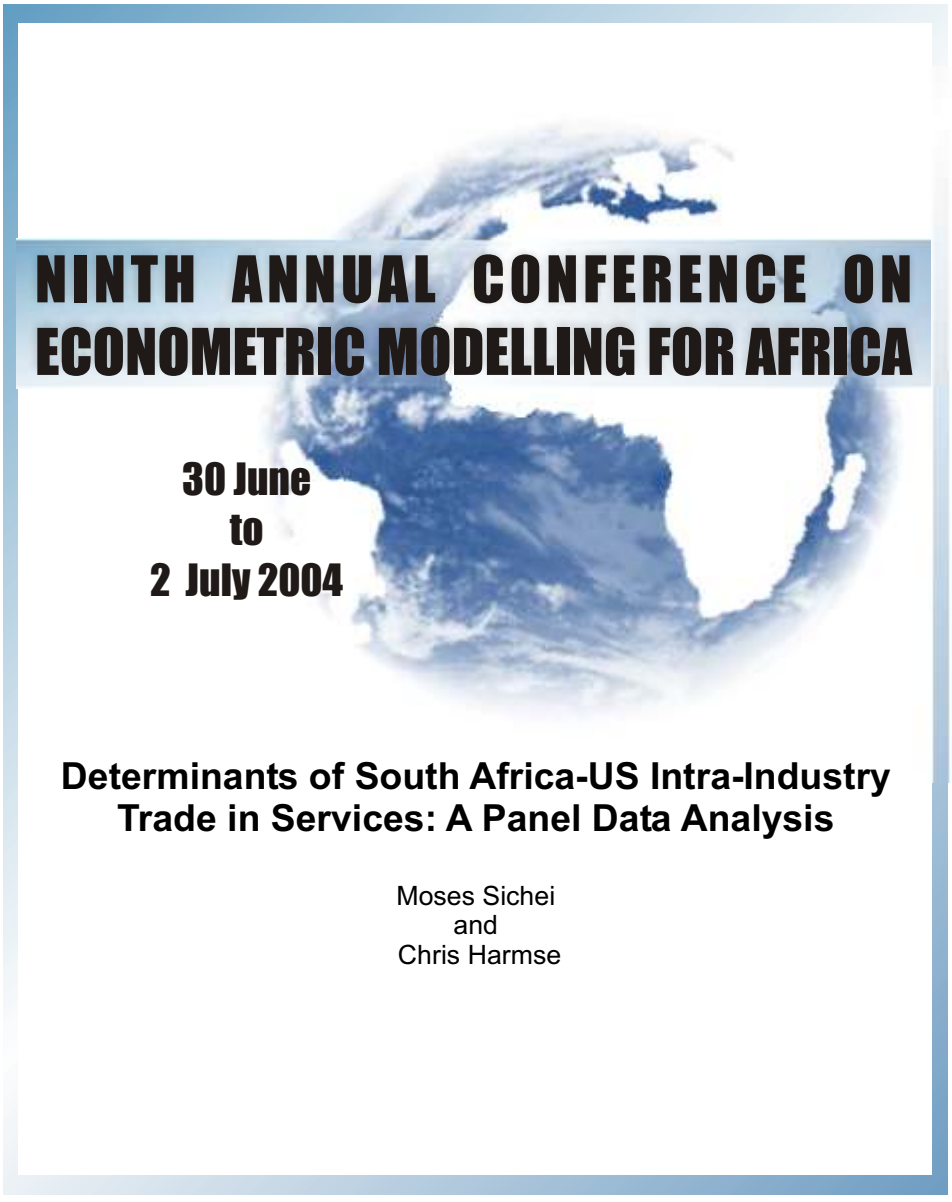

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Determinants of South Africa-US Intra-Industry Trade in Services: A Panel Data Analysis

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1. Introduction

In the last two decades, services sector has experienced phenomenal growth in terms of its contribution to national output, employment and international trade. In South Africa, its contribution to GDP was 66 per cent in 2000 up from 46 per cent in 1980. At the same time, its contribution to total employment was about 30 per cent in the period 1980 to 2002.

Linders (2001:38-45) and Wong et al. (2001) identify three underlying reasons for this growth. First, technological innovations in some sectors (mainly telecommunications) have considerably reduced the costs of service delivery and increased their demand and even rendered the protectionist regulations in some sectors obsolete.

Second, there was a general realisation among policy makers that a competitive services sector is an important element for economic growth and development. Such awareness led to the inclusion of services in the multilateral trade negotiations under the General Agreement of Trade in Services (GATS) at the Uruquay Round in 1994. Under GATS national government measures affecting trade in services became subject to multilateral discipline for the first time. Since then, there has been renewed interest in trade in services, mainly in the measurement of the market access and national treatment that are subject to the regulation of the GATS.

Finally, the global trend of fragmentation of production process has stimulated the demand for trade in services since many services such as telecommunications, distribution, and financial services are essential in the production process.

In light of the growing volume of trade and international international competition in services one of the important empirical questions to be addressed in South Africa is the level and determinants of intra-industry trade in the services.

Intra-industry trade (IIT) in services is the value of services exports of an "industry", which is exactly matched by the imports of the same industry (Grubel and Lloyd 1975:20). This is different from inter-industry trade, in which a country specialises in the production of a service and exports it in exchange for a different service which it has no comparative advantage. Initially, when the phenomenon of intra-industry trade was discovered in the 1960s by Verdoon (1960), Balassa (1966) and Grubel (1967) it appeared as though it cast doubt on the traditional theories of international trade based on Ricardo's comparative advantage.

This spawned a lot of theoretical and empirical literature in the 1970s and 80s (see for instance Krugman,1979,1980,19811991, 1994 and Lancaster 1979,1980) centred on three controversial issues (Lloyd 2002). The first controversy lies on how to incorporate intra-industry trade into the factor content of trade model (new trade theories). In this regard, IIT theory, which is an extension of the Heckscher-Ohlin-Samuelson trade theory was formalised as part of the new trade theories monopolistic competition with economies of scale and product differentiation and industrial organisation theory were introduced as part of the factors which contribute to the volume of IIT. The theory was synthesised by Helpman and Krugman (1985) while Markusen and Venables introduced foreign direct investment as another factor affecting the volume of IIT. The second controversy relates to aggregation of international trade statistics into exports and imports from "industries" defined in an economically meaningful way. The third problem is the choice of an appropriate measure of intra-industry trade from a plethora of indices.

