A Macroeconomic Model for Inflation Control in Market-Based Grid Environment

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Abstract - Providers and consumers as two main elements in economic grid environment try to reach the maximum efficiency of the environment. Providers attempt to obtain the maximum income using a suitable pricing mechanism. Consumers also seek resources with the minimum cost. Due to the autonomous nature of grid environment, providers may price their resources without taking the consumers' conditions into account. Therefore, consumers face budget deficit for buying their required resources. So, the number of unused resources will increase. As a result, consumers' satisfaction rate and providers' efficiency will decrease. This issue leads to the inefficiency of market-based economic grid environment. In this study, a model is presented based on the macroeconomics concepts in order for the providers and consumers to price and budget, respectively, considering the expected rate of inflation. The obtained results demonstrate the usefulness of this model.

Keywords: Economic grid, Price of resources, Function of satisfaction, Efficiency of resources, Inflation.

1. Introduction

By economic grid appearance, different methods of resource management for the resources’ optimum allocation were introduced to the applicants [1],[2]. Resource owners in the economic grid environment use different methods of pricing in order to reach income. On the other hand, consumers should have sufficient budget for getting their required resources. Consumers pay according to the resources provided by providers. Providers should price the resources in a way that leads to consumers’ satisfaction. Therefore, it is essential that a mechanism should price the resources and budget aiming at providing both applicants’ satisfaction and provider’s interests.

1.1 Terminologies

In this paper, economic concepts are used for managing resource application and their allocation to the consumers [3]. Therefore, it is required that several terminologies which have been used in economic grid be investigated.

1.1.1 Economic period

Brokers can examine statistical condition for different resources’ trade between providers and consumers during various time periods [4]. This examination may include an inventory of traded resources, average price of resources, and number of consumed resources and so on. Time period can be a function in terms of time or a function based on the number of resources presented to the market.

1.1.2 Inflation

In economics, excessive increase of price in relation to the past is called inflation [3]. In the economic grid system, inflation phenomenon is defined as follows:

Unsuitable pricing of resources by providers in a way that prices of resources are much more than their prices in previous periods. In the heterogeneous economic grid environment, providers try to consider the maximum price for their resources in order to obtain the maximum income. Therefore, inflation may occur as a result of autonomous resource pricing by providers.

1.1.3 Macroeconomics and Microeconomics

Science of economics is divided into two sections of macroeconomics and microeconomics [3]. Microeconomics, also called pricing theory, exclusively studies economy and analyzes the market and consumer behavior. Microeconomics deals with people’s behaviors and selections at micro or small economic levels like an individual, a business, an industry or the market of a special product. Specifically, microeconomics refers to the patterns of supply and demand for the products and also determines the output price in special markets. Macroeconomics, in fact, deals with studying and analyzing total economic variables and phenomena like total level of society production and its composing factors are general price level, employment level, and economic growth and so on. Furthermore, it investigates the relationships between total economic variables and phenomena in order to predict and make suitable policies in future and revise economic decisions and policies.

The presented model in this paper, in one hand prevents selfish pricing of resource by providers and on the other hand compels consumers to reform budgeting
based on the trade condition in market, which none of the mechanisms have presented till haven’t observed this. The presented model also causes a mutual connection in economic grid environment and for each type of demand such as resource type and a number of requests along with autonomy protection of consumers and providers, cause justly and stable condition.

Other parts of this study organize as such: in part 2 we study the previous works. Many mechanisms presented for pricing of resource, that we use some of them. In part 3 we introduce the model based on inflation controlling in market and prove them. Evaluate and compare introduce in part 4. Simulation and estimation results are presented in part 5 and future works introduce in part 6.

2. Related Work

Different providers and consumers participate in economic grid environments aiming at obtaining their desired and suitable efficiency. Both try to fairly gain profit from the environment in proportion to their capabilities. Providers and consumers hope for obtaining more income and providing their resources at the minimum cost, respectively. Resource management system should make suitable decisions considering each factor’s requirements in order to cause a fair environment.

