**Assessing the Accuracies of the Sectoral Multipliers using the FLQ and CHARM Methods: Case Study of Gilan Province, Iran**

**A. A. Banouei[[1]](#footnote-1), P. Mohajeri[[2]](#footnote-2), S. Kavoosi[[3]](#footnote-3) and N. Sadeghi[[4]](#footnote-4)**

**Abstract**

Using the prevailing non-survey methods to estimate the RIOTs has been a common practice in Iran. Due to the lack of survey-based RIOTs in Iran, the reliabilities and accuracies of the estimated RIOTs have not so far been assessed. Recently the Management and Planning Organization of the province of Gilan complied a survey-based IOT for the year 2002. This Table paved the way to assess the accuracies of the estimated tables using three non-survey methods: The FLQ, CB and the CHARM methods with special emphasis on regional sectoral multipliers. We have two survey-based RIOTs. One is the original and other is the modified table. The overall results show that both the CB and CHARM methods overestimate the average supply multiplier by 15 and 12 percent in the original table whereas the FLQ method underestimates the average output multiplier by 1 percent. Considering the modified table we find that first of all both the CB and CHARM methods overestimate the average supply multiplier by 3.4 and 1.3 percent respectively, whereas FLQ method underestimates the average output multipliers by around 16 percent. With respect to the total exports of Gilan, the CHARM method has an edge over the CB method. The former overestimates total exports by 4.3 percent in both the tables whereas the latter underestimates the total export by 30 percent of the true value. Considering the performance of both the methods in estimating total imports the results are not satisfactory. The deviations for CHARM and CB are 80 and 86 percent in the original table whereas for the modified table, the deviations are 24 and 47 percent.

**Introduction**

Harry William Richardson, in his seminal paper, observes that there are three major phases of the historical development of regional input-output analysis. The first phase was the development of techniques in the 1950s. The second phase marked the era of construction of survey-based Regional Input-Output Tables, which was then followed by the realization that the construction of these tables was an expensive and lengthy task. These motivated the analysts since the 1970s to search for alternatives to the survey-based (Richardson, 1985).

 With regards to the non-survey methods, he concludes that the mechanical non-survey methods are unsatisfactory, the short-cuts are ingenious, but probably unacceptable; and therefore, the future of RIOTs lies with mixed survey/non-survey and other hybrid methods.

 Looking into the stock of the improved non-survey methods at the end of twentieth century, and specially the twenty first century, Richardson’s predicted future vision does not appear to have come true. On the one hand, at the end of the 20th Century, Flegg and his colleagues have improved the prevailing traditional CILQ methods which are known as FLQ and AFLQ methods [1]. These alternative methods motivated lively debates regarding the reliabilities and accuracies of overestimation of regional output multipliers and underestimation of regional imports with special focus on a varying relative regional size in the 21 Century [2]. On the other hand, in the 21 Century, Kronenberg has modified the existing traditional Commodity Balances (CB) of Walter Isard (Isard, 1953) and subsequently introduced a new method of Cross-Hauling Adjusted Regionalization Method (CHARM); (Kronenberg, 2009). As Compared to the LQs and their modified methods, CHARM method has three main advantages: One is the estimation of a separate regional sectoral imports and exports and sectoral trade balances and the second is the measurement of Cross-Hauling which is apparently ignored by the LQs; and the third, specifies the type of national Input-Output Table (IOT) with respect to the treatment of imports to be used for the estimation of RIOTs. Similar to the FLQ methods, CHARM method is also sensitive to the reliabilities and accuracies of the estimated tables regarding the underestimation of output multipliers and overestimation of regional imports (Kronenberg, 2009)

 From the empirical point of view, we observe that both the FLQ and CHARM methods have been applied mainly for the regions of developed countries with advanced data base, like, Avon in Scotland, Peterborough, in England (Flegg and Webber, 1997), different regions of Finland (Tohmo, 2004, Flegg and Tohmo, 2013, 2014), and a modified version of FLQ, like SFLQ for the German Federal State of Baden-Württemberg (Kowalewski, 2015). The CHARM method has been mainly applied for the German Federal State (Kronenberg and Tobben, 2013). Recently Flegg and his colleagues have applied the CHARM method for Hubi region in China (Flegg, et al, 2015) and observed that more applications and tests are needed, especially for countries less economically advanced with relatively poorer data base than Finland, Germany and England.

 In response to the above demands, we observe that first of all no such a systematic and empirical regional research exists in Iran, and the second, the lack of the survey-based RIOTs in Iran, compelled the Iranian Regional analysts to use variants of LQ methods without assessing the reliabilities and accuracies of the estimated Tables [3].

 The main objective of this paper is to fill this lacuna. For this purpose, we use the FLQ and CHARM methods to estimate regional input coefficient, sectoral output multiplier and imports with the view to assess the accuracies of overestimation of output multipliers and underestimation of regional imports for a relatively small region of Gilan Province which has 2.5 percent share of the total output of Iran in 2002.

 The availabilities of national IOT and corresponding survey based RIOT of Gilan for 2002 [4] paves the way to assess the degree of the above mentioned accuracies. For this purpose, the contents of this paper are organized in the following four sections. In Section 1, main socio-economic characteristics of Gilan province are given. In Section 2, we briefly highlight the methodological aspects of the FLQ and CHARM methods. In Section 3, we discuss the data base of national and Gilan IOTs, followed by empirical analysis in Section 4. The final section is devoted to Conclusions.

**1. A Glimpse of Socio-Economic Characteristics of Gilan Province**

At Present, Iran has 31 provinces and the unit of division is “political and administrative”. This unit is used by the Statistical Center of Iran for the estimation of Regional Accounting for all 31 provinces for 72 sectors, comparable with the corresponding classification of National Accounts since 2000 (Statistical Center of Iran, 2003). Three out of 31 provinces are known as “Green-Belt-Provinces”, Gilan, Golestan and Mazandaran, adjacent to the Caspian Sea, North of Iran (please see the map).



Green Belt Provinces

Caspian Sea

**Gilan**

 Gilan is a relatively small province. Its average share of GDP to the national GDP during 2009-2010 is around 2.16 percent and it produced on an average 2.24 percent of total output of the nation. Agriculture and agro-based industries are relatively important sectors in Gilan with rice and tea as the main agricultural products. According to the 2011 National Census of Population and Housing, the number of population in Gilan is 2,480,874 persons which constitute 3.4% of the total population of the country (Statistical Center of Iran, 2012).

 In order to capture the sectoral specialization in particular sectors and also the sectoral diversity of Gilan and Iran, we have computed the output shares, Simple Location Quotient (SLQ) [5] and the degree of the heterogeneity of products as shown in Table 1. From the table we can make the following general observations: One, out of 40 sectors, SLQs of 21 sectors in Gilan are greater than unity which prima facie indicate that Gilan province is a specialized province.

From the figures in Table 1, one can see, for example that despite negligible shares of output in forestry and fishing, they have highest SLQ, 3.434 and 4.316.