Since the time the phenomenon of IIT was identified in the 1960s, most empirical studies (other than Kierzkowski, 1989 and Lee and Lloyd, 2002, Li,Moshiran and Shim, 2003) have been confined to trade in goods due to two factors: the believe that services were largely non-tradable and lack of comprehensive data on services trade. The existing data on services is reported according the fifth edition of the IMF balance of payments manual, which does not require countries to report the data on origin to destination basis thus making it difficult to model bilateral IIT without suffering from the problem of geographical and industrial bias.

Discussions are underway for a Free Trade Agreement (FTA) between the United States and the South African Customs Union (SACU). The Unites states is the leading South Africa's export destination of services (see appendix 1). An understanding of the determinants of the South Africa-US IIT in services may complement other studies (such as Hodge and Nordas, 2001, Walley and Keith, 2003) in informing the services component of the SACU-US FTA Negotiations.

It is against this background that this paper attempts to test the determinants of IIT in services between the United States and South Africa in the period 1994-2002 using panel data of 8 service industries. The novelty of this paper is in attempting to find the empirical determinants of South Africa-US IIT in services. The study finds that empirical results support the modern trade theories with regard to dissimilarities in demand structure, degree of market openness and economies of scale. First, the dissimilarities in demand structure between South Africa and the United States reduce the level of trade in differentiated services. Second, economies of scale play some role in determining the level of IIT in some services: research & development and testing services; travel; education and training services; telecommunications; business, professional and technical services.

The rest of the paper is organised as follows. Section 2 basically deals with the background knowledge on intra-industry trade in services. Specifically, it covers issues on definition, unique characteristics of services and importance of IIT in services.

Section 3 deals with the empirical estimation and discussion while section 4 highlights the conclusions and policy implications.

2.1 The Definition of International Trade in Services

There are basically two definitions of international trade in services. The first definition is based on the fifth edition of the IMF Balance of Payments Manual (IMF, 1993) known as "BMP5". It defines international trade in services as being between residents and non-residents of an economy. This corresponds to the concept of trade in services in the "rest of the world" account in 1993 System of National Accounts (1993 SNA).

The second definition is used by the General Agreement on Trade in Services (GATS). Article 1 of GATS defines a service as "any service that is supplied across national borders by one of the following four modes". These modes are *cross-border supply* of the service (mode 1); supply to a service consumer who moves to the country of service supplier, (*consumption abroad* or mode 2); supply by a service supplier who moves to the country of the consumer (*commercial presence* or mode 3); and supply through temporary movement of natural persons (*presence of natural persons* or mode 4).

2.2 The Unique Characteristics of Services

Classical and neo-classical economists held that services could be considered simply as "intangible products". The corollary of this is that trade in goods does not differ in any basic ways from trade in services implying that existing IIT models for goods apply to services as well. However, there are unique characteristics of services that are important when analysing intra-industry trade in services since they are crucial in returning a verdict as to whether a particular IIT model for goods is appropriate for services or not.

Wong et al. (2001:1) and Linders (2001:38-44) highlight four major features of services. The first characteristic, which was also recognised by the classical economists, is intangibility and transitoriness (*non-storable* or *transportable*). This emanates from the fact that a service is absorbed as it is produced, implying that it is intangible and consequently non-storable. The fact that consumption and production of services take place simultaneously calls for service providers and consumers to be located near each other, either physically or through telecommunications networks.

The second characteristic is *heterogeneity* and high flexibility of production. The fact that services are intangible and non-storable increases the need for customisation. The close relationship between the producer and consumer implies that the latter is capable of providing immediate feedback to the former, which can continuously adjust quality of the service. Many services such as accounting, management consulting, transportation, insurance, telecommunication and financial services are used as intermediate inputs in the production of other goods/services. Therefore they are peculiar and highly specific to individual customer's unique taste. Even for services sold as final goods, consumers choose service providers according to a host of demand considerations such as reliability, after-sale service, ability to offer related services etc.

Third, services are characterised by *imperfectly competitive* market structure (monopolistic competition, oligopoly and monopoly). The actual market structure depends on the cost structure, socio-political factors of a particular market. Technically, induced economies of scale and scope are relatively unimportant in most services, except for transport, telecommunications and commerce and some independent services such as entertainment and rental services.

Fourth, services markets are characterised by *asymmetric information*. Services are knowledge and experience-intensive. Many services are experienced goods (similar to knowledge-based assets (Markusen et al.1995: 396-398). Once learned, the producer has an information advantage over consumers with respect to quality of the service and that of competitors. Imperfect information causes problems for the market mechanism because of the tendency for *moral hazard*, in which the quality of services change over time, and *adverse selection* in which low quality services drive out high quality services.

These characteristics have far reaching implications on the intra-industry trade models for services. For instance it can be inferred from the characteristics highlighted that IIT in services can be motivated to a large extent by "new trade theories" dealing with imperfect competition, returns to scale and differentiation.

2.3 Importance of IIT in Services

Intra-industry trade occurs in homogeneous services and in horizontally and vertically differentiated services. Intra-industry trade is important for a number of reasons (Sawyer and Sprinkle, 2003:97-98). Welfare gains under IIT for a country are similar to those under inter-industry trade if the services are homogeneous. These gains would occur as the services trade is based on lower opportunity costs (Ricardo-Torrens model) and factor abundance (Heckscher-Ohlin Samuelson model). However, if services are horizontally or vertically differentiated, there are additional welfare gains.