In [4], grid service providers create different resource combinations to account for the users’ requests. Total cost of each combination is used as the parameter for estimating each resource’s merit level; in such a way that if the price of each resource is more than that of total collection (combination), the considered resource will have higher merit. Providers present resource grid services to consumers according to merit level. In this strategy, grid service providers estimate the resources’ merit level according to the current price. The price of resources in a combination may irregularly increase compared with previous periods and this may lead to an increase in the total cost of a combination. This issue does not influence resources’ merit level; however, it makes troubles for consumers in buying the resources. Consumers present their proposed price according to the previous trade information while providers may price resources without considering resources’ history and consumers’ conditions.

In [6], a dynamic mechanism is introduced for allocating resources’ time cuts for tasks. Resources can be available for consumers in pre-determined time cuts. Resources with different prices participate in the environment and receive money in terms of the number of time units which are busy. Therefore, in each time unit, there may exist resources with different characteristics and this is inevitable due to grid environment’s dynamic, autonomous and heterogeneous nature. While different time cuts are passing, different resources’ prices may increase compared with previous prices or the prices proposed by consumers may be lower than the allowed one determined by providers; as a result, resources are not allocated to tasks. Only these two reasons are enough for some problems to happen in time cuts, which include creation of idle resources, consumers’ dissatisfaction, and decrease in resources’ efficiency and so on.

In [7], a dynamic mechanism is used by providers for pricing resources. Providers apply different pricing policy based on the number of applied resources. If the number of applied resources in the environment is high, providers will apply increasing pricing function. And this way, if the number of applied resources is low or average, providers will use decreasing and fixed pricing policy, respectively. Although this mechanism effectively considers consumers’ satisfaction and resources’ efficiency, it acts weakly in providing providers satisfaction. If the reason for the existence of idle resources and decrease in the number of applied resources is the low prices proposed by consumers, providers will suffer and should decrease the price of their resources. This trend is not correct according to the material investigated in previous section (Individual Rationality). Providers should propose prices in terms of requested resource types; in other words, they should budget correctly.

Among the mechanisms introduced by now, in order to create a fair environment in which consumers can provide their required resources or providers can obtain more income; either provider determine prices considering the consumers’ proposed price or consumers completely accept the resources’ prices. However, these approaches cannot always account for an environment which is naturally decentralized, autonomous and heterogeneous. To reach suitable service quality, both providers and consumers should announce prices and requests, respectively, considering other participants’ conditions.

3. Our Proposed Model Based On Controlling Inflation in Economic Grid

The proposed model works for controlling and managing inflation in economic grid environment based on the proposed price of resources by providers and the proposed budget of consumers. As mentioned before, in this model, the details of pricing and budgeting are not taken to account and only the results of pricing and budgeting are dealt with.

In the economic grid environment, resource characteristics (R) include value (v) and unit price (ρ).

In order to compare the efficiency rate of different resources, these characteristics are considered as evaluation and comparison parameters. Value can have
different meanings considering the resource type in economic grid environment. For example, if a CPU resource is considered, value is the processor’s computing power and, for a resource like memory, information trading rate is the resource value; accordingly, unit price is determined by resource providers in terms of per unit of using the resource value.

Considering the mentioned attributes for the grid resources, each resource can be demonstrated as follows:

\[ R = (v, \rho) \]  

In fact, other attributes can be also mentioned for the resources which are not considered in this study.

Different types of resources can exist in the economic grid environment considering efficiency and application rate; obviously, for each resource, several samples can be imagined. If \( \theta \) is the type of resource i, each resource can be depicted as follows:

\[ R_{\theta i} = (v_{\theta i}, \rho_{\theta i}) \]  

3.1 Price Index

In order to estimate or predict inflation in the market, price indices are excavated for each type of good based on the resources’ history. According to price index, prices’ growth rate is determined on the basis of the foundation period. Price increase or decrease occurs based on the inflation coefficient which is explained below. For instance, Table 1 demonstrates 10 resources with various specifications.

If \( v_{\theta i} \) and \( \rho_{\theta i} \) are value and price of the ith resource, type \( \theta \), the price index of type \( \theta \) at the t period can be computed in relation to the foundation period \( t=0 \) as follows [3]:

\[
I_{\theta i} = \frac{\sum_{i=1}^{n} v_{\theta i} \rho_{\theta i}}{\sum_{i=1}^{n} v_{\theta i} \rho_{\theta i}}
\]

(3)

The value of shows the amount of price increase for the resource type \( \theta \) at the t period in relation to the foundation period \( t=0 \). In this relation, the foundation period is assumed as the first period; however, foundation can be changed at will. It is assumed that the price level of different resources of one type does not differ a lot; thus, price index is not severely influenced by the limited number of resources.

