The Feasibility of Optimal Monetary Zone Formation between Iran and Shanghai Group Using Fuzzy Clustering Algorithm Approach

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Abstract

Considering the importance of joining of countries to regional convergences, optimal monetary zone is established in order to provide preparations to enter global market. Using theory of optimal monetary zone and investigating commercial density index variables of imports, Linder variable of degree of economic openness, liquidity of purchasing power, and ratio of liquidity to GDP, the current study examines the feasibility of a successful monetary union formation among the countries of Shanghai Group using fuzzy clustering algorithm. The results of this study show that countries do not have full convergence in criteria of optimal monetary zone. Accordingly, Iran cannot form optimal monetary zone even in long run.

Keywords: Currency Union, Shanghai Group, Phase Clustering Algorithm.
Introduction

The countries of the world seek to improve the economic condition and develop economic relationships and especially business relationships between one another in the form of regional and sometimes transregional treaties. This discussion lies in the frame of the economic convergence theory. This theory reviews discriminatory trade policies and other economic cooperation which are based on the reduction and elimination of the business constraints among member countries and other economic collaborations.

Economic convergence has various levels: the first level is the preferential business agreements in which, by reducing or eliminating semi-tariff and non-tariff barriers and adopting other policies, the field for developing business exchanges among the member countries is provided. In the next stage, convergence gradually evolves. Free business zones are a higher level of preferential business agreements. In this mode, all of the business limitations among the member countries are eliminated; but the rules are considered in association with countries that are not a member. Customs union is the next stage; at this level the member eliminate all of the tariff barriers between themselves and develop mutual business policies against other countries. A higher level of economic convergence is a mutual market. Mutual market provides free current of production factors such as capital, workforce and entrepreneurship in addition to permitting the free current of goods and services. Total economic union is the most perfect type of economic convergence, in which there are mutual monetary and financial policies among members in addition to having all of the features of mutual market. Among these, given the significance of forming a successful currency union between the countries of the group, we can observe the elimination of serious constraints and prohibitions among members. By forming a successful monetary union, the rate of business between members will naturally increase by eliminating financial limitations.

One of the advantages of forming a currency union is that other business men won't be concerned with the unpredicted changes in the exchange rate. Currency union eliminates this risk like all of the constant exchange rate systems. One of the impacts of this matter will be the increase of international business among the members of this union. Empirical evidences show that adopting a mutual currency can increase business more; whereas reduction of the uncertainty of the exchange rate alone won't have significant impacts on business. In contrast, the advantage which is seen in the increase of international business, it also causes loss of control over the monetary policies of the countries. Countries whose governments control their money supply typically use monetary policies for affecting the level of the activities done in domestic economy. Therefore these countries shall come to an agreement about a unified monetary policy to eliminate the problem of business cycle in some countries.

Among the different regional organizations established in this area Shanghai Cooperation Organization (SCO) in the Eurasia region has a significant effect and dynamic. The SCO was
established in 2001 with the presence of China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Besides the main members, at first Mongolia in 2004 and a year later Iran, Pakistan and India were added to the organization as observer members. Nowadays, this organization with the geographical coverage of about 37 million square kilometers and a population of 2500000 with 20 percent of world’s oil reserves and about 50 percent of world’s gas reserves has undeniable capabilities and potentials.