First, IIT has less adjustment costs for an economy like South Africa moving towards free international trade in services. For instance when factors of production used to produce banking services are shifted to and adapted to the production of education services, the effort is substantial. Contrariwise, if trade is IIT, this is not the case because it is easier for resources to reallocate among service industries participating in intra-industry trade because those industries have similar factor intensities. The rationale for this that both the contracting industry and expanding industry are either capital intensive or skilled-labour intensive. For instance it is easier for labour to move from banking services to insurance than to travel services.

Second, IIT in differentiated services improves the general welfare of a country to the extent that domestic consumers have more types of the service available from which to choose from to satisfy the demand for "ideal varieties". Additional types of the same differentiated service lower the prices of those services and improve the range of quality of those services. For instance in the education sector, if there was no possibility of

South Africans studying abroad, South African universities would probably be offering lower quality education. The same can be said for financial services, legal services, etc.

Third, IIT is effective in reducing the monopoly power of domestic firms (i.e.-competitive gains to trade). This leads to lower prices, more varieties and hence an improvement in consumer welfare. However, it is imperative to be cognisant of the contestability agenda and national interests when it comes to some industries such as telecommunication.

Fourth, IIT makes it possible for firms to produce at higher levels of output. Producing at higher levels means that firms can enjoy the lower costs due to economies of scale and consequently lead to reduced prices not only in the export market but also in the domestic market.

3. Empirical Estimation

3.1 The Panel Data Model

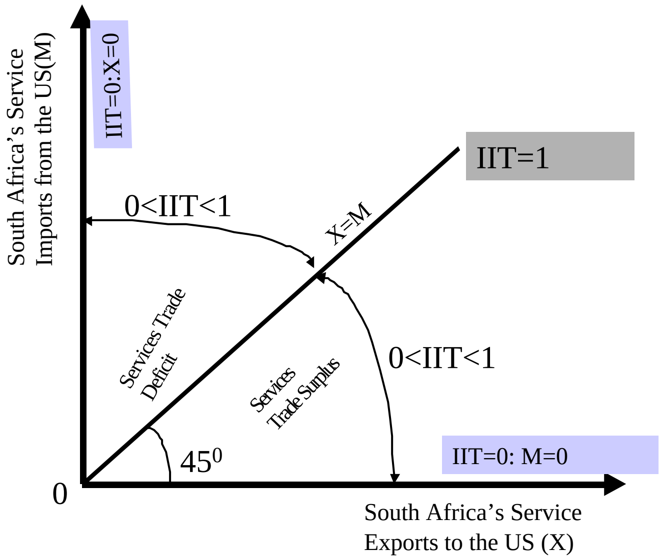
In constructing empirical models that relate South Africa-US IIT in specific services to industry-specific factors and other characteristics, we adopt a "looser theoretical paradigm" rather than the precise formal models. This is consistent with the findings of majority of existing empirical studies, which draw hypotheses from a variety of models (Veeramani 2003). Gray (1988) defends this approach on the grounds that the phenomenon of IIT is too complex and too service sector-idiosyncratic to justify the use of one single model for all services. In what follows, we adopt this approach and that of Balassa and Bauwens (1987) by combining "country-specific" and "industry specific" determinants of bilateral IIT in services in one equation.

The paper uses panel data techniques for a number of reasons (Baltagi 2001:5-7). First, it helps to control for service heterogeneity. Second, panel data blows up degrees of freedom. The data points increase from 9 years (i.e.1994-2002) to 72 (9 cross-sections multiply by 8 years). Finally, panel data techniques combine the best of the two worlds of cross-section ("picture or snapshot") with time series ("path or movie") by treating cross-sections as repeated draws from the same distribution. Moreover, certain panel statistics converge in distribution to normally distributed random variables.

On the basis of the "looser theoretical paradigm", the model for IIT in services is constructed as follows.

$$IIT = 1 - \frac{|X - M|}{X + M} \text{ or } IIT = 1 - \frac{2Min(X, M)}{X + M} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Figure 1: Grubel and Lloyd IIT Index



To constrain the IIT within (0,1), a linear logistics regressions model is used. In the Grubel and Lloyd index, there are two classes that any trade (exports and imports) in services will take; intra-industry or inter-industry. Let G_i be the class that trade in services can take.

$$G_i = \begin{cases} 1: Intra - Industry \\ 2: Inter - Industry \end{cases} \quad \ldots\ldots(2)$$

We can then model the posterior probabilities of the two classes via linear functions in explanatory variables, while at the same time ensuring that they sum to one and remain within (0,1) but on a continuous scale. The model takes the form;

$$\frac{\Pr\left(G_{it} = 1 \middle| X = z_{it}\right)}{\Pr\left(G_{it} = 2 \middle| X = z_{it}\right)} = \frac{IIT_{it}}{1 - IIT_{it}} = e^{b_i' z_{it}} \quad \ldots\ldots(3)$$

Where $b_i' z_{it} = b_{i1} PID_t + b_{i2} TIM_t + b_{i3} DMM_{it} + b_{i4} DREGSA_{it} + b_{i5} DREGUS_{it} + b_{i6} TIN_t + e_{it}$

The description of the variables are as follows;

IIT_{it} =Grubel-Lloyd Intra-industry trade in services index.

PID_t =Index of difference in per capita income between South Africa and United States
.

TIM_t =Trade imbalance (goods and services) between US and South Africa

DMM_{it} = Index of the difference in market size between South Africa and her trading partners

$DREGSA_{it}$ =Sectoral index of the degree of economic freedom (deregulation) in South Africa.

$DREGUS_{it}$ =Sectoral index of the degree of economic freedom (deregulation) in the US

TIN_t = The trade intensity in goods and services between South Africa and the United States

i=Research & Development and testing services (Royalties and fees); Travel services; Education and training services, Financial services; Telecommunication services; Airfreight services; Airport services; Ocean Freight services; Business, Professional and technical services.

t=1994,...,2002

Taking natural logarithms on both sides;

$$\ln \frac{\Pr(G_{it} = 1 | X = z_{it})}{\Pr(G_{it} = | X = z_{it})} = \ln\left(\frac{IIT_{it}}{1 - IIT_{it}}\right) = b_i' z_{it} + e_{it}$$

$$\ln\left(\frac{IIT_{it}}{1 - IIT_{it}}\right) = b_{i1} PID_{it} + b_{i2} TIM_{it} + b_{i3} DMM_{it} + b_{i4} DREGSA_{it} + b_{i5} DREGUS_{it} + b_{i6} TIN_t + e_{it}$$

….(4)

This states that the log odds ratio for intra-industry trade is determined by the variables on the right hand side. The error term can be decomposed into three parts i.e. two-way error components: $e_{it} = m_i + n_{it}$

where m_i denotes service-specific effects, n_{it} is the remainder error term, which varies across services.

