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Economic Performance of Housing Sector in Iran

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Abstract

Housing forms an important sector of the national economy and the largest component of household net wealth in most countries. In this study, Data Envelopment Analysis (DEA) is used to evaluate housing industry performance in different states of Iran based on relevant data collected from the Ministry of Housing and Urban Development and Statistical Centres of Iran during 2008-2009. The results show that only 37 percent of the states operate technically efficient and the average overall efficiency score obtained by all the states is 0.90. On the other hand, 63 percent of the states are found to be relatively inefficient and mostly present decreasing returns to scale. The paper concludes that, appropriate mechanisms should be implemented for all interventions of the government for stabilizing housing environment within different states, ensuring maximal benefit of state housing expenditures, mobilising private savings and finally coordinating public and private sector investment on a multi-functional basis.
Keywords: Housing, Performance, Data Envelopment Analysis, Efficiency, Iran.

1- Introduction

The bilateral relationship between housing investment and economic growth has long been a popular issue of debate in the literature of economic development, and planners almost believe that encouraging housing improvement should not only be considered as a part of economic development strategy but also as a necessary outcome of economic growth. It has been well demonstrated by the known hypothesis of Turin (1973) that

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because of the relationship between construction activity and economic development, housing and related infrastructure can revitalize and sustain economic growth and development, employment creation and poverty reduction. After analyzing data on all significant countries for period 1955-1965, he concluded that developed countries typically have stronger construction industries which contributed 5-8% to GDP, while in less developed countries the proportion is around 3-5% of GDP. On the basis of cross sectional data for 87 countries in his study, Turin (1978) found that construction industry can play a central role in development strategy of many less-industrialized countries by creating durable and productive employment at relatively low level of capital intensity.

In the international literature, Ofori and Han (2003) examined the relationship between construction activity and economic development at the provincial level of China during the period 1990-2000, and show that construction industry has acted in both sides, a stimulus of economic growth and a cause of problem also in China. Further in the Chinese literature, Zheng (2003) found that domestic housing investment has significant short-run impacts on GDP and a co integrating relationship between housing investment and GDP does exist. On the other hand the lack of housing access could bring the most serious and widespread consequences such as poverty in the county. As a visible output, housing in India is an effective mirror of economic development for creating non farm activities and generating government taxes and wages that positively influence the quality of life. Thus, the government policies on the housing front have a direct impact on the health of the economy, particularly for the lower and middle income segments of the population whose need is for affordable houses (National Housing Bank,2009).The Government of India has been transforming housing sector into an engine of economic growth through prudent policies and a host of initiatives including the extension of benefits to mass housing projects, increased rebates for housing loans, increased depreciation for employee housing, lower interest rates, securitization of housing loan etc. Information provided by Haq (2009) shows that housing construction is one of the most labour intensive economic activities in Pakistan, requiring large numbers of workers, creating hundreds of thousands of jobs and when the buyers move in, they will demand all kinds of products and services to furnish their homes, thereby creating further employment opportunities.

Generally speaking, most of the research studies have clearly demonstrated that housing has the potential of becoming an engine of economic growth because of its high yield on invested resources, a high multiplier effect and a host of beneficial forward and backward linkages in the economy. It is a fact that increased housing activities give impetus to the economy with enhanced capacity utilization of related industries such as steel, cement, transportation etc. leading to an increase in revenue by way of excise and other taxes. Another important aspect is that the demand for institutional finance for housing has been on a steady increase over the years resulting in the entry of a large number of players into the housing finance scene. In this study an attempt has been made to discuss the empirical results derived from efficiency measurement analysis of housing activities in 30 provinces of Iran using Data Envelopment Analysis.

2- The context of Iran

Economic activities in Iran are dominated by industrial sector, which represents about 45% of the country's GDP and includes oil and gas, petrochemicals, steel, textile, and automotive manufacturing (Ilias, 2008).Iran is one of the few major economies that did not suffer directly from the current downturn crisis. High oil prices in recent years have enabled Iran to amass US$ 97 billion in foreign exchange reserves. Although this increased revenue has aided self-sufficiency and domestic investments, but double-digit unemployment and inflation remain while economy has seen only moderate growth (World Bank, 2009).In the wake of the global economic crisis, Iran has found its economy facing pressure from the rapidly declining price of oil, which has plummeted to $46 per barrel in early January 2009 from a high of $147 per barrel in early July 2008 (Qazavi,2009).Thereby Iran's economic growth dropped to 3.3 percent between March and September 2008 and the country planned to reduce its dependence on oil export revenues by building up other sectors of its economy just like housing construction sector.

