Exploring the Effects Trade Finance has on Intra-industry Trade

An Empirical Investigation

Jonathan Creem

University of Connecticut

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Abstract

In an effort to further the collective knowledge of intra-industry trade, I use two proxy variables that measure the amount of trade finance that a nation can provide, and I show that the weaker the combined financial strength between the United States and its partner will lower the potential for trade over-lap measured by the Grubel-Lloyd Index. My results have an impact on international economics in two ways. First, it reinforces the well-established empirical literature on the effects know variables have on the Grubel-Lloyd Index, and second, it extends the knowledge of how critical the financial strength of partner economies has on intra-industry trade.

1. Introduction

The following paper expands the understanding of intra-industry trade by providing one of the first observations of how the combined financial strength of the United States and its trading partner will affect the degree of trade overlap measured by the Grubel-Lloyd Index. Using well-established proxy variables that measure the amount of trade finance that a nation can provide, I show that the weaker the combined financial strength between the United States and its partner will lower the potential for intra-industry trade.[1] To my knowledge, no one has attempted to study how a nations ability to provide trade finance would affect intra-industry trade but, as I will elaborate momentarily, it is a meaningful topic to analyze given the undeniable and detrimental reaction world trade had during the Great Recession.

Two traditional theories on international trade identify factors unique to an individual country as the primary reason an exchange takes place. The first is the theory of comparative advantage proclaimed by the British political economist David Ricardo. In his theory, a nation should tailor its resources to the production of goods they make best compared to their trading partner [Ricardo (1817)]. The other traditional theory held in high regard is the Heckscher–Ohlin model of trade. Heckscher-Ohlin extend Ricardo's theory of comparative advantage by concluding that specialization will occur given the differences in a country's factor endowments [Samuelson (1948)].

The realities of international trade, however, have seen exchange patterns

[1] Intra-industry trade is defined as the simultaneous import and export of products that belong to the same statistical category.

move away from a system of producing only the goods determined by one's factor endowments to a system of trade overlap for the same items. Beginning in the 1960's with Verdoorn (1960), Balassa (1963), and Kojima (1964), economists started to notice that trading nations import and export goods categorically belonging to the same industry. The unexpectedness of this occurrence and its counterargument to traditional inter-industry trade is eloquently articulated in Kojima (1964) after discovering the rapid growth in trade between developed countries: "We need to uncover the force underlying this conspicuous trend and define any new philosophy that may have evolved which is contrary to the traditional comparative costs theory."[2] In essence, Kojima (1964) began to see evidence that the foundations of the conventional trade theory of Heckscher-Ohlin and Ricardo may not be as theoretically sound as previously thought.

2. Reviews of Literature

This paper adds to the well-documented literature of the determinants of intra-industry trade.[3] Beginning in the 1960's empirical analyses have be done to study the structure and economic factors that would explain why nations participate in intra-industry trade while testing some of the theories that have been developed.

The determinants that are often used in these studies are grouped into two categories. One group considers the country level determinants that effect intra-industry trade. These factors include macroeconomic variables such as a nation's

[2] See Kojima (1964), Page 36

[3] Andresen (2003) provides an in depth literature review of the most well know empirical studies on intra-industry trade. For documentation and a summary of the variety of theories supporting the empirical research see Tharakan (1981) and Davis (1995).

GDP which, for example Helpman (1987) and Hummels and Levinsohn (1995) used to test the effects a nation's relative economic size has on intra-industry trade, and a nation's GDP Per Capita which Balassa (1986) and Bergstrand (1990) use to test the theory that nations with similar levels of income will prefer similar products.

The other group considers industry level statistics such as the degree of Product Differentiation in an industry [Caves (1981) and Greenaway and Milner (1984)], and an industry's concentration ratio, which is used in Toh (1982) to test the theory that intra-industry trade will be greater in a market with monopolistic competition. A set of both country and industry level variables are tested in my study to compare and reinforce the previous literature.

There is, however, one seemingly obvious variable that has been neglected from being tested as a determinant and that is trade finance. Funding sources that allow firms to trade is a critical factor for determining access to the international market. Many studies such as [Schmidt–Eisenloher (2013), van der Veer (2010), and Wilner (2000)] look at these measures of trade finance but only on how they affect international trade in general.

Studies on intra-industry trade all have one other distinct feature that, unfortunately, contributes the lack of significant progress made to its understanding. Because the studies being done tend to examine data from a specific country or industry rather than intra-industry trade as a whole, attaining consistent conclusions about the broad nature of intra-industry trade are hard to develop.

I have focused the purpose of this study on developing the initial empirical framework for measuring the effects trade finance has on intra-industry trade as a

whole. The industry I have chosen to observe is the U.S. automobile industry from the years 1998 to 2011. As I will demonstrate in Section 4, the international market for automobiles and automobile parts rely heavily on a nation's ability to access funding sources to complete transactions [Bank of International Settlements (2014)]. It is therefore a worthy industry to derive relative conclusions on the effects trade finance has on intra-industry trade.

The rest of this paper proceeds as followed. Section 3 details the index we will use to observe intra-industry. Section 4 highlights the avenues that trade is financed, and how important an economy's financial system is to international trade. In Section 5, I review the determinants that will be tested in the model and the theories that support them. In Section 6 I introduce the estimation techniques and methodologies used in the model. Finally, in Section 7 I report the results of my model and in Section 8 provide concluding remarks.

3. Intra-Industry Trade

Intra-industry trade (IIT) is defined as the simultaneous import and export of products that belong to the same statistical category. Being in the same statistical category, however, does not necessarily mean the products being traded are identical. In accordance with the scope of this study, say for example an individual is comparing two motor vehicles, a Ford and a Mercedes Benz. Statistically, both cars have the same categorization but most would agree that the two products are far from equal. As I will explain, this type of product differentiation will be an underlying foundation that makes IIT possible.

