

The Impact of Sanction on Bilateral Intra-Industry Trade between Iran and SCO Countries

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Abstract

This paper analyses the impact of sanctions against Iran in addition to other country-specific determinants on intra-industry trade between Iran and Shanghai Cooperation Organization (SCO) countries over the period 1997-2013. By disentangling total intra-industry trade (IIT) into horizontal and vertical IIT and after investigating bilateral trade pattern between Iran and SCO countries, determinants of IIT, horizontal IIT and vertical IIT are assessed using fixed effect panel data. Using panel data model, two main findings are released. First, trade barriers indicators and difference in factor endowments are crucial in determining of IIT indicators. Second, sanction index does not have significant impact on IIT measures.

Keywords: Intra-Industry Trade (IIT), Horizontal and Vertical IIT, Shanghai Cooperation Organization, Sanction.

JEL Classification: F12, F14, F15.

1. Introduction

The history of sanctions against Iran -started by U.S.- dates as far back as 1979. Over the years, the U.S. government has approved and tightened sanctions. In 2010, the United Nations and the European Union, and other countries around the world also have sanctions against Iran. If we exclude a variety of reasons that why sanctions have been charged against Iran, they established multidimensional sanctions mainly on restricting dealings in the energy sector, prohibiting the international transfer of funds, freezing the assets and restricting Iran of joining to international economic organization. So, sanctions can be considered as a kind of trade barrier that unlike usual

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barriers it is enforced by outside of the country. Although, the influence of trade barrier on intra-industry trade (IIT), vertical IIT (VIIT) and horizontal IIT (HIIT) is paid attention by researchers (Falvey 1981, Balassa 1986, Brulhart 2009), no study is done to examine the significance of sanctions as a special trade barrier on IIT measures. Hence, this paper contributes to the literature by providing an econometric approach to evaluate the effect of sanctions on IIT. To achieve this target, we use bilateral trade between Iran and members of Shanghai Cooperation Organization (SCO) during 1997-2013. This organization is selected because it is possible for Iran to join as a full membership in it after Iran, the P5+1 (China, France, Germany, Russia, the United Kingdom, and the United States), and the European Union reached Joint Comprehensive Plan of Action (JCPOA) in July, 2015. However, since trade data between Iran and Tajikistan during the selected period was not available, we exclude it from the sample.

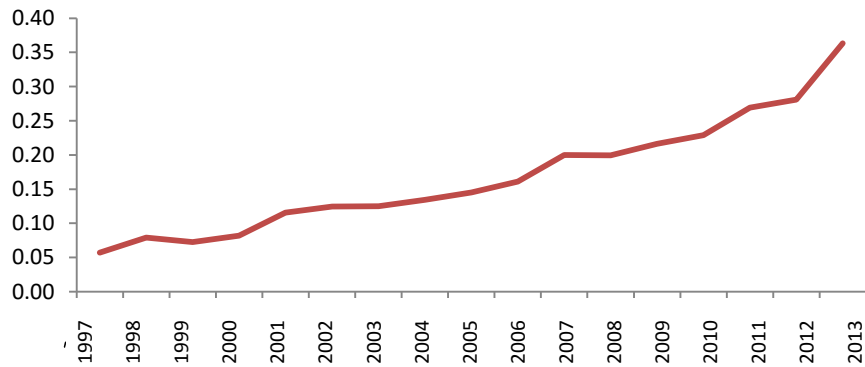
The rest of the paper is organized as follows. The next Section contains the general trade between Iran and SCO countries; Section 3 describes different hypotheses on determinants of IIT measures according to the literature as well as hypothesis on the impact of sanctions on IIT measures; Section 4 explains computing IIT, HIIT, VIIT and the specification of the regression model used to identify the determinants; Section 5 presents the IIT measures pattern between Iran and SCO countries along with empirical results and Section 6 concludes the paper.