**Table 1. Shares of output SLQ and the Heterogeneity of Products in 2002 for Iran and Gilan**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Share of output | SLQi | Degree of heterogeneity of products |
| Iran | Gilan | Iran$$h\_{i}^{N}$$ | Gilan$$h\_{i}^{R}$$ |
| 1. Farming and Gardening | 0.070 | 0.122 | 1.753 | 0.069 | 0.087 |
| 2. Animal Husbandry, Raising Worms, Honey, Hunting | 0.041 | 0.053 | 1.296 | 0.009 | 0.148 |
| 3. Forestry | 0.002 | 0.006 | 3.434 | 0.019 | 0.023 |
| 4. Fishing | 0.003 | 0.011 | 4.316 | 0.001 | 0.170 |
| 5. Crude Oil and Natural Gas | 0.115 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6. Other Mining | 0.004 | 0.001 | 0.275 | 0.113 | 0.296 |
| 7. Manu. of food products and beverages | 0.058 | 0.072 | 1.236 | 0.046 | 0.259 |
| 8. Manu. of tobacco products | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 |
| 9. Manu. of textiles | 0.015 | 0.017 | 1.125 | 0.228 | 0.028 |
| 10. Manu. of wearing apparel, dressing and dyeing of fur | 0.003 | 0.011 | 3.452 | 0.198 | 0.020 |
| 11. Tanning and dressing of leather, luggage, handbag, saddles, harness and foot wear | 0.003 | 0.002 | 0.634 | 0.263 | 0.126 |
| 12. Manu. of wood and wood products | 0.003 | 0.007 | 2.448 | 0.020 | 0.188 |
| 13. Manu. of paper and paper products | 0.002 | 0.010 | 4.221 | 0.017 | 0.482 |
| 14. Publishing, printing and reproduction of recorded media | 0.001 | 0.001 | 0.700 | 0.020 | 0.077 |
| 15. Manu. of coke, refined petro. products and nuclear fuel | 0.015 | 0.000 | 0.011 | 0.502 | 0.000 |
| 16. Manu. of chemical and chemical products | 0.022 | 0.010 | 0.433 | 0.165 | 0.013 |
| 17. Manu. of rubber and plastic products | 0.007 | 0.007 | 1.016 | 0.073 | 0.063 |
| 18. Manu. of other non-metallic mineral products | 0.018 | 0.024 | 1.347 | 0.049 | 0.032 |
| 19. Manu. of basic metals | 0.023 | 0.001 | 0.027 | 0.095 | 0.003 |
| 20. Manu. of fabricated metal except mach. and equip. | 0.013 | 0.013 | 0.989 | 0.039 | 0.092 |
| 21. Manu. of mach. And equip. n. e. c. | 0.014 | 0.014 | 0.955 | 0.025 | 0.135 |
| 22. Manu. of office, accounting and computing mach. | 0.000 | 0.000 | 0.000 | 0.004 | 0.000 |
| 23. Manu. of electrical mach. And operations, n.e.c. | 0.007 | 0.012 | 1.625 | 0.041 | 0.126 |
| 24. Manu. of radio, television and communication equip and apparatus | 0.003 | 0.000 | 0.031 | 0.017 | 0.000 |
| 25. Manu. of medical, precision and optical instruments, watches and clocks | 0.001 | 0.001 | 1.065 | 0.010 | 0.173 |
| 26. Manu. of motor vehicles, trailer and semi-trailers | 0.036 | 0.007 | 0.205 | 0.008 | 0.007 |
| 27. Manu. of other transport equip. | 0.003 | 0.000 | 0.050 | 0.006 | 0.015 |
| 28. Manu. of furniture and recycling | 0.006 | 0.004 | 0.657 | 0.028 | 0.060 |
| 29. Electricity | 0.015 | 0.033 | 2.230 | 0.014 | 0.000 |
| 30. Distribution of Gas  | 0.007 | 0.005 | 0.735 | 0.140 | 0.000 |
| 31. Water | 0.004 | 0.004 | 1.133 | 0.000 | 0.000 |
| 32. Construction | 0.075 | 0.105 | 1.410 | 0.000 | 0.000 |
| 33. Whole sale, retail sale, repairs of motor vehicles | 0.110 | 0.145 | 1.315 | 0.006 | 0.000 |
| 34. Hotel and Restaurants | 0.011 | 0.019 | 1.625 | 0.051 | 0.000 |
| 35. Transport, Storage and Communication | 0.068 | 0.064 | 0.939 | 0.137 | 0.172 |
| 36. Financial Inter mediation | 0.016 | 0.017 | 1.052 | 0.040 | 0.000 |
| 37. Real estate, renting and business services | 0.089 | 0.074 | 0.834 | 0.007 | 0.000 |
| 38. Education | 0.029 | 0.037 | 1.297 | 0.002 | 0.000 |
| 39. Health and social work | 0.026 | 0.033 | 1.256 | 0.001 | 0.000 |
| 40. other services | 0.061 | 0.057 | 0.930 | 0.014 | 0.000 |
| Mean | 1 | 1 | 1 | 0.062 | 0.070 |

**Source: The calculations are based on the IOTs of Iran and Gilan in 2002.**

 Whereas, sectors like transportation, storage, communications; and real estate, renting and business services with the output shares of respective 6.4% and 5.7% have SLQs below unity. Therefore if we judge the diversity of the economy from the degree of heterogeneity of products, from Table 1, we observe that the mean heterogeneity for Gilan is 0.062 whereas for the nation ut is 0.070 which figures are surprisingly close to each other.

**2. Regionalization of the FLQ and CHARM Methods**

**2-1. The FLQ Method**

Round’s (1979) seminal article triggered the development of Flegg and his colleagues method which generally known as Flegg’s methods (Flegg, et. al. 1995, Flegg and Webber, 1996, 1997, 2000, Flegg and Tohmo, 2013, 2014).

In order to capture all three desirable properties simultaneously of spatial factors, namely, the relative size of supplying sectors the relative size of purchasing sectors and the relative size of region, Round has introduced the following semi-logarithmic adjustment formula.

$$RLQ\_{ij}≡{SLQ\_{i}}/{log\_{2}(1+SLQ\_{j})} (1)$$

Where

$$SLQ\_{i}≡\frac{{RO\_{i}}/{TRO}}{{NO\_{i}}/{TNO}}≡\frac{RO\_{i}}{TRO}×\frac{NO\_{i}}{TNO}$$

$$SLQ\_{j}≡\frac{{RO\_{j}}/{TRO}}{{NO\_{j}}/{TNO}}≡\frac{RO\_{j}}{TRO}×\frac{NO\_{j}}{TNO}$$

Where

$RO\_{i}$= regional output of sector i

$RO\_{j}$= regional output of sector j

$NO\_{i}$= national output of sector i

$NO\_{j}$= national output of sector j

TRO= Total output of region

TNO= Total output of nation

With respect to the Eq. (1), Flegg and his colleagues have expressed two reservations: one is that the relative size of region (${TRO}/{TNO}$) in the Eq. (1) [6]. The second is the theoretical plausibility of why the logarithmic transformation should be applied to $SLQ\_{j}$ rather than to $SLQ\_{i}$ [7].

In order to solve counter intuitive of Round’s method (see footnote 7), and also consider the explicit role of relative regional size, Flegg and his colleague have introduced two following methods:

$$FLQ\_{ij}=CILQ\_{ij}×λ^{\*} for i\ne j (2)$$

$$FLQ\_{ij}=CILQ\_{ij}×λ^{\*} for i=j (3)$$

Where

$$CLQ\_{ij}={SLQ\_{i}}/{SLQ\_{j}} (5)$$

And

$$λ^{\*}≡[log\_{2}(1+^{TRO}/\_{TNO})]^{δ} (6)$$

 It is assumed that $0\leq δ<1$; as $δ$ increases, so too does the allowance for interregional imports. $δ=0$ reveals a special case where $FLQ\_{ij}=CLQ\_{ij}$. The following formulae suggest that how similar to the LQ methods, FLQ too has the same common characteristic:

$$a\_{ij}^{R}=\left\{\begin{array}{c}a\_{ij}^{N} if FLQ\_{ij}\geq 1\\FLQ\_{ij}.a\_{ij}^{N} if FLQ\_{ij}<1\end{array}\right. (7)$$

 Where $a\_{ij}^{R}$ = local regional input-output coefficients where supply and purchasing sectors (i and j) are from the region, excluding imports from the rest of the nation and from outside the nation.

$a\_{ij}^{N}$= national input-output coefficients excluding imports from the outside the nation.

The implementation of FLQ method is carried out under condition of$ a\_{ij}^{R}\leq a\_{ij}^{n}$. In real world, taking into account the regional sectoral specialization, (Mc Cann and Dewhurst, 1998), one can expect that regional input-output coefficients might even be higher than the national average, so that $ a\_{ij}^{R}>a\_{ij}^{n}$ [8].

In response to McCann and Dewhurst reservation, Flegg and Webber (2000) have modified the Eq. (7) which is generally known as the augmented FLQ (AFLQ) method as follow

$$AFLQ\_{ij}=\left\{\begin{array}{c}FLQ\_{ij}.\left[log\_{2}\left(1+SLQ\_{j}\right)\right] for SLQ\_{j}>1\\FLQ\_{ij} for SLQ\_{j}<1\end{array}\right. (8)$$

Even though the Equation (8) explicitly considers the regional sectoral specialization, it is not immue to the strong assumption that the value of the exponent $δ$ is equal to all regional sectors.

Kowalewski (2015) takes this issue and subsequently introduces a new improved version of FLQ method, namely industry-specific FLQ (SFLQ) which is defined as follows:

$$SFLQ\_{ij}=CILQ\_{ij}.\left[log\_{2}\left({TRO}/{TNO}\right)^{δ\_{j}}\right] (9)$$

As compared to Eqs. (7) and (8) the variation in regional size ($δ$) in Eq. (9) is considered the key factor determining the allowance for regional imports (regional propensity to imports), the variation in $δ\_{j}$ shows that regional sectoral specifics can now play an important role as a factor for adjustment of regional input coefficients and providing suitable allowance for regional imports [9].

**2-2. The CHARM Method**

The revival of the Isard’s (1953) traditional Commodity Balances (CB) method could be taken as a starting point for the analysis of CHARM method. This method has been recently introduced by Kronenberg (Kronenberg, 2009, 2012, Tobben and Kronenberg, 2015). Like the prevailing standard SLQ and CILQ methods, CB method, for two main reasons, is prone to the overestimation of regional sectoral multipliers and underestimation of regional imports. The first reason is that, both the methods ignore Cross-hauling (the simultaneous two ways trade of a given commodity and the second reason is that, they do not consider the relative size of a region [10]. However, both of them have one major common characteristic, i.e. the key assumption of equal technology between national and regional [11].

The regional demand equation in the CB method is expressed as follows:

$$dx\_{i}^{R}=\sum\_{j}^{}a\_{ij}^{N}x\_{j}^{R}+df\_{i}^{R} (11)$$

$dx\_{i}^{R}$= total value of output in sector i in region R which is either available in the region vague must be estimated.

$a\_{ij}^{N}$= national input-output coefficient including imports from other regions or from outside the nation.