Annual reports of Iran Central Bank on housing economy shows that at current prices, investment in housing has increased more than 75 times in the 24 years 1975-99 and the average share of investment in housing in the GDP in this period has been 5.7 percent. In the thirty-year period 1971-2000, on average 33 percent of the total investment was in housing. The average share of the private sector in investment on housing has been 92.5 percent, thus accounting for the bulk of investment in this sector. According to Zanjani (2006), between 1966 and 1996 there was an annual increase of 3.44 percent in housing units, whereas the annual increase in the number of households was 3.02 percent. That means in all three decades the growth rate of housing exceeded the growth rate of households and population. In his empirical study further concludes that the physical and economic criteria of housing in Iran faced great changes during the years of development planning as follows;

- Total number of one-room housing units in urban and rural areas fell 80 percent while the number of three-room and plus housing units rose by 67 percent.
- The number of rooms at the disposal of each household increased significantly due to relatively large traditional structure in Iran.
- The number of non-durable housing units with construction material (mud brick and wood, mud bricks with clay and straw plaster, straw huts) fell to one-fourth and the number of durable housing units with construction material (brick and steel, stone and steel and concrete) increased by more than five times. The ratio of these housing units in the rural areas has increased from 1.1 percent to 28.3 percent (nearly 26 times).
- The rate of ownership increased rapidly in the urban areas, expressing that owning a house is considered an important status symbol in Iran as elsewhere.
- The ratio of households having facilities and amenities such as electricity, water, gas and telephone at their disposal has continuously risen.

3- Materials and Methods

According to Dyson (2001), performance measurement plays an essential role in evaluating productivity and efficiency because it can define not only the current state of the system but also its future in the economy. Productivity and efficiency are the two most important concepts in measuring performance. The productivity of a producer can be loosely defined as the ratio of output(s) to input(s). Efficiency on the other hand can be defined as relative productivity over time or space, or both (Wang et. al, 2010). Nearly five decades ago, Farrell (1957) introduced a methodology for measuring efficiency and his methodology is still undergoing refinement and improvement. There are two approaches to estimating technical efficiency, parametric and non-parametric. The stochastic production frontier (SPF) developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977) is a parametric approach which is used for the estimation of production frontiers. On the other hand, Data Envelopment Analysis (DEA) developed by Charnes et al., (1978), is a non-parametric approach. It is a Linear Programming methodology to measure the efficiency of multiple Decision Making Units (DMUs) when the production process presents a structure of multiple inputs and outputs. DEA is used to measure the relative productivity of a DMU by comparing it with other homogeneous units transforming the same group of measurable positive inputs into the same types of measurable positive outputs.

Moreover to discuss about technical efficiency measurement, one may address the question: “By how much can input quantities be proportionally reduced without changing the output quantities produced?", which is an input-oriented measurement. On the other hand one may alternatively ask the question that: “By how much can output quantities be proportionally expanded without altering the input quantities used?", which is an output-orientated measurement. The difference between the output- and input-orientated measures can be illustrated using a simple example involving one input and one output. This is depicted in Figure 1(a) where we have decreasing returns to scale technology represented by f(x), and an inefficient firm operating at the point P. The Farrell input orientated measure of TE would be equal to the ratio AB/AP, while the output orientated measure of TE would be CP/CD. The output- and input-orientated measures will only provide equivalent measures of technical efficiency when constant returns to scale exist, but will be unequal when increasing or decreasing returns to scale are present (Fare and Lovell 1978). The constant returns to scale case is depicted in Figure 1(b) where we observe that AB/AP=CP/CD, for any inefficient point P we care to choose.