Reference to IIT dates back to the 1930s with Ohlin (1933) but serious attempts to explain its occurrence has taken place in the 1960s, 1970s and 1980s. Dixit and Stiglitz (1977) introduced this notion of product differentiation while examining aspects of monopolistic competition. As a result, theory has segmented the study of IIT into two forms, Horizontal IIT and Vertical IIT. Horizontal IIT refers to the exchange of products that are similar in quality but have slightly different attributes. In reference to the motor vehicle example from above, trade between two luxury car brands, say for example Mercedes-Benz and Lexus, may be considered horizontal IIT because the cars are of the same quality. Vertical IIT refers to the trade of similar products that clearly differ in quality, such as the Ford versus Mercedes-Benz referenced before.

Models have been developed to help explain both varieties of IIT. First, Krugman (1979, 1980, 1981), Lancaster (1980), Helpman (1981), and Helpman and Krugmen (1985) developed a theory of horizontal IIT within the confines of monopolistic competition, focusing on the effects of the economies of scale, product differentiation, and "love of variety". Models by Falvey (1981) and Falvey and Kierzkowski (1987) looked to explain vertical IIT through the differences in factor endowments of a nation. Falvey and Kierzkowski (1987) conclude that higher quality products are produced in nations where capital is more abundant while lower-quality products are produced in more labor abundant nations. The resulting share of Vertical IIT will, therefore, increase as a nation's capital to labor ratio diverges.

The controversial nature of studying intra-industry trade is twofold. First is that much of the work being done to capture the causes and effects of IIT is largely empirical, and changes in the structure or the combination of variables being tested can cause variation in results. For example, it is documented in Andresen (2003) that studies focused primarily on country-level variables are relatively consistent in the results they produce, such as Helpman (1987) and Hummels and Levinsohn (1995) both finding the absolute value difference in GDP per capita of a nation to have a significant negative effect on the IIT. On the other hand, studies testing industry-level variables were found to have inconsistent results in both direction of effect and significance. Take, for example, the research done on how product differentiation at the industry level determines IIT. Toh (1982), using the Hufbauer (1970) Index to study product differentiation in United States manufacturing industries for the years 1970 and 1971, shows that product differentiation has a positive and significant effect on IIT, while Hughes (1993), using the proportion of non-manufacturing staff to total employment as a measure of product differentiation to study major OCED nations from 1980-1897, shows that the impact varies across countries.[4]

The other problem that plagues these empirical studies is that there has not been a singular method that can accurately test the broad scope of IIT. Due to the complexity of data generation, many papers focus their studies on either a specific

[4] The proportion of non-manufacturing staff (i.e. Advertisers, Designers, Engineers, etc.) to total employment is considered an indication of product differentiation because it is thought that these employees are the ones who are generally responsible for creating the variation.

industry or the trade of a specific country [Andresen (2003)]. With such a narrow range of observations, it is difficult to make general conclusions about IIT.

The other controversial aspect of IIT is that it essentially conflicts with the sound theory of comparative advantage that dominated the academic work on international trade dating back to David Ricardo. According to Ricardo's theory, intra-industry should not exist. The fact that a large volume of trade for a particular product exists between countries with similar factor endowments would seem to contradict claims that a nation's comparative advantage is the key to growing global output [Krugman and Obstfeld (1991)].

The realities of international trade, as shown by the data, instead illustrate a system driven by product differentiation and consumer preferences rather than factor endowments. I test variables that attempt to articulate the possible reasons why product differentiation and consumer preference has now become the driving force behind international trade.

3.1. Measuring Intra-Industry Trade

The first attempt at an empirical analysis of intra-industry trade, Balassa (1966), also provided a way to adequately measure the degree of trade overlap. Balassa fitted the combination of imports and exports that a country observes into an index that ranges from zero to one. In Balassa's model, zero represented trade that was completely intra-industry while a one indicated trade that was purely inter-industry.

As others attempted to utilized Balassa's index in their own studies, criticisms about the unappealing nature of assigning a value of zero to pure intra-

industry trade. Although correct in depicting the amount of trade over lap, this method frustrated researchers and an alternative index was created in Grubel and Lloyd (1975).

Grubel and Lloyd (1975) has since become the standard paper other empirical studies refer to when undertaking an analysis of intra-industry trade and their method of calculation is shown below:

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

where *i* refers to the commodity within the industry being studied, *X* represents the home country exporting abroad, and *M* represents the imports from the foreign country.[5]

As was the case with the Balassa index, the Grubel-Lloyd index measures the degree of trade overlap within an industry ranging from zero to one. Now, however, an industry is considered pure intra-industry with a value of one. To gain a better understanding of the index, consider the three scenarios depicted in Table 1.

[5] For the purposes of this study X_i represents US exports of commodity *i* to its trading partner, and M_i represents US imports of commodity *i* from its trading partner.

Table 1.

	US Luxury Car Export	US Luxury Car Import	Grubel-Lloyd Index
	X	**M**	**IIT**
Scenario 1	2	2	1
Scenario 2	0	2	0
Scenario 3	2	0	0

In this example, the United States is trading luxury cars with a foreign partner. X represents the amount of cars the US is exporting to its trading partner, M represents the amount of cars the US is importing from its trading partner, and IIT represents the Grubel-Lloyd value after the index is calculated in each scenario.

Scenario 1 portrays the situation in which both nations import and export the exact same amount of luxury cars. When this happens trade is considered pure intra-industry because the exchange within the commodity unit is balanced, rendering an index value of 1.

Scenario 2 considers the opposite situation. Here, the United States exports zero luxury cars to its trading partner but continues to import two units. The index has produced a calculation of zero because the exporting nation is not allotted any units of luxury cars in return.

Finally, Scenario 3 depicts an important aspect of the Grubel-Lloyd Index that should be noted. The index does not indicate which direction trade is flowing. One can simply reverse the flow of luxury cars, as I have done in Scenario 3, and the

index value will also be zero. The Grubel-Lloyd index is constructed to indicate the extent to which nations participate in trade of symmetric items. When the index is calculated to zero, trade between the two nations is considered to be between asymmetric items.

3.2 Shortfalls of the Grubel-Lloyd Index

Like the majority of empirical studies, this paper will consider a calculated Grubel-Lloyd Index as its dependent variable. The index, however, is not without its own certain flaws and criticisms.