Subject literature

Sato, Zhang, Allen(2008) The establishment of monetary union in East Asia using Johannes collective method was examined in 1978- 2006. The results indicated that some East Asian countries have the potential to form monetary union. In other words, ASEAN countries have no potential to establish monetary union without the participation of Japan. In addition, results show that China is not a good candidate to join the considered monetary union. Shirono(2008) The feasibility of creating common money in East Asia was investigated using gravity model in 17 countries during 1970- 1990. Results suggest that common money would increase trade and consequently will increase prosperity in these countries. Additionally, increased trade with Japan is more in this union compared to absence of Japan. Based on the results, formation of common money among these countries will lead to convergence among them. Ozer, I. and I. Ozkan (2007), with the purpose of analyzing Turkey and the countries of currency union based on criteria of the theory of optimal currency areas, compared the obtained criteria by using Boxer-King (B-K) filtration and Hudric-Prescott (H-P) filtration. The result of the article showed that by using the H-P filtration technique and by selecting the value of proper smoothing parameter, some acceptable clusters can be created among European countries, countries which are joining and countries selected to joint such as Turkey. Song, Wei and Wang, Weiyue (2009) reviewed the single currency for the 3+ASEAN countries. By using the two methods of phase clustering and hierarchal clustering and putting the country China as the reference country showed that the countries Japan, South Korea, Hong Kong, Malaysia, Philippines, Singapore, Thailand, Cambodia and Vietnam have the maximum convergence with China and these countries have the most similarity for membership in the Asian monetary union. Glick and Rose (2001) have reviewed the impact of mutual money on business for 217 countries by using panel data of 1948-1997. In the required regression, the fixed effects have been used for reviewing the entering and exiting the monetary union. The research results indicate that as a country exit the monetary union, the volume of its business of that country reduces and it increases in case of entrance. Chow and Kim (2003) have reviewed the possibility of creating a mutual currency in the countries of Eastern Asia (Korea, China, Malaysia, Singapore, Taiwan and Philippines) in a study. The results of this research show that the countries of Eastern Asia are highly affected by the regional shock; whereas European countries which are a member of economic and currency union are not that much affected by the economic and monetary union. The research results indicate that Asian countries have different economic structures and are most probably affected by asymmetric shocks. Given the optimal monetary area theory, forming a currency union in the Eastern Asia has high costs. Biabani, et al. (2012), by using the optimal currency area theory, reviewed the possibility of a currency union among the countries of ECO economic cooperation by using the phase algorithm compared to center and studied the convergence degree of ECO
countries based on six criteria of optimal currency area theory. The results of this article show that ECO countries do not have a complete convergence in the criteria of optimal currency area theory and have defected convergence. Also the convergence of ECO countries has relatively increased over time. zeraNejad and Majidi (2013) reviewed the formation of currency union in 49 member countries of Islamic conference by using the OCA theory and gravity model. Jalaee, et al. (2014) reviewed the synchronization of business cycles and economic convergence of Iran with the D8 countries. The results showed that the most important effective factors on the interactive business of Iran and member groups were, respectively, the population of countries, degree of economic openness of the countries, and gross domestic production of the member countries and by adding the Linder variable of the explanatory power of the model has increased. The result specifies that the economic similarities of the member countries can affect the volume of their business currents. Also the impact of synchronization of business cycles on the volume of mutual business of the reviewed countries has been diverse. Ultimately, they came to this conclusion that Iran's economic convergence in the countries of D8 group can be justified. Shakibae and Shah Sanaee (2012) examined the economic convergence and synchronization of business cycles in Shanghai Group using generalized gravity model between years 1996 to 2009. The results showed that there is no commercial convergence between Iran and Shanghai Group, and there is negative relationship between synchronization of commercial cycles and convergence of these countries. Derakhshideh et al(2015) Investigating economic convergence and synchronization of business cycles of Iran and Shanghai Group using spatial econometrics approach indicated that countries have spatial correlation and trade status of every country is affected by that of neighboring countries. Despite lack of synchronization in economic cycles, economic convergence can be justifies.

Research method

The optimal currency area theory is a theoretical framework based on which an economic region with the costs and advantages of the fixed and floating exchange rate for various countries, the conditions for formation of a single currency are reviewed for the formation of a single currency and optimal currency area (OCA) is a geographical area which uses a single currency for maximizing the economic efficiency (Baldwin and Wyplosz, 2004). The optimal currency area theory (OCA) explains the costs and advantages of forming an optimal currency area. In addition, rate of optimal exchange is a tool for the quality of selecting a regime (Broz, 2005). Generally, two modern and traditional approaches are prominent.

In the traditional OCA theory, the following criteria have been referred to for joining currency unions. Flexibility of wages and prices: while facing the shocks in case of flexibility of wages and prices, moderation is done through changes in the rate of unemployment, level of prices or the rate of nominal exchange (Friedman, 1953). High mobility of the production factors between regions: in this mode, a country or a region attracts the production factors through movement without the need to moderate the rates of nominal exchanges of the shocks (Mundell, 1961). The high degree of openness of economy: what is meant by a more open economy is the reduction of repeated allocation costs of the resources between the exchangeable and non-exchangeable
sections after moderations of the rate of nominal exchange (MxKinnon, 1963). High diversity of productions: this issue reduces the need for a repeated moderation of the nominal exchange rates (Kenen, 1969). High financial convergence: this issue leads to the attraction of the effects of asymmetric shocks during financial transmissions from one country to another; therefore the need for a repeated moderation of the nominal exchange rates reduces (Kenen, 1969). Convergence in inflation rates: large difference in the rates of inflation leads to change related to the exchanges and this issue leads to the imbalance in the current accounts of members (Fleming, 1971). Political factors: existence of a political authority is necessary for the integration of the members (Mintz, 1970).