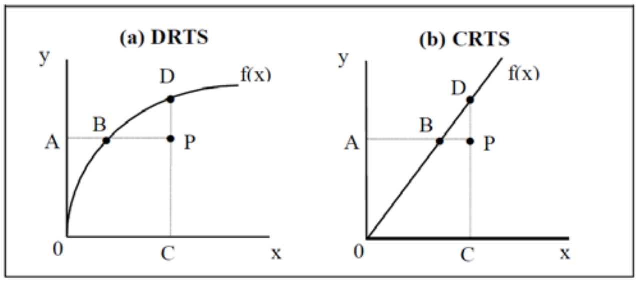

Figure 1-Input and Output Oriented Technical Efficiency Measures and Returns to Scale

In general when the production process presents a structure of multiple inputs and outputs the input and output data can be expressed by matrixes x and y, in which x_{ij} refers to the i^{th} input data of DMU_j, whereas y_{ij} is the i^{th} output of DMU_j .In this method, efficiency is defined as a weighted sum of outputs to a weighted sum of inputs (eq.1), where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed (Charnes et. al, 1978). First of all the CCR model can be expressed in a fractional way through equations (eq.1)-(eq.4) and then in linear programming way through equations (eq.5)-(eq.9):

$$(FP_o) Max \quad \theta = \frac{u_1 y_{1o} + u_2 y_{2o} + \cdots + u_n y_{no}}{v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo}} \quad (1)$$

$$\text{Subject to} \quad \frac{u_1 y_{1j} + u_2 y_{2j} + \cdots + u_n y_{nj}}{v_1 x_{1j} + v_2 x_{2j} + \cdots + v_m x_{mj}} \leq 1 \quad (j = 1, \cdots, s) \quad (2)$$

$$v_1, v_2, \cdots, v_m \geq 0 \quad (3)$$

$$u_1, u_2, \cdots, u_n \geq 0 \quad (4)$$

The CCR model measures the maximum efficiency of each DMU by solving the fractional programming (FP) problem in (eq.1) where the input weights v_1, v_2, …v_m and output weights u_1, u_2, …u_n are variables to be obtained. *o* in (eq.1) varies from 1 to *s* which means *s* optimisations for all *s* DMUs. Constraint 2 reveals that the ratio of 'virtual output' $(u_1 y_{1o} + u_2 y_{2o} + \cdots + u_n y_{no})$ to 'virtual input' $(v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo})$ cannot exceed than 1 for each DMU, which conforms to the economic assumption that the output cannot be more than the input in production.

Moreover, the above FP (eq.1)-(eq.4) is equivalent to the following linear programming (LP) formulation given in equations (eq.5)-(eq.9).That is necessary to note that transforming the FP model into the LP model has been of great significance for the rapid computation and wide application of DEA.

$$(LP_o)Max \quad \theta = u_1 y_{1o} + u_2 y_{2o} + \cdots + u_n y_{no} \tag{5}$$

Subject to

$$v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo} = 1 \tag{6}$$

$$u_1 y_{1j} + u_2 y_{2j} + \cdots + u_n y_{nj} - v_1 x_{1j} - v_2 x_{2j} - \cdots - v_m x_{mj} \leq 0 \quad (j = 1, \cdots, s) \tag{7}$$

$$v_1, v_2, \cdots, v_m \geq 0 \tag{8}$$

$$u_1, u_2, \cdots, u_n \geq 0 \tag{9}$$

The study applies data envelopment analysis (DEA) to evaluate the overall efficiency of housing sector production in 30 states of Iran, taking each state as a DMU in the model. Relevant Data for the present study were obtained from the six month statistical reports for all states, published by the ministry of housing and urban planning, Iran statistical center and Central Bank of Iran for the period 2008-2009.In order to present a structure of multiple inputs and outputs, according to Keeney and Raiffa (1993), a desirable set of measurement factors should be complete, decomposable, operational, no redundant and minimal. Since inputs can normally be generalized as natural resources such as land, human resources and man-made aids to further production, three important inputs are selected for the study as follows:

Input 1-Total Area of Lands under building construction (scale: 1000 square meters)

Input 2- Total Private Investment on building construction (scale: 1000000 Rials)

Input 3- Total expenditures of building construction (scale: 1000000 Rials)

On the other hand, since outputs can be categorized into tangible products including goods and intangible products including services, therefore three important inputs are selected as follows:

Output 1-Total Number of buildings constructed (units)

Output 2- Total Area of flats constructed (scale: 1000 square meter)

Output 3- Total Land Value of Buildings after construction (scale: 1000000 Rials)

In order to validate set of variables in DEA model, one way is to run a test of reliability on the efficiency scores and comparing them for two or more consecutive years using the same variables and methods (Parkin and Hollingsworth, 1997).Another way is to examine the assumptions of the "isotonicity" relationships between the input and output factors, i.e., an increase in any input should not result in a decrease in any output. Following Golany and Roll (1989), regression analysis on the selected input and output factors is a useful procedure to examine the isotonicity relationships between the input and output factors. If the correlation of the selected input and output factors is positive, these factors are isotonically related and can be included in the model. Alternatively, a strong correlation may indicate that the information contained in one factor is already represented redundantly by other factors (LIU, 2005). In addition, according to Golany and Roll (1989), the number of DMUs should be at least twice of the total number of input and output factors considered when applying the DEA model. In this study the number of DMUs is 30, i.e., more than twice of the selected six factors. Therefore, the proposed DEA model has high construct validity.

4- Results

After specifying and collection of data regarding input and output factors for the period 2006-2009, statistical description has been presented with valuable information about inputs (total area of lands under building construction, total private investment on building construction, total expenditures of building construction) and outputs (total number of buildings constructed, total area of flats constructed and total land value of buildings after construction) in table 1. For the validation of the model; regression and correlation analysis on the selected input and output factors is applied to investigate strong and positive relationships between the factors. Following Golany and Roll (1989), regression analysis on the selected input and output factors is a useful procedure to examine the isotonicity relationships between the input and output factors. If the correlation of the selected input and output factors is positive, these factors are isotonically related and can be included in the model. The test of reliability is shown in table 2. The significant p-values less than α=0.05 strongly proves that an increase in any input definitely results in an increase in any output.

Further in the analytical study with the help of DEAP computer program (Coelli, 1996); DEA methodology has been applied to measure the overall efficiency of state housing construction undertakings in Iran. That's why the CCR model with constant returns to scale has been applied to evaluate the overall efficiency in each state and also BCC model is used to decompose the total efficiency into the technical and scale efficiency. In their study, (Banker et.al, 1984) developed the model BCC assuming variable returns to scale (VRS). Indeed the scale efficiency score of a DMU is the ratio of the overall efficiency to the technical efficiency.

The overall efficiencies of 30 states are presented in Table 3. The average efficiency score obtained by all states is 0.90 and only 37 percent of the states including East Azarbaijan, West Azarbaijan, Tehran, Razavi Khorasan, Zanjan, Semnan, Sistan & Baluchistan, Qazvin, Lorestan and Markazi are overall efficient among the other states. The interesting point is that among the overall efficient states there are developed states like Tehran, Semnan, Razavi Khorasan ,Zanjan, Qazvin and also economically deprived areas such as West Azarbaijan, Sistan& Baluchistan, Lorestan and Hormozgan .On the other hand it is found that about 63 percent of the states are relatively inefficient out of which the states, Mazandaran, Hamadan, Kerman and Ilam obtain the lowest efficiency scores (i.e.,0.762 0.751, 0.709, 0.646) and states Yazd,Bushehr,Esfahan and North Khorasan achieve the highest efficiency scores (i.e., 0.982, 0.942, 0.942, 0.941).

On the basis of microeconomic production theory a DMU that is overall inefficient could be either technical inefficient or scale inefficient. The overall efficiency calculated from the CCR model has been further decomposed into the technical efficiency and the scale efficiency, measured by BCC model. The overall efficiency of a DMU equals to its technical efficiency if and only if that DMU is operating at the most productive scale size, and thus, its scale efficiency is 1. Alternatively if the scale efficiency is less than 1, the DMU will be operating either at decreasing returns to scale (DRTS) or increasing return to scale (IRTS). This implies that resources may be transferred from DMUs operating at decreasing returns to scale to those operating at increasing returns to scale in order to increase the overall average productivity at both sets of DMUs. The fact behind this reason may be that these inefficient DMUs, due to their relatively poor quality inputs or mismanagement, do not possess economies of scale, or possibly, have been unable to compete with other efficient DMUs (Boussofiane et al., 1991).As a result the inefficient DMUs with positive slacks are considered to be operating at decreasing returns to scale which need to cut their inputs and inefficient DMUs with negative slacks are considered to be operating at increasing returns to scale which need to increase their inputs in order to achieve maximum outputs (Table 4).To discriminate efficient States for Housing Construction Undertakings in more depth, some studies have suggested that it is worth identifying the number of times that an efficient States acts as a peer (Hlingsworth and Parkin, 1995). Peer states are those active states with higher referenced frequencies which can be regarded as better performing units due to their outstanding operating environment (Table 4).