$df\_{i}^{R}$= the regional final demand excluding regional export (Kronenberg, 2009) on the basis of Eq. (11), one can express the surplus or deficit of ith CB as following:

 If the total estimated regional demand ($dx\_{i}^{R}$) is less than the supply ($x\_{i}^{R}$); $dx\_{i}^{R}<x\_{i}^{R}$ for commodity i, after meeting all the regional demands (intermediate and final demand), the remaining commodity output surplus is assumed to be exported. Conversely, if $dx\_{i}^{R}>x\_{i}^{R}$ , it is presumed that the deficit commodity output i will be imported to compensate the regional demand, which suggests that CB method excludes the role of Cross-hauling. With the introduction of cross-hauling in the CHARM method, Kronenberg has succeeded in solving a previously unsolved problem which bedeviled regional analysts for a long-time (Harrigan, et al, 1981, Richardson, 1985 and Jackson, 2014).

As far as CB in Eq. (11) is concerned, trade balance is considered implicitly and also expressed indirectly and is defined as

$$x\_{i}^{R}-\sum\_{j}^{}a\_{ij}^{R}x\_{j}^{R}+df\_{i}^{R}≡b\_{i}^{r}≡e\_{i}^{r}-m\_{i}^{r} \left(12\right)$$

 Where $e\_{i}^{r}$ and $m\_{i}^{r}$ represent value of exports and imports respectively and $b\_{i}^{r}$ denotes the trade balance which is computed as the estimated output commodity; ($dx\_{i}^{r}$ in eq. 7) minus the estimated sum of intermediate and domestic final demand ($\sum\_{j}^{}a\_{ij}^{R}x\_{j}^{R}+df\_{i}^{R}$). We should make clear this important point that both CB and CHARM methods give identical result for $b\_{i}^{ }^{r}$ values however they provide different values for the volume of trade, $e\_{i}^{r}+m\_{i}^{r}$ . This is because CHARM considers cross-hauling, $ch\_{i}$ explicitly into account as shown in

$ch\_{i}=\left(e\_{i}+m\_{i}\right)-\left|(e\_{i}-m\_{i})\right| ($13)

 From the above equation, we infer a direct relationship between $ch\_{i}$ and volume of trade ($e\_{i}+m\_{i}$). The larger the volume of trade, the larger is $ch\_{i}$ and the smaller the absolute trade balance, $\left|(e\_{i}-m\_{i})\right|$. Besides, the Eq. (13) reveals an important fact that $ch\_{i}>0$ means a simultaneous $e\_{i}>0$ and $m\_{i}>0$ is possible for most of the commodities cases whereas for CB, $ch\_{i}=0$ as $e\_{i}>0$ and $m\_{i}>0$ cannot, by assumption occur together (Flegg, et. al, 2015).

To estimate$ ch\_{i}$, Kronenberg assumes proportionality between $ch\_{i}$ and the sum of domestic production, $x\_{i}$ intermediate use, ($Xe=\sum\_{j}^{}x\_{ij}$) and final demand $f\_{i}$. This factor proportionality which shows the degree of heterogeneity of commodities is defined as:

$$h\_{i}=\frac{ch\_{i}}{x\_{i}+Xe+f\_{i}} (14)$$

 Where $f\_{i}$ constitutes household consumption, Government consumption and fixed capital formation.

 In order to ease the procedure of estimation of $ch\_{i}$, Kronenberg assumes that $ch\_{i}$ is invariant across regions and depends only on the characteristics of products. This assumption will produce a plausible reason to equate national $ch^{N}\_{i}$ with the regional $ch\_{i}^{R}$, on the basis of which one can compute regional cross-hauling, $ch\_{i}^{R}$.

Using CB method in Eq. (12), the estimation of a separate exports and imports is not possible, because it presumes that the volume of trade is equal to the absolute trade balance (Flegg, et. al , 2015). With the rearrangement and manipulation of the equations (12) and (13) as follows:

$$ch\_{i}=\left(e\_{i}+m\_{i}\right)-\left(e\_{i}-m\_{i}\right) (15)$$

Where

$$v\_{i}=e\_{i}+m\_{i} (15.1)$$

$$b\_{i}=e\_{i}-m\_{i} (15.2)$$

Then

$ch\_{i}=v\_{i}-\left|b\_{i}\right|$ (15.3)

 In the CHARM method, it is assumed that $ch\_{i}^{N}=ch\_{i}^{R}$ . Therefore, the first step is to compute $ch\_{i}^{N}$ and at the national level as follows:

$$ch\_{i}^{N}=\frac{v\_{i}^{N}-\left|b\_{i}^{N}\right|}{x\_{i}^{N}+Xe\_{i}^{N}+d\_{i}^{N}}=\frac{ch\_{i}^{N}}{x\_{i}^{N}+Xe\_{i}^{N}+d\_{i}^{N}}$$

$$ch\_{i}^{N}= h\_{i}^{N}(x\_{i}^{N}+Xe\_{i}^{N}+d\_{i}^{N})$$

 With the assumption$ ch\_{i}^{N}=ch\_{i}^{R}$, the regional cross-hauling can be estimated as follows

$$ch\_{i}^{R}= h\_{i}^{N}(x\_{i}^{N}+Xe\_{i}^{N}+d\_{i}^{N})$$

 Based on the rearrangement of Eqs. (15.1), (15.2) and (15.3), the separate sectoral exports and imports can be calculated as follow

$$v\_{i}^{R}+b\_{i}^{R}=e\_{i}^{R}+m\_{i}^{R}+(e\_{i}^{R}-m\_{i}^{R})$$

$$2e\_{i}^{R}=v\_{i}^{R}+b\_{i}^{R}$$

$$e\_{i}^{r}=\frac{v\_{i}^{R}+b\_{i}^{r}}{Y}$$

$$ch\_{i}^{R}=v\_{i}^{R}-\left|b\_{i}^{R}\right|\rightarrow v\_{i}^{R}=ch\_{i}^{R}+\left|b\_{i}^{R}\right|$$

Therefore

$$e\_{i}^{R}=\frac{ch\_{i}^{R}+\left|b\_{i}^{R}\right|+b\_{i}^{r}}{2} (16)$$

$$v\_{i}^{R}-b\_{i}^{R}=\left(e\_{i}^{R}+m\_{i}^{R}\right)-(e\_{i}^{R}-m\_{i}^{R})$$

$$v\_{i}^{R}-b\_{i}^{R}=2m\_{i}^{R}$$

$$m\_{i}^{R}=\frac{v\_{i}^{R}-b\_{i}^{R}}{2}=\frac{ch\_{i}^{R}+\left|b\_{i}^{R}\right|-b\_{i}^{R}}{2} (17)$$

**3. Data Base**

For the applications of the FLQ and CHARM methods, and then assessing the accuracies of regional sectoral multipliers and also the estimated sectoral exports and imports of Gilan province, we have used two IOTs. One is the national IOT and the other is the IOT of Gilan for the year 2002, the latest available survey-base national IOT for the year 2001. Therefore, we are compelled to update this table for 2002. This table is in terms of activity by activity and comprises 40 sectors. In order to make them comparable, the 72 sectors of Gilan IOT is aggregated into 40 sectors. For the application of FLQ method, the domestic IOTs are required. No such tables exist in Iran, therefore, in order to separate imports from total transactions at national and regional, we have used the prevailing domestic supply ratio (Jiansuo. et. al. 2012). In addition to that, we have observed that the total import of Gilan is 77 percent of total output and 1.22 times of its GDP which is difficult to understand. We have used the method of proportionality of total domestic demand of region to the corresponding nation. Both the regional and modified survey-based tables have been used for empirical purposes.

**4. Empirical Analysis**

The determination of the optimal value of $δ$ in the FLQ is the key issue for the estimation of regional domestic output multiplier. Using different statistical methods [12], we get optimal value for $δ=0.105$ which gives the minimum sectoral deviation of the estimated sectoral output multipliers from the corresponding survey-based and modified survey-based multipliers [13].

 For the CB and CHARM methods, we have used both the tables as well as the modified table (including imports) for the estimation of sectoral output multipliers. The results of the average sectoral multipliers of the survey-based and the modified survey-based with the corresponding estimated averages, derived from the FLQ, CB and CHARM methods are shown in the Tables 2 and 3 respectively.

 From the results of the Table 2 and 3, we can make the following main observations. The average sectoral multipliers derived from the total and domestic transactions in Table 2 are 1.294 and 1.299 respectively. This means that the effect of an average, one unit increase in final demand, will increase an average of supply and output multipliers of Gilan’s economy by 1.294 and 1.299 units. Surprisingly the average of supply multiplier is less than the corresponding domestic output multiplier. One possible reason is the large imports in the original survey-based table which has 77 percent of total output and is 1.22 times more than the GDP of Gilan. The estimated average sectoral multipliers for CB and CHARM are 1.490 and 1.455 units which suggest that as compared to the survey based, both the methods overestimate the multipliers, on an average, by 15 and 12 percent respectively. The overestimation of CHARM is less than the CB method due to explicit account of cross-hauling. The estimated average output multiplier in FLQ is 1.287 which underestimates the corresponding true output multipliers by 1 percent.

