International Journal of Business and Development Studies **Vol. 6, No. 1,** (2014) pp. 21-38

Optimal and Sustainable City Size by Estimating Surplus Function for Metropolitans of Iran

Naser Yarmohammadian[*] Nemat Akbari[**]
Ali Asgary[***] Naser Movahedinia[****]

Abstract:

By shouldering the burden of a big chunk of global production, and giving Shelter to half of the world's population, currently cities play an important role in national economies. Benefits of agglomeration in cities have played a major role in the process of economic development of different countries, however, the expansion of urbanization has produced some problems including environmental and noise pollutions and traffic problems. Therefore many of the Metropolitan residents blame the population growth for the problems they face while urban governors have to find an answer to the question that if there is an optimum size for their cities, what is that size?

This essay reflects on the optimal and sustainable size of the metropolitans in Iran and gives separate estimation for each. Due to scarcity of statistical information this article includes five metropolitans of Tehran, Isfahan, Mashhad, Shiraz and Ahvaz, within the time span of 1999 to 2012. This survey is based on the estimation of surplus function including the pollution externalities. The results show that Tehran is overpopulated to the excess of 71 percent of its optimum size, and also it has exceeded its sustainable size by five percent. Also other four metropolitans of Isfahan, Mashhad, Shiraz and Ahvaz have exceeded their optimal size but they still are in their relevant sustainable limits.

Keywords: local economy, optimal size, sustainable size, metropolises of Iran

1. Introduction

The importance of cities is based on their economic activity hubs. City is a geographical location that differs from other areas in terms of the scale

---

[*] PhD candidate of Economics, Department of Economics, University of Isfahan, Isfahan-Iran. Email: naser.yarmohamadian@yahoo.com
[**] Professor of Economics, Department of Economics, University of Isfahan, Isfahan-Iran. Email: nemata1344@yahoo.com
[***] Associate Professor of Disaster & Emergency Management, School of Administrative Studies,York University, Toronto-Canada. Email: asgary@yorku.ca
[****] Professor of Computer Engineering, Computer Engineering Department, University of Isfahan, Isfahan-Iran. Email: naserm@eng.ui.ac.ir

of activities of entrepreneurs and entrepreneurship. Statistics show that the top thirty cities related to GDP approximately have produced 16% of the products in the world in 2005. Likewise the top 100 cities have produced almost 25 percent of productions in the world. Therefore a direct relationship exists between level of urbanization and economic development in various countries. (World Development Report, 2009)

On one hand relationship between urbanization and benefits of agglomeration suggests not imposing limitations on the size of cities. On the other hand dissatisfaction of most of inhabitants of cities over the bothering effects of population congestion, like air and noise pollutions, high rent rates, and heavy traffic, have led to demands for imposition of limitations on the expansion of these cities. The number of those who live in cities currently forms more than fifty percent of the world's population, as this ratio is growing continuously (Fujita, 1996). This trend manifests a higher acceleration in developing countries in comparison to the population growth in industrial countries of the fifteenth century. Many countries which faced mushroom growth of their urban population chose to put a limit on the size of the cities. Such policies have hindered the abrupt growth of the cities in some countries in recent decades. Lack of attention to the benefits of agglomeration is one of the basic critics against such policies (Yezer and Goldfarb, 1978). The optimum size of cities has occupied not only the minds of the policy makers, but also caused many debates among experts. These debates have started before Alanso (1971) and have been there up till now. Prior to Alanso (1971) most of studies saw the optimum size of the cities in relations to the minimum cost of public goods, and they believed the best level of population where the expenditure of local governance in minimum. Trusting the previous studies which had not considered the benefits of agglomeration, Alanso studied both positive and negative aspects of population growth in the cities that is the economies and diseconomies of agglomeration. After Alanso in 70s and 80s many studies were conducted which flared up disagreements. For example, disagreements over the yard stick for optimum size, the type and the way of calculation for congestion costs, considering spatial aspects, and so on.

Despite their small number, these disagreements did not spare experimental studies. For example some of experts used Henry George's Theorem to examine the Too Large hypothesis of city, and some others have used Surplus Function to decide the optimum size of a city and some authors have used the general equilibrium Model to identify the optimum ratio for metropolitan population in Economy. Disagreement over approaches have been so much that for example Zheng's (2007) estimation for the population of Tokyo was 18 million, while Kamagni (2012), with the inclusion of the pollution externalities, has put his estimation lower that 400 thousands for the very city.