The modern theory refers to the advantages and costs of the members of optimal currency area (OCA). Among the advantages of currency unions for the members of these unions, the following items can be referred to: sustainability of macroeconomics: while a country with low inflation joins currency union, the currency authorities become committed to the anti-inflationary policies; therefore convergence is created to the rate of low inflation and the issue of time incompliance is not prominent. In a limited mode and in short-term (vertical Philips curve), this issue only leads to the reduction of the rate of inflation without an increase in the rate of unemployment (Giavazzi and Pagano, 1988). Increase of business: (Rose, 2001) joining the currency union increases business (due to the elimination of fluctuations of the exchange rate, transparency of prices and higher financial integration); this issue leads to the synchronization of the business cycles of the members. Saving exchange reservoirs: (Mundell, 1973 and Frankle, 1999). By joining the currency union, the member countries do not need international reservoirs for the interactions between members; in addition, integration of exchange reservoirs leads to the elimination of the risk. Political advantages: (Gandolfo, 2002) currency union has more power compared to each of the other members in the international bargains.

The following items are the costs of joining currency unions for the members of these unions: Losing the independence of currency policy (De Grauwe, 1992): by joining the currency union, the openness degree reduces for facing the external shocks; the following points can be mentioned in this respect: Similarity of the shocks: if the countries face asymmetric shock, this issue leads to the damage of the union in case of presence of the leading countries. Also it intensifies the internal business cycles. Therefore the degree of asymmetry of the shocks is crucially important (Alsina, et al. 2002). Synchronization in the business cycles: if the members face a similar shock, but the stages of facing business cycles are different among members; the countries would need different policies. This issue increases the cost of similar currency policies. Therefore the degree of synchronization of the business cycles among members is an important criterion (Alsin, et al. 2002). Nature of shocks: the cost of losing currency policies is different based on the nature of the shocks (Gandolfo, 2002). The modern approach express that the rate of fixed exchange is better in facing the currency shocks of demand and total supply shocks; whereas the rate of floating exchange is better in facing total demand shocks.
Specializes in the production (Artis, 1991): in the regimes of fixed exchange rate, the countries are encouraged to use relative advantages (productions become more specialized and concentrated), and this issue increases the cost of moderation in facing asymmetric shocks. Frankel and Rose (1997) express that this impact is compensated through increasing business. Also, joining currency union leads to the synchronization of business shocks.

Negative impacts of financial policies: Velasco (2001) expresses that the rate of fixed exchange has more order compared to floating exchange rate; but in the regime of fixed exchange rate, he analyzed the increase of public payments of exchange reservoirs. Also Feldstein (2005) expresses that there is the signaling problem. A single currency policy leads to the creation of free transportation without considering the members' financial policies (profligate countries cause a disruption in the market order through higher profit rates).

Losing the independence of financial policies (De Gravio, 1996): there is the possibility of disruption of currency union in case of absence of financial regulation. This issue leads to the necessity and sustainability of the members to some criteria in the financial policies.

Generally, six factors are necessary for forming currency union in the optimal currency area theory (OCA): mobility of workforce in the currency region, the ability of physical mobility (absence of labor law, visa, etc.) and cultural mobility (such as a different language, etc.), economic openness along with the mobility of capital and inflexibility of prices and wages, presence of risk sharing system, similar business cycles, diversity of production and similar preferences.

**Model estimation**

In this section, by using phase clustering method, the possibility of forming a mutual currency union and therefore creation of an optimal currency area are reviewed.

Statistical population of the research is composed of the countries of sco group and the results obtained from data clustering have been reviewed since 1995 to 2011 with the separation of year. The reviewed variables are:

- Mijt: the index of business density of importations shows that the share of importation of a country is more or less than another country in total importations compared to the share of exportations of the opponent country in total world exportations. If the index of business density of the importations is more than one, it means that the share of business between two countries is more than the share of their participation in the world business. If it is less than one, it means that the share of business between two countries is less than the share of their participation in the world business. What is expected from this theory is that the estimated coefficient $\alpha_3$ is more than zero. The index of business density of the importations can be defined as follows:

$$MI_{ij} = \frac{\left[ \frac{M_{ij}}{M_i} \right]}{\left[ \frac{X_j}{X_w - X_i} \right]}$$