Postulations: $b_{i1} < 0, b_{i2} < 0, b_{i3} < 0, b_{i4} > 0, b_{i5} > 0$

From equation 6 it is possible to derive the equation for IIT_{it} i.e.

$$IIT_{it} = \frac{1}{1 + e^{-b_i' z_{it}}} \quad \text{……...(5)}$$

Most of empirical studies on intra-industry trade (see for instance, Lee and Lloyd, 2002, Li et al (2003) use equation 5 by adding an error term and perform nonlinear estimation.

Hypothesis 1: The extent of IIT in services is related negatively with the differences in per capita gross domestic product of South Africa and US.

There are two sides to this proposition; supply and demand. On the *supply side*, the extent of IIT in services is positively related to South Africa's per capita income. This proposition is consistent with models of IIT in goods, which can be extended to services of cross-border type (Lee and Lloyd, 2002:168).

Applying Falvey (1981) model to services, the higher-quality varieties of differentiated services are produced using relatively capital-intensive techniques. Similarly, adopting the Helpman and Krugman (1985) model to services, a differentiated service is assumed to be capital-intensive. The United States, which is a higher-income country, is capital-abundant relative to South Africa and hence it specialises in the production of horizontally and vertically differentiated services.

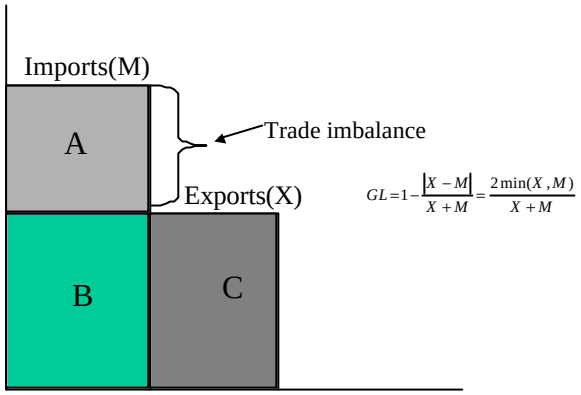
On the demand side, the extent of IIT in services is positively correlated with South Africa's per capita income, through a more diversified pattern of demand for services. Linder's (1961) overlapping demand hypothesis, Dreze (1960), Helpman (1981), Balassa and Bauwens (1987) propose that the difference in per capita income represents a difference in the demand structure. Combining demand and supply, and being cognizant of the fact that South Africa has a trade deficit in all service categories with the US, proposition 1 above is used.

In line with Balassa and Bauwens (1987), absolute differences between the two countries' per capita incomes are not used because they are subject to a change of unit in measurement and may suffer from a size bias.

Hypothesis 2: Trade Imbalance in goods and services (TIM) is negatively related to intra-industry trade in services.

The rationale for including trade imbalance emanates from Grubel and Lloyd (1975:22) who argued that intra-industry trade is biased downwards if total trade is imbalanced. Aquino (1978) and Lee and Lee (1993) use trade imbalance as an explanatory variable to control for any possible downward bias in estimating the determinants of IIT.

Figure 2: Trade Imbalance



Intra-industry trade is the overlap trade (i.e. portions B and C). Therefore the larger the trade imbalance the less the intra-industry. TIM is calculated as follows;

$$TIM = \frac{|X-M|}{X+M} \quad \text{.....(6)}$$

***Hypothesis 3*:** The differential between South Africa's market sizes in the specific Service and US is negatively related to the odds ratio of IIT in services.

Helpman (1981), Balassa and Bauwens (1987) argue that the share of IIT in total trade will be negatively correlated with the difference in country size, as similar country size indicates similar economies of scale and ability to produce differentiated products. Empirical test of this postulation has shown that country size is not a good indicator of economies of scale. Some researchers solved the problem by using market size as an indicator of economies of scale. Countries of similar market size will have similar services, thus stimulating IIT in that service sector. The proxies of market size in each sector is presented in table 4.

***Hypothesis 4*:** The degree of economic freedom in South Africa increases the likelihood of IIT in services.

Falvey (1981) demonstrates that countries with lower trade barriers have higher levels of intra-industry trade. Although there have been many trade barriers and restrictive national regulations, a new era of free trade in services following the successful conclusion of the Uruguay Round in 1994, has seen growth in the importance of service liberalization and deregulation in the whole world.

***Hypothesis 5*:** The degree of economic freedom in the Unites States increases the likelihood of IIT in services.

***Hypothesis 6*:** There is a positive relationship between foreign direct investment (FDI) and IIT in services.

Markusen (1994), Markusen and Venables (1998, 2000) extended the trade theories of IIT in the presence of FDI developed by Helpman and Krugman in the 1980s. They argue that FDI positively contributes to the volume of IIT and therefore any IIT model should take into account the positive contribution of FDI. Markusen and Venables (1998,2000) note that MNC overcome the costs of trade barriers by establishing themselves in the host countries and then generating trade with the source country.

3.2 Panel Data Estimation Procedure

A Fixed effects rather than random effects model is estimated because the study focuses on a specific set of services sectors and statistical inference is restricted to the behaviour of these services. The service-specific effects are time-invariant and account for any service-sector specific effect that is not included in the regression equation 3.

3.2.1 Panel Unit Roots

The need to test for unit root in time series emanates from the fact that a regression equation with integrated variables is likely to be spurious (unless there is cointegration). Panel-based unit root tests have higher power than unit root tests based on individual time series.