2. Iran-SCO Bilateral Trade

SCO as a political, economic and military organization was founded in 2001 in Shanghai. The full members of this organization are China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, and Uzbekistan. The share of trade between Iran and SCO as a percentage of total trade between Iran and the world is represented in Figure 1. In addition, the ratio of trade between Iran and each SCO country to total trade between Iran and SCO is shown in Figure 2. According to Figure 1, trade between Iran and SCO is increased from 5% in 1997 to above 35% in 2013. As it is depicted, the rising trend before 2012 was smooth but after that it dramatically increased. As reported by Figure 2, while the share of trade between Iran and China determined absolutely to be the

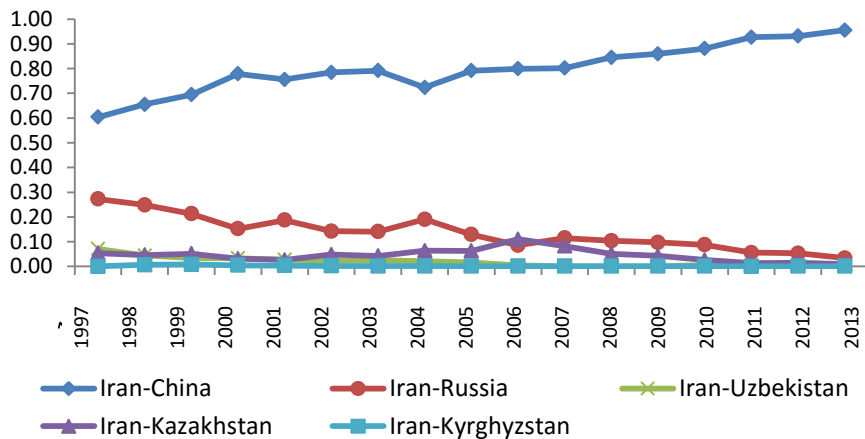
maximum among SCO countries, the trade between Iran and other members of SCO is so meaningless. Iran-China bilateral trade continuously increased from 60% in 1997 to about 90% in relation to total trade between Iran and other SCO countries. Although trade with Russia was assigned to be about less than 30% in 1997, it decreased continuously to 3% in 2013. Therefore, it can be concluded that the ascending trend observed in Figure 1 is totally belong to growing share of trade between Iran and China.

Figure 1: Ratio of Total Trade between Iran and SCO to Total Trade between Iran and the World



Source: Author calculation based on UN Comtrade database

Figure 2: Ratio of Total Trade between Iran and each SCO Country to Total Trade between Iran and SCO



Source: Author calculation based on UN Comtrade Database

3. Hypotheses on IIT Determinants

3.1 Traditional Hypotheses

The start of IIT literature dates back 1960s by researches implemented by of Verdoorn (1960), Balassa (1966). They evidenced that certain developed countries exported and imported products in the same product categories. This subject received more attention when Grubel & Lloyd (1975) introduced an index to measure IIT. According to this evidence, HO model could not explain some part of trade between countries especially among trade partners with similar endowment. This incapability of traditional international trade theories to explain new evidence, caused emergence of new trade theories due to Krugman (1979), Lancaster (1980), Helpman (1981), Eaton & Kierzkowski (1984), Falvey (1981), Falvey & Kierzkowski (1987), Flam & Helpman (1987). As stated in different models, the products are horizontally differentiated when different varieties of a product are of a similar quality and the products are vertical differentiated when different varieties are of different qualities. Through a variety of models, different predictors are defined to explain IIT, HIIT and VIIT.

Following the literature, the closer trading partners in terms of their relative economic size have greater intra industry trade. To control for relative size effects, two variables MinGDP and MaxGDP are included in the model (Hummels & Levinsohn 1995). MinGDP is a measure of the lower value of GDP between Iran and its trade partner, whereas MaxGDP represents the higher value in each such case.

Hypothesis 1: There is a positive (negative) relationship between MinGDP (MaxGDP) and IIT, HIIT and VIIT.

Following Helpman (1987), Helpman and Krugman (1985) and Greenaway, Hine et al. (1994), absolute difference in GDP per capita (DPGDP) between two partners is a proxy that can be used to explain relative factor endowments differences between countries. Although DPGDP is introduced by Linder (1961) as an indicator of country preferences, the final relationship between DPGDP and IIT is similar. According to different empirical results, while most of them obtained negative relationship between DPGDP and IIT and HIIT, there is no consensus in regard to the sign between DPGDP and VIIT (Pittiglio 2012).

Hypothesis 2: There is a negative (positive) relationship between

DPGDP and IIT, HIIT, (VIIT).

Falvey (1981) shows outward oriented countries with low trade barriers will have greater amounts of IIT. Trade orientation (TO) is proxied by the residuals from a regression of per capita trade on per capita GDP and population (Balassa 1986; Balassa & Bauwens 1987; Stone & Lee 1995). Also, Trade openness (OPEN) shows degree of trade barriers and indicates higher volumes of trade which in turn result in higher IIT (Brulhart 2009).