Mi – importations of the country i; Mij – importations of the country i from the country j; Xj – exportations of the country j; Xi – total exportations of the country I; Xw – world exportations
LIN\textsubscript{iji}: it is the Linder variable. In order to express the economic similarities between each of the couple of countries of business party enter the model:

\[ ldeen_{ijt} = LN\left( \frac{GDP_{it} - GDP_{jt}}{POP_{it} - POP_{jt}} \right)^2 \]

SYNCH\textsubscript{ij}: it is the synchronization index of the business cycles of the two countries i and j. Kalemli-Ozcan, Sebnem. Elias, Papaioannou. Luis, Peydro (2009) have calculated it as follows:

\[ SYNCH_{ijt} = -\left| \left( Ln Y_{it} - Ln Y_{it-1} \right) - \left( Ln Y_{jt} - Ln Y_{jt-1} \right) \right| \]

In which, \( Y_{it} \) is the natural gross production of the country i at the time of t and \( Y_{jt} \) is the natural gross production of the country j at the time of t.

The more the value of this index is more in term algebraic and closer to the value zero, synchronization will be more in the business cycles of the two countries. Mundell and McKinon argues that synchronization of business periods is a precondition for integrating countries in the form of a regional business agreement; because the probable cost of adopting anti-cycle economic policies reduce the synchronization of the business periods.

Open: it is indicative of the degree of openness of economy and it is obtained from the sum of the importations and exportations of the country and dividing it to the gross domestic production. This index shows the extent to which the production of that country is related to world economy. \( open = export + import / gdp \)

Ppp: equality of purchasing power between the exchanged currencies of the two countries A and B, the number of exchange units of the country B (or A) which is as much as the purchasing power of an exchange unit of the country A (or B). In other words, ppp is a kind of rate of exchange which is equal to the ratio of the costs of two similar baskets of goods in two societies based on national currencies.

The ratio of liquidity to the gross domestic production: this index indicates that the rate of liquidity is the ratio of gross domestic production in economy. In this section, the clustering of the countries has been calculated based on the mentioned variables by separating the years. It is necessary to mention that countries' cluster will continue until the time that presence of the reviewed countries is significant in the clusters. Accordingly, first the results obtained from data clustering are reviewed by separating the number of clusters and the rate of attachment of the countries to the clusters are reviewed separated in the studied interval and ultimately, by concluding the rate of attachment of the countries to the clusters and by reviewing the repetition of this attachment, the ultimate outcome will be provided with a statistical review of the series of clusters of decision making.

results of estimating

Binary clusters:

Analysis of binary clusters since 1995 to 2011

| cluster in 1995 | \{CHN,IND,IRN,KAZ,MNG,PAK,RUS,TJK,UZB\} ,\{KGZ\} |
| cluster in 1996 | \{CHN,IND,KAZ,MNG,PAK,RUS,\} ,\{IRN,KGZ,TJK,UZB\} |
| cluster in 1997 | \{CHN,IND,KAZ,MNG,PAK,RUS,\} ,\{IRN,KGZ,TJK,UZB\} |
cluster in 1998: \{CHN,IND,KAZ,MNG,PAK,RUS,TJK,UZB\}, \{IRN,KGZ\}

cluster in 1999: \{CHN,IND,KAZ,MNG,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}

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cluster in 2002: \{CHN,IND,KAZ,MNG,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}

cluster in 2003: \{CHN,IND,KAZ,MNG,PAK,RUS,UZB\}, \{IRN,KGZ,TJK\}

cluster in 2004: \{CHN,IND,KAZ,MNG,PAK,RUS,UZB\}, \{IRN,KGZ,TJK\}

cluster in 2005: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2006: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2007: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2008: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2009: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2010: \{CHN,IND,IRN,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{TJK\}

cluster in 2011: \{CHN,IND,KAZ,KGZ,MNG,PAK,RUS,UZB\}, \{IRN,TJK\}

Table 1 – Statistical review of the series of clusters

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<th>Cluster</th>
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Analysis of 3 clusters since 1995 to 2011

cluster in 1995: \{CHN,IND,KAZ,MNG,PAK,RUS,TJK,UZB\}, \{KGZ\}, \{IRN\}

cluster in 1996: \{CHN,IND,KAZ,MNG,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}, \{MNG\}

cluster in 1997: \{CHN,IND,KAZ,MNG,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}, \{MNG\}