Beside contradictory estimates, another problem with experimental studies is the presentation of a fixed figure for all cities in an urban framework, while any city must have its own optimum size based on its spatial structure. Lack of separate estimates for the optimum size of every city in an urban framework might be because of scarcity of statistical figures as this is a common problem for most of the cities. This essay tries to estimate the optimum size of metropolitans in Iran, based on the surplus function of Zheng's framework. Another aspect of this essay which differs from other essays of this kind is the inclusion of pollution surplus as a disutility similar to its presence in experimental models. Camagni has done this through the deduction of pollution indicator from the utility variable in such a way that the marginal disutility of pollution is equal to one. This is not a flaw-free calculation because the yardstick for pollution and utility are considered as the same.

2. Literature Review

With respect to many articles published totally in past, but there are too little ones published in recent times. Attention to optimal city size models have been occurred in 1970s, for example see Barr (1972), Boeventer (1970, 1973), Tolley (1974) but the most seminal paper is written by Alonso (1971) developed by Evans (1972) and Richardson (1972, 1983). He had a theoretical look based on economics at optimal city size and used basic conception of economics to explain what optimal city size means. His framework also has been used in this paper and some other empirical studies such as Zheng (2007). Before 70s studies focused on best size of the cities related to minimum cost of local public goods provision that leads to estimate optimal city size for a vast variation range (e.g. 30-250 thousand people by Svimez (1967)-quoted by Cameron (1970) to 1 million people by Redcliffe-Maud Commission (1969)). Richardson (1972) believes these studies underestimate the optimal city size because they ignore benefits of population. In 70s and 80s specialist pay more attention to positive side of population in cities. These studies relying on Marshal

(1820) model agglomeration economies and diseconomies of population as positive and negative side of urban population. For example Alonso (1971), Evans (1972), Dixit (1973), Henderson (1974), Singell (1974), Richardson (1972, 1983), Arnott (1977) Kanemoto (1976, 1996) see the optimal city size as an outcome of economic agents interaction. Most of these papers have seen theory of optimal city size as an analogy for microeconomic theory of production replacing population with quantity of production. Later on, additional determination of city size has been put to analysis. As Papageorgiou and pines (1999) mentioned another source for inverted U shape utility function of urban in term of population is provided by Tiebout (1956)'s theory of local public goods and club theory of Buchanan (1965). In this framework the positive effect can be shown by declining burden of sharing the cost of local public good as the population increase (Berglas and pines, 1981 and scotchmer and wooders, 1987). Fisch (1975, 1976) provide a framework that connects the theory of clubs and optimal city size. His first finding is that the optimal size of urban population is finite. Among all authors considered two side of agglomeration, diseconomies of scale vary wildly. Dixit (1973) use traffic congestion as negative side of agglomeration and Henderson (1974) uses land scarcity and its effect on the production of housing while Arnott (1979) uses residential crowding and Berglas and pines (1981) uses congestion from using the collective good.

In contrast to theoretical work, empirical works are much less than those. First empirical study based on literature provided in 70 decade is Yezer and Goldfarb (1978). He developed an indirect empirical test given the presence of agglomeration economies and congestion externalities. He concludes that migration to cities populated from 1.5 to 2.5 million impose external cost that exceed the external benefits while migration to larger cities does not have such a cost. Another section of literature of optimal city size theory is based on Henry George's proposal. George (1879) believes there is no right for land owner to gain benefits from land rent. So all land rents should be taxed away and used to finance public expenditure. According to this proposal Henry George theorem state when a city has an optimal population size, the aggregate urban differential land rents can cover the costs of pure public goods (Fu, 2004). Kanemoto and et al. (1996) introduces a test based on Henry George Theorem to test if Japanese cities, in particular, Tokyo, are too large. Their evidence does not support the hypothesis that Tokyo is too large. Next generation of technique to determinate optimal city size in the literature is maximizing surplus function that is defined as the difference between the total income and the total expenditure of the households in the city. In this context the optimal city size is where the marginal social benefits are equal to optimal social cost of urban. Capello and camagni (2000) use 58 Italian cities data to estimate the average location benefit function and the average cost function. They show the city size at highest average benefit function and at lower average cost is 361,000 and 55,500 population, respectively. Nakamura and kanauchi (2001) estimate both the average benefit function and the average cost function using between 666 and 693 Japanese cities data. They find social optimal city size between 3.32 million to 5.21 million populations (quoted by Mizutani and et al., 2012). Zheng (2007) estimate urban benefits and costs of city for major Japanese cities and find optimal city size of 18 million by maximizing surplus function. Mizutani (2012) estimate total surplus function for the year 2000 in Japanese metropolitan areas and determine optimal city size of 393,151 people and sustainable city size of 1,057,412 people where total benefits would be equal to total cost. All of empirical studies in the literature with different techniques find a unique amount of optimal city population whereas each city supposes to have its own benefit and cost function. It is because agglomeration economies of scale depend on spatial structure of a city (Anas and et al, 1998). Urban spatial structure that is the way that urban space is arranged affect different aspect of city include benefit and cost of the agents. Urban spatial structure is affected by different natural and artificial factors. Natural factors such as climate, land type and comparative advantage, and policy-made factors such as the type of zoning (Anas and et al, 1998), durability of housing investment (Anas and et al, 1998), kind of specialization of city and so on. Thus each city attains its optimal city size through maximizing its own surplus function.