Hypothesis 3: There is a positive relationship between TO/OPEN and IIT, HIIT, VIIT.

The geographical distance between the capitals (DIST) is an indicative of transportation and transaction costs. By closing two partners geographically to each other, firstly the information costs needed to trade differentiated goods will be low stimulating to trade this type of products and secondly demand structure of two close partners is similar due to cultural proximity that again increases share of IIT in total trade (Krugman 1979, Balassa & Bauwens 1987, Zhang, van Witteloostuijn et al. 2005). Hence, we expect to have negative relationship between DIST and IIT. Beside, since the products involved in HIIT are more easily substitutable than the products subject to VIIT we expect that HIIT is more sensitive to DIST than VIIT.

Hypothesis 4: There is a negative association between DIST and IIT, HIIT, VIIT.

The average GDP between Iran and its SCO trading partners is used as a proxy for the overall economic dimension and a positive sign is expected for all IIT measures (Greenaway, Hine et al. 1994).

Hypothesis 5: There is a positive relationship between AGDP and all IIT measures.

3.2 Hypothesis on Sanction Effect

Generally, sanctions against Iran pushed the government to find new customers to sell oil and offer discounts to maintain previous or new customers, and finally because of financial sanctions i.e. prevent to transfer oil income, it must enter into barter arrangements or conduct transactions in terms of local currencies which reduces the range of imports that Iran can get from trading partners. So, it is expected that

sanctions result in negative impact on total trade and hence IIT by rising severity of sanctions. Also, if we suppose that the target of decreasing national income is achieved then we can expect that by growing sanctions severity, the government allocates foreign reserves to import goods with different quality. Therefore, there would be a negative (positive) relationship between sanctions and HIIT (VIIT). To measure extent of the sanctions severity on Iran, we employ four variables related to the international trade behavior. Firstly, to capture the effect of limitation on selling oil we make use of total export of oil barrels (OIL). Secondly, to take the effect of financial sanction, we utilize three variables foreign ratio of domestic investment on GDP (FDI), trade openness (OPEN) and total external trade (EXT). Then, in order to observe the effect of sanction as one variable on IIT measures and to do not lose model's degree of freedom, we select first principle component of the four defined variables and call it SAN.

Hypothesis 6: There is a negative (positive) relationship between SAN and IIT and HIIT (VIIT).

Table 1: Eigenvalues and Eigenvectors of Different Components of Sanction Variables

	PC1 (SAN)	PC2	PC3	PC4
Eigenvalues	2.27	1.36	0.19	0.15
% of variance	0.56	0.34	0.04	0.03
Cumulative %	0.57	0.91	0.96	1.00
Variable	Vector 1	Vector 2	Vector 3	Vector 4
FDI	0.34	0.69	0.63	0.01
EXT	0.60	-0.25	-0.04	-0.76
OPEN	0.58	0.29	-0.64	0.40
OIL	0.42	-0.61	0.43	0.52

Notes: FDI = Foreign Domestic Investment/GDP; EXT = Total External Debt; OPEN= Trade/GDP; OIL= total export of oil barrels

4. Methodology

4.1 Measurement of Intra-Industry Trade

One of the main approaches that is utilized in the IIT literature to disentangle vertical and horizontal IIT is what proposed by Greenaway, Hine et al. (1994). According to this method, Grubel-

Lloyd (GL) index decompose into vertical and horizontal IIT using unit values of exports and imports. Although a huge number of researches employ this method, it is faced by some critics. Arbitrary choice of the threshold ratio of unit values of exports, imperfect indicator of quality by using price and inflated VIIT are among criticizes presented (Azhar & Elliott 2006; Zhang & Clark 2009). Hence, the present study uses the methodology of Kandogan (2003) for separating IIT into its components. In this methodology, HIIT is defined as the overlapping trade in a broad industry category that consists of two-way trade within narrowly defined industries. VIIT is the balanced trade within a broadly defined industry-class that comprises exports and imports across narrowly defined industries (Bergstrand & Egger 2006). HIIT and VIIT sum up to overall IIT. The methodology of Kandogan (2003) is summarized as follows:

$$TT_i = X_i + M_i \quad (1)$$

$$IIT_i = TT_i - |X_i - M_i| \quad (2)$$

$$HIIT_i = \sum_p (X_{ip} + M_{ip} - |X_{ip} - M_{ip}|) \quad (3)$$

$$VIIT_i = IIT_i - HIIT_i \quad (4)$$

Since this approach calculates IIT, HIIT and VIIT in levels and not the corresponding shares in total trade, we employ normalized aggregated indices of the different measures as follows (Thorpe & Leitao 2013):

$$IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}, HIIT_i = 1 - \frac{|\sum_p (X_{ip} - M_{ip})|}{\sum_p (X_{ip} + M_{ip})}, VIIT_i = IIT_i - HIIT_i \quad (5)$$

