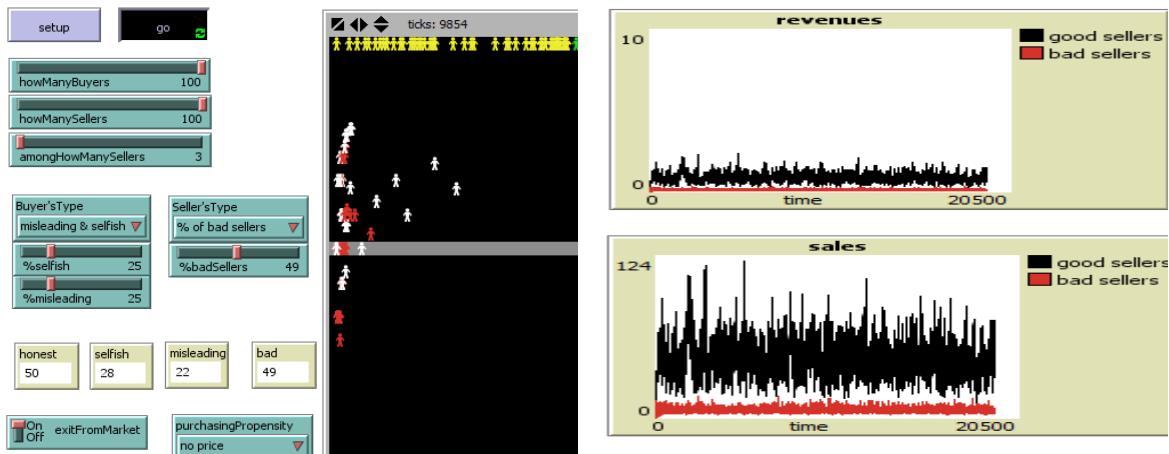
2.6. The opportunity cost of searching a counterpart

When we deal with a world with a lot of buyers and sellers, who do not care about the price level and choose among a very limited number of buyers we can see that initially sellers have a lot of difficulties to sell their goods. They have difficulties because is very probable that there will be some sellers that will never be considered by buyers, so they will be “forced” to exit from the market even if they sell good quality goods and they potentially will have a very high level of reputation. We see that in a setup like the previous one, the number of sales and profits doesn’t differ a lot among good and bad sellers. In a pattern like this one no one will finish the amount of products that she has to sell. If instead we do not allow the possibility of going out from the market, we can see that the first ones that finish their goods are good sellers, and once that good sellers have finished their good we can see that also bad sellers start to sell and so they start to have profits.



From the above figure we notice the trend of profits and sales after and before having allowed to exit from the market. When we allow to exit from the market, all sellers (bad and good) will sell few quantity of goods and will exit from the market very often. When they cannot exit from the market, they will sell goods and if they do not sell will stay in the market and wait for an agent to negotiate. We see that good sellers sell more products than bad sellers and their amount of profits is higher than the amount of profits for bad sellers. When buyers make their choice among few individuals we can notice that we dealing with a trade off. Buyers in this way increase the possibility of having chosen only sellers which are

bad so if in one hand they reduce the opportunity cost in searching more possible agents in the other hand they increase the possibility of buying a good of low quality. When we analyze the economy from the point of view of sellers, we can see that in a normal setting where they are allowed to leave the market there is not a reward for being a good seller. We can see that good sellers have more possibility to last in the market, but they will never reach the grey strip in the right hand side of the graph because they will exit from the market.



In order to exit from a situation as the one represented in the figure above, we have to set “exitFromMarket” off and only in this case being a good seller will be rewarded, moreover only in this case the market will finish and agents will lie in the strip in the right hand side.