Panel-based unit root tests have been advanced by, among others, Qua (1994), Levin and Lin (1993), Levin, Lin and Chu (2002), Maddala and Wu (1999), Hadri (2000), Breitung (2000), Im, Pesaran and Shin (1995,2003).

The panel unit root tests spring from the following autoregressive process for panel data;

$$y_{it} = r_i y_{it-1} + d_i x_{it} + e_{it} \quad \text{.....(7)}$$

where $i = 1,2,...,8$ service sectors observed over periods $t = 1994,1995,...,2002$. The variable x_{it} represent the exogenous variables in the model, including any fixed effects or individual trends, r_i are the autoregressive coefficients, e_{it} is identically and independently distributed disturbance term. If $|r_i| < 1$ then y_{it} is stationary and if $|r_i| = 1$, then y_{it} is nonstationary.

The test for panel unit roots can be classified into two groups. The first class of tests assume that the autoregressive parameters are common across services so that $r_i = r$ for all i. The Levin, Lin, and Chu (2002), Breitung (2000), and Hadri (2000) tests all

employ this assumption. The first two tests employ a null hypothesis of a unit root while the Hadri test uses a null of no unit root.

The second class of tests allow r_i to vary across the cross-sections (services). The Im, Pesaran, and Shin (1995,2003), and the Fisher-ADF and PP tests (Maddala and Wu (1999) and Choi(2001) all allow for individual unit root processes so that r_i may vary across cross-sections. The tests are all characterized by the combining of individual unit root tests to derive a panel-specific result.

Table 1:Summary of Panel Unit Root Tests

	Null: Unit root (Homogeneous)		**Null: Unit root (heterogeneous)**			**Null: No unit root (homogeneous)**
Variable	*LLC t-stat*	*Breitung t-stat*	*IPS w-stat*	*ADF-Fisher chi square*	*PP- Fisher chi square*	*Hadri z-test*
Log odds of IIT	-1.987 (0.024)*	-1.024 (0.153)	-0.468 (0.320)	20.841 (0.185)	45.878 (0.000)**	7.618 (0.000)**
PID	-4.062 (0.000)**	-1.548 (0.061)	-0.413 (0.340)	18.200 (0.312)	18.200 (0.312)	1.987 (0.024)*
TIM	-7.222 (0.000)**	-0.188 (0.425)	-2.168 (0.015)*	40.116 (0.001)*	45.716 (0 .000)**	3.374 (0.000)**
DMM	-2.493 (0.006)*	-0.385 (0.350)	0.404 (0.657)	15.115 (0.516)	16.326 (0.431)	7.165 (0.000)**
FDI	-7.926 (0.000)**	-5.392 (0.000)**	-1.541 (0.062)	32.935 (0.008)*	55.511 (0.000)**	18.686 (0.000)**
DREGSA	-3.212 (0.001)*	1.035 (0.849)	0.143 (0.557)	13.615 (0.627)	21.833 (0.149)	6.329 (0.000)**
DREGUS	-6.376 (0.000)*	-1.749 (0.040)*	-0.405 (0.343)	25.072 (0.069)	32.457 (0.009)*	7.092 (0.000)**
TIN	7.718 (1.000)*	-6.049 (0.000)**	3.014 (0.999)	0.380 (1.000)	0.282 (1.000)*	8.484 (0.000)**

* and ** denotes rejection of null at 5% and 1% significance levels.

Sample: 8 cross-sections, period 1994-2002
Probabilities for Fisher tests are computed using asymptotic chi-square distribution. The other tests assume asymptotic normality.

A number of conclusions can be drawn from the unit root tests. First the dependent variable (log odds ratio of IIT) is I(0) implying that the explanatory variables should be I(0). Second, a rejection of null by at least one test is used to return a verdict as to whether a variable is I(0) or not. From this it is concluded that all the variables are stationary implying that there is no need to proceed to test for panel cointegration.

3.2.2 The Estimation of the Equations

The fixed effects model can be estimated in two different ways. The first approach referred to as the Least Squares Dummy Variable (LSDV) entails estimating the parameters, including the dummies. This approach suffers from a large loss of degrees

of freedom since too many dummies may aggravate the problem of multicollinearity among the regressors.

To solve this problem, a "WITHIN" model entails first premultiplying the regression equations with a centering matrix around the mean before performing ordinary least squares. This is equivalent to running a regression through the origin (in deviation form from the mean) and with an intercept. This transformation effectively wipes out the individual service sector effects and hence too many parameters are not estimated, as is the case with LSDV. The individual effects are then recovered and hence they have no standard errors attached to them to facilitate hypothesis testing. The parameters for the regressors, however, are not different from the two methods. In view of data limitations, we use the within estimation method.

3.2.3 Seemingly Unrelated Regression Model

The motivation for using Zellner's (1962) seemingly unrelated model emanates from the fact that the error terms in equation 3 might be contemporaneously correlated (i.e. capturing same effects), which can be utilised to get efficient estimates for the parameters. The factors that may cause contemporaneous cross-equation correlation may be the general state of the economy in South Africa and the US, capacity utilisation in the various service sectors, the political environment etc. Let $y_{it} = \ln\left(\frac{IIT_{it}}{1-IIT_{it}}\right)$, then equation 3 can be written in SUR form as;

$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \\ . \\ y_{8t} \end{bmatrix} = \begin{bmatrix} z_{1t} & 0 & 0 & ... & 0 \\ 0 & z_{2t} & 0 & ... & 0 \\ 0 & 0 & z_{3t} & ... & 0 \\ . & . & . & . & . \\ 0 & 0 & 0 & ... & z_{8t} \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ . \\ b_8 \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_2 \\ e_{3t} \\ . \\ e_{8t} \end{bmatrix} \quad \text{.....(8)}$$

Where the numbers 1 to 8 correspond to the various service sectors. Although each sector has the same explanatory variables, the SUR framework allows the explanatory variables to vary across service sectors (Wooldridge 2002: 144).