Finally to get aggregate indexes for each year, we multiply computed IIT_i , $HIIT_i$ and $VIIT_i$ for each industry to their trade value share as follows:

$$\begin{aligned}
IIT &= \sum_{i=0}^9 w_i * IIT_i, \quad HIIT = \sum_{i=0}^9 w_i * HIIT_i, \quad VIIT \\
&= IIT - HIIT
\end{aligned} \quad (6)$$

$$\text{where } w_i = \frac{X_i + M_i}{\sum_{i=0}^9 X_i + M_i}$$

4.2 Data and Model Specification

The analysis of the determinants of IIT as well as its components (HIIT and VIIT) is undertaken using a panel approach. The model specifications considered were pooled OLS, fixed effects (FE) and random effects (RE) estimators.

$$\begin{aligned}
IIT_{it} &= \alpha_0 + \alpha_1 \text{LogMinGDP}_{it} + \alpha_2 \text{LogMaxGDP}_{it} + \alpha_3 \text{LogDPGDP}_{it} \\
&\quad + \alpha_4 \text{TO}_{it} + \alpha_5 \text{LogOPEN}_{it} + \alpha_6 \text{LogDIST}_{it} \\
&\quad + \alpha_7 \text{LogAGDP}_{it} + \alpha_8 \text{SAN}_{it} + \eta_i + \delta_t \\
&\quad + \varepsilon_{it}
\end{aligned} \quad (7)$$

where dependent variable is Iran's total, horizontal or vertical IIT index (IIT, HIIT or VIIT) with partner country i in year t . Also η_i , δ_t and ε_{it} are unobserved time-invariant specific effects, a common deterministic trend and a random disturbance assumed to be normal, and identical distributed ($E(\varepsilon_{it}) = 0, \text{Var}(\varepsilon_{it}) = \sigma^2 > 0$) respectively.

Since the dependent variable contains value between 0 and 1, normality assumption of error term will be violated. Although, one method to correct this problem is using logistic transformation, it is incapable to solve the problem when dependent variable value is equal to 0. Hence, a Box-Cox transformation by Yoshida (2008) is implemented that has the following form (Yoshida, Carlos Leitao et al. 2009).

$$\text{BC} = \frac{\left(\frac{Y}{1-Y}\right)^\lambda - 1}{\lambda} \quad \lambda \in (0,1] \quad (8)$$

Table 2 briefly summarizes predictions regarding the determinants analyzed in present paper.

Table 2: Expected Determinants

Variable	Expected effect on		
	IIT	HIIT	VIIT
MinGDP	+	+	+
MaxGDP	-	-	-
DPGDP	-	-	+/-
TO	+	+	+
OPEN	+	+	+
DIST	-	-	-
AGDP	+	+	+
SAN	-	-	+

The calculation of the IIT measures was based on data from COMTRADE database published by The United Nations Statistics Division (2003). Data on GDP, per capita GDP, Foreign direct investment and openness were obtained from the World Bank's World Development Indicators. The remaining variables are obtained from Central Bank of Iran and OPEC annual statistical bulletin 2014.

5. Results

5.1 IIT Pattern between Iran and SCO

The bilateral IIT, HIIT and VIIT indexes between Iran and the 5 SCO economies over the period 1997-2013 are reported in Table 3. The average of IIT indicates ranging from as low as 15 percent (China) to as high as 36 percent (Kyrgyzstan). While, based on Figure 2, China is the main trade partner with Iran among SCO countries, average index of IIT equal to 15 percent reveals that the major part of trade between Iran and China belongs to inter-industry trade. Moreover, average of HIIT and VIIT indicates that significant share of IIT between Iran and China attribute to VIIT. On the other hand, the average IIT, HIIT and VIIT between Iran and other SCO countries disclose that trade pattern between these are so similar, generally. Except for Kazakhstan in which share of HIIT and VIIT are roughly close to each other, average HIIT dominates VIIT.