The most prevailing imperfections in studying intra-industry trade are the discrepancies that arise from inconsistent aggregation in product classification and the issue of trade imbalances. An example where obvious misinterpretations of the Grubel-Lloyd Index can result from irrational categorization was made shortly after Grubel and Lloyd (1975) was published. Using the 3-digit Standard Industrial Trade Classification (STIC) system, Lipsey (1976) noted that canoes and 200,000 ton tankers are considered at the same level of aggregation in the "ships and boats" industry. Clearly, any reasonable analysis of intra-industry trade would need to consider these two items separate.

This sensitivity when defining the industry has lead many economists to question the integrity of the Grubel-Lloyd measurement [Finger (1975) and Rayment (1983)]. Lipsey (1976) goes as far as saying that intra-industry trade may simply be a "statistical phenomenon".

Indeed, in order to ensure robust measurements, much care is needed when defining the industry of interest. Sawyer and Sprinkle (2012) note that higher levels

of aggregation tend to exhibit higher levels of intra-industry trade. Fortunately, the 10-didgit, Harmonized Tariff Schedule (HTS) system, which publishes 20,000 commodity classifications, should alleviate much of the criticism that followed the 3-digit STIC but the possibility of aggregation issue should be considered.[6]

The other notable issue with Grubel-Lloyd's measurement of IIT is the size of the trade imbalance bias between the two nations being observed. When large trade imbalances exist the measure of the Grubel-Lloyd Index has been shown to be bias downward because exports and imports cannot match in every industry [Aquino (1978), Grubel and Lloyd (1975), Kol and Mennes (1989), and Vona (1991)]. This flaw essentially prevents the Grubel-Lloyd Index from attaining a value of 1 if large trade imbalances exist between nations.

Luckily, an adjusted Grubel-Lloyd index has been developed to eliminate many of these issues:

$$IIT_{ikt} = \frac{\sum_{i=1}^{n}(X_{ikt} + M_{ikt}) - \sum_{i=1}^{n}|X_{ikt} - M_{ikt}|}{\sum_{i=1}^{n}(X_{ikt} + M_{ikt})}$$

where *i* is the individual product of the industry in which the United States is exporting *X* and importing *M* with country *k* at year t. Like the unadjusted index, a measure closer to zero would indicate trade between nations that was primarily inter-industry, while a measure near one would depict trade that was intra-industry. As used in Turkan and Ates (2010), the adjustment eliminates the aggregation bias that would trend the index closer to 1. This adjusted index will

[6] Andresen (2010) (pg. 799) emphasizes the advantage a more disaggregated classification system such as the HTS system has over the STIC system.

then be used as the dependent variable in the model. I do, however, believe some sort of downward bias is still affecting my calculations of the Grubel-Lloyd indexes, as my measurements are slightly lower than I would have expected.

4. How is trade financed?

Trade finance is the system in which the banking industry supports international trade. Typically, large shipments of imports or exports lack the funding or necessary insurance through its firm's internal cash flow or retained earnings to complete transactions across boarders, and thus requires a third party institute, often a bank, to assist in the operation. The demand for trade finance is also extremely large. Auboin (2009) estimates that approximately 90% of world transactions involve some form of trade finance. Exporting, specifically, requires a significant upfront cost related to international trade [Chor and Manova (2012)], as well as taking an average of thirty to ninety days longer to process than goods set to be delivered domestically [Djankov et al. (2010)]. Historically, trade finance has been processed through loans or Letters of Credit. These instruments make or guarantees payment to the importer or exporter on behalf of the other party once the delivery is made and the proper documentation is presented.

An alternative to typical trade finance is funding international transactions through inter-firm trade credit. An agreement on trade credit occurs in two forms. "Open account transactions" occur when a shipment is delivered prior to payment being made and the exporter is made whole at a later date. The third trade credit agreement is known as "cash-in-advance-transactions" and describes an operation in which payment of a shipment is made prior to the delivery of the product.

Schmidt-Eisenlohr (2013) analyzes the three finance options for international trade that I have mentioned. His model attempts to derive the optimal financing instrument taking into consideration the various risks involved in the transaction.

Risk is a natural aspect of trade finance in two ways. From a micro-level standpoint, the risk that an importer (exporter) faces after financing a trade is associated with the window of uncertainty of the exporter (importer) failing to deliver payments. According to Schmidt-Eisenlohr (2013), the use of a Letter of Credit or loans from a bank should alleviate part of this payment risk because neither importer nor exporter has the ability to withdraw from the transaction.

The second aspect of risk that is involved in international trade extends from the involvement of the banking systems. When employing the services of banks, the ability to access this finance fluctuates with the macro-economic conditions of both the source country and the destination country [Schmidt-Eisenlohr (2013)].[7]

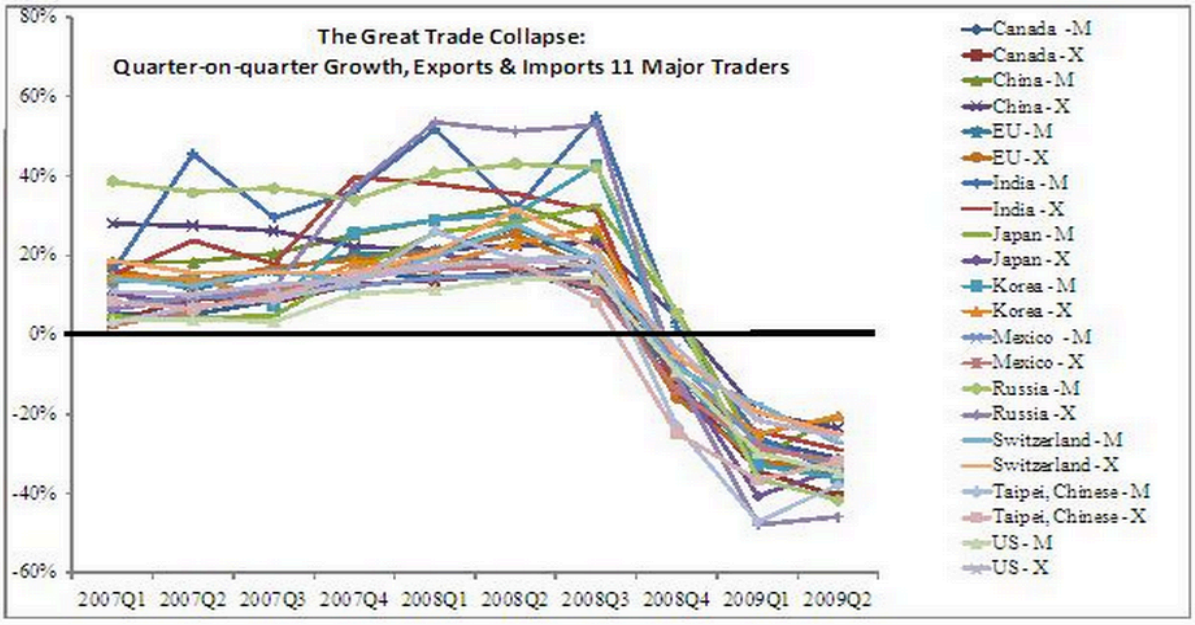
A great example of how vital a role the banking systems pays in funding transactions can be found during the days of the financial crisis of 2008-2009. During the peak of the financial crisis, international trade avenues deteriorated in response to both a global postponement in demand, especially for durable goods, and due to disruptions in credit markets [Baldwin (2009)]. This time period has since been named "The Great Trade Collapse".[8] During that time, imports and exports collapsed between 20 and 30 percent for the EU27 nations plus Canada,