**Table 2- The Overall Average Sectoral Multipliers of Survey-Based and Estimated FLQ, CB and CHARM Methods for the Province of Gilan in 2002**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Survey- Based (Original) | Non-Survey-Based Methods | Ratios of non-Survey to Survey (Original) |
| FLQ | CB | CHARM | FLQ | CB | CHARM |
| Total Transaction | 1.294 | - | 1.490 | 1.455 | - | 1.15 | 1.12 |
| Domestic Transaction | 1.299 | 1.287 | - | - | 0.99 | - | - |

**Source: Column Sums of Table 4.**

**Table 3- The overall average sectoral Multipliers of the Modified Survey-Based and the Estimated FLQ, CB and CHARM**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Survey- Based (Modified) | Non-Survey-Based Methods | Ratios of non-Survey to Modified Survey |
| FLQ$$δ=0$$ | FLQ$$δ=1$$ | CB | CHARM | FLQ$$δ=0$$ | FLQ$$δ=1$$ | CB | CHARM |
| Total Transaction | 1.443 | - | - | 1.490 | 1.455 | - | - | 1.036 | 1.013 |
| Domestic Transaction | 1.425 | 1.350 | 1.039 | - | - | 0.961 | 0.753 | - | - |

**Source: Column Sums of Table 5.**

 The results of Table 3 are based on the modified survey-based methods where the share of imports to total output and GDP is around 33 and 28 percent. The true average multiplier derived from the total and domestic transactions are 1.443 and 1.425 units. The difference between the two can be considered as import leakage. The CB method on average overestimates the corresponding true multiplier by 3.3 percent whereas the overestimation for CHARM method is only 1.3 percent. Unfortunately, we could not get an optimum $δ$ for FLQ method. The overall findings suggest that the determination of optimum value of $δ$ is very sensitive to the data base and as suggested by regional analysts, the determination of optimum $δ$ is always considered as an empirical matter. From the point of sectoral multipliers, we find that when using original survey based table, the average deviation in FLQ is less than CB and CHARM. With the modified table, the results in Table 3 show that CHARM method outperforms CB method. As mentioned above, we could not get optimum value of $δ$ and therefore, the FLQ results are not presented in the Table 3.

 The results of sectoral multipliers for 40 sectors of Gilan (based on original and modified) tables are shown in Tables 4 and 5. Columns (1), (2) show that around 50 percent of the domestic sectoral multipliers are greater than the corresponding supplier multipliers. The share of imports in the total output is more than 77 percent, this could be one possible reason that average supplier multiplier is less than corresponding average domestic multipliers. Columns (3) to (5) reveal the estimated sectoral multipliers of FLQ, CB and CHARM methods. The ratios of the estimated to the true value is considered as the accuracies of the estimated methods and shown in column (6) to (7) in Table 4. The average deviation in the FLQ method is 1 percent whereas at the sectoral level, the deviation varies from minimum 0.2 percent for hotel and restaurant to maximum 38 percent. On an average the CB and CHARM methods overestimate sectoral multipliers by 15 and 12 percent respectively. The minimum and maximum of sectoral deviation in the former is between 4.9 percent for the financial intermediation to 69 percent for leather and leather products whereas for the latter it is between 0.4 percent for coke, refined petroleum and nuclear fuel to 49.7 percent for leather and leather products.

**Table 4. The Survey-Based and the Estimated Domestic and Supply Multipliers of Gilan Province in 2002**

|  | **Survey Based Domestic Multipliers****(1)** | **Survey Based Supply Multipliers****(2)** | **Estimated** | **Estimated to Survey-Based** |
| --- | --- | --- | --- | --- |
| **FLQ****(3)** | **CB****(4)** | **CHARM****(5)** | **FLQ** | **CB** | **CHARM** |
| 1. Farming and Gardening | 1.225 | 1.316 | 1.1896 | 1.397 | 1.367 | 0.971 | 1.062 | 1.038 |
| 2. Animal Husbandry, Raising Worms, Honey, Hunting | 1.601 | 1.840 | 1.5154 | 1.874 | 1.849 | 0.946 | 1.019 | 1.005 |
| 3. Forestry | 1.241 | 1.285 | 1.0793 | 1.365 | 1.354 | 0.870 | 1.062 | 1.054 |
| 4. Fishing | 1.287 | 1.468 | 1.1051 | 1.607 | 1.594 | 0.859 | 1.095 | 1.086 |
| 5. Crude Oil and Natural Gas | 1.000 | 1.000 | 1.0000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 6. Other Mining | 1.323 | 1.365 | 1.2657 | 1.140 | 1.123 | 0.956 | 0.835 | 0.823 |
| 7. Manu. of food products and beverages | 1.791 | 1.522 | 1.8091 | 2.231 | 2.154 | 1.010 | 1.465 | 1.415 |
| 8. Manu. of tobacco products | 1.000 | 1.000 | 1.0000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 9. Manu. of textiles | 1.478 | 1.350 | 1.4783 | 1.874 | 1.664 | 1.000 | 1.388 | 1.232 |
| 10. Manu. of wearing apparel, dressing and dyeing of fur | 1.290 | 1.212 | 1.1554 | 1.691 | 1.530 | 0.896 | 1.395 | 1.262 |
| 11. Tanning and dressing of leather, luggage, handbag, saddles, harness and foot wear | 1.262 | 1.113 | 1.6315 | 1.882 | 1.667 | 1.293 | 1.690 | 1.497 |
| 12. Manu. of wood and wood products | 1.559 | 1.215 | 1.3396 | 1.788 | 1.768 | 0.859 | 1.472 | 1.455 |
| 13. Manu. of paper and paper products | 1.641 | 1.540 | 1.2547 | 2.120 | 2.086 | 0.764 | 1.377 | 1.355 |
| 14. Publishing, printing and reproduction of recorded media | 1.421 | 1.269 | 1.4559 | 1.458 | 1.441 | 1.025 | 1.149 | 1.136 |
| 15. Manu. of coke, refined petro. Products and nuclear fuel | 1.667 | 1.006 | 1.2511 | 1.015 | 1.010 | 0.750 | 1.009 | 1.004 |
| 16. Manu. of chemical and chemical products | 1.272 | 1.154 | 1.2920 | 1.274 | 1.229 | 1.016 | 1.103 | 1.064 |
| 17. Manu. of rubber and plastic products | 1.447 | 1.157 | 1.3831 | 1.892 | 1.809 | 0.956 | 1.635 | 1.564 |
| 18. Manu. of other non-metallic mineral products | 1.326 | 1.271 | 1.2946 | 1.709 | 1.671 | 0.977 | 1.344 | 1.314 |
| 19. Manu. of basic metals | 1.245 | 1.005 | 1.4687 | 1.019 | 1.017 | 1.179 | 1.014 | 1.012 |
| 20. Manu. of fabricated metal except mach. and equip. | 1.108 | 1.208 | 1.2486 | 1.730 | 1.699 | 1.127 | 1.432 | 1.407 |
| 21. Manu. of mach. And equip. n. e. c. | 1.156 | 1.314 | 1.2850 | 1.409 | 1.394 | 1.112 | 1.073 | 1.061 |
| 22. Manu. of office, accounting and computing mach. | 1.000 | 1.000 | 1.0000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 23. Manu. of electrical mach. And operations, n.e.c. | 1.186 | 1.334 | 1.2066 | 1.797 | 1.762 | 1.018 | 1.347 | 1.321 |
| 24. Manu. of radio, television and communication equip and apparatus | 1.316 | 1.006 | 1.3594 | 1.117 | 1.114 | 1.033 | 1.111 | 1.108 |
| 25. Manu. of medical, precision and optical instruments, watches and clocks | 1.344 | 1.534 | 1.2991 | 1.201 | 1.196 | 0.967 | 0.783 | 0.780 |
| 26. Manu. of motor vehicles, trailer and semi-trailers | 1.336 | 1.148 | 1.3941 | 1.693 | 1.679 | 1.044 | 1.475 | 1.462 |
| 27. Manu. of other transport equip. | 1.036 | 1.006 | 1.4251 | 1.145 | 1.143 | 1.375 | 1.138 | 1.135 |
| 28. Manu. of furniture and recycling | 1.127 | 1.292 | 1.5051 | 1.896 | 1.856 | 1.336 | 1.467 | 1.436 |
| 29. Electricity | 1.854 | 1.958 | 1.3940 | 1.744 | 1.728 | 0.752 | 0.891 | 0.883 |
| 30. Distribution of Gas  | 1.234 | 1.829 | 1.2620 | 1.413 | 1.354 | 1.023 | 0.772 | 0.740 |
| 31. Water | 1.631 | 1.767 | 1.3751 | 1.559 | 1.553 | 0.843 | 0.883 | 0.879 |
| 32. Construction | 1.339 | 1.309 | 1.2981 | 1.798 | 1.785 | 0.969 | 1.374 | 1.364 |
| 33. Whole sale, retail sale, repairs of motor vehicles | 1.086 | 1.139 | 1.1216 | 1.271 | 1.263 | 1.033 | 1.116 | 1.109 |
| 34. Hotel and Restaurants | 1.322 | 1.623 | 1.3085 | 1.780 | 1.726 | 0.990 | 1.097 | 1.064 |
| 35. Transport, Storage and Communication | 1.180 | 1.281 | 1.2408 | 1.419 | 1.360 | 1.052 | 1.108 | 1.062 |
| 36. Financial Inter mediation | 1.181 | 1.241 | 1.1852 | 1.302 | 1.286 | 1.004 | 1.049 | 1.036 |
| 37. Real estate, renting and business services | 1.075 | 1.123 | 1.1280 | 1.185 | 1.181 | 1.049 | 1.055 | 1.052 |
| 38. Education | 1.090 | 1.135 | 1.0960 | 1.201 | 1.197 | 1.005 | 1.058 | 1.054 |
| 39. Health and social work | 1.144 | 1.196 | 1.1619 | 1.312 | 1.307 | 1.016 | 1.097 | 1.093 |
| 40. other services | 1.123 | 1.212 | 1.1973 | 1.304 | 1.295 | 1.066 | 1.076 | 1.069 |
| Mean | **1.299** | **1.294** | **1.287** | **1.490** | **1.455** | **1.004** | **1.163** | **1.136** |