Trade patterns of each SCO country with Iran over the time –the corresponding Figures are presented in Appendix- illustrate some interesting points. In regard to Iran-China trade, other than 1997 which IIT was equal to 46 percent, for other years until 2013 it

fluctuated smoothly around 10%. Besides, the trend of HIIT and VIIT points out that except for one year i.e. 1998 sizable ratio of IIT belongs to VIIT. Respecting to bilateral trade between Iran-Russia, although average IIT shows the extent of 32% for all the selected period, some years such as 1999, 1997 and 2006 disclose extent of 75%, 57% and 50% respectively. Other than these three years, IIT index range varies around 25%. Except for 2006, 2011 and 2013, HIIT and VIIT amounts explain that VIIT share dominated by HIIT. About Iran-Kazakhstan trade, only for 2001 and 2003, major part of trade was intra-industry trade which the extent of IIT was 63% and 61% respectively. Also, the trend shows after 2009, significant section of trade was inter-industry trade. Additionally, as simple average of HIIT and VIIT between Iran-Kazakhstan indicates, trend of these two IIT components were close to each other. Concerning to Iran-Kyrgyzstan trade pattern, while IIT extent was increasing from 11% to 68% over the period 1998-2004, it dropped sharply and reached to 5% in 2011 and then again sharply returned and passed highest record and reached to 71% in 2012 which the significant part was belong to HIIT. In relation to Iran-Uzbekistan trade style, if we ignore the years that there was no trade data, then the extent of IIT shows a decreasing trend.

Finally, investigation of trade shape between Iran and selected SCO countries explain that while for China, Russia and Uzbekistan, IIT index decreased firstly and then move with a light fluctuation, trade shape between Iran and Kazakhstan and Kyrgyzstan roughly started an increasing IIT and then continue with a high variation. Furthermore, since significant part of trade between Iran and SCO countries belong to trade between Iran and China, it is possible to conclude that trade pattern between Iran and SCO can be explained by trade pattern between Iran and China. Hence, firstly most part of Iran-SCO trade belongs to inter-industry trade and secondly in regard to the small share of IIT in comparison to total trade, VIIT forms the significant part of IIT.

5.2 IIT Determinants between Iran and SCO

The results of the specified model (7) are presented in Table 4. As the Table shows it is included of three specifications in which only their dependent variables are not the same. Based on the results of different

estimations of a panel data model, fixed effects model was selected and reported based on Hausman test and significance of individual effects.

Table 3: Overall Intra-Industry Trade Index between Iran and each SCO Country

Year	China			Russia			Kazakhstan			Kyrgyzstan			Uzbekistan		
	IIT	HIIT	VIIT	IIT	HIIT	VIIT	IIT	HIIT	VIIT	IIT	HIIT	VIIT	IIT	HIIT	VIIT
Average (simple)	0.15	0.04	0.11	0.32	0.21	0.11	0.20	0.09	0.11	0.36	0.22	0.14	0.33	0.23	0.10
1997	0.46	0.20	0.26	0.57	0.50	0.07	0.25	0.16	0.09	-	-	-	0.93	0.33	0.60
1998	0.08	0.07	0.01	0.05	0.03	0.01	0.07	0.07	0.00	0.11	0.09	0.02	0.43	0.43	0.00
1999	0.16	0.06	0.10	0.75	0.74	0.01	0.08	0.04	0.04	0.47	0.41	0.06	0.48	0.48	0.00
2000	0.13	0.05	0.08	0.35	0.17	0.17	0.37	0.16	0.21	0.48	0.14	0.34	0.03	0.03	0.00
2001	0.15	0.02	0.13	0.07	0.06	0.01	0.63	0.35	0.28	0.45	0.23	0.22	0.21	0.05	0.16
2002	0.05	0.01	0.04	0.33	0.30	0.03	0.41	0.16	0.25	0.19	0.15	0.04	0.14	0.11	0.04
2003	0.14	0.02	0.12	0.37	0.32	0.05	0.61	0.22	0.39	0.60	0.37	0.23	0.23	0.12	0.11
2004	0.13	0.05	0.08	0.42	0.26	0.16	0.07	0.05	0.02	0.68	0.08	0.60	0.17	0.09	0.08
2005	0.19	0.04	0.16	0.30	0.22	0.08	0.16	0.06	0.10	0.38	0.18	0.19	0.16	0.08	0.08
2006	0.14	0.04	0.10	0.50	0.07	0.43	0.09	0.02	0.07	0.50	0.28	0.23	-	-	-
2007	0.16	0.04	0.12	0.21	0.15	0.06	0.26	0.05	0.21	0.20	0.13	0.08	-	-	-
2008	0.11	0.02	0.09	0.20	0.15	0.04	0.16	0.14	0.02	0.13	0.05	0.08	-	-	-
2009	0.15	0.02	0.13	0.12	0.08	0.05	0.01	0.01	0.01	0.18	0.13	0.05	-	-	-
2010	0.08	0.02	0.07	0.20	0.11	0.09	0.01	0.00	0.01	0.14	0.12	0.02	0.20	0.18	0.02
2011	0.12	0.02	0.10	0.46	0.18	0.28	0.09	0.03	0.05	0.05	0.05	0.00	0.64	0.61	0.03
2012	0.14	0.03	0.12	0.28	0.16	0.13	0.05	0.01	0.04	0.71	0.67	0.04	-	-	-
2013	0.11	0.02	0.09	0.25	0.07	0.18	0.05	0.01	0.04	0.45	0.45	0.00	-	-	-