3. The basic model

We consider a local economic model in which three actors play role. These actors are firm, household and local government. Firms produce exported goods. Households are monopolistic supplier of labor in market and receive wages in return of their supply. They are also consumer of final output. Local government induces tax to household and produce public good of amenities because during producing output, pollution which is supposed the disutility is being produced. Local economy model is similar to that of the national model with a difference that the economic factors are located in one region but maintain exchanges with other regions. Exchanges are done through trade of goods or migration of work force. The other difference of this model with a national economic model is that for a closed country there is no transaction with the outside world and therefore there is no market for national exchange currencies, as all transactions are done through a single currency

Firm:

The production function of exported good, X for the firm is given by:

$$Q_x = Q_x(N)$$

In which Q_x is production quantity of X and N is labor as input. The wages that firm should pay to labor, W^*, is determined by profit maximization of the firm that is given as follow:

$$\text{Max } P.Q_x(N) - W.N$$

In which P is the price of final output. Wage paid to labor is equal:

$$W^* = P.Q_x'(N)$$

Household:

Household has a utility function as it earns its utility from imported goods (M) and residential goods (s). The consumer decides how much to consume from any commodity through maximizing utility function in its budget limits. Similarly it is assumed that production and consumption of goods spread pollution and consequently the utility level of households would be lowered. Therefore based on this viewpoint the optimization problem of the household would be as follows:

$$\text{Max } U(M, S) + f(E)$$

$$\text{S.t:} \quad P.M + r.S = W - T$$

In which E is environmental pollution with $f' > 0$, and P, r that is given are price and rent, respectively. T is tax Levied by local government.

With the assumption that the households are identical, in an equilibrium situation (optimal spatial structure), the utility level must be the same all over the city, otherwise, the household that is located in a low utility zone of the city is motivated to move to a higher utility zone and in such situations budget allocations (including land) is not in favor of market equilibrium (Kanemoto, 1980). Therefore, the other assumption regarding utility function is that utility is identical all over the city and is equal to$\bar{u}$. With a fixed utility level, the optimization problem of households can turn to minimizing expenditure in terms of consumption goods.

$in\ EX = P.M + r.S - T$

$S.t: \quad U(M, S, E) + f(E) \geq \bar{U}$

By solving minimization problem the household expenditures function is as below:

$HC^{*} = P.M(P, r, U, E) + r.S(P, r, U, E) = HC(P, r, U, E)$

Externalities: pollution

While production of goods for export and increase in the city population leads to higher levels of pollution, in this model, pollution is considered as the externalities of production and provisions of work force. Therefore the amount of emitted pollution (e) is dependent on supply of goods and labor. Besides some part of pollution is absorbed by the nature, increase in levels of pollution, further damages the nature and consequently lowers the nature’s ability to absorb pollution. This fact is illustrated with the substitution of the level of remaining pollution in nature, (E), in pollution function.

$e = e(M, N, E)$

Local government:

In this model the public sector is also included. The local government is responsible for supplying of public goods. Public goods obviously include decreasing the air pollution or in other words “clean air services.” To perform this task, the government collects taxes (T), and provides services for measures against pollution. The government spends all of its tax revenue on production of clean environment as a commodity. Therefore the provision of the government’s budget is as follows:

$t.N = q.g$

in which t, q and g are tax rate, cost of providing a unit of clean air and clean air services provided by local government.

Pollution after the production of public goods is equal to:

$E = e(N, E\ \ ) - q.g = e(N, E\ \ ) - t.N = E(N, E\ \ , t)$

Taking into account the fact that the previous level affects the next level of pollution, the previous pollution level is shown with E_{-1}. Therefore as we substitute the above phrase in expenditure function we have:

$E = e(N, E_{-1}) - q.g = e(N, E_{-1}) - t.N = E(N, E_{-1}, t)$

By substituting this equation into expenditure function we have:

$HC(P, r, U, E(N, t, E_{-1})) = HC(P, r, U, N, t, E_{-1})$

Finally surplus function can achieve by subtracting total expenditure function from total benefit function:

$TW = TB - TC$

In which TB is total benefit function extracted by aggregating household income function over the city households and TC is total cost function by aggregating expenditure function over the city households.