[7] Schmidt-Eisenlohr (2013) notes that much of the previous literature on trade and financial conditions has primarily focused on the conditions of the host country. His paper is thus one of the first to try and model trade finance incorporating credit conditions from both parties.

[8] Baldwin (2009) associates the trade collapse being between the third quarter of 2008 and the second quarter of 2009.

China, India, Japan, Korea, Mexico, Russia, Switzerland, Chinese Taipei, and the United States:

Figure 1: The Great Trade Collapse, 2008 Q2 to 2009 Q2



Source: Baldwin (2009), WTO Online Database

It has been the general consensus of the literature that a sudden drop in global demand was the main driver of the collapse. Given, however, the importance of financing international transactions and mitigating the risk involved, analyst have concluded that the collapse was, at least in part, due to a lack of trade credit (Auboin 2009). Many studies, like the one done by the Bank of International Settlement's Committee on the Global Financial System (CGFS), attribute the reduction to the deterioration in trade finance following the bankruptcy of the investment bank Lehman Brothers [Bank of International Settlements (2014)]. In particular, the Bank of International Settlements notes that one-fifth of total trade decline may have been a result of the reduced availability of trade finance. In the aftermath of the

contraction, and to advert any further tightening of the system, G20 policy makers approved the creation of a $250 billion fund that would support trade-financing activities [G20 (2009)].

The Bank of International Settlements also notes that the automobile industry is unique in that it's reliance on trade finance instruments, namely Letters of Credit, exceeds that of other industries. This is not all that surprising given the expensive nature of automobiles and risk involved in international trade as I alluded to above. They note that in 2009, South Korea utilized Letters of Credit for over 50% of their automobile trade, and that the security of the payment method compensated for the lack of credit between firms.[9] This evidence along with the relatively accessible data on auto parts and products solidified my choice to examine intra-industry trade and how it is affected by trade finance from the perspective of the United States automobile industry.

4.1 Data on Trade Finance

The largest impediment to empirical research on trade finance is the lack of comprehensive data. The report published by the Bank of International Settlements in 2014 provides an excellent look into the disappointing efforts to record country level data.[10] Efforts by its contributors to collect adequate statistics fall short because there is no international standard for record keeping, and therefore the data is inconsistent or partial in some countries.[11]

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[9] See Graph 3b on page 15 of Bank of International Settlements (2014)
[10] The data has been collected by the member nations that make up the CGFS, plus the UK.
[11] See Table 1 on page 6 of Bank of International Settlements (2014) for a list of the full and partial data collected by member nations

The Bank of International Settlements also highlights data collected by the International Chamber of Commerce (ICC) and by bank surveys done by the International Monetary Fund (IMF) in association with the Bankers' Association for Finance and Trade – International Financial Services Association (BAFT-IFSA), as well as other institutes. The ICC reports are intended to document short-term trade finance product defaults and loss records but they are not published frequently enough for regular analysis or monitoring. The IMF and BAFT-IFSA surveys are a result of the 2008-2009 financial crises and were intended to look at volumes, pricing, and trends in the trade finance market in 2009. Finally, the ICC runs an annual global trade finance survey of 260 firms, and the Institute of International Finance's (IIF) quarterly Emerging Markets Bank Lending Conditions Survey (EMLC) looks at 130 banks to derive trade finance information for emerging markets.

Publications have also empirically analyzed trade finance using a variety of datasets. Not surprisingly the motivation for many of these studies is due in large part to the financial crisis. Briconge et al (2012) use French firm-level credit constraint data to analyze export flows and determine that the trade collapse was due in part to shock in consumer demand. Chor and Manova (2012) use a nations interbank rate to measure the effect macro credit conditions had on that nation's exports to the United States during the financial crisis. Van der Veer (2010) uses data measuring the real value of insured exports to be the link between private credit and exports.

Beck (2009) examines the shortfalls of global financial reporting prior to the financial crisis and highlights the actions from various international and government bodies to reform and make international banking more transparent. By providing statistics on the size, activity, efficiency, and stability of banks, non-banks, and bond markets, Beck (2009) has contributed to the growing demand for reliable sources of different dimensions of the financial system. Schmidt-Eisenlohr's (2013) empirical analysis uses Beck's (2009) net interest margin indicator as a measure of trade finance. I have determined that Beck's (2009) data is the best to use to measure the effects trade finance has on IIT, and in Section 5 I will review its effectiveness and limitations.

5. Determinants of Intra-Industry Trade

Andersen (2003) offers a superb review of the measurements that empirical economist have used to analyze intra-industry trade as well as the variables used as determinants. Along with focusing this study on how trade finance will affect intra-industry trade, I have also chosen to include a variety of the most well established determinants in the literature. In this section, I will describe each explanatory variable that I have included in my regression along with the theoretical justification for its inclusion. For each variable, the subscript *k* represents the country participating in trade with the United States, and *t* represents the year being observed.