Source: Authors' calculations using trade data from the UN Comtrade Database

Table 4: IIT, HIIT, VIIT Determinants

Variables	IIT	HIIT	VIIT
MinGDP	-4.251 (3.077)	-1.300 (1.227)	-3.052 (2.191)
MaxGDP	-7.397 (4.600)	-3.302 (2.257)	-4.954* (2.633)
DPGDP	-0.832** (0.304)	-0.410* (0.237)	-0.723** (0.260)
TO	-3.578** (1.776)	-3.454** (1.443)	-0.382 (1.130)
OPEN	3.229** (1.313)	2.872*** (0.555)	0.359 (0.435)
DIST	-1.734 (2.675)	-1.255 (2.179)	-3.414* (1.927)
AGDP	13.94 (9.758)	4.990 (4.347)	9.983* (6.265)
SAN	-0.0433 (0.165)	-0.0386 (0.0377)	0.129 (0.180)
Constant	214.3 (138.6)	86.50 (66.22)	168.1 (90.07)
Observations	80	80	80
Number of country	5	5	5

Robust standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1

The empirical results indicate 1) the signs of all the explanatory variables except for MinGDP and TO, are consistent with the hypotheses; 2) in significant point of view, the coefficients of three variables i.e. DPGDP, TO and OPEN are significant disregard to HIIT and IIT as dependent variables; 3) by considering VIIT as dependent variable, four variables MaxGDP, DPGDP, DIST and AGDP are significant at least at 10% level; 4) the common significant determinant among three specification is DPGDP that explain difference in factor endowment has important role in demonstrating of IIT measures; 5) the coefficients of SAN variable which is applied as a proxy of sanctions severity against Iran, imply that firstly in sign point of view it is in accord with our hypothesis and secondly in significant point of view, it is not a main determinant of IIT measures; 6) among significant independent variables, trade barriers indicators i.e. TO and OPEN when IIT/HIIT are used as dependent variable and AGDP when VIIT is employed as dependent variable are the main determinants among all.

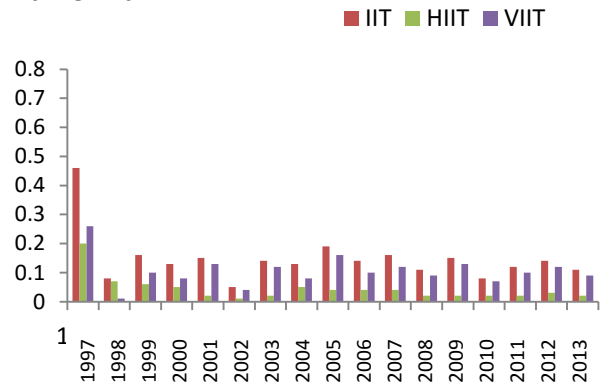
6. Conclusion

In this paper, we provided a general review of the trade between Iran and 5 selected SCO countries, i.e. China, Russia, Kazakhstan, Kyrgyzstan and Uzbekistan. Generally, trade between Iran and China considerably dominates trade between Iran and other SCO countries. Then, to measure intra-industry trade, we employed Kandogan method due to shortcoming of current measures. IIT measures indicate that firstly significant share of trade between Iran and SCO countries belong to inter-industry trade that can be explained by traditional trade theories and secondly IIT is found to be dominated by vertical rather than horizontal IIT. However to explain the determinants of IIT measures, we employed a model that covers the time period of 1997 to 2013 which included common variables along with a new variable that is called severity of sanctions against Iran (SAN). In part of econometric methodology with panel data, we used fixed-effects estimation with Box-Cox transformed dependent variables. In regard to the obtained results, while totally support the hypotheses of this study, the main IIT/HIIT and VIIT determinants are trade barriers indicators i.e. TO and OPEN and AGDP respectively. Moreover, the