4. Empirical model

To estimate the surplus function, the cost and benefit functions for the city must be estimated. Therefore the surplus function is the difference between the other two variables. As we discussed earlier, city benefits were dependent upon the general price level, P, the marginal production of the work force, and the city population, N. The marginal production of the labor itself depends on the environment of economic activity in the city. Activity environment in cities, particularly in metropolitans depend on the ease and conditions of transportation. Therefore in this model the real benefits of the city depend on the city population and the situation in transportation which are shown with TR_1andTR_2. So total benefit function is as follow:

$$Ln\left(\frac{TB_{it}}{P_{it}}\right) = \beta_0 + \beta_1 Ln(Tr_{1_{it}}) + \beta_2 Ln(Tr_{2_{it}}) + \beta_3 Ln(N_{it}) + u_{it}$$

According to the local economic model, total expenditure was a function of price level, rent, Pm, utility level in the city, u, population, previous level of pollution, En, and the tax rate, t. For the ease of calculation two things are pre-assumed: the first one is that the utility level is identical in all studied cities, otherwise the estimation for the equation of overall expenditures are not possible. This assumption obviously proves to be correct for long term situations because based on indifference principle in an economy that allows cheap and easy internal immigration, residence satisfaction would be equal in different cities. The other assumption is about the tax rate. It is assumed that tax rate is equal in all cities. Of course this assumption is not far from reality, as the value added and direct tax rates are decided on national levels, therefore these rates are equal all over the country. Based on explanations the regression equation of total expenditures would elaborate as follows:

$$Ln(TC_{it}) = \alpha_0 + \alpha_1 Ln(P_{it}) + \alpha_2 Ln(Pm_{it}) + \alpha_3 Ln(En_{it}) + \alpha_4 Ln(N_{it}) + u_{it}$$

After the estimation of the metropolises cost and benefit functions, the surplus function would be calculated as follows:

$$TW = EXP[\beta_0 + \beta_1 Ln(Tr_{1_{it}}) + \beta_2 Ln(Tr_{2_{it}}) + \beta_3 Ln(N_{it})] - EXP[\alpha_0 + \alpha_1 Ln(P_{it}) + \alpha_2 Ln(Pm_{it}) + \alpha_3 Ln(En_{it}) + \alpha_4 Ln(N_{it})]$$

For identifying the optimum city size in relation to efficiency, the surplus function must be at its maximum in respect to the city population, and then optimum population that maximizes net urban benefit is calculated. Since the attention is on the optimum size of the city, the surplus function must be at its maximum in connection to the city population; therefore first order condition of optimum city size is

$$EXP[\beta_0 + \beta_1 Ln(Tr_{1_{it}}) + \beta_2 Ln(Tr_{2_{it}}) + \beta_3 Ln(N_{it})] \frac{\beta_3}{N_{it}} - EXP[\alpha_0 + \alpha_1 Ln(P_{it}) + \alpha_2 Ln(Pm_{it}) + \alpha_3 Ln(En_{it}) + \alpha_4 Ln(N_{it})] \frac{\alpha_4}{N_{it}} = 0$$

And optimal city size is equal to:

$$N^* = EXP\left\{\frac{1}{\alpha_4 - \beta_3}[\beta_0 - \alpha_0 + Ln(\beta_3) - Ln(\alpha_4) + H_1 - H_2]\right\}$$

$$H_1 = \beta_1 Ln(Tr_{1_{it}}) + \beta_2 Ln(Tr_{2_{it}})$$

$$H_2 = \alpha_1 Ln(P_{it}) + \alpha_2 Ln(Pm_{it}) + \alpha_3 Ln(En_{it})$$

The optimum city size is the amount of population, which is calculated based on central planner, through maximizing the surplus function. Basically, optimality in economics is a situation that is based on maximum efficiency. Similarly, here maximum efficiency is considered through equality of marginal costs, with marginal benefits. In the optimal point the earned benefits of last settler of the city would be equal to her imposed costs, and if more people migrate to the city, the imposed costs would become higher than the earned benefits. However, this situation does not necessarily occur because immigrants still have enough motivation to enter the city. As long as the surplus function is positive ($TW > 0$) and average benefits is more that the average costs ($\frac{TB}{N} > \frac{TC}{N}$), the immigrant's motivation is in favor of entering the city. The private motivation to enter the city diminishes at a time when the average benefits equal the average costs ($TW = 0$), as increasing the city size would result in a downturn on benefits of everyone including those who have entered the city. The situation that the surplus function equals to zero, and the private motivation to enter the city diminishes is called sustainability and the population is called the sustainable city size, $\overline{N}$. Therefore, based on this, the sustainable city size is:

$$\overline{N} = EXP\left\{\frac{1}{\alpha_4 - \beta_3}[\beta_0 - \alpha_0 + H_1 - H_2]\right\}$$

5. Estimation

As it was said earlier, the logarithmic function of total benefits, and then the logarithmic function of total costs are specified and then the surplus function is determined. Tables No. 1 and 2 show the results of estimated total costs and benefits consequently. The second column of the tables shows the estimated co-efficients and the third and fourth columns show statistics and probabilities. Furthermore the R square and F statistics are presented in the tables.