5.1 Trade Finance Variables

Average Net Interest Margins (NIM_{kt})

As mentioned above, research into the effects trade finance have on IIT is limited by subpar data sources. An ideal measure for our purposes would be to have the amount of loans made, or the number of Letters of Credit approved for corporations in countries trading with the United States. In times of financial volatility, like the crisis of 2008-2009, researches would be able to observe exactly how the reduction of these financial tools during the period affected the amount of trade overlap. Until efficient data sources become available, proxy variables will be used to gage the effects of trade finance.

Net interest margin has been used in various studies, including Schmidt-Eisenlohr (2013), as an efficiency measure for the overall banking sector in an economy. Calculated ex-post, the net interest margin is the ratio between the accounting value of the net interest revenues and the total assets of all banks and other financial institutions. A higher net interest margin would indicate a less efficient financial system that results in higher costs in the form of interest rates. The higher costs of the interest rates as a result of the NIM_{kt} lead to lower investments and slower economic activity [Dumičić and Ridžak (2012)]. This weaker banking system then limits the amount of funding available to exporters that look to send their products overseas and importers that look to consume foreign goods. To incorporate the financial capacity of both trading nations, I have averaged the foreign country's NIM_{kt} with that of the United States in a given year.

This will allow the financial conditions of both economies to be represented in the observation.

In his application of the role trade finance has on international trade, Schmidt-Eisenlohr's (2013) regression shows a negative relationship between the NIM_{kt} proxy variable and the number of "open account transactions". He explains that higher financing costs in the source country make banks and other financial institutions less willing to provide the type of credit needed by foreign buyers to complete transactions.

My prediction of how the net interest margin will affect IIT also incorporates this relationship. By averaging the two net interest margins, I can observe how the fluctuations in the financial environments of the two participants affect the amount of intra-industry trade. A limit to this method is that it will be difficult to distinguish the amount IIT is being affected by the financial system of the United States or its trading partner. This method, thus, is unable to specify which of the two nations affects IIT the most.

At first, one may consider this a critical limitation to our results. By identifying which partner affects our measure of IIT most, we may be able to dissect that nation's financial system and gain further knowledge of its impact. But recall that the Grubel-Lloyd Index, by construction, does not allow us to observe in which direction the flow of trade is going. We can hypothesize, however, that both economies will contribute to our measure of IIT. Amiti and Weinstein (2011) and Paravisini et al. (2011) both establish causal relationship between the financial conditions of the source country and trade, and therefore an average is appropriate

to use. Furthermore, as I will expand on below, averaging the variable of interest to account for the impact of both nations is consistent with other empirical studies of the determinants of IIT.

I predict that our measure of IIT will be negatively affected by the average net interest margin variable. The data is taken from Beck et al (2009) and it is represented in the model by the NIM_{kt} variable.

Average Private Credit (PVC_{kt})

To assuage the limits of average net interest margins, I will supplement my model using the ratio of private credit to GDP as another indication of how trade finance affects IIT. Private credit to GDP refers to the financial resources provided to the private sector by domestic money banks as a share of GDP.

Recall from Section 4 the role that private institutions have in providing financial resources to fund trade activities. This is a much broader indicator of the role the domestic financial system plays in comparison to NIM_{kt} because it captures not only the lending to fund international trade but also the lending for other purposes in a domestic economy. Beck et al. (2009) considers the variable to be an indicator for the general financial development of a nation, and shows that private credit to GDP varies positively to a nation's level of economic development.

As with NIM_{kt}, I will average both the private credit to GDP of the United States and its trading partner in a given year to reflect the financial environment of both nations. Given Beck et al.'s (2009) observation that private credit to GDP is positively related to a nation's level of economic development, I expect PVC_{kt} to have a positive relationship with IIT.

5.2 Other Variables

Average GDP (AY_{kt})

The size of the economy of trading nations has been frequently tested in the empirical literature. The theoretical work in explaining IIT as a results of "love of variety" and economies of scale conclude that trade between nations tend to increase relative to average economic size [Helpman and Krugman (1985)]. Also, with larger markets, demand for differentiated products would increase the potential for IIT. To test this hypothesis, an average was taken between the United State's GDP and its trading partner in a given year and is represented by the variable AY_{kt}. Turkcan and Ates (2010) and Clark and Stanley (1999) have also used this indicator to see the effects of economic size on IIT and each found the variable to have a positive relationship. Because of these consistent conclusions, I expect my results to also show that the share of trade overlap will increase with the average level of GDP between trading nations.

Difference in GDP (DY_{kt})

Helpman and Krugman (1985) also comment on the potential effects of the difference in economic size between trading partners. Their claim is that countries with similar market size have the ability and resources to create slightly differentiated products, thus driving IIT. As the gap in GDP increases, it is thought that a nation's factor endowments become more dissimilar and the potential for manufacturing goods that are slightly different than the ones imported from abroad is less likely. In this case, we would expect a negative relationship between the difference in GDP and our indicator of total IIT.

Attempts at capturing this difference have normally been done by taking the absolute difference in GDP of two 's nations. Turkan and Ates (2010) take this approach and find that IIT does have a negative relationship between the differences in GDP of the trading nations. Balassa (1986) indicates that another index can be used to capture market size differential:

$$DGDP_{ijt} = 1 + \frac{[\omega \ln(\omega) + (1-\omega) ln(1-\omega)]}{\ln 2},$$

where $\omega = GDP_i/(GDP_i + GDP_j)$, i and j are the respective countries, and t represents the year observed. The index produces a scale ranging from zero to one with the difference in GDP increasing as the index increases.

I will not include Balassa (1986) index in my regression and will only measure the effects of similar market size using the absolute difference in GDP represented by the variable DY_{kt}.

Average GDP per capita (APC_{kt})

GDP per capita is used to measure the level of economic development in a country (Linder, 1961). Two theoretical perspectives dominate the effects Average GDP per capita has on IIT. From a demand standpoint, a higher level of GDP per capita will afford consumers to purchase differentiated products. From this perspective, we expect APC_{kt} to have a positive effect on IIT.

Helpman and Krugman (1985) provide a different theory. They claim that a higher average GDP per capita is representative of a higher average capital-labor ratio and that the more capital intensive an economy becomes, the more it tends to produce differentiated products. This production of differentiated products allows for IIT to take place. Like average AY_{kt}, this effect can be observed by studying the

average level of GDP per capita between the US and its partner, and I anticipate the effect to have a positive relationship with IIT.