**Table 5. The Survey-Based and the Estimated Domestic and Supply Multipliers of Gilan Province in 2002 Based on the Modified Table**

|  | **Survey Based Domestic Multipliers** **(Modified Table)** | **Estimated** | **Ratio of Estimated to Survey** |
| --- | --- | --- | --- |
| **FLQ****Min** $δ$ | **FLQ****Max** $δ$ | **CB** | **CHARM**  | **FLQ****Min** $δ$ | **FLQ****Max**$δ$ | **CB** | **CHARM**  |
| 1. Farming and Gardening | 1.243 | 1.230 | 1.009 | 1.397 | 1.367 | 0.989 | 0.812 | 1.053 | 1.030 |
| 2. Animal Husbandry, Raising Worms, Honey, Hunting | 1.683 | 1.668 | 1.020 | 1.874 | 1.849 | 0.991 | 0.606 | 0.945 | 0.933 |
| 3. Forestry | 1.296 | 1.115 | 1.004 | 1.365 | 1.354 | 0.860 | 0.774 | 1.021 | 1.012 |
| 4. Fishing | 1.453 | 1.143 | 1.008 | 1.607 | 1.594 | 0.787 | 0.694 | 1.000 | 0.992 |
| 5. Crude Oil and Natural Gas | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 6. Other Mining | 1.447 | 1.279 | 1.036 | 1.140 | 1.123 | 0.884 | 0.716 | 0.795 | 0.783 |
| 7. Manu. of food products and beverages | 2.036 | 2.078 | 1.031 | 2.231 | 2.154 | 1.021 | 0.507 | 1.158 | 1.119 |
| 8. Manu. of tobacco products | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 9. Manu. of textiles | 1.765 | 1.624 | 1.019 | 1.874 | 1.664 | 0.920 | 0.578 | 1.053 | 0.935 |
| 10. Manu. of wearing apparel, dressing and dyeing of fur | 1.572 | 1.237 | 1.006 | 1.691 | 1.530 | 0.787 | 0.640 | 1.284 | 1.162 |
| 11. Tanning and dressing of leather, luggage, handbag, saddles, harness and foot wear | 1.504 | 1.712 | 1.033 | 1.882 | 1.667 | 1.138 | 0.687 | 1.394 | 1.234 |
| 12. Manu. of wood and wood products | 1.681 | 1.399 | 1.018 | 1.788 | 1.768 | 0.832 | 0.606 | 1.053 | 1.041 |
| 13. Manu. of paper and paper products | 1.730 | 1.313 | 1.023 | 2.120 | 2.086 | 0.759 | 0.591 | 1.384 | 1.362 |
| 14. Publishing, printing and reproduction of recorded media | 1.552 | 1.514 | 1.039 | 1.458 | 1.441 | 0.976 | 0.669 | 0.871 | 0.860 |
| 15. Manu. of coke, refined petro. Products and nuclear fuel | 1.708 | 1.262 | 1.205 | 1.015 | 1.010 | 0.739 | 0.705 | 1.008 | 1.003 |
| 16. Manu. of chemical and chemical products | 1.591 | 1.326 | 1.023 | 1.274 | 1.229 | 0.833 | 0.643 | 0.914 | 0.882 |
| 17. Manu. of rubber and plastic products | 1.645 | 1.486 | 1.020 | 1.892 | 1.809 | 0.903 | 0.620 | 1.136 | 1.086 |
| 18. Manu. of other non-metallic mineral products | 1.616 | 1.390 | 1.013 | 1.709 | 1.671 | 0.860 | 0.627 | 0.967 | 0.946 |
| 19. Manu. of basic metals | 1.299 | 1.488 | 1.325 | 1.019 | 1.017 | 1.145 | 1.020 | 0.993 | 0.991 |
| 20. Manu. of fabricated metal except mach. and equip. | 1.174 | 1.306 | 1.011 | 1.730 | 1.699 | 1.113 | 0.862 | 1.018 | 1.000 |
| 21. Manu. of mach. And equip. n. e. c. | 1.244 | 1.347 | 1.013 | 1.409 | 1.394 | 1.084 | 0.815 | 1.074 | 1.063 |
| 22. Manu. of office, accounting and computing mach. | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 23. Manu. of electrical mach. And operations, n.e.c. | 1.410 | 1.281 | 1.009 | 1.797 | 1.762 | 0.908 | 0.716 | 1.040 | 1.020 |
| 24. Manu. of radio, television and communication equip and apparatus | 1.800 | 1.391 | 1.254 | 1.117 | 1.114 | 0.773 | 0.697 | 1.098 | 1.095 |
| 25. Manu. of medical, precision and optical instruments, watches and clocks | 1.466 | 1.387 | 1.014 | 1.201 | 1.196 | 0.946 | 0.692 | 0.838 | 0.835 |
| 26. Manu. of motor vehicles, trailer and semi-trailers | 1.453 | 1.429 | 1.061 | 1.693 | 1.679 | 0.984 | 0.731 | 1.169 | 1.159 |
| 27. Manu. of other transport equip. | 1.147 | 1.449 | 1.218 | 1.145 | 1.143 | 1.264 | 1.062 | 1.036 | 1.034 |
| 28. Manu. of furniture and recycling | 1.259 | 1.562 | 1.030 | 1.896 | 1.856 | 1.241 | 0.819 | 1.187 | 1.162 |
| 29. Electricity | 1.902 | 1.442 | 1.022 | 1.744 | 1.728 | 0.758 | 0.537 | 0.892 | 0.884 |
| 30. Distribution of Gas  | 1.285 | 1.321 | 1.013 | 1.413 | 1.354 | 1.028 | 0.789 | 0.820 | 0.786 |
| 31. Water | 1.663 | 1.492 | 1.016 | 1.559 | 1.553 | 0.897 | 0.611 | 0.877 | 0.873 |
| 32. Construction | 1.615 | 1.421 | 1.013 | 1.798 | 1.785 | 0.880 | 0.627 | 0.986 | 0.979 |
| 33. Whole sale, retail sale, repairs of motor vehicles | 1.116 | 1.160 | 1.005 | 1.271 | 1.263 | 1.039 | 0.901 | 1.106 | 1.100 |
| 34. Hotel and Restaurants | 1.511 | 1.459 | 1.011 | 1.780 | 1.726 | 0.966 | 0.669 | 1.063 | 1.031 |
| 35. Transport, Storage and Communication | 1.257 | 1.299 | 1.011 | 1.419 | 1.360 | 1.033 | 0.804 | 1.064 | 1.020 |
| 36. Financial Inter mediation | 1.207 | 1.246 | 1.009 | 1.302 | 1.286 | 1.032 | 0.836 | 1.053 | 1.040 |
| 37. Real estate, renting and business services | 1.158 | 1.146 | 1.006 | 1.185 | 1.181 | 0.990 | 0.869 | 0.985 | 0.982 |
| 38. Education | 1.119 | 1.131 | 1.004 | 1.201 | 1.197 | 1.010 | 0.897 | 1.048 | 1.044 |
| 39. Health and social work | 1.185 | 1.205 | 1.007 | 1.312 | 1.307 | 1.017 | 0.850 | 1.047 | 1.042 |
| 40. other services | 1.207 | 1.255 | 1.009 | 1.304 | 1.295 | 1.040 | 0.836 | 1.020 | 1.013 |
| Mean | **1.425** | **1.350** | **1.039** | **1.490** | **1.455** | **0.961** | **0.753** | **1.036** | **1.013** |

 The results of the true and the estimated sector multipliers which derived from the modified table are presented in Table 6. The results show that, on an average, the deviations for the CB and CHARM methods are 3.6 and 1.3 percent which suggests that under the modified table, the CHARM methods outperforms the CB methods. The average sectoral multipliers under FLQ methods (when $δ=0$ and 1) are 1.350 and 1.039 which underestimate of true multipliers by 4 and 25 percent.

 As Compared to the other non-survey methods, the CHARM method can estimate the sectoral exports and imports. Based on the original and modified tables of Gilan, we have applied the CB and CHARM methods with the view to assess the accuracies of the estimated sectoral exports and imports. The results of the total exports, total imports, total volume of trade and total trade balance of Gilan are presented in Tables 6 and 7.