Table 1: estimated parameters for urban total benefits function

Variables	**Coefficient**	**t statistics**	**prob**
Constant	24.16	17.4	0.000
Tr1	-0.08	-0.53	0.61
Tr2	1.16	9.7	0.000
Urban pop	0.09	2.4	0.061
R square	0.99		
F statistics	266		

Table 2: estimated parameters for urban total cost function

Variables	Coefficient	t statistics	prob
Constant	21.21	7.5	0.000
P	0.51	-0.64	0.53
Pm	0.19	0.17	0.86
E	-0.03	-0.48	0.64
Urban pop	0.02	18.5	0.000
R square	0.98		
F statistics	114		

After estimating the co-efficients, it is possible to calculate the optimum and sustainable city sizes using the two equations of optimal and sustainable city size.

Table No. 3 presents the optimum size for five metropolitans of Tehran, Isfahan, Shiraz, Ahwaz, and Mashhad. The approach was through the averaging of the explaining variables in the period under study and applying them to the equation of the optimum size of the city. We can see that the optimum size for Tehran is in the range of 2 million and 300 thousand people and shows that it has gone beyond its efficient level. The third column shows the actual population for the same period in which Tehran holds 7 million people. The last column shows the surplus population ratio and means the percentage of surplus population beyond the optimum level. Tehran holds the highest surplus population among Iranian metropolitans which amounts to 71%. This ratio is less for the other metropolitans as it stands at 52% for Ahwaz, 53% for Shiraz, 51% for Isfahan, and 67% for Mashhad. Among these cities Isfahan has the lowest surplus population.

Table 3: Optimal size and Surplus ratio of metropolises

	Optimal size	Actual size	Surplus ratio
Tehran	2304907	8086310	71.4
Ahvaz	515065	1084759	52.5
Shiraz	659923	1412404	53.2
Isfahan	835491	1724762	51.5
Mashhad	873563	2696722	67.6

As it was mentioned before, although from the central planning point of view, an efficient situation happens at the optimum level of cities, but it is not necessarily sustainable because still the positive balance for the net profits for the residents attracts more people to the city. As the city gets to its sustainable size, this motivation tapers. Table No. 4 refers to the sustainable size for the considered cities. The sustainable size for Tehran is a little below its actual size and stands at 7 million and 600 thousand people. However for the rest of metropolitans the sustainable population is more than the actual population, and that means, residing in those cities secures positive net benefits for entrance and as the city expands, it is still able to provide positive net benefits for its population. This is shown in the ratio of actual size over sustainable size in the last column. This ratio for Tehran is equal to 105%, which shows Tehran is off its limits by 5%. In other words one can say that only 95% of the population in Tehran is able to earn positive net profit and the rest of population cause the city's net profit to become negative. This ratio for the other cities of Ahwaz, Shiraz, Isfahan, and Mashhad stand at 63%, 64%, 62%, and 92% respectively. Therefore among these cities Isfahan has more capacity and more space to its sustainable size which is 38%. On the contrary, Mashhad has less capacity to its sustainable size so that the ratio for this city is 92%, therefore it an 8% distance to its sustainable size.

Table 4: Sustainable size of metropolises

	Sustainable size	Actual size	Actual / Sustainable
Tehran	7654167	8086310	105.65
Ahvaz	1710437	1084759	63.42
Shiraz	2191483	1412404	64.45
Isfahan	2774510	1724762	62.16
Mashhad	2900941	2696722	92.96