Difference in GDP per capita (DPC_{kt})

Along with noting that the ability for consumers to make choices based on preference and induce IIT, Linder (1961) tells us that countries with the most similar demand preferences, or similar consumer taste given differentiated goods, will be those with similar per capita income. The difference in GDP per capita, as explained by Bergstrand (1990), is also one of the most common measures of inequality between nations. Helpman (1981), Krugman (1981), Helpman and Krugman (1985) formally show the effects of this inequality using models that depict the negative correlation as the difference in capital-labor ratios. A greater disparity in GDP per capita, therefore, should produce lower levels of total IIT.

Foreign Direct Investment (FDI_{kt})

The theory behind how foreign direct investment (FDI) will affect IIT is divided depending on the type of FDI being considered. Market-seeking FDI looks to implement manufacturing process into a foreign nation for the purposes of gaining profitability from local production. It is considered by many to be a substitute to trade and therefore would reduce overall exports from the home nation. Markusen (1984) and Brainard (1997) claim that this effect dominates the complementary effects of efficiency-seeking FDI and therefore be negatively correlated with IIT.

Efficiency-seeking FDI can be thought of as foreign investment that is made to reduce the cost of production, such as moving manufacturing operations outside of the United States to save on labor cost and then have the goods exported back to

the home country. According to Helpman (1984) and Helpman and Krugman (1985), transactions such as these are thought to cause FDI to have a positive relationship with IIT. The variable (FDI_{kt}) used to test this hypothesis is the total stock of outward FDI from the United States to its trading partner in a year.

Exchange Rate (EX_{kt})

The real exchange rate variable represents a monthly average of local currency units relative to the U.S. dollar. With respect to trade credit conditions, Section 6.1 of Chor and Manova (2012) investigates the role the nominal bilateral exchange rates had on trade flows. They show that exports to the United States decrease as the exporter's exchange becomes stronger. Turkan and Ates (2010) make no predictions for the expected sign of the exchange rate variable because depreciation in the dollar implies an advantage for US exports but a disadvantage for US imports. The results of their study, however, indicate that the exchange rate has a positive impact on IIT.

Because the Grubel-Lloyd index does not indicate the direction of trade flows it will be difficult to interpret the meaning of the sign.

Weighted Distance (WD_{kt})

Geographical location plays a significant role not only intra-industry trade but in international trade in general. As I discussed above, added distance increases the riskiness of an exchange along with the logistical transaction costs. In general, countries that are closer in proximity have lower costs stemming from insurance and transportation fees and, therefore, transactions are less expensive to complete.

As outlined by Andresen (2003), two other reasons why distance plays an

important role in intra-industry trade refer to the consumption behavior of the trading nations. Countries that are closer in proximity may have similar preferences and taste in the assortment of products they buy, thus increasing the potential for IIT. Second, countries tend to have similar resources the closer they are in proximity that will allow them to purchase similar goods. To account for these additional factors in consumption patterns I incorporate the weighted distance variable used in Balassa and Bauwens (1987):

$$WDIST_{kt} = \frac{DIST_k * GDP_{kt}}{\sum_{k=1}^{39} GDP_{kt}}$$

where $DIST_k$ refers the total distance in kilometers between Washington D.C. and its trading partner's capital k, and GDP_{it} refers to the GDP of trading partner k in year t.

Krugman (1980) and Balassa (1986) show that the share of IIT is negatively correlated with geographical distance. I expect IIT to be negatively related to the weighted distance factor.

Average Tariff Levels (ATR_{kt})

The consensus on the effects barriers to free trade have on IIT is of no real surprise. All studies I have come across predict that trade barriers such as the average tariff rate for imports in a given country will negatively effect IIT as it would in general international trade. Bergstrand (1990) shows that the average tariff level is negatively correlated with IIT.

My study uses the average Ad Valorem duty rate associated with each of the Harmonized System (HS) 6-digit product codes in a given year.[12] The duty rate is averaged between both the United States and its trading partner and is represented by the variable ATR_{kt} in the model. I expect the average tariff level to be negatively correlated with IIT.

Studies have also considered how non-tariff barriers affect IIT, although, due to difficulties generating data, I will not be making this observation. One attempt witness this effect was in Balassa (1986) who used a variable that measures the deviations from a hypothetical level of per capita exports. Countries that have lower per capita exports than this hypothetical value have high non-tariff barriers to trade.

6. Estimation

Initially, the standard estimation method of the determinants of IIT measured the effects using ordinary least squares (OLS) [Andresen (2003)]. But because of the nature of the Grubel-Lloyd Index being between zero and one, OLS could produce forecasted measures that lie outside of that range. Therefore, some studies, including Caves (1981) and Turkcan and Ates (2010), use the logit transformation to better estimate the effects. The transformation of the Grubel-Lloyd Index is shown in the equation below, with IIT_{ikt} representing our dependent variable, and where *i* represents the product being traded and *k* represents the trading partner at year *t.*

$$IIT'_{ikt} = \ln\left(\frac{IIT_{ikt}}{1 - IIT_{ikt}}\right)$$

[12] The complete list of Harmonized System (HS) 6-digit product codes that were used in this study are listed in Table 2.

This transformation, however, can also cause some issues in estimation given the calculations of the Grubel-Lloyd Index takes on a zero value. One option to remedy this situation would be to remove these observations from the model but doing so would remove opportunities to observe trade that is completely inter-industry. An alternative option would be to follow the studies done by Balassa (1986) and Balassa and Bauwens (1987, 1988) and use the non-linear method of least squares of the logistic function.

$$IIT_{kt} = \frac{1}{1 + \exp(-\beta' x_{kt})} + e_{kt}$$

where $-\beta' x_{kt}$ represents the linear combination of explanatory variables and e_{kt} is a random disturbance term.