5- Conclusion

Studying state housing production and its performance is becoming more important than ever before because of the increasingly integrated national economy and the significant contribution that housing construction makes to this process. As a national priority, future housing strategy has a direct bearing on meeting basic needs, developing human resources, democratizing the society and implementing national level reconstruction and development program. In the current downturn with respect to declining oil prices and global economic sanctions imposed on Iran, the government’s housing growth plans can present an opportunity for ensuring new homes are delivered of the right type, in the right place and linked to wider economic outcomes of the nation. In this study Data Envelopment Analysis (DEA) proved to be a powerful non-parametric technique for comparison of different States (DMUs) and provide a summary measure of relative performance for each Unit. Two DEA models (CCR model and BCC model) were used to evaluate the overall efficiency and further decomposed into technical and scale efficiency of each state. Based on the results, the study found that only 37 percent of the states operate technically efficient and the average technical efficiency score obtained by all the states is 0.90. On the other hand 63 percent of the states are found to be relatively inefficient which mostly present decreasing returns to scale. Therefore it is recommended that states like Ilam, Kerman, Hamadan and Mazandaran which posses the lowest level of efficiency scores need to reorganize their structure of inputs in order to get optimum level of outputs.

In order to distinguish efficient states in further analysis, it is suggested to identify the number of times that an efficient state is being referenced by other relatively inefficient states and acts as a peer. In addition an alternative way to discriminate efficient state is to identify the slacks which explore the ways a weak efficient state needs to readjust its weakest areas of performance towards achieving fully efficient status. This is because the process of efficiency measurement based on DEA technique involves relative measurement in which the efficiency score of each state is computed relative to the best performing other states of the country.

Overall, our results strongly suggest that housing sector in Iran needs to aim at mobilizing the combined resources of communities through stabilizing the housing environment, ensuring maximal benefit of state housing expenditure, facilitating technical and logistical housing support mechanisms to enable communities to improve their housing circumstances, mobilizing private savings and housing credit at scale with adequate protection for consumers, providing subsidy assistance to disadvantaged individuals to assist household's affordability and finally coordinating and integrating public and private sector investment on a multi-functional basis.

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Table 1- Descriptive Statistics of the Variables

Variable	Mean	St.Dev	Minimum	Maximum
Input 1	8142475	14515978	1132499	81174854
Input 2	3114	2683	467	11575
Input 3	3695450	23261075	2313331	130809299
Outpu1	5022	6949	717	38393
Outpu2	15309480	36904371	1574218	205728415
Outpu3	12412	11009	1844	47152

Table 2- Regression Analysis and Correlations of the Variables

	Output1	Output2	Output3
Input 1	0.992 (0.000)	0.993 (0.000)	0.795 (0.000)
Input 2	0.846 (0.000)	0.738 (0.000)	0.923 (0.000)
Input 3	0.991 (0.000)	0.993 (0.000)	0.788 (0.000)

Regression	F	P
(O1)= 245 +0.000319(I1)+0.453 (I2)+0.000056(I3) S = 509.965 R-Sq = 99.5% R-Sq(adj) = 99.5%	1786.30	0.000
(O2) =-2772952 +1.41(I1) +1568 (I2) + 0.837(I3) S = 3511969 R-Sq = 99.2% R-Sq(adj) = 99.1%	1058.74	0.000
(O3) = 2708 +0.00376(I1)+3.25 (I2)- 0.00227(I3) S = 3767.34 R-Sq = 89.5% R-Sq(adj) = 88.3%	73.89	0.000