Table 1: Grid resources

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>( v_{\theta} )</th>
<th>( \rho_{\theta} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1396</td>
<td>501</td>
</tr>
<tr>
<td>1</td>
<td>1464</td>
<td>385</td>
</tr>
<tr>
<td>2</td>
<td>1798</td>
<td>473</td>
</tr>
<tr>
<td>3</td>
<td>1074</td>
<td>134</td>
</tr>
<tr>
<td>4</td>
<td>1506</td>
<td>411</td>
</tr>
<tr>
<td>5</td>
<td>1771</td>
<td>575</td>
</tr>
<tr>
<td>6</td>
<td>1021</td>
<td>215</td>
</tr>
<tr>
<td>7</td>
<td>1227</td>
<td>420</td>
</tr>
<tr>
<td>8</td>
<td>1763</td>
<td>277</td>
</tr>
<tr>
<td>9</td>
<td>1717</td>
<td>630</td>
</tr>
</tbody>
</table>

In order to clarify the concept, if \( I_{\theta 0} = 1 \), it means that there is no price increase at period t in relation to the previous period (foundation period) \( (\lambda = 0) \). For instance, if \( I_{\theta 0} = 1.2 \), it means that there is a price increase by 20\% \( (\lambda = 1) \). And if \( I_{\theta 0} < 1 \) there is a price decrease \( (\lambda = -1) \) which is not within this study. Figure 1 shows the changes in price index for 10 resources during 10 periods.

![Figure 1](image1.png)

Figure 1. Changes of price index

3.2 Inflation

At the end of each period, brokers examine inflation in the market. They can compute inflation rate for each resource according to accountancy information in the grid bank. Considering the level of price index at the foundation period and t period, inflation rate can be computed as follows [3]:

\[
\varphi_t = \frac{I_{\theta t} - I_{\theta 0}}{I_{\theta 0}}
\]

(4)

\( \varphi_t \) Shows inflation rate at t period; in other words, change percentage (decrease or increase) of price indices for the resource type \( \theta \) at the period t in relation to t=0. Figure 2 demonstrates inflation rate for each of different periods.
Inflation rate determines the level of trade usefulness; however, budgeting and resource pricing are not sufficient for making decisions.

### 3.3 Price Function

Whichever price the pricing function determines for the resources shows decrease or increase in comparison with the foundation price of $k$. As a result, provider’s resources’ price function can be stated in terms of foundation price $\rho_0$ and the value of $k$.

$$\rho(r) = \rho_0 + k \times \lambda$$  \hspace{1cm} (5)

### 3.4 Resource Efficiency Function

If $r$ is the number of resources which is shared by the provider and $\alpha$ is the actual number of allocated resources, efficiency function is defined as follows:

$$U(r) = \frac{\alpha}{r}$$  \hspace{1cm} (6)

The value of $U$ determines efficiency rate. Brokers present resources to users considering the price. Resources’ suitable price leads users to use more resources and, as a result, resources’ efficiency rate increases. This trend decreases idle resources in the environment. Figure 3 shows the number of idle resources at different periods. The number of idle resources is high at the periods which have more inflation compared with other periods.

Different methods can be used for presenting the maximum resources to the users according to resource prices and users’ suggested budget. In fact, one of the objectives is to set pricing function in order to prevent from creation of idle resources and inflation.

### 3.5 Function of Satisfaction

Users can obtain different resources from the provider in order to meet their needs and they can use resources for a definite amount of time depending on their needs. It is obvious that, in computing the cost, users should consider the time period for using the resources based on the defined time unit. In this study, the number of this time is considered one.