Fortunately, my Grubel-Lloyd indexes do not report any observations with a zero value, and therefore, the logit transformation is appropriate. The model can be interpreted as to what extend does the explanatory variables effect the probability of the dependent variable taking a value of one. Hence, we can observe whether an increase in our explanatory variables would increase or decrease the likelihood that the observed international trade will be intra-industry. The model we will use to estimate test the determinants of IIT is as follows:

$$IIT'_{ikt} = \beta_0 + \beta_1 \mathrm{NIM}_{kt} + \beta_2 \mathrm{PVC}_{kt} + \beta_3 \mathrm{AY}_{kt} + \beta_4 \mathrm{DY}_{kt} + \beta_5 \mathrm{APC}_{kt} + \beta_6 \mathrm{DPC}_{kt} + \beta_7 \mathrm{FDI}_{kt} + \beta_8 \mathrm{EX}_{kt} + \beta_9 \mathrm{WDkt} + \beta_{10} \mathrm{ATR}_{kt} + \mathcal{E}_{kt}$$

The dataset is constructed to reflect records on thirty-nine nations over a period of thirteen years. Given this panel data structure, I have estimated the model using fixed effects (FE), random effects (RE) and pooled OLS methods. My first

objective is to determine which method most accurately estimates the data, testing to see if we need to account for the numerous unobserved heterogeneities between economies.[13] We can assume that nations would have a number of legal, cultural, and domestic factors not controlled for in the model. For example, Schmidt-Eisenlohr (2013) details the important role a nation's legal system, specifically their system to enforcement contracts, has on international trade. I attempt to discover which method is best by employing a Hausmen test, and the result is noted in Table 4.

7. Results

Upon completion of the Hausmen test, a significant Chi-squared value indicates that individual effects of the nations are correlated with the variables and, therefore, the fixed effects model should be used. This result rules out both the random effects model and the pooled OLS model because both methods do not consider the cross-country heterogeneities I mentioned above. The efficiency of my results, however, should be taken with caution. Although the Hausmen test indicates that the fixed effect is the preferred model, multicollinearity may have been introduced. Furthermore, considering the value of rho produced for the fixed effects model (.76917) it does seem as though there is evidence of endogeneity. The random effects model and pooled OLS model indicate a much lower level of endogeneity with a rho value of .59802. With that said, I have decided to sacrifice the efficiency of the random effects model for the unbiased results of the fixed

[13] Turkan and Ates (2010) note that the pooled OLS method of estimating the determinants has been known to produce biased results because it excludes any possible cross-country heterogeneity. Nevertheless I have included its results in Table 4.

effects model as the best estimates of the coefficients. All coefficient results, their t-statistic values, and level of significance are reported in Table 4.

To begin with, our first proxy variable for trade finance (NIM_{kt}) has a negative effect on intra-industry trade, but the results do not seem to have any significance in all three models. This negative effect shows that as the average net interest margin increases between the trading partners, intra-industry trade will tend to decrease. The intuition for this finding is logical and not surprising. As explained above, the expense associated with international trade makes trade finance and the financial health of an economy an important factor. Economies who suffer financially, either by lower investments and slower economic growth, as I have depicted using the average net interest margin variable or for other reasons, are unable to efficiently finance the trade operations their producers and consumers need.

The results of my tests using Average Private Credit (PVC_{kt}) also produced the predicted coefficients but in this case, the results are significant at the 1% level in both the fixed effect model and the random effects model, and the pooled OLS model is significant at the 10% level. Recall that PVC_{kt} will rise with the level of economic development. The data shows a positive relationship between this measure of trade finance and IIT as expected, and the results are encouraging to draw significant conclusions on how trade finance may affect IIT. As nations develop a more sophisticated financial system they should also create an environment where the nation can finance its trade operations.

As expected the average GDP (AY_{kt}) between the United States and its trading partner has a positive effect on the amount of intra-industry trade measured by the Grubel-Lloyd Index. This supports the empirical findings noted above by Turkcan and Ates (2010) and Clark and Stanley (1999), and is consistent with the theory that trade between nations tends to increase with the size of a nation's economy. Unlike Turkcan and Ates (2010) and Clark and Stanley (1999), however, AY_{kt} does not affect IIT with any significance in all three models.

The absolute difference in GDP (DY_{kt}) between the US and its trading partner also resulted in the predicted sign without any significance. As hypothesized, the larger the difference in GDP between nations the less intra-industry trade occurs between them. Economies of similar economic size, according to Helpman and Krugman (1985), have the ability to produce slightly differentiated products thus driving demand for IIT.

The only variable not to produce the effect I expected was the average GDP per capita (APC_{kt}) variable. I predicted that average GDP per capita would have a similar effect on IIT as did average GDP and be positively related to the amount of intra-industry trade between nations. This unexpected result may have been a consequence of the industry I have chosen to observe. Recall that in Helpman and Krugman (1985), APC_{kt} can be considered a reflection of the average capital-labor ratios unique to an economy given a certain time period, and an increase the average capital-labor ratio would reflect a nation becoming more capital intensive. A negative correlation between APC_{kt} and IIT may be reflecting production of automobile products categorized at the HS 6-digit level as more labor intensive than

I initially thought. Nevertheless, the sound theory of Linder (1961) and Helpman and Krugman (1985) do make the result of this variable particularly disappointing.

The absolute difference in GDP per capita (DPC_{kt}) did, however, have the sign I expected (and that theory predicts) with significance at the 1% level for the fixed effect model and the random effects model, and the 5% level for the pooled OLS model. This shows that nations that are unequal in the income level are less likely to participate in trade for automobiles.

FDI (FDI_{kt}) and the Exchange Rate (EX_{kt}) variable both have positive effects on IIT. FDI_{kt} was not significant in our fixed effects but was significant at the 5% level in our random effects model and the pooled OLS model. With FDI_{kt} exhibiting a positive correlation, we can infer that we are observing efficiency-seeking FDI as the dominant effect, and Markusen (1984) and Brainard (1997) claim is contradicted.

EX_{kt} did see significance at the 5% level in the random effects model, 1% significance in the pooled OLS model, but no significance in the fixed effects model. As the dollar depreciates, we can interpret the positive effect on IIT as depicting US exports to foreign nations as having the dominant effect. That is, nations who import US automobile products are able to purchase more goods with a weaker dollar and drive the trade overlap.

The similarity in sign between EX_{kt} and FDI_{kt} in the fixed effects model creates another interesting interpretations; in fact, the two signs complement each other. With EX_{kt} suggesting that IIT is being driven by US exports to other countries, the effects lead us to believe that US manufactures are not implementing operations

in foreign nation to substitute for trade and they are participating in market-seeking FDI.