cluster in 1998: \{CHN,IND,KAZ,KGZ,PAK,RUS,UZB\}, \{MNG\}, \{IRN,TJK\}

cluster in 1999: \{CHN,IND,KAZ,PK,RUS,TJK,UZB\}, \{IRN,KGZ,TJK\}, \{MNG\}

cluster in 2000: \{CHN,IND,KAZ,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}, \{MNG\}

cluster in 2001: \{CHN,IND,KAZ,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}, \{MNG\}

cluster in 2002: \{CHN,IND,KAZ,PAK,RUS\}, \{IRN,KGZ,TJK,UZB\}, \{MNG\}

cluster in 2003: \{CHN,IND,PAK,RUS,UZB\}, \{IRN,KGZ,TJK\}, \{MNG\}, \{TJK\}

cluster in 2004: \{CHN,IND,KAZ,PAK,RUS,UZB\}, \{IRN\}, \{KGZ,TJK\}

cluster in 2005: \{CHN,IND,IRN,KAZ,KGZ,PAK,RUS,UZB\}, \{MNG\}, \{TJK\}
cluster in 2006: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}
cluster in 2007: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}
cluster in 2008: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}
cluster in 2009: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}
cluster in 2010: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}
cluster in 2011: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\} \{IRN\} \{TJK\}

Table 1 – statistical review of the series of clusters

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Analysis of 4 clusters since 1995 to 2011

cluster in 1995: \{KGZ\}, \{TJK, UZB\}, \{IRN\}, \{CHN, IND, KAZ, MNG, PAK, RUS, UZB\}
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cluster in 1997: \{CHN, IND, KAZ, PAK, RUS\}, \{IRN\}, \{MNG\}, \{KGZ, TJK, UZB\}
cluster in 1998: \{CHN, IND, KAZ, MNG, PAK, RUS\}, \{IRN\}, \{KGZ\}, \{TJK, UZB\}
cluster in 1999: \{CHN, IND, KAZ, PAK, RUS, UZB\}, \{IRN\}, \{KGZ, TJK\}, \{MNG\}
cluster in 2000: \{CHN, IND, KAZ, PAK, RUS\}, \{IRN\}, \{KGZ, TJK, UZB\}, \{MNG\}
cluster in 2001: \{CHN, IND, KAZ, PAK, RUS\}, \{IRN\}, \{KGZ, TJK, UZB\}, \{MNG\}
cluster in 2002: \{CHN, IND, MNG, RUS\}, \{IRN, KAZ\}, \{KGZ, PAK, UZB\}, \{TJK\}
cluster in 2003: \{CHN, IND, KAZ, KGZ, PAK, RUS, UZB\}, \{IRN\}, \{MNG\}, \{TJK\}
cluster in 2004: \{CHN, IND, KAZ, KGZ, PAK, RUS, UZB\}, \{IRN\}, \{MNG\}, \{TJK\}
cluster in 2005: \{CHN, IND, KAZ, KGZ, MNG, PAK, RUS, UZB\}, \{IRN\}, \{MNG\}, \{TJK\}
cluster in 2006: \{CHN, IND, KAZ, KGZ, PAK, RUS, UZB\}, \{IRN\}, \{MNG\}, \{TJK\}
cluster in 2007 {CHN,IND,KAZ,MNG,RUS,UZB},{IRN},{KGZ,PAK},{TJK}
cluster in 2008 {CHN,IND,KAZ,MNG,RUS,UZB},{IRN},{KGZ,PAK},{TJK}
cluster in 2009 {CHN,IND,KAZ,MNG,RUS,UZB},{IRN},{KGZ,PAK},{TJK}
cluster in 2010 {CHN,IND,KAZ,MNG,RUS,UZB},{IRN},{KGZ,PAK},{TJK}
cluster in 2011 {CHN,IND,KAZ,MNG,RUS,UZB},{IRN},{KGZ,PAK},{TJK}

Table 1 – statistical review of the series of clusters

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Conclusion
Optimal monetary zone formation increases trade exchanges between business partners due to the reduction of barriers to trade. Hence, this study investigated the feasibility of formation of successful monetary union between Iran and Shanghai Group countries by using fuzzy clustering algorithm. Results of data clustering were presented based on variables, separately for each cluster. Degree of attachment of countries to clusters was examined separately in the period studied. Finally, making conclusion on degree of attachment of countries to clusters and investigating the frequency of this attachment, result was presented by statistical examining of clusters to make decision. According to the results obtained, it can be claimed that there is no feasibility for successful monetary union formation between Iran and Shanghai group. Given type of clustering, this problem extends to long term.
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