In the proposed model, a consumer buys the list of resources from the environment based on her/his budget. Therefore, at the end, the $P_l$ list includes the cost of those resources which are economical and obtainable for the consumer. Total price of $C$ resources is as follows:

$$C = \sum_{i=1}^{n} P[i]$$  \hspace{1cm} (7)

The function of satisfaction should be in a way that, if price is not balanced, or in other words, if inflation rate is high, satisfaction from the market decrease. On the other hand, resource efficiency should also directly influence satisfaction. The following function is used as the market’s satisfaction function:

$$S(U(r), P(r)) = \frac{1}{\rho_0} \times U$$  \hspace{1cm} (8)

Figure 4 shows satisfaction level at different periods. The periods with lower inflation rate and higher efficiency function have higher satisfaction compared with other periods.
3.6 Brokers Roles

Resources’ price increase and, as a result, inflation and insatisfaction are the results of two factors:

a) Increasing value of resources: Providers update resources and strengthen them during the time and aiming at more income. Therefore, the finished cost of resources is higher compared with previous periods. Thus, consumers should increase their budget in order to be able to buy resources.

b) Increasing price of resources: Providers selfishly increase the price of resources to obtain more income. In other words, providers use a price function which is not in proportion with buyers’ budget.

Brokers should follow different approaches considering the reason of inflation. Equation (9) can be used for discovering the reason of inflation [3]:

\[
\sum_{i=1}^{n} v_{ib} P_{(b)(i-1)} < \sum_{i=1}^{n} v_{ib} P_{ib}
\]

If the above equation is true, inflation is caused by price increase and provider should correct their pricing function. Otherwise, the reason of inflation will be the increase in resource power and consumers should provide their budget deficit.

After \( z \) time period units passed, \( j \)th period will be assumed as the foundation period and \( F_j \) as the expected inflation rate for other periods. The period with the highest satisfaction function will be identified as the foundation period and its inflation rate as the expected inflation rate. Considering the rate of expected inflation rate, the value of \( k \) for price function will be as follows:

\[
0 \leq k \leq F_{ij} \times \rho_i / 100
\]

Now, the scheme of the proposed model is presented which can be used by dealers for trading resources between providers and consumers:

Starting Step:

1. Providers present the list of available resources to brokers along with their prices under the \( R_i \) vector.
2. According to the information from previous periods, brokers compute \( I_{ip} \) and \( \varphi_i \) for each period.
3. Brokers announce the \( F_j \) to users and provider.

Second Step:

4. Brokers receive list of \( R_i \) and \( q_i \) from provider and customers, respectively.
5. While (\( z > 0 \)) do step 6 to 8
6. For each resource \( i \) in \( R_i \) do
7. If \( \rho_i \leq \rho_h + ((\rho_h \times F_{ij}) / 100) \) then
   \( R[i] \) is allocated to the user and \( u[i] \leftarrow 1; \)
   Else \( u[i] \leftarrow 0; \)
8. \( z \leftarrow z - 1; \)
9. End.

Brokers present the \( F_j \) which is acceptable for users and users, considering this rate, are informed of the market prices at other periods. This issue helps users to increase their budget in ratio with price growth at next periods in order to participate in the market. If \( \varphi_i \) is the inflation rate accepted by the brokers at period \( t \), users at period \( T \) are informed of price indices in the following way:

\[
I_T = I_{ip}(1 + \varphi_i)
\]  

This relation helps users to have initial information about market situation for a special good relative to previous situations.

4. Evaluate and Compare

Considering the potential heterogeneity of the economic grid environment, the probability of inflation happening at different periods is very high. In this paper, a macroeconomics model is presented for controlling and improving inflation in the economic grid. In this model, providers price the resources according to resource trade history and consumers’ satisfaction. Consumers budget for buying their required resources considering the expected inflation rate. The proposed model has better characteristics compared with other methods which have been presented so far and these characteristics are mentioned below:

4.1 Budget-Balance

Consumers should pay the cost of used resources. Without considering different methods of payment [5], consumers should not require external grant-in-aid for a long time in order to make up for their budget deficit.
Consumers’ budget should be balanced with the price of resources. The proposed mechanism leads to a balance in consumers’ budgeting for buying the resources. Among the strategies which are related to the present research, no strategy presents a method for changing the budget considered by consumers. But, to reach a fair situation, providers try to price resources considering consumers’ conditions; consumers should also adapt their budget with the resources’ fair price rates. None of the strategies mentioned in this study [4], [6], [7], [8], [9], [10], [12] have presented clear methods for the budgeting policy of consumers.