6. Data and sample

Similar to many emerging countries in recent decades, Iran has been faced with a high degree of urbanization which has developed from 31% in 1956 to more than 71 % in 2011. According to the national census of 2011, Iran has 8 metropolitans with populations above one million. Due to difficult access to the details of census results, this survey reflects on situations in five metropolitans including Tehran, Mashhad, Isfahan, Shiraz and Ahvaz. 15 milion and 150 thousand people of the country's population are living in these five cities as the national population stands at 75 million and 150 thousand which amounts to 20% of the country's population. Based on the national census of 2011, urban population in five Metropolitans of Tehran, Mashhad, Isfahan, Shiraz and Ahvaz stood at 8154000, 2766000, 1756000, 1460000, and 1112000 respectively. More than 8 million people, that are 11% of the country's population, live in Tehran. After Cairo and Istanbul, this Metropolitan is considered the third populated city in the Middle East. In recent years, the government has tried to slow down the pace of population growth in Tehran, however based on the 2011 census it has been above the average figure of the national population growth. The government's efforts to depopulate the capital city of Tehran have led the parliament to raise the issue of relocation of the capital and ratification of an act to set the general policies ruling such relocation. Therefore the optimal size of the city is one of the main questions that the policy makers in Iran should decide on. The collection of data for the model variables has been very difficult because most of the statistic data in Iran's Census Bureau and other similar sources are about one region like a province or a township while the data which is used in this essay is particularly related to urban regions. Besides the census calendars for cities are not compatible, that is to say the municipalities of metropolitans in Iran which compile census data on their cities do not follow the same structure and categories for data publishing. For example there are cases that in some census data no information is available about urban transportation or if there is such section in the census the indicators are totally different. However the data for this essay has been collected from Iran's National Census Bureau, Iran's Central Bank, and metropolitan's census information of the country. For example the region-wise Consumption Price Index is used to show the variability of "price level" and; also leased house price index in urban area published by the Censes Bureau of Iran is used to represent rent. For the variable of urban population the data is derived from the national Census data for the local calendar years of 1385, and 1390 (2006 and 2001), and the other years in this time span has been based on estimations. The variable of city expenditures has been calculated based on the household expenditure and benefits data, published by Iran's National Census Bureau. How this essay calculated the overall expenditure for the city, (i) was based on the following equation: $\mathbf{TC_i}$

$$TC_i = \frac{HE_i}{L} \times N_i$$

In which $HE_i$and $N_i$are the household expenditures and population respectively in the i-th city and L is the dimension of the household. The total benefit for the city is calculated based on the value added estimations for the city (based on the average ratio of city population to the province population), and national provincial accounts published by the National Census Bureau. For the variables of $Tr_1$and Tr_2which represent the control variables of the transportation situation in the formula, the data is derived from the urban transportation fleet figure and the annual number of the transferred passengers in the city. This data is extracted from the city census publications. For the variable of environment, En, the information is derived from the number of "unhealthy" days and worst in the Air Quality Index of the case study cities. The reason this variable is used is that it shows the air quality situation after the production of public goods, which we discussed in the methodology. This variable is derived from the city census data which is published separately for metropolitans in Iran. Worthy to note is that due to scarcity of information, the time span for this survey is chosen between the years of 1387 to 1391 (2008 to 2012). Besides, due to limitations in census data availability, this study did limit itself to cities of Isfahan, Ahwaz, Tehran, Shiraz and Mashhad which had published city census data.

7. Conclusion

While most of policy makers in Iran have paid special attention to the population in the country's metropolitans, this essay tried to estimate the optimum size and the sustainable size of the aforesaid cities in the country. Research methodology for this study was based on surplus function (which is the difference between the total benefits and total costs functions). In this approach the regression equation of total costs and benefits for urban areas are estimated and then the surplus function is determined. The results show that all the case cities in Iran are situated above optimum levels. The surplus ratios indicating the percentage of the overflow for the optimum population show that Tehran has the greatest ratio which stands at 71 percent above the optimum population. Based on the abundance of the surplus ratio the other cities include Mashhad, Shiraz, Ahwaz, and Isfahan respectively. Local economic model shows the optimum city size that is decided by the central planners is not necessarily sustainable and due to the private motivations to enter the city, city size usually is more than the optimal level. Meanwhile figures show only the metropolitan of Tehran has surpassed its sustainable size and the ratio of its actual population over sustainable population is equal to 105 percent. This indicates the population has gone above the sustainable level by 5 percent. However other metropolitans still have room to their sustainable size, as for the cities of Isfahan, Ahwaz, Shiraz, and Mashhad stands at 62%, 63%, 64%, and 92% percent respectively, hence among these cities Isfahan has the most and Mashhad the least space to their sustainable sizes. Still one question remains unanswered and that is the high desire of people for moving to Tehran, while the city's net profit is negative. We should not forget that every model is interpretable in its own framework of assumptions and violation of any one of the assumptions can change the outcome. One of the implicit assumptions for this model is the lack of spatial dynamic and ignoring the immigration. As this model has not included the surplus function of other small cities and even rural areas, one of the reasons could be because of exclusion of dynamics.