**Table 6. The Modified Survey-Based and Estimated Total Exports, Imports and Trade Volume of Gilan Province in 2002 (Million, Iranian Rials at Current Prices)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Survey-Based | Estimated | Estimated to Survey-Based |
| CB | CHARM | CB | CHARM |
| Total Exports | 5062508 | 3544927 | 5284343 | 0.700 | 1.04 |
| Total Imports | 28649970 | 4095872 | 5835288 | 0.143 | 0.204 |
| Trade Volume | 33712478 | 7640799 | 11119631 | 0.227 | 0.329 |
| Trade Balance | -23587462 | -550945 | -550445 | - | - |

**Table 7. The Estimated and Survey-Based Total Exports, Imports and Trade Volume of Gilan Province in 2002 (Million, Iranian Rials at Current Prices)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Survey-Based | Estimated | Estimated to Survey-Based |
| CB | CHARM | CB | CHARM |
| Total Exports | 5062508 | 3544927 | 5284343 | 0.700 | 1.043 |
| Total Imports | 7701964 | 4095872 | 5835288 | 0.532 | 0.758 |
| Trade Volume | 12764472 | 7640799 | 11119631 | 0.598 | 0.872 |
| Trade Balance | -2639456 | -550945 | -550945 | - | - |

 With respect to the estimated total exports we find that the CHARM method overestimates the total exports in both original and modified tables by 4.3 percent respectively whereas CB method underestimates by about 30 percent. The main reason is the explicit account of CHARM relative to CB.

 Regarding the total imports, both the methods do not give satisfactory results in both regional and modified tables. In the original table, both the methods underestimate total imports by 86 and 80 percent whereas for the modified table, the deviations are reduced by 47 and 26 percent. The detailed results of the Tables 6 and 7 are presented in the Tables 8 and 9.

 From the Table 8, we observe that out of 40 sectors of Gilan, 15 sectors do not export. All the service sectors except Transportation, Storage and Communications, Water, Electricity, Distribution of Gas have no exports. Besides that of Gilan do not produce Crude Oil and Natural Gas, Tobacco Products and Coke Refined Petroleum Products and Nuclear Fuel, their respective exports are zeros. Regarding the imports, the figures show that except the distribution of Gas, the remaining sectors imports. Sectoral exports and exports under the CB method show that sector (sectors) have exports ($e\_{i}^{R}>0$), do not imports ($m\_{i}^{R}$) and vice versa. The CHARM method gives different pictures. First of all, due to the cross-hauling, export two sectors like Crude Petroleum and Natural Gas and Distribution of Gas, do not have exports whereas the remaining sectors do exports. Even sectors like Tobacco Products, and specially Coke, Petroleum Products and Nuclear fuel which have very negligible shares (0.1 and 0.03 percent) of the total output have export figure of 3 million and 122812 million Rials respectively.

**Table 8. The Survey-Based and the Estimated Sectoral Exports, Imports and Total of Volume of Trade for the Province of Gilan in 2002**

 **(Million Rials at Current Prices)**

|  |  |  |
| --- | --- | --- |
|  | Original Survey-Based Table | Non-Survet |
| CB | CHARM |
| Exports | Imports | Trade Volume | Trade Balance | Exports | Imports | Trade Volume | Trade Balance | Exports | Imports | Trade Volume | Trade Balance |
| 1. Farming and Gardening | 2006446 | 322897 | 1683549 | 2329343 | 721445 | 0 | 721445 | 721445 | 989546 | 268101 | 721445 | 1257646 |
| 2. Animal Husbandry, Raising Worms, Honey, Hunting | 721360 | 257511 | 463849 | 978871 | 455968 | 0 | 455968 | 455968 | 469956 | 13988 | 455968 | 483944 |
| 3. Forestry | 5814 | 33961 | -28147 | 39775 | 107279 | 0 | 107279 | 107279 | 109649 | 2370 | 107279 | 112019 |
| 4. Fishing | 279458 | 54187 | 225271 | 333645 | 76020 | 0 | 76020 | 76020 | 76267 | 247 | 76020 | 76515 |
| 5. Crude Oil and Natural Gas | 0 | 80962.00 | -80962.00 | 80962.00 | 0 | 34561 | -34561 | 34561 | 0 | 34561 | -34561 | 34561 |
| 6. Other Mining | 25133 | 11533 | 13600 | 36666 | 0 | 76364 | -76364 | 76364 | 13767 | 90131 | -76364 | 103899 |
| 7. Manu. of food products and beverages | 1025421 | 3619163 | -2593742 | 4644584 | 0 | 201593 | -201593 | 201593 | 133476 | 335068 | -201593 | 468544 |
| 8. Manu. of tobacco products | 0 | 85298 | -85298 | 85298 | 0 | 2731 | -2731 | 2731 | 3 | 2734 | -2731 | 2736 |
| 9. Manu. of textiles | 20333.04995 | 901284 | -880951 | 921617 | 0 | 52387 | -52387 | 52387 | 157382 | 209768 | -52387 | 367150 |
| 10. Manu. of wearing apparel, dressing and dyeing of fur | 16217 | 808818 | -792601 | 825035 | 0 | 181176 | -181176 | 181176 | 118094 | 299270 | -181176 | 417364 |
| 11. Tanning and dressing of leather, luggage, handbag, saddles, harness and foot wear | 29317 | 367702 | -338385 | 397019 | 0 | 12371 | -12371 | 12371 | 20016 | 32388 | -12371 | 52404 |
| 12. Manu. of wood and wood products | 43027.2391 | 643263 | -600236 | 686290 | 126323 | 0 | 126323 | 126323 | 128935 | 2613 | 126323 | 131548 |
| 13. Manu. of paper and paper products | 190094 | 185011 | 5083 | 375105 | 78268 | 0 | 78268 | 78268 | 83371 | 5103 | 78268 | 88475 |
| 14. Publishing, printing and reproduction of recorded media | 4807 | 66974 | -62167 | 71781 | 0 | 37751 | -37751 | 37751 | 1444 | 39194 | -37751 | 40638 |
| 15. Manu. of coke, refined petro. Products and nuclear fuel | 0 | 822819 | -822819 | 822819 | 0 | 238780 | -238780 | 238780 | 122812 | 361592 | -238780 | 484404 |
| 16. Manu. of chemical and chemical products | 8404.520231 | 1448766 | -1440361 | 1457171 | 0 | 475063 | -475063 | 475063 | 137788 | 612851 | -475063 | 750639 |
| 17. Manu. of rubber and plastic products | 24817.82234 | 1245890 | -1221072 | 1270708 | 38909 | 0 | 38909 | 38909 | 55019 | 16110 | 38909 | 71130 |
| 18. Manu. of other non-metallic mineral products | 33838.3057 | 1392580 | -1358742 | 1426418 | 265277 | 0 | 265277 | 265277 | 295645 | 30368 | 265277 | 326012 |
| 19. Manu. of basic metals | 1827.403512 | 3741414 | -3739587 | 3743241 | 0 | 988384 | -988384 | 988384 | 96532 | 1084916 | -988384 | 1181448 |
| 20. Manu. of fabricated metal except mach. and equip. | 35884.55258 | 1248733 | -1212848 | 1284618 | 98366 | 0 | 98366 | 98366 | 113809 | 15443 | 98366 | 129251 |
| 21. Manu. of mach. And equip. n. e. c. | 105262 | 702332 | -597070 | 807594 | 0 | 491603 | -491603 | 491603 | 25270 | 516873 | -491603 | 542143 |
| 22. Manu. of office, accounting and computing mach. | 0 | 37869 | -37869 | 37869 | 0 | 2716 | -2716 | 2716 | 11 | 2727 | -2716 | 2738 |
| 23. Manu. of electrical mach. And operations, n.e.c. | 33927.15446 | 526844 | -492917 | 560771 | 120206 | 0 | 120206 | 120206 | 133261 | 13055 | 120206 | 146316 |
| 24. Manu. of radio, television and communication equip and apparatus | 35.02169386 | 385919 | -385884 | 385954 | 0 | 19498 | -19498 | 19498 | 382 | 19880 | -19498 | 20262 |
| 25. Manu. of medical, precision and optical instruments, watches and clocks | 7982 | 15167 | -7185 | 23149 | 0 | 130178 | -130178 | 130178 | 1777 | 131955 | -130178 | 133732 |
| 26. Manu. of motor vehicles, trailer and semi-trailers | 4223.486619 | 1484658 | -1480435 | 1488881 | 0 | 163104 | -163104 | 163104 | 3598 | 166701 | -163104 | 170299 |
| 27. Manu. of other transport equip. | 578.5030087 | 547289 | -546710 | 547868 | 0 | 32171 | -32171 | 32171 | 229 | 32400 | -32171 | 32629 |
| 28. Manu. of furniture and recycling | 14087 | 177132 | -163045 | 191219 | 34487 | 0 | 34487 | 34487 | 37867 | 3380 | 34487 | 41248 |
| 29. Electricity | 0 | 4 | -4 | 4 | 373096 | 0 | 373096 | 373096 | 385282 | 12186 | 373096 | 397468 |
| 30. Distribution of Gas | 0 | 0 | 0 | 0 | 0 | 62429 | -62429 | 62429 | 34609 | 97038 | -62429 | 131648 |
| 31. Water | 0 | 3 | -3 | 3 | 0 | 24330 | -24330 | 24330 | 0 | 24330 | -24330 | 24330 |
| 32. Construction | 0 | 4864416 | -4864416 | 4864416 | 93254 | 0 | 93254 | 93254 | 93254 | 0 | 93254 | 93254 |
| 33. Whole sale, retail sale, repairs of motor vehicles | 0 | -2 | 2 | -2 | 844870 | 0 | 844870 | 844870 | 873221 | 28351 | 844870 | 901572 |
| 34. Hotel and Restaurants | 0 | 4 | -4 | 4 | 80489 | 0 | 80489 | 80489 | 112179 | 31690 | 80489 | 143869 |
| 35. Transport, Storage and Communication | 424213 | 537757 | -113544 | 961970 | 0 | 79602 | -79602 | 79602 | 340621 | 420222 | -79602 | 760843 |
| 36. Financial Inter mediation | 0 | 6 | -6 | 6 | 0 | 46270 | -46270 | 46270 | 27304 | 73574 | -46270 | 100878 |
| 37. Real estate, renting and business services | 0 | 948644 | -948644 | 948644 | 0 | 189570 | -189570 | 189570 | 20334 | 209905 | -189570 | 230239 |
| 38. Education | 0 | 61061 | -61061 | 61061 | 0 | 70335 | -70335 | 70335 | 3100 | 73435 | -70335 | 76535 |
| 39. Health and social work | 0 | 254302 | -254302 | 254302 | 30670 | 0 | 30670 | 30670 | 31422 | 752 | 30670 | 32174 |
| 40. other services | 0 | 767799 | -767799 | 767799 | 0 | 482905 | -482905 | 482905 | 37112 | 520017 | -482905 | 557130 |
| Mean | 5,062,508  | 28,649,970  | 23587462 | 33712478 | 3,544,927  | 4,095,872  | -550945 | 7640799 | 5,284,343  | 5,835,288  | -550945 | 11119631 |