Table 3 - Operating Efficiency of State Housing Construction Undertakings

States (DMUs)	Overall Efficiency	Technical Efficiency	Scale Efficiency	Returns To Scale
1-East Azarbaijan	0.940	0.981	0.958	IRTS
2-West Azarbaijan	1.000	1.000	1.000	CRTS
3-Ardabil	0.938	0.997	0.941	DRTS
4-Esfahan	0.942	0.985	0.957	DRTS
5-Ilam	0.646	0.773	0.836	DRTS
6-Bushehr	0.942	0.965	0.976	DRTS
7-Tehran	1.000	1.000	1.000	CRTS
8-Charmahal & Bakhtry	0.929	0.951	0.977	DRTS
9-South Khorasan	0.918	0.927	0.990	DRTS
10-Razavi Khorasan	1.000	1.000	1.000	CRTS
11-North Khorasan	0.941	0.971	0.969	DRTS
12-Khuzestan	0.799	0.994	0.804	DRTS
13-Zanjan	1.000	1.000	1.000	CRTS
14-Semnan	1.000	0.999	1.001	CRTS
15-Sistan & Baluchistan	1.000	1.000	1.000	CRTS
16-Fars	0.847	0.895	0.947	IRTS
17-Qazvin	1.000	1.000	1.000	CRTS
18-Qom	0.839	0.973	0.862	DRTS
19-Kurdistan	0.937	1.000	0.937	DRTS
20-Kerman	0.709	0.910	0.779	DRTS
21-Kermanshah	0.865	0.960	0.901	DRTS
22-Kokiluye & Bu.Ahmad	0.923	1.000	0.923	DRTS
23-Golestan	0.770	0.991	0.777	DRTS
24-Gilan	0.771	0.956	0.806	DRTS
25-Lorestan	1.000	1.000	1.000	CRTS
26-Mazandaran	0.762	0.961	0.793	DRTS
27-Markazi	0.839	0.966	0.868	DRTS
28-Hormozgan	1.000	1.000	1.000	CRTS
29-Hamadan	0.751	0.974	0.771	DRTS
30-Yazd	0.982	1.000	0.982	IRTS
Average	0.900	0.971	0.925	

Table 4- Peer Group, frequency of references and Slacks towards full efficiencies

State No.	Referenced (Peer)	Peer Frequency	Slacks					
			output 1	output 2	output 3	input 1	input 2	Input 3
1	1 ,7 , 25	0	0	0	0	0	0	0
2	2	8	0	0	0	0	0	0
3	1 , 2, 10 ,14	0	0	468681	0	0	0	6241108
4	2, 7, 13 ,17	0	0	0	8129	0	1225	34530432
5	1, 7, 10 ,17	0	0	314359	0	31548	0	2313331
6	1,7,10,14	0	0	0	1016	0	0	5806657
7	7	7	0	0	0	0	0	0
8	2, 7, 13	0	0	0	2877	0	329	4619441
9	2, 7, 13, 14,15	0	0	0	0	49	82554	2466087
10	10	6	0	0	0	0	0	0
11	2, 14	0	0	76004	682	50664	0	3564729
12	1, 2, 10, 25	0	0	2601611	0	220829	0	0
13	13	4	0	0	0	0	0	0
14	14	7	0	0	0	0	0	0
15	15	2	0	0	0	0	0	0
16	17 ,19 ,22 ,25	0	0	0	799	0	0	20568736
17	17	7	0	0	0	0	0	0
18	17,19 , 25 ,28	0	0	0	238	0	0	7471465
19	19	8	0	0	0	0	0	0
20	22 ,25	0	0	464087	2182	0	1568	8341041
21	21 ,14	3	0	0	359.4	21345	1447	0
22	22	4	0	0	0	0	0	0
23	19 ,21, 24,10	0	0	867069	0	123776	0	0
24	19, 24, 14	3	0	0	1423	0	1323	0
25	25	8	0	0	0	0	0	0
26	19, 21, 24, 2	0	0	1128961	0	308655	0	13631219
27	17, 19 ,22	0	0	0	649.73	40814	0	7350078
28	17, 25 ,28	2	0	0	0	0	0	0
29	19 ,25	0	0	195099	267	786516	0	7119501
30	30	2	0	0	0	0	0	0