For example, if the other small cities, which are not included in the model, provide less profit to their inhabitants, due to the scarcity of job opportunities and high unemployment rates, these inhabitants get more motivation to immigrate to bigger cities, despite the fact that the earned profit in their destination city is negative.

References:

1- Abdel-Rahman, H.M (1988), Product differentiation, monopolistic competition and city size, Regional Science and Urban Economics 18, 69-86.

2- Abdel-Rahman, H.M. (1990), Agglomeration economies, types, and sizes of cities, Journal of Urban Economics 27, 25-45.

3- Abdel-Rahman, Hesham, and Fujita, Masahisa (1990). ‘‘Product Variety, Mar-shallian Externalities, and City Sizes.’’J. Regional Sci. 30, p 165–83.

4- ALONSO, W. (1971) the economics of urban size, Papers and Procee dings of the Regional Science Association, 26, pp. 67 – 83.

5- Anas, Alex; Richard Arnott and Kenneth Small (1998), “Urban spatial structure,” Journal of Economic Literature, 36, 1426-1464.

6- Arnott, R. (2004) Does the Henry George Theorem provide a practical guide to optimal city size?, The American Journal of Economics and Sociology 63, 1057–1090 .

7- Arnott, R. and J.E. Stiglitz (1979) Aggregate land rents, expenditure on public goods, and optimal city size, Quarterly Journal of Economics 93,471–500.

8- Arnott, R. and J.G. Riley, (1977), "Asymmetrical Production Possibilities, the SocialGains fromInequalityand the OptimumTown", Scandinavian Journal ofEconomics79, 301-311.

9- Au, Chun-Chung and J.V. Henderson (2006), ―Are Chinese Cities Too Small?‖ Review of Economic Studies, 73(3): 549-576.

10- BARR. J.L. (1972) City size. Land rent, and the supply of public goods. Journal of Urban Economics. 2(1).

11- Behrens, K. and Y. Murata (2009) City size and the Henry George Theorem under monopolistic competition, Journal of Urban Economics 65, 228–235.

12- BOEVENTER. E.G. (1970) optimal spatial structure and regional development. Kyklos. 23(a)

13- BOEVENTER. E.G. (1973) City size systems, theoretical issues. Empirical Regularities and Planning Guide; Urban studies,10(l)

14- Buchanan, J. M., "An Economic Theory of Clubs", Economica, vol. 32 (1965), pp. 1-14.

15- Burton, E. (2000) “the compact city: just or just compact? A preliminary analysus” urban studies, Vol. 37, no. 11, pp. 1969-2001

16- CAMERON, G .C .(1970). Growth Areas, Growth Centres and Regional Conversion. Scottish Journalof Political Economy, Vol. 21, pp. 19-38.
17-CAPELLO, R. (1998) Urban return to scale andenvironmental resources: an estimate of environmental externalities in an urban production function, International Journal of Environment and Pollution, 10, pp. 28 – 46.
18- Capello, R. and R. camagni (2000), beyond optimal city size: An Evaluation of Alternative Urban Growth Patterns, Urban Studies, vol.37, no.9, pp.1479-1496.
19- Cervero, R. (2001) "efficient urbanization: economic performance and the shape of the metropolis" urban studies, vol. 38, no. 10, pp. 1651-1671.
20- Dixit,A.K.(1973).The optimum factory town. Bell Journal of Economics and Management Science, 4, 637 — 51.
21- EVANS, A.W. (1972) The pure theory of city size in an industrial economy. Urban Studies, 9(1).
22- Fisch, Oscar, 1975, Optimal city size, land tenure and the economic theory of clubs, Journal of regional Science and Urban Economics, no2 p 13~c.
23- FISCH, 0. (1976) Optimal city size, land tenure and the economic theory of clubs. Regional Science and Urban Economics, 6(l).
24- Fu, Shihe (2004), Dynamic Henry George Theorem and Optimal City Sizes, unpublished manuscript.
25- Fujita, M., 1976, Spatial patterns of urban growth: Optimum and market, Journal of Urban Economics 3, 209-241.
26- Fujita, M., 1982, Spatial patterns of residential development, Journal of Urban Economics 12, 22-52.
27- Fujita, M., 1988, A monopolistic competition model of spatial agglomeration: Differentiated product approach, RegionalScience and Urban Economics 18, 87-124.
28- Fujita, M., 1989, Urban economic theory (Cambridge University Press, Cambridge).
29- Fujita, Masahisa; Krugman, Paul R.; and Mora, T. ''On the Evolution ofHierarchical Urban Systems.''Manuscript. Philadelphia: Univ. Pennsylva-nia, 1995.
30- Fujita, Masahisa, and Ogawa, Hideaki. ''Multiple Equilibria and StructuralTransition of Non-monocentric Urban Configurations.''Regional Sci. andUrban Econ. 12 (May 1982): 161–96.