The covariance matrix of the joint disturbance vector is given by;

$$E(e'e) = \Omega = \sum \oplus I$$

where $\sum = \begin{bmatrix} s_{11} & s_{12} & . & . & s_{18} \\ s_{21} & s_{22} & . & . & s_{28} \\ . & . & . & . & . \\ . & . & . & . & . \\ s_{81} & s_{82} & . & . & s_{88} \end{bmatrix}$ .....(9)

If the SUR model above is viewed as a single equation, the parameter vector b can be estimated by the generalised least squares (GLS). There are, however, a number of conditions that must be satisfied. First, the explanatory variables must be orthogonal to the errors i.e. $E(z'_{it}e_{it}) = 0$. Second, the matrix $(z'_{it}z_{it})$ must be singular. Finally, the covariance matrix of the joint disturbance vector must be known. The GLS estimator is then given by;

$$\hat{b} = \left[z'\left(\sum^{-1} \oplus I\right)z\right]^{-1}\left[z'\left(\sum^{-1} \oplus I\right)y\right] \text{.....(10)}$$

When $s_{ij} = 0$ for $i \neq j$ or if $z_1 = z_2 = ... = z_7$ the SUR estimation and ordinary least squares estimations are not different. Since $\sum$ is not known apriori feasible GLS is employed whereby $\hat{\sum}$ is based on least squares residuals. The SUR estimation then proceeds as follows. First, the equation for each service is estimated separately using ordinary least squares. Second, the residual from the ordinary least squares is used to estimate $\sum$. Finally, the seven equations are jointly estimated using the feasible GLS from step two[1].

Cross-Section SUR (WITHIN Estimation)

Table 2: Dependent variable: Log odds ratio of intra-industry trade

Independent Variables and Service Sector	**Coefficient**	**t-statistic**
Homogeneous coefficients:		
Constant	-44.5068	-2.8131
Per capita income difference	-5.1082	-2.3972
SA trade imbalance (merchandise and services)	3.3256	2.9909
Difference in Market size:		
Research & Development and Testing Services	-27.7963	-6.4636
Travel services	-52.6991	-4.4794
Education and training services	-6.1737	-12.7027
Financial services	83.6934	4.9592
Telecommunication services	-3.0815	-0.4288

[1] Although there are 13 service sectors, SUR estimation was only done for 8 service sectors because of the violation of singularity condition i.e. the matrix $(z'_{it}z_{it})$ is singular.

Air freight services	3.8279	0.3258
Ocean freight services	263.1837	4.0029
Business, professional and technical services	-11.6508	-2.9421
Deregulation (Economic freedom) in South Africa:		
Research & Development and Testing Services	2.4960	0.6201
Travel services	-5.1798	-1.8239
Education and training services	-0.7990	-4.1110
Financial services	1.4185	5.6398
Telecommunication services	-1.2492	-0.7916
Air freight services	-0.7626	-1.0713
Ocean freight services	5.0036	2.1958
Business, professional and technical services	-1.2395	-2.8506
Deregulation (Economic freedom) in the US:		
Research & Development and Testing Services	5.5977	2.4516
Travel services	-1.2901	-0.4944
Education and training services	1.0636	1.8451
Financial services	-2.7863	-4.3743
Telecommunication services	11.1452	1.7655
Air freight services	0.5386	0.3691
Ocean freight services	-1.4621	-0.2913
Business, professional and technical services	4.1973	2.8506
US Foreign Direct Investment in South Africa:		
Research & Development and Testing Services	59.7867	1.3230
Travel services	16.5734	1.0439
Education and training services	5.7342	0.7134
Financial services	-7.5212	-5.6195
Telecommunication services	59.9687	2.2371
Air freight services	24.9902	2.1051
Ocean freight services	53.3860	1.8210
Business, professional and technical services	-54.7381	-3.4309
Service-Specific Fixed effects:		
Research & Development and Testing Services	7.8082	
Travel services	119.9006	
Education and training services	43.6217	
Financial services	-19.0825	
Telecommunication services	-32.9788	
Air freight services	44.4012	
Ocean freight services	-186.3645	
Business, professional and technical services	22.6941	
Diagnostic statistics		
Weighted statistics		
R-squared: 0.9997 Adjusted R-squared: 0.994		
F-statistic: 2688(0.000)		
Durbin-Watson statistic: 2.5248		
Unweighted Statistics		
R-squared: 0.6899		
Durbin-Watson statistic: 2.5248		

Note: Sample period: 1994-2002
Cross-section SUR Standard errors and covariance used and degrees of freedom corrected
Model estimated using Eviews5 econometric software

Since the above model is a logistics model but on continuous scale, the coefficients should be interpreted accordingly. The significantly negative coefficient of per capita income difference means that income dissimilarity between the South Africa and the US lower the log odds of intra-industry trade. However, since the logarithm is strictly monotone, we can directly conclude that the income dissimilarity makes trade South Africa-US trade in services to be less of intra-industry type (i.e. more inter-industry). The results also show that income dissimilarities reduce the odds ratio of intra-industry by a factor of 165(i.e. $\exp(-5.1082) = 165.4$).

This finding confirms hypothesis 1, which states that dissimilarities in demand structure or resource endowments will reduce the possibility of South Africa exporting relatively differentiated domestic services and importing relatively differentiated foreign US services. This is basically the Linder's (1961) *preference similarity hypothesis* and Dreze's (1960) trade based on style. Although Linder and Dreze analyses are based on manufactured products with different *quality characteristics*, their analysis can be extended to trade in services. The theoretical foundation of this assertion is expounded in Helpman's (1981) "ideal variety" model. Using Helpman's model, since consumers in South Africa and the US prefer their "ideal varieties" of services, there has to be compensation for not consuming the "ideal variety". This means that if there are no market access and national treatment restriction on services, a consumer (e.g. an exporter of minerals) in South Africa and the US will first choose the variety of services that meet his/her needs (e.g. insurance, trade finance or transportation). The consumer then chooses the service that best meets his/her needs among all varieties of services available in the market and taking into account the relative prices.