4.2 Computational Tractability

Considering the dynamic environment of each period, consumers may demand differently. Customers’ demands may differ from earlier periods in terms of number of demand for resources, demand type for resources and so on. The proposed mechanism is able to make decisions about the resource allocation based on input amount at the time of operation. In other words, this mechanism acts on the supply and demand basis. In [6], nodes are able to perform tasks in parallel; however, if they want to increase prices for higher income or update the resources, they cannot account for any consumer requests. Considering the grid’s heterogeneous and autonomous nature, the above-mentioned problems’ possibility is very high and the presented mechanism in [6] cannot support them.

4.3 Individual Rationality

Different consumers and providers participate in economic grid environment with different motivations. The goals of each consumer or providers may contradict those of others. No element of the grid should bear the loss caused by other elements. For instance, assume two consumers A and B. Also, assume that resource price is not important for consumer A while it is vital for consumer therefore, providers may increase prices after considering consumer A’s policy and satisfaction. This will lead consumer B to suffer because s/he cannot buy the resources due to its limited budget. Although this problem can be solved using different mechanisms, it decreases the efficiency of resource allocation system. The presented mechanism prevents such problems. Consumers and providers participate in the market based on the expected inflation rate which is satisfactory for all environmental elements. Although [4] and [7] attempt to allocate resources based on providers’ merit, providers with lower abilities and consumers with lower purchasing power are the victims of efficient providers and consumers, respectively, and have no motivation for being present in the grid environment; this is the motivation which causes providers and consumers to optimize pricing and budgeting policies, respectively, in order to continue their partnership. According to [12], although inefficient SLAs (Service Level Agreements) are penalized by giving tasks to other SLAs, if available, one of the reasons for SLAs’ inefficiency may be lower prices proposed by buyers. In [12], providers may be penalized because of consumers’ inappropriate operation. This issue is observed in the proposed model of this study and getting informed of the market’s current and previous situation is an element that creates motivation for more partnership in the market. In other words, in this proposed model, providers and consumers do not suffer from the losses caused by other elements.

4.4 Double-Sided Market

Consumers and providers may use different strategies for presenting their requests and replications, respectively. The proposed mechanism supports different policies of both sides for developing a business relationship. This mechanism only deals with the finished cost of providers’ resources and consumers’ suggested budget and, as far as resource allocation trend is concerned, it makes decisions without any need for the internal details of each one. The method proposed in [6] is not a useful method considering the conflicting goals of both consumers, who try to obtain their required resources at the minimum cost, and providers, who share their resources at the maximum price in order to obtain more income although suitable time intervals are allocated to them considering the proposed prices of tasks. In simple terms, time intervals might not be processed because of low level of proposed prices by consumers or inappropriate pricing policy by the providers. The model presented in [9] is designed only aiming at maximizing the provider's income considering the delay rate of different classes of tasks for operationalizing the provider's resources. The policy of increasing income for providers is not observed in the mechanism applied in [10] since providers change the price of resources according to the amount proposed by the consumers in order to increase the productivity rate of their resources.

4.5 Bundling

Consumers’ demands for resources or job may have internal relations and dependencies. The proposed mechanism is able to support the demands’ internal dependencies. For instance, consumers may require a resource with the computational and price power which is compatible with other resources. This mechanism should process the demands of consumers considering current conditions. As time goes on, providers may increase the prices of their resources and consumers may not be able to obtain some of their required resources. According to the mechanism presented in [6], although it is possible to classify different types of tasks based on their different dependencies and then present them to the nodes, consumers’ proposed prices may not be equal since dependent tasks and nodes are able to process only a number of them. Therefore, considering the providers’ motivation for increasing their ability or price for obtaining more income, the mechanism
proposed in [6] is not suitable for processing dependent tasks. However, in the model presented here, this problem is solved during the time and in future periods since price growth rate and budgeting are functions of inflation.

4.6 Time Constraints

Providers need complete information about other providers and consumers in order to price the values and make decisions about resource distribution. Consumers also need complete information on resources and accountancy in order to announce their demands. In this mechanism, consumers and providers have access to all the required information such as price of resources, time that resource is occupied, time that job starts and so on. Unlimited accessibility to different types of information may be regarded as a pre-requisite for the grid scheduling system in order to allocate resources to tasks; however, in the business strategies between consumers and providers, which have been presented till now and are discussed in this paper [6], [7], [8], [9], [10] no effective use has been made of this information for stabilizing economic grid market and satisfying providers and consumers. In [4], only the statistics of the resources used in previous periods for effective allocation of resources is applied and no attention is paid to the reason of low supply-and-demand rate, which may be because of the irregular increase in resources’ prices.