Finally, Weighted Distance (WD_{kt}) and Average Tariff Levels (ATR_{kt}) also affected IIT as predicted. From a cultural perspective consumers are more likely to prefer similar goods when they are closer in proximity, as well as having similar resources to attain common products. My model shows that the greater the distance between nations the less potential for IIT. My results show that WD_{kt} negatively affects IIT but no significance is noticed. ATR_{kt} negatively affects IIT with a 10% significance level in our fixed effect model; a result that is consistent with Bergstrand (1990).

The other aspect of my model to consider is how well it explains the variation in IIT within and between countries using the R^2 statistic. I will first note that the within, between, and overall R^2 output for the random effects model and the pooled OLS model are the same, indicating similar explanatory power. The fixed effects model, however, produces a different series of explanation.

My results show that, in the fixed effects model, my model accounts for 0.0398 of the variation in IIT from with an individual country (R^2 Within), and 0.0108 of the variation in IIT across countries (R^2 Between). These results indicate that my independent variables may not necessarily be a better predictor of IIT than a calculated average of the dependent variable, even though the directions of the coefficients are consistent with previous studies. I will note that the series of R^2 values produced by the random effects model do seem to do a better job in indicating the between variation ($R^2 = 0.3014$) but if we were to consider the

random effects model to be our best predictor, than we would have to assume that the independent variables were not correlated with any country specific effects. I do not believe this is the correct assumption make nor does the Hausmen test indicate the random effects model is preferred.

8. Conclusion

In general, my results are consistent with the predicted effects on IIT. Both trade finance variables I have studied, NIM_{kt} and PVC_{kt}, provide the conclusion that the weaker a nation's financial system is the less IIT it will participate in.

It is easy to be critical of globalization if you are part of a group who is becoming disadvantaged by its onset. This paper is not intended to argue for or against globalization and international trade but instead to observe what aspects of the global economy contribute to its complex nature.

Table 2. Harmonized System 6-Didget Product Codes

381900	**840820**	**851140**	**870422**	**910400**
382000	**840991**	**851150**	**870423**	**940120**
400912	**840999**	**851180**	**870431**	**940190**
400922	**841330**	**851190**	**870432**	**940390**
400932	**841391**	**851220**	**870490**	
400942	**841430**	**851230**	**870600**	
401110	**841459**	**851240**	**870710**	
401120	**841520**	**851290**	**870790**	
401211	**842123**	**852721**	**870810**	
401212	**842131**	**852729**	**870821**	
401219	**842139**	**853180**	**870829**	
401220	**842549**	**853641**	**870831**	
401310	**842691**	**853910**	**870840**	
401699	**843110**	**854430**	**870850**	
681310	**848210**	**870120**	**870870**	
681390	**848220**	**870210**	**870880**	
700711	**848240**	**870290**	**870891**	
700721	**848250**	**870322**	**870892**	
700910	**848310**	**870323**	**870893**	
732010	**850710**	**870324**	**870894**	
732020	**850790**	**870331**	**870899**	
830120	**850790**	**870332**	**871690**	
830210	**851110**	**870333**	**902910**	
830230	**851120**	**870390**	**902920**	
840734	**851130**	**870421**	**902990**	

Table 3. Variable Predictions

Tested Data	Variable	Predicted Result
Average Net Interest Margins	NIM_{kt}	–
Average Private Credit	PVC_{kt}	+
Average GDP	AY_{kt}	+
Difference in GDP	DY_{kt}	–
Average GDP per Capita	APC_{kt}	+
Difference in GDP per Capita	DPC_{kt}	–
Foreign Direct Investment	FDI_{kt}	+/-
Exchange Rate	EX_{kt}	+/-
Weighted Distance	WD_{kt}	–
Average Tariff Levels	ATR_{kt}	–

Table 4. Estimation Results

IIT	Fixed Effect Model	Random Effects Model	Pooled OLS
NIM_{kt}	-0.0372497	-0.0133047	-0.0133047
	(0.84)	(0.30)	(0.37)
PVC_{kt}	.0120009	.0092797	.0092797
	(4.18)***	(3.40)***	(1.65)*
AY_{kt}	2.17e-13	8.71e-14	8.71e-14
	(1.16)	(0.57)	(0.45)
DY_{kt}	-1.87e-13	-5.23e-14	-5.23e-14
	(1.02)	(0.35)	(0.28)
APC_{kt}	-5.47e-06	-8.94e-07	-8.94e-07
	(0.39)	(0.07)	(0.04)
DPC_{kt}	-0.0000202	-0.0000246	-0.000246
	(2.62)***	(3.47)***	(2.09)**
FDI_{kt}	0.000027	0.0000425	0.0000425
	(1.34)	(2.23)**	(2.54)**
EX_{kt}	0.0000712	-0.0001852	-0.0001852
	(0.40)	(2.55)**	(4.49)***
WD_{kt}	-0.0002354	-0.0001457	-0.0001457
	(0.60)	(0.41)	(0.45)
ATR_{kt}	-0.0208698	-0.0185513	-0.0185513
	(1.78)*	(1.91)*	(2.05)**
_cons	-2.065	-2.112	-2.112
	(6.18)***	(6.70)***	(4.56)***
R^2 *Within*	0.0398	0.0306	0.0306
R^2 *Between*	0.0108	0.3732	0.3732
R^2 *Overall*	0.0729	0.3014	0.3014
N	474	474	474
Hausmen Test	15.28***		
Rho	.76917	.59802	.59802

* $p<0.10$; ** $p<0.05$; *** $p<0.01$

Table 5. Countries in Study

Australia	Germany	Korea, Rep.	Singapore
Austria	Greece	Malaysia	Slovak Republic
Belgium	Hong Kong SAR	Mexico	South Africa
Brazil	Hungary	Netherlands	Spain
Canada	Iceland	New Zealand	Sweden
China	India	Norway	Switzerland
Czech Republic	Indonesia	Philippines	Thailand
Denmark	Ireland	Poland	Turkey
Finland	Italy	Portugal	United Kingdom
France	Japan	Russian Federation	

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