South Africa's trade imbalance increases the odds ratio of intra-industry trade. This contradicts hypothesis 2. Ideally, the Grubel and Lloyd index assumes that trade is balanced.

The differences in market size is negatively related to odds ratio of intra-industry trade in research & development and testing services; travel services, educational and training services; telecommunications; business, professional and technical services. The difference in market size represents the existence of economies of scale and the different ability of South Africa and US to provide differentiated services. The more different the ability of South Africa and the US to provide differentiated services, the less likely that the degree of intra-industry will be higher.

This confirms hypothesis 3 for some sectors. However, for financial services, airfreight services and ocean freight services, economies of scale do not increase the odds ratio of IIT.

The degree of deregulation in South Africa enhances IIT in financial services and ocean freight. Access to sound money (i.e. growth of money supply, inflation variability and freedom to own foreign currency), used as a proxy of market openness in financial services, enhances IIT in financial services. This is not surprising given the fact that South Africa has a fairly liberal and robust financial sector policy. The regulation

allows foreign banks to enter South Africa by establishing a representative office, branch or a subsidiary (Hodge and Nordas, 2001). Similarly, regulatory barriers (i.e. hidden import barriers and costs of importing) in South Africa also enhance IIT in ocean freight. This is in line with hypothesis 4. However, the degree of deregulation is inimical to IIT in travel; education services; business, professional and technical services and has no role in research & development and testing services; travel services; telecommunications and air freight services.

The degree of deregulation in the US enhances IIT in research & development and testing services; and business, professional and technical services. This is also in line with hypothesis 5. However, the degree of deregulation is inimical to IIT in financial services and has no role in travel services; education services; telecommunication; airfreight services and ocean freight.

The positive significance of foreign direct investment for most services shows that the activities of US multinational corporations in South Africa increases intra-industry trade in unaffiliated services. This consistent with the theoretical trade models of Helpman and Krugman (1985) and Markusen and Venables (1998,2000). However, for financial services and business, professional and technical services, the activities of US multinationals in South Africa decreases IIT of unaffiliated trade. This means that affiliated trade is a substitute for unaffiliated trade. In other words, South Africa-US trade is financed by American financial institutions based in South Africa (e.g. Citibank group) thus reducing the financial services provided by South African financial institutions.

The sector-specific effects tend to enhance IIT for most services except financial, telecommunication; and ocean freight. This means that there are some unique characteristics not captured in the model, which hamper South Africa-US IIT in these three services. With regard financial services, although South Africa has a high access to sound money rating (proxy for financial deregulation), it has not opened fully to cross-border trade in financial services and indeed there are restrictions on foreign banks operating in South Africa. Hodge and Nordas (2001) argue that most important of these restrictions are capital controls on the capital account of the balance of payments. The regulation does not allow a foreign bank to engage in retail banking market. It also requires them to have an endowment capital and capital requirement of 8 per cent of risk-adjusted assets to be held in South Africa. These are some of the issues that explain the negative financial sector-specific effects.

It is also important to notice the significant negative common constant, which tend to pull down IIT in service across all service sectors.

4.0 Conclusions and Policy Implication

The finding that the dissimilarities in demand structure reduce the possibility of trade in differentiated services between South Africa and the US has implications when it comes to liberalisation of services and US-SACU FTA. If there are no *market access* and *national treatment* restrictions, consumers in South Africa and US will choose their

"ideal varieties" irrespective of whether they are produced by South Africans or Americans. The questions that this finding raises are "do services produced in South Africa match those from the US in terms of quality?, will the services component of the US-SACU FTA lead consumers to shun South African services? "

The finding that economies of scale play some role in determining IIT in research & development and testing services; travel services, educational and training services; telecommunications; business, professional and technical services implies that South Africa can reap some benefits in these sectors. There is need to expand and provide more varieties in these services.

The study finds that market openness in South Africa and the US is important. Indeed, a more open economy will encourage internationalisation of services and hence greater volume of IIT. The theoretical models of Leamer (1988) and Harrigan (1994, 1996) confirm that market openness contribute to the expansion of trade and hence IIT. If South Africa wants to engage in international economic activities with the US, it is in her best interests to be proactive in following the trends towards globalisation and deregulation of the service industries.

The finding that the activities of US multinationals in South Africa decreases IIT of unaffiliated trade in financial services and business, professional and technical services, raises questions as to whether South Africa should promote FDI in these two service sectors. This also has implications the concessions that South Africa should give to US in the US-SACU FTA in these services.

The negative common constant and service sector-specific effects for financial services, telecommunication and ocean freight means that there are issues that hamper IIT, which can be unearthed by conducting a detailed survey.

Bootstrapping

The above results are based on first-order asymptotic theory to obtain an approximation to the type I critical values. However, as pointed out by Horowitz and Savin (2000) and Horowitz (2001), Monte Carlo experiments show that first-order asymptotic theory often gives a poor approximation to the distribution of test statistics with the samples used in most econometrics applications. Consequently, the true nominal probabilities that a test makes a type I error can be very different when an asymptotic critical value is used as in the results presented.

This problem can be solved to some extend by using bootstrap methodology, introduced by Efron (1979), to provide an approximation for the critical values that is more accurate than the approximation of first-order asymptotic theory. According to Mooney and Duval (1993: 1), bootstrapping explores the analogy between the sample and the population from which the sample was drawn. It involves "resampling" either the data or the error term with replacement many times in order to generate an empirical estimate of the entire sampling distribution of the parameters.

The panel data models can be bootstrapped in two ways. The most straightforward approach is to resample the entire cases of the data to generate B resamples of size n. Bootstrapped regression coefficients are then estimated for each resample using generalised linear model (GLM)[2]. The bootstrapped coefficient estimates can be converted into an estimate of the sampling distribution by placing a probability of 1/B at each value of $\hat{b}$. The weakness of this approach is that it ignores the error structure of the regression model.

