

Full Length Research Paper

Intra-industry trade in the agriculture sector: The experience of United States

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This study analyses the determinants of United State's intra-industry trade (IIT) applied to the agriculture sector. The results indicate that IIT in this sector is a negative role of the difference in GDP per capita between U S. and its trade partners. This is according to the literature; that is, countries with similar demands will trade similar products. Statistically strong evidence is also found that this trade is influenced by the economic dimension between trading partners. The foreign direct investment inflows have a positive influence on U.S. bilateral IIT.

Key words: Intra-industry trade, United States, agriculture sector, panel data.

INTRODUCTION

This manuscript examines the agriculture intra-industry trade (IIT) of United States with trade partner of NAFTA, European Union and ASEAN over the period 1995-2008, using a panel data analysis. In the twentieth century emerged numerous studies about phenomenon of intra-industry trade. Balassa (1966) demonstrated that there is possible explain the simultaneous imports and exports within the same industry in both trade partners. This contribution was important because until then trade was explained based on the theories of comparative advantage (Heckscher-Ohlin). Our study try to examine the determinants of United States intra-industry trade applied to the agriculture sector for the recent period (1995-2008). This paper contributes to the literature on the intra-industry trade (IIT) in three ways.

Firstly, and from theoretical point of view, it means a steep forward in the discussion of the validity of Cournot style model. Secondly, at the empirical level, it contributes to the discussion of the development of agriculture. Thirdly, understanding the main features of agriculture intra-industry trade developed in United States. The results provide evidence that could be used to better sector performance. Our Study is also important because there are few studies that analyze IIT in agriculture (Qasmi and Fausti 2001; Kim et al., 2003; Clark et al.,

2001).

INTRA-INDUSTRY TRADE AND EMPIRICAL STUDIES

The IIT literature began in the 1960s, when Balassa (1966) pointed out that most of the growth in manufacturing followed the formation of a customs union in Europe. The first theoretical models of IIT were synthesized in Helpman and Krugman's model, which is a Chamberlin-Heckscher-Ohlin model. This is a model that combines monopolistic competition with the Heckscher-Ohlin (HO) theory, incorporating factor endowments differences, horizontal product differentiation and increasing returns to scale.

The intra-industry trade (IIT) or two-way trade is defined as simultaneous exports and imports of a product within country or a particular industry. Following Cournot style (Helpman, 1987; Helpman and Krugman, 1985), we consider two countries (home and foreign), and two goods (X and Y). The good X is intensive in capital (K), and Y in labour (L). The home country is relatively abundant in K, and the host country in L. Heckscher-Ohlin factors explains inter-industry specialization, while economies of scale and horizontal product differentiation

explain IIT.

Product demand

$$p = a - bQ \quad (1)$$

$$Q = nq + n^* q^* \quad (2)$$

The utility is represented as:

$$U = U[u_1(\cdot), \dots, u_i(\cdot)]nq \quad (3)$$

Which the consumers have identical, and homothetic preferences in within countries. Then the Grubel and Lloyd (1975) index (the IIT) is given by:

$$IIT = \frac{1 - \left| \frac{nq - n^* q^*}{nq + n^* q^*} \right|}{1} \quad (4)$$

The IIT index as given by (4) depends on the relative factor endowments and other country characteristics. Therefore, we can test the hypothesis that the larger the difference in factor endowments, the less will be the share of intra-industry trade (IIT).

Pelzman (1977), McCorrison and Sheldon (1991), Hirschberg et al. (1994), Neff et al. (1996) Qasmi and Fausti, (2001), and Sharma, (2002) are some examples of empirical studies that analyze the intra-industry applied to the agricultural sector. It should be noted that most studies of intra-industry trade (IIT) exclude the agriculture sector. Pelzman (1977) was the first to investigate the question of intra-industry trade among centrally planned economies. More recently Bojnec (2001) studied this type of trade for Central and Eastern European countries (CEECs). McCorrison and Sheldon (1991) conducted a study on IIT for U.S agricultural products. The authors found that U.S and world trade in processed agricultural products was essentially of the inter-industry type. For EC trade, McCorrison and Sheldon (1991) concluded that this trade was also essentially of the IIT type. Sharma (2002) concluded that product differentiation and scale economies contribute positively to IIT, and trade protection discourages IIT.