**Table 9. The Modified Survey-Based and the Estimated Sectoral Exports, Imports and Total Total of Volume of Trade for the Province of Gilan in 2002**

 **(Million Rials at Current Prices)**

|  |  |  |
| --- | --- | --- |
|  | Original Survey-Based Table | Non-Survet |
| CB | CHARM |
| Exports | Imports | Trade Volume | Trade Balance | Exports | Imports | Trade Volume | Trade Balance | Exports | Imports | Trade Volume | Trade Balance |
| 1. Farming and Gardening | 2006446 | 265013 | 1741433 | 2271459 | 721445 | 0 | 721445 | 721445 | 989546 | 268101 | 721445 | 1257646 |
| 2. Animal Husbandry, Raising Worms, Honey, Hunting | 721360 | 15719 | 705641 | 737079 | 455968 | 0 | 455968 | 455968 | 469956 | 13988 | 455968 | 483944 |
| 3. Forestry | 5814 | 5611 | 203 | 11425 | 107279 | 0 | 107279 | 107279 | 109649 | 2370 | 107279 | 112019 |
| 4. Fishing | 279458 | 151 | 279307 | 279609 | 76020 | 0 | 76020 | 76020 | 76267 | 247 | 76020 | 76515 |
| 5. Crude Oil and Natural Gas | 0 | 80962.00 | -80962.00 | 80962.00 | 0 | 34561 | -34561 | 34561 | 0 | 34561 | -34561 | 34561 |
| 6. Other Mining | 25133 | 6284 | 18849 | 31417 | 0 | 76364 | -76364 | 76364 | 13767 | 90131 | -76364 | 103899 |
| 7. Manu. of food products and beverages | 1025421 | 1232542 | -207121 | 2257963 | 0 | 201593 | -201593 | 201593 | 133476 | 335068 | -201593 | 468544 |
| 8. Manu. of tobacco products | 0 | 85298 | -85298 | 85298 | 0 | 2731 | -2731 | 2731 | 3 | 2734 | -2731 | 2736 |
| 9. Manu. of textiles | 20333.04995 | 192422 | -172089 | 212755 | 0 | 52387 | -52387 | 52387 | 157382 | 209768 | -52387 | 367150 |
| 10. Manu. of wearing apparel, dressing and dyeing of fur | 16217 | 619648 | -603431 | 635865 | 0 | 181176 | -181176 | 181176 | 118094 | 299270 | -181176 | 417364 |
| 11. Tanning and dressing of leather, luggage, handbag, saddles, harness and foot wear | 29317 | 103326 | -74009 | 132643 | 0 | 12371 | -12371 | 12371 | 20016 | 32388 | -12371 | 52404 |
| 12. Manu. of wood and wood products | 43027.2391 | 38302 | 4725 | 81330 | 126323 | 0 | 126323 | 126323 | 128935 | 2613 | 126323 | 131548 |
| 13. Manu. of paper and paper products | 190094 | 215053 | -24959 | 405147 | 78268 | 0 | 78268 | 78268 | 83371 | 5103 | 78268 | 88475 |
| 14. Publishing, printing and reproduction of recorded media | 4807 | 10184 | -5377 | 14991 | 0 | 37751 | -37751 | 37751 | 1444 | 39194 | -37751 | 40638 |
| 15. Manu. of coke, refined petro. Products and nuclear fuel | 0 | 685632 | -685632 | 685632 | 0 | 238780 | -238780 | 238780 | 122812 | 361592 | -238780 | 484404 |
| 16. Manu. of chemical and chemical products | 8404.520231 | 512726 | -504322 | 521131 | 0 | 475063 | -475063 | 475063 | 137788 | 612851 | -475063 | 750639 |
| 17. Manu. of rubber and plastic products | 24817.82234 | 138207 | -113389 | 163025 | 38909 | 0 | 38909 | 38909 | 55019 | 16110 | 38909 | 71130 |
| 18. Manu. of other non-metallic mineral products | 33838.3057 | 100433 | -66595 | 134272 | 265277 | 0 | 265277 | 265277 | 295645 | 30368 | 265277 | 326012 |
| 19. Manu. of basic metals | 1827.403512 | 648632 | -646805 | 650460 | 0 | 988384 | -988384 | 988384 | 96532 | 1084916 | -988384 | 1181448 |
| 20. Manu. of fabricated metal except mach. and equip. | 35884.55258 | 52408 | -16524 | 88293 | 98366 | 0 | 98366 | 98366 | 113809 | 15443 | 98366 | 129251 |
| 21. Manu. of mach. And equip. n. e. c. | 105262 | 792463 | -687201 | 897725 | 0 | 491603 | -491603 | 491603 | 25270 | 516873 | -491603 | 542143 |
| 22. Manu. of office, accounting and computing mach. | 0 | 37593 | -37593 | 37593 | 0 | 2716 | -2716 | 2716 | 11 | 2727 | -2716 | 2738 |
| 23. Manu. of electrical mach. And operations, n.e.c. | 33927.15446 | 82849 | -48922 | 116776 | 120206 | 0 | 120206 | 120206 | 133261 | 13055 | 120206 | 146316 |
| 24. Manu. of radio, television and communication equip and apparatus | 35.02169386 | 165341 | -165306 | 165376 | 0 | 19498 | -19498 | 19498 | 382 | 19880 | -19498 | 20262 |
| 25. Manu. of medical, precision and optical instruments, watches and clocks | 7982 | 36155 | -28173 | 44137 | 0 | 130178 | -130178 | 130178 | 1777 | 131955 | -130178 | 133732 |
| 26. Manu. of motor vehicles, trailer and semi-trailers | 4223.486619 | 348985 | -344761 | 353208 | 0 | 163104 | -163104 | 163104 | 3598 | 166701 | -163104 | 170299 |
| 27. Manu. of other transport equip. | 578.5030087 | 30439 | -29860 | 31017 | 0 | 32171 | -32171 | 32171 | 229 | 32400 | -32171 | 32629 |
| 28. Manu. of furniture and recycling | 14087 | 24105 | -10018 | 38192 | 34487 | 0 | 34487 | 34487 | 37867 | 3380 | 34487 | 41248 |
| 29. Electricity | 0 | 18099 | -18099 | 18099 | 373096 | 0 | 373096 | 373096 | 385282 | 12186 | 373096 | 397468 |
| 30. Distribution of Gas | 0 | 31786 | -31786 | 31786 | 0 | 62429 | -62429 | 62429 | 34609 | 97038 | -62429 | 131648 |
| 31. Water | 0 | 0 | 0 | 0 | 0 | 24330 | -24330 | 24330 | 0 | 24330 | -24330 | 24330 |
| 32. Construction | 0 | 0 | 0 | 0 | 93254 | 0 | 93254 | 93254 | 93254 | 0 | 93254 | 93254 |
| 33. Whole sale, retail sale, repairs of motor vehicles | 0 | 34834 | -34834 | 34834 | 844870 | 0 | 844870 | 844870 | 873221 | 28351 | 844870 | 901572 |
| 34. Hotel and Restaurants | 0 | 65939 | -65939 | 65939 | 80489 | 0 | 80489 | 80489 | 112179 | 31690 | 80489 | 143869 |
| 35. Transport, Storage and Communication | 424213 | 356862 | 67351 | 781075 | 0 | 79602 | -79602 | 79602 | 340621 | 420222 | -79602 | 760843 |
| 36. Financial Inter mediation | 0 | 38800 | -38800 | 38800 | 0 | 46270 | -46270 | 46270 | 27304 | 73574 | -46270 | 100878 |
| 37. Real estate, renting and business services | 0 | 76952 | -76952 | 76952 | 0 | 189570 | -189570 | 189570 | 20334 | 209905 | -189570 | 230239 |
| 38. Education | 0 | 79676 | -79676 | 79676 | 0 | 70335 | -70335 | 70335 | 3100 | 73435 | -70335 | 76535 |
| 39. Health and social work | 0 | 12091 | -12091 | 12091 | 30670 | 0 | 30670 | 30670 | 31422 | 752 | 30670 | 32174 |
| 40. other services | 0 | 460442 | -460442 | 460442 | 0 | 482905 | -482905 | 482905 | 37112 | 520017 | -482905 | 557130 |
| Sum | **5062508** | **7701964** | **-2639456** | **12764472** | **3544927** | **4095872** | **-550945** | **7640799** | **5284343** | **5835288** | **-550945** | **11119631** |