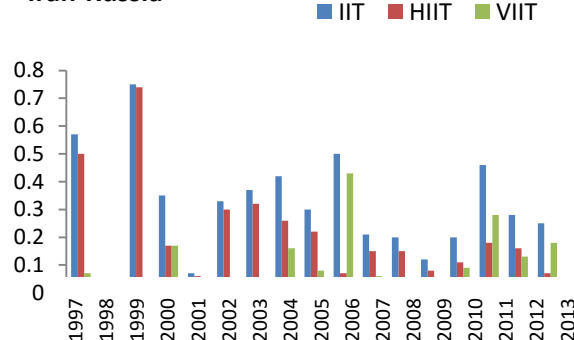
results indicate difference in factor endowments play a common role in explaining of bilateral IIT measures between Iran and SCO countries. An interesting conclusion is that although the sign of sanctions' severity index is consistent with the hypothesis explained in the study, its coefficient reveals that it is not significant. The insignificance of sanctions against Iran can be attributed to Iran's foreign reserve that is collected from oil and gas revenue in the last ten years in which can be examined in later researches. Finally, to have a better finding of international trade pattern of a country such as Iran that has been suffered from significant sanctions, it would be interesting to assess industry-level determinants of IIT measures especially industries that have been target of sanctions.

Appendices

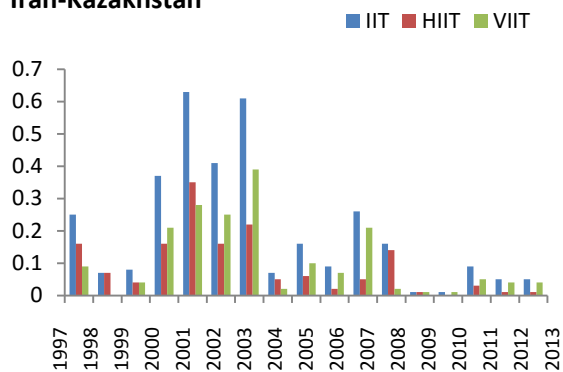
Iran-China



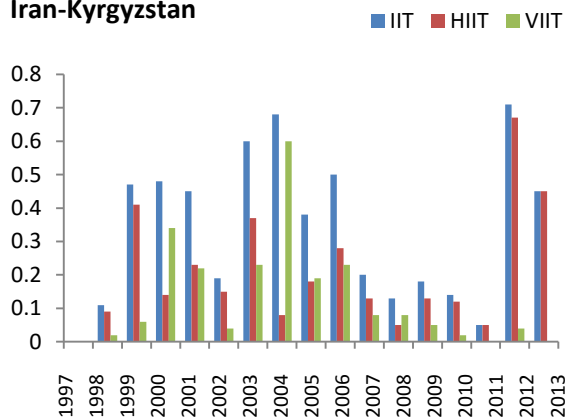
Iran-Russia



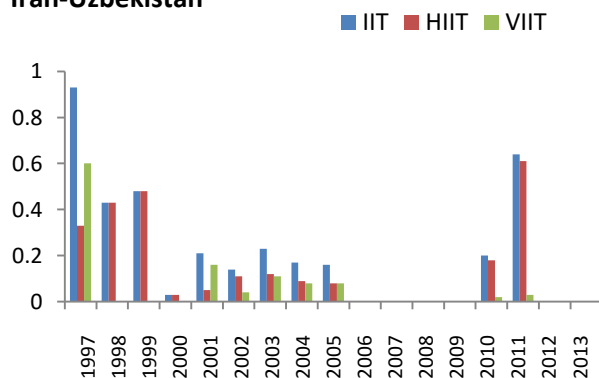
Iran-Kazakhstan



Iran-Kyrgyzstan



Iran-Uzbekistan



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