The studies of Sharma (2002) and Qasmi and Fausti (2001) show that inter-industry trade predominant in this sector. Fertő (2005) studied the relationship between factor endowments and IIT in agri-food products traded between Hungary and the EU. Fertő (2007) investigated the horizontal and vertical intra-industry trade in agri-food products between Hungary and EU. The results show that vertical intra-industry trade predominates. The study demonstrates that the agri-food products are explained by different types of quality (vertical intra-industry trade).

Leitão and Faustino (2008) analyses the determinants of intra-industry trade in the Portuguese food processing sector. The results of Leitão and Faustino (2008) indicate that IIT is explained by difference in GDP per capita, geographical distance, industrial concentration and foreign direct investment. Wang Jing (2009 a) analyses the IIT on agricultural products of china. The study demonstrates that IIT is low in this sector.

The study of Wang Jing (2009b) showed that differences in GDP per capita are positively correlation to the level of IIT, factor endowments presents a positive relationship with IIT, and geographical distance has a negative coefficient. Yercan and Isikli (2009) demonstrated the importance of Turkish horticultural products. Turkey has comparative advantage in horticultural products. Teweldemedhin and Schalkwyk (2010) analyse the international trade of agriculture sector in South African. The authors applied a OLS estimator to evaluate the determinants of intra-industry trade. Teweldemedhin and Schalkwyk (2010) concluded that trade liberalisation and trade agreements promotes the specialisation and competitiveness.

DEVELOPMENT OF HPYPOTHESIS

Hypothesis 1: There is a negative sign between differences in income per capita and bilateral trade.

Loertscher and Wolter (1980) suggest a negative sign for the IIT model. Linder (1961) considers that countries with similar demands will trade similar products. Greenaway et al. (1994), and Hummels and Levinshon (1995) also found a negative sign.

Hypothesis 2: The larger economic dimension (average of GDP) increases bilateral trade.

The hypothesis 2 is supported in Egger (2005) and Gross and Helpman (2005), that is, economies of scale, and product differentiation. The study of Fertő (2009) found a positive correlation.

Hypothesis 3: There is a positive correlation between foreign direct investment and IIT.

The relationship between IIT and the level of FDI is somewhat ambiguous since FDI may be a substitute for the trade. Gray (1988) considers an ambiguous relationship between FDI and IIT. Greenaway et al. (1994) estimated a positive sign for the coefficient of this variable.

Hypothesis 4: There is a negative relationship between trade imbalance and IIT.

The trade imbalance is a control variable. According to empirical model (Lee and Lee, 1993) a negative sign is

Table 1. The determinants of intra-industry trade: Fixed effects estimator.

| Variables | Fixed effects | t-Statistics | Significance |
|------------------|---------------|--------------|--------------|
| LogDGDP | -8.958 | (-2.77) | *** |
| LogDIM | 9.445 | (2.73) | *** |
| LogFDI | 2.645 | (2.59) | *** |
| LogTIMB | -0.121 | (-2.75) | *** |
| $\overline{R^2}$ | 0.862 | | |
| Observations | 252 | | |

T-statistics (heteroskedasticity corrected) are in round brackets.
 ***- statistically significant, respectively at the 1%, level.

expected. Wang Jing (2009b) and Leitão and Faustino (2008) found a negative sign.