31- Glaeser, E.L., H.D. Kallal, J.A. Scheinkman and A. Shleifer, 1992, Growth in cities, Journal of Political Economy 100, 1126-1152.
32- George, Henry, 1879, Progress and Poverty, Water J.Black, Inc., New York (1942)
33- HENDERSON, J.V. (1974) Optimum city size, the external diseconomy question. Journal of Political Economy, 82(2).
34- Holden, E. and I. T. Norland (2005), three challenges for the compact city as a sustainable urban form: household consumption of energy and transport in eight residential areas in the greater Oslo Region, urban studies, vol. 24, no. 12, pp. 2145-2166.
35- Kanemoto, Y., 1980, Theories of urban externalities (North-Holland, Amsterdam).
36- Kanemoto, Y., (1976),"A Reexamination of the Tiebout Hypothesis," unpublished manuscript.
37- Kanemoto, Y. T. Kitagawa, H. Saito and E. Shioji (2005) Estimating urban agglomerationeconomies for Japanese metropolitan areas: Is Tokyo too large? In: A. Okabe (ed.) GIS – Based Studies in the Humanities and Social Sciences. Taylor & Francis, Boca Raton, pp. 229–241.
38- KANEMOTO, Y., OHKAWARA, T. and SUZUKI,T. (1996) Agglomeration economies and a test for optimal city sizes in Japan, Journal of the Japanese and International Economies, 10, pp. 379–398.
39- Marshall, Principles of Economics (Macmillan, London, 1890)
40- Mizutani, F. ,T. Tanaka, N. Nakayama, (2012) “Estimation of Optimal Metropolitan Size in Japan with Consideration of Social Costs”, Kobe University, Discussion Papers no. 2012-19.
41- Nakamura, R. and M. kaneuchi (2001), Efficient City Size in Terms of Population: Empirical Study by Cost and Benefit Approach, DBJ Kansai Discussion paper series, no.0101 (in Japanese)
42- Berglas, E., and Pines, D. (1981). Clubs, local public goods and transportation costs. Journal of Public Economics 15:141– 62.
43- REDCLIFFE-MAUD, LORD (1969) .Royal Commissionon Local Government in England.Cmnd .4040,H .M.S .O.
44- RICHARDSON, H.W. (1983) the Economics of Urban Size. Saxon House, London.
45- Richardson H. W. Theory of the distribution of cities: Review and prospects, Regional Studies, 7, 239-251 (1973)
46- RICHARDSON, H.W. (1972) Optimality in city size, system of cities and urban policy. a sceptic’s view. Urban Studies, 9(l).

47- RICHARDSON, H.W. (1973a) A comment on some uses of mathematical models in urban economics. Urbun Studies, 1012.
48- Scotchmer, S. , and Wooders, M. (1987) .Competitive equilibrium and the core in club economies with anonymous crowding, Journal of Public Economics 34, 159–73.
49- SINGELL, L.D. (1974) Optimum city size, some thoughts on theory and policy. Land Economics, SO (3).
50- SOLOW, R. M. "Congestion, density and the use of land in transportation." Swedish Journal of Economics, Vol. 74, No. 1 (March 1972), pp. 161-173
51- SOLOW, R. M. "On equilibrium models of urban location," in J. M. Parkin, ed., Essays in Modern Economics, Longmans, 1973
52- SOLOW, R. M. "Congestion cost and the use of land for streets." The Bell Journal of Economics and Management Science, Vol. 4, No. 2 (Autumn 1973), pp. 602-618.
53- Stiglitz, J.E. (1977) The theory of local public goods. In: Feldstein, M.S. and R .P. Inman (eds.) The Economics of Public Services. MacMillan, London, pp. 274–333.
54- Papageorgiou, Y.Y., and Pines, D. (1999).An Essay in Urban Economic Theory. Dordrecht: Kluwer Academic Publishers.
55- Tiebout, Charles M., 1956, A pure theory of local expenditures, Journal of Political Economy 64, Oct., 416—424
56- TOLLEY, G. (1974), the welfare economics of city bigness. Journal of Urban Economics, 10(l).
57- World Bank (2009), World Development Report 2009: Reshaping Economic Geography
58- YEZER, A. M. J. and GOLDFARB, R. S. (1978) An indirect test of efficient city sizes, Journal of Urban Economics, 5, pp. 46–65.
59- Zheng, X. (2007) "measure of optimal city size in japan: a surplus function approach" urban studies, vol. 44, no. 5/6, pp. 939-951