4.7 Allocative Efficiency

In the economic grid environment, there are different providers and consumers with different efficiency goals. Consumers demand their requirements aiming at providing their required resources at the minimum cost. Providers seek more income through trading resources. The presented mechanism provides suitable efficiency considering each of these elements. The strategies referring to the interaction between providers and consumers in the economic grid environment which have been presented thus far [4], [6], [7], [8], [9], [10] have not be able to adequately satisfy consumers and providers simultaneously because they have considered the parameter of service quality in only few cases. However, in the model proposed here, a large number of main parameters of service quality are supported for providers and consumers which include growth rate of prices, rate of idle resources, rate of providers’ income, average price of different resources, generalizability to the environments with larger sizes, rate of inflation and so on.

The proposed mechanism controls and organizes market’s trading trend considering the inflation rate and satisfaction of providers and consumers in different periods. The aim is to create a fair business environment for the main elements.

5. Design and Evaluation

In order to show the proposed approach’s efficiency, the economical grid environment is simulated using VC# codes. To obtain better results, the number of resources is assumed to be 100 and the value of $z$ is chosen to be 10. At the end of each period of $z$, the superior period is chosen as the foundation period for the following periods.

For Table 1, after the first period, resources’ efficiency function rate and satisfaction and also inflation rate for each period are demonstrated in Figure 5.

Considering Figure 5(a), it can be seen that price indices are at higher levels before implementing the proposed method. Furthermore, price indices face severe changes in each period; this situation is natural considering the autonomous nature of grid environment; however, this trend can cause dissatisfaction among consumers and lead to low resource efficiency. As can be observed in the diagram, index rate of prices decreases noticeably after only one period of implementing the proposed algorithm and severe changes among the periods disappear. This trend leads consumers to appropriately budget for the next periods considering the price indices. In simple terms, the general level of resource prices can be predictable.

Price levels which are higher than that of the basic period cause an increase in the inflation rate. The higher the inflation rate, the lower the satisfaction level of consumers. It is clear in Figure 5.b that, in periods with no control over the price indices, inflation rate increases, which is natural considering the motivation of providers for obtaining more income; however, it leads to resource inefficiency.

Moreover, Figure 5(b) demonstrates that, after one period of implementing the proposed method, inflation rate noticeably decreases. It may seem that lower inflation rate leads to lower provider income; however, considering the points that (1) inflation control increases consumers’ motivation for participation in the market and (2) economic grid environment has mutual...
characteristics, inflation control positively influences resources’ supply-and-demand rate. In addition, although providers cannot increase prices more than an expected amount, price increases can repeatedly occur in different periods, which happens gradually and during the time.

![Figure 5(b): Inflation rate](image)

In simple terms, inflation control spreads negative influences of price increase during various time periods and does not damage the trading trend in the market.

One of the negative influences of inflation phenomenon is the existence of idle resources in the market. When providers selfishly price resources, consumers cannot purchase their required resources, which leads to the creation of idle resources. Figure 5(c) shows that the number of idle resources in periods with inflation efficiency and resource prices.

![Figure 5(c): Idle resources](image)

When the inflation rate is high, resources’ efficiency rate is low. Increase in inflation rate leads to the decrease in the satisfaction from the trading trend of resources in the market. Figure 5(d) indicates that, in periods with more idle resources and higher inflation, satisfaction rate is very low and vice versa.

6. Conclusion and Future Works

In this paper, the attempt is to introduce a homogenous and coordinated system for trading different resources in the economic grid environment. Providers and users participate in the market considering the market specifications. In this study, the mentioned different problems are effectively prevented through limiting the pricing function by providers. For the future work, users’ budget can be also determined from the environment considering the expected inflation rate and income level in order to help the efficiency of the proposed approach.

References


[7] Xin Bai, Dan C. Marinescu a, Ladislau Bölöni, Howard Jay Siegel, Rose A. Daley,I-Jeng Wang, A