METHODOLOGY AND RESEARCH DESIGN

The present study uses the index of Grubel and Lloyd (1975) as dependent variable. Grubel and Lloyd (1975) define IIT as the difference between the trade balance of industry i and the total trade of this same industry. In order to make comparisons easier between industries or countries, the index is presented as a ratio, where the denominator is total trade.

$$IIT_{it} = 1 - \frac{|X_i - M_i|}{(X_i + M_i)}$$

$$\Leftrightarrow IIT_{it} = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \tag{5}$$

The data for the explanatory variables is sourced from the World Bank Indicators, and the source used for the dependent variable is STAN bilateral trade database at the 5- digit industry level and covers a recent period of 1995-2008.

We use a panel data approach. In panel data, pooled OLS, fixed effects (FE) and random-effects (RE) estimators are used in this type of study. The RE estimator was excluded because our sample is not random. Furthermore, the Hausman test rejects the null hypothesis RE versus FE. We also introduced a dynamic panel data. The estimator used (GMM-SYS) estimator permits the researchers to solve the problems of serial correlation, heteroskedasticity and endogeneity of some explanatory variables. These econometric problems were resolved by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998, 2000), who developed the first- differenced GMM (GMM-DIF) estimator and the GMM system (GMM-SYS) estimator.

Explanatory variables

Economic differences between countries (DGDP): This is difference in GDP (PPP, incurent international dollars) between U.S and the partner country.

$$|GDP_{U.S.} - GDP_{partner}|$$

DIM: This is the average of GDP per capita between U.S and the

partner country.

$$\frac{1}{2}(GDP^{US} + GDP^{Partner})$$

FDI: This is foreign direct investment inflows

TIMB (Trade imbalance): Following Lee and Lee (1993) the study considers the trade imbalance as a control variable, where TIMB is defined as:

$$TIMB_j = \frac{|X_j - M_j|}{(X_j + M_j)}$$

This variable represents the net trade as a share of trade and takes a value of zero at the lower extreme if there is no trade imbalance and a value of one if there are neither exports nor imports.

MODEL ESTIMATION AND DISCUSSION OF RESULTS

$$IIT_{it} = \beta_0 + \beta_1 X_{it} + \delta + \eta_i + \epsilon_{it} \tag{6}$$

Where IIT_{it} is the intra-industry trade (IITit), X is a set of explanatory variables. All variables are in the logarithm form; η_i is the unobserved time-invariant specific effects;

δ captures a common deterministic trend; ϵ_{it} is a random disturbance assumed to be normal, and identical distributed (IID) with $E(\epsilon_{it})=0$; $Var(\epsilon_{it}) = \sigma^2 > 0$.

The model can be rewritten in the following dynamic representation:

$$IIT_{it} = IIT_{it-1} + \beta_1 X_{it} - \rho\beta_1 X_{it-1} + \delta + \eta_i + \epsilon_{it} \tag{7}$$

The fixed effects estimator is reported in Table 1. The explanatory power is very high (Adjusted R2=0.86). All

Table 2. The determinants of intra-industry trade: GMM-System estimator.

| Variables | GMM-SYS | t-Statistics | Significance |
|--------------|-----------------|--------------|--------------|
| LogIIT t-1 | 0.765 | (25.2) | **** |
| LogDGDP | -1.142 | (-1.81) | * |
| LogDIM | 1.440 | (1.89) | * |
| LogFDI | 0.766 | (5.61) | *** |
| LogTIMB | -0.302 | (-2.15) | ** |
| C | -2.611 | (-2.03) | ** |
| M1 | -1.059 | [0.290] | |
| M2 | 1.015 | [0.310] | |
| Sargan | 12.48 ; Df= 202 | [1.000] | |
| Observations | 234 | | |

T-statistics (heteroskedasticity corrected) are in round brackets. The null hypothesis that each coefficient is equal to zero is tested using second -step robust standard error. T-statistics (heteroskedasticity corrected) are in round brackets. ***indicates statistically significance, respectively at the 1% level. P-values are in square brackets. Year dummies are included in all specifications (this is equivalent to transforming the variables into deviations from time means, that is, the mean across the fourteen countries for each period). M1 and M2 are tests for first-order and second-order.