**5. Conclusions**

The lack of the survey-based regional IOT bedeviled regional analysts to assess the accuracies of the estimated regional input coefficients and the regional output or supply multipliers in many countries of the world, and Iran is no exception. Recently the Management and Planning Organization of province of Gilan has complied a survey-based IOT for the year 2002. the availability of this table has for the first time paved the way to assess the accuracies of the estimated sectoral output and supply multipliers of Gilan using two non-survey based methods of FLQ, CB and CHARM. For assessing the accuracies of the estimated sectoral multiplier we have used two versions of the survey-based Gilan IOT. One is the original table whereas the share of imports to total output is 77 percent and 1.22 times larger than GDP of Gilan. The difficulty of understanding of these figures compelled us to modify the imports in the original table, using the proportionality of regional to national demand. To assess the accuracies of sectoral multipliers one national and two survey-based (original and modified IOTs) in the framework of FLQ and CHARM methods have been used. The results show that on an average, both the CB and CHARM methods overestimates the supply multipliers by 15 and 12 percent in original table and by 3.6 and 1.3 decent in the modified table. On the other hand the FLQ method, underestimates the average output multipliers for both the tables: In the original table by 1 percent and for the modified table by around 4 percent when $δ=0$ and 25 percent when $δ=1$. By taking the average of two average output multipliers as a cut-off point for optimum value of $δ$, we get $\frac{1.35+1.039}{2}=1.194$, and therefore, 0.837 which underestimates the true value by around 16 percent. Moreover as compared to the FLQ method, the CB and CHARM methods have the advantages of estimating regional sectoral exports and imports. The overall results reveal that the CHARM methods overestimates the total exports of Gilan by 4.3 percent for both the original and modified tables whereas the CB method underestimates the total exports by 30 percent. Considering the total imports, we observe poorer performance in both the methods. In the original table, the underestimations are 79.6 percent for CHARM and 85.7 percent for CB whereas in the modified table, the results improve by around 24.2 percent deviation for CHARM and 46.8 percent deviation for CB.

**Notes**

[1]- For more information on the modified traditional CILQ method at the end of quarter 20th century refers to:

Flegg, Webber and Elliot (1995), Flegg and Webber (1996, 1997), Flegg and Webber (1998, 2000)

[2]- For the assessment of the accuracies of overestimation of regional output multipliers and underestimation of regional imports of modified CILQ methods are evaluated in the followings: Tohmo (2004), Flegg and Tohmo (2011), Lehtonen and Tykkylainen (2014), Bonfiglio (2009), Flegg and Tohmo (2014), Flegg and Tohmo (2013) and Kowalewski (2015).

[3]. See for example, Azadinajad, et. al. (2013 and 2014), Homayoonifar, et. al. (2014), Hosseinzadeh and Sharify (2014), Management and Planning Organization of Khozestan Province (2014). Exceptions are; Banouei, et.al. (2007), and Bazzazan, et.al. (2007) who have for the first time attempted to use the Ghosh supply model for determination of the appropriate$ δ$ in the FLQ method.

[4]. The management and Plan Organization of Gilan Province (MPOGP) has complied a survey-based IOT for the year 2002 (MPOGP, 2006)

[5]. The following formula has used for the computation of SLQs.

$$SLQ\_{i}≡\frac{{RO\_{i}}/{TRO}}{{NO\_{i}}/{TNO}}≡\frac{RO\_{i}}{TO\_{i}}×\frac{TNO}{TRO}$$

Where, $RO\_{i}$ and $NO\_{i}$ are respective regional and national output in sector i; TRO and TNO are the corresponding regional and national totals.

[6]. Flegg and his colleagues have shown that entering implicitly relative size of region in the formula, does not adequate allowance for imports of larger and smaller regions (Flegg, et. al. 1995)

[7]. To illustrate, how Round’s method in Eq. (1) works, Flegg and his colleagues use two hypothetical regions, A. and B. The region B is larger than region A. Applying RLQ method, they found that RLQ (A) =0.703 and RLQ (B) =0.590. Therefore m (A)=1-0.703=0.297 and m (B)=1-0.590=0.41. These hypothetical figures suggest that RLQ method make larger allowance for regional imports for larger region and smaller allowance of imports for smaller region. Based on this classic hypothetical figures, Flegg and his Colleagues claim that RLQ’s method works counterintuitive (( for the pros and cons of this aspect see scientific dialogue between Brand (1997) anf Flegg and Webber (1997)). To remedy the counterintuitive of the RLQ’s method, Flegg and his Colleagues propose the following method:

MRLQij=Log2 (1+SLQi)/SLQj and found that MRL (A)= 0.707 and MRL (B)= 0.809. Therefore, m(A)=1-0.707=0.293 and m (B)= 1-0.809=0.191. The modified hypothetical figure suggests that, smaller regions, rather than large, need larger allowance for imports.

[8]. McCann and Dewhurst questioned that the regional sectoral specialization has been neglected by FLQ method. Their main criticism is that regional sectoral specialization involves the creation of local economies which generally can bring about a greater degree of a diversified economic structure and hence more local intra-sectoral and inter sectoral linkages.

[9]. Kowalewski has applied the SFLQ for the German Federal state of Baden-Wuerttemberg for the year 1993 and the results compared with the outcomes of AFLQ, FLQ, CILQ and SLQ methods. Her overall findings show that “owing to the chosen criterion for an optimal value of $δ\_{j}$, the absolute (relative) deviation of the estimated multipliers is lower to the FLQ estimates” (Kowalewski, 2015, p. 14)

[10]. In the section 2.1, we have observed that RLQ methods consider the regional size, but according to Flegg and his colleague is appears to be counter -intuitive. Flegg and his associates takes this issue as a starting point - and subsequently introduced new methods of FLQ and AFLQ to solve the problem of overestimation and underestimation.

[11]. The issue of the “technology” should be used with caution. As all the LQ methods use domestic input-output coefficients excluding imports from other regions and other countries at the national level which is coined as “technical coefficients” whereas for the CB method technological input-output coefficients, including imports from other regions and foreign imports are used.

[12]. For the determination of the optimal value of $δ$, the following statistical methods are applied

$$sm\_{1}=\frac{1}{n}\sum\_{j}^{}{\left|\overbar{om}\_{j}-om\_{j}\right|}/{om\_{j}}$$

$$sm\_{2}=\frac{1}{n}\sum\_{j}^{}\left|\overbar{om}\_{j}-om\_{j}\right|$$

$$sm\_{3}=100\sqrt{{\sum\_{j}^{}(\overbar{om}\_{j}-om\_{j})^{2}^{ }}/{\sum\_{j}^{}om\_{j}}}$$

$$sd=[(\frac{1}{n})^{j}\sum\_{j}^{}\{\left|\overbar{om}\_{j}-om\_{j}\right|-sm\_{2}\}^{2}]^{0.5}$$

$$sm\_{4}=(\frac{100}{n})^{j}\sum\_{j}^{}{\left|\overbar{om}\_{j}-om\_{j}\right|}/{om\_{j}}$$

$$sm\_{5}=100\sum\_{j}^{}{e\_{j}\left|\overbar{om}\_{j}-om\_{j}\right|}/{om\_{j}}$$

Where

$\overbar{om}\_{j}$= The estimated domestic multiplier of sector j, i. e. the column sum of the simulated Leontief inverse.

$om\_{j}$= Survey based multiplier of sector j

n and e= number of sectors and output share respectively

[13]. Surprisingly, out of five statistical methods, only standard deviation method provides optimal value of $δ$ whereas the remaining methods give trend diviations. Besides, for the Modified table, we could not get any optimal value of $δ$.

[14]. Flegg, et al have applied the CB and CHARM methods for the province Hubei, China. They have arrived at estimated mean figures of 2.218 and 2.078 respectively with survey-based of 1.919. The ratios of estimated to the true figure are: 1.156 and 1.082. Both the methods overestimate the true figure by around 16% and 8% and the deviation in CB method is two times that of CHARM method.

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. Professor of Planning and Development, Faculty of Economics, Allameh Tabataba’i University, Tehran, Iran, (Banouei@atu.ac.ir) [↑](#footnote-ref-1)
2. . Assistant Professor of Economics, Faculty of Economics, Allameh Tabataba’i University, Tehran, Iran, (Parisa\_m2369@yahoo.com) [↑](#footnote-ref-2)
3. . Senior Expert in Management and Planning Organization of Gilan Province, Rasht, Gilan (kavosi\_sh@yahoo.com) [↑](#footnote-ref-3)
4. . Expert in Parliament Research Center, Tehran, Iran (nargessadeghi\_1386@yahoo.com) [↑](#footnote-ref-4)