explanatory variables are significant (LogDGDP at 1%, LogDIM, LogFDI at 1% level, and LogTIMB). The economic differences between countries (LogDGDP) are statistically significant, with an expected negative sign. These results are according to previous studies (Helpman and Krugman, 1985). As expected, the variable economic dimension (LogDIM) has significant and positive effect on IIT. This result confirms the importance of economies scales and product differentiated. Foreign direct investments (LogFDI), the dominant paradigm predicts a positive sign. The result confirms a positive effect on the IIT. As expected, the variable trade imbalance (LogTIMB) has significant and negative effect on IIT (Lee and Lee 1993).

In Table 2 we can observe the determinants of IIT using GMM-system estimator. The model presents consistent estimates, with no serial correlation (m1, m2 statistics). The specification Sargan test show that there are no problems with the validity of instruments used. The GMM system estimator is consistent if there is no second-order serial correlation in the residuals (m² statistics). The dynamic panel data are valid. We used the criterion of Windmeijer (2005) to small sample correction. The IIT model presents all significant variables (LogIITt-1, LogDGDP, LogDIM, LogFDI, and LogTIMB). The instruments in levels used are LogIITt-1(3,6), LogDGDP (3,6), LogDIM (3,6), and LogFDI(3,6) for first differences. For levels equations, the instruments are used first differences all variables t-2. The results confirming the theoretical forecast proposed by the literature. Our results show that United States IIT is negatively correlated with factor endowment (LogDGDP), and trade imbalance (LogTIMB). We can conclude that trade partners have similar demands and preferences. Following Helpman and Krugman (1985) and Hummels and Levinsohn (1995), the study includes a proxy to

evaluate the relative size effects. A positive effect of economic size on bilateral IIT was expected and the results confirm this, underlining the importance of economies scale and product differentiation for all trade. The coefficient of foreign direct investment flows (LogFDI) is positive with significant. So we can conclude that FDI and IIT are complementary.

Conclusions

In recent years, there has been a significant growth of IIT literature as in the marginal intra-industry trade adjustment, the New Geography models, migration and fragmentation. Most studies of intra-industry trade exclude the agriculture sector. Empirical studies on IIT in this sector have been limited with some exceptions (Pelzman, 1977; McCorriston and Sheldon, 1991; Hirschberg et al., 1994; Neff et al., 1996; Qasmi and Fausti, 2001; Sharma, 2002).

The objective of this study was to analyze some of the determinants of agriculture IIT in United States. Comparing our findings with other empirical studies, we obtained similar results. Econometrics estimations support the hypothesis formulated. Our results are robust with static and dynamic panel data.

As our result show, IIT has a dynamic nature. To understand this phenomenon we applied a dynamic panel data and we compared the results with a static panel data. The lagged intra-industry trade variable presents an expected positive sign.

In view of the results, it would seem evident that the economic policy in U.S. towards developing IIT is an important factor. The economic difference between countries (LogDGDP) has been statistically significant. This result is in line with those obtained by Greenaway et

al. (1994), Loertscher and Wolter (1980) and Linder (1961). The economic size (LogDIM), which is a fundamental element of economies of scale, and product differentiated, is according to the literature. In addition to foreign direct investment (FDI) which reveals a positive impact on IIT. The trade imbalance (LogTIMB) is statistically significant with negative signs for different estimators (FE and GMM-SYS); this result is according to the previous literature (Lee 1993). This study has however some limitations. For future research, we need to introduce a dynamic analysis using Brühlhart (1994) marginal IIT index. We also need to consider the vertical IIT and horizontal IIT, because these different types of IIT have different determinants. The mythology by which to separate HIIT from VIIT is available (Abel-el-Rahaman, 1991; Greenway et al., 1994; Kandogan, 2003).

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