The other approach is to resample the observed errors. Following (Amemiya 1985, Davidson and Hinkley 1998, Mooney and Duval, 1993, Efron and Tibshirani,1993), the approach proceeds as follows. First, the panel regressions are estimated and residuals generated. Second, calculate the empirical distribution function of the residuals. Third, we resample these residuals with replacement to generate random variables. Fourth, we generate a bootstrapped vector of response variable for this resample, by adding the resampled vector of residuals to the vector of fitted response values from the sample. Fifth, we calculate the parameters b_t^* and this is repeated B times. The distribution of $\hat{b}$ is approximated by the empirical distribution function of b_t^*.

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[2] Generalised linear model (See Fahmeir and Tutz 1994) assumes that the dependent variable belongs to exponential family of distributions so that OLS which assumes normal distribution is just a special case.

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Appendix 1

Indicators of South Africa-OECD Total Services Trade						
	Imports(mn US $)			*Exports(mn US $)*		
OECD Countries	**1999**	**2000**	**2001**	**1999**	**2000**	**2001**
Australia	111	119	88	107	101	123
Austria	92	82	62	45	40	36
Belgium-Luxembourg	158	175	167	144	143	132
Canada	94	81		41	52	
Czech Republic		1	0		3	5
Denmark	15	16	19	20	23	15
Finland	0	0	0	2	3	3
France	193	214	218	183	218	216
Germany	438	453		741	643	
Greece			13			13
Hong Kong, China						
Hungary		0	1		1	1
Ireland						
Italy		95	94		176	170
Japan	154	147	124	182	194	162
Korea						
Netherlands	221	192	153	156	155	156
Norway						
Portugal	41	40	26	28	26	21
Slovak Republic		0	0		2	2
Spain						
Sweden			33			30
United Kingdom	1,647	1,440	1,484	654	781	767
United States	1,308	1,351	1,228	887	909	937

Source: OECD,July 2003

* Authors' calculations

Appendix 2: Data Description

The following data are used for estimation;

IIT: Mirrored service unaffiliated trade data used to calculate South Africa-US intra-Industry Grubel and Lloyd index are taken from the United States Bureau of Economic Analysis (http://www.bea.gov/bea/di/1001serv/intlserv.htm). The data is in nominal figures due to lack of sectoral deflators. The IIT is calculated as follows;

$$IIT = 1 - \frac{|X - M|}{X + M} \text{ or } IIT = 1 - \frac{2Min(X, M)}{X + M}$$

PID: Nominal GDP per capita (US$) is for South Africa and US is collected from the IMF's International Financial Statistics. Instead of taking absolute values of intercountry differences in per capita incomes, we use a measure indicating relative differences that takes values between 0 and 1. This index is calculated using equation.

TIM: Trade Imbalance in goods and services. TIM is calculated as follows;

$$TIM = \frac{|X - M|}{X + M}$$

Where X and M are South Africa's exports and imports of goods and services to and from the United States respectively.

DMM: Data used to calculate differences in market size was collected from different sources. Proxies for market size variable differ from service to service as shown in the table below;

Appendix 2.1: Proxies for Market Size

Service	Proxy of Market Size	Source
Air freight	Air transport freight (million tons per KM)	World Development Indicators
Airport Services	Aircraft departures	World Development Indicators
Education	South African students enrolled in US tertiary institutions and vice versa	Open doors. **http://opendoors.iienetwork.org/**
Financial services	Foreign assets of banking and financial institutions	IMF International Financial Statistics
Legal services	Civil cases of Debt	STATSA and Federal Court
Management, Consulting and Public Relations	Data on other services in UNCTAD services trade data	UCTAD
Other Business, Technical and Professional services	Data on other services in UNCTAD services trade data	UCTAD
Ocean freight	Merchant shipping fleets: total (000 gross registered tons)	UN Statistical Yearbook
Ocean port services	Merchant shipping fleets: total (000 gross registered tons)	UN Statistical Yearbook
Research & Development, and Testing services	Trademarks and patents granted	World Intellectual Property Organisation (WIPO) **http://www.wipo.int**
Telecommunications	Fixed telephone lines and mobile subscribers per 1000 people	World Development Indicators
Travel	Number of tourist arrivals	World Development Indicators

Instead of taking absolute values of inter-country differences in market size, equation is used to calculate a measure indicating relative differences that takes values between 0 and 1. The calculation of this index solves two problems. First, it is not affected by magnitudes of particular country characteristics. This is indeed very important when comparing United States (large country) with South Africa (small country). Second, this index avoids the different units of measurements for the proxies of market size in different services. This is particularly useful when dealing with panel regression.

Indeed, without this index, pooling data is only feasible through seemingly unrelated regression (SUR).

DREG: *Index of Economic Freedom* published by the Fraser Institute (**http://www.freetheworld.com/**) is used as a proxy to measure the degree of deregulation in a particular service sector in South Africa and the United States.

The index measures the degree of economic freedom present in five major areas;
Size of Government: Government Consumption, Transfers and Subsidies, Government Enterprises and Investment, Top Marginal Tax Rate (Income Tax and Payroll Tax
Legal Structure and Security of Property Rights: Judicial Independence, Impartial Courts, Protection of Intellectual Property, Military Interference, and Integrity of the Legal System.
Access to Sound Money: Growth of Money Supply, Inflation Variability, Freedom to Own Foreign Currency
Freedom to Exchange with Foreigners: Taxes on International Trade (as percentage of exports and imports, mean tariff rate and variability of tariff rates), Regulatory Trade Barriers (Hidden import barriers, cost of importing), Size of Trade Sector, Restrictions on Capital Markets (Access to foreign capital, restrictions on foreign capital transactions)
Regulation of Credit, Labour and Business: Regulation of Credit Markets (Private ownership of banks, competition from foreign banks, extension of credit to private sector, avoidance of negative real interest rates), Regulation of Labour Markets (Impact of minimum wage, flexibility in hiring and firing, collective bargaining, incentives for unemployment benefits, military conscription), Regulation of Business (Price controls, administrative obstacles to new businesses, time spent with government bureaucracy, ease of starting a new business, irregular payments to government officials)

On a scale of 0 to 10, the measure gives a higher value to the country where there is limited state regulation on economic activity.

Table2.2: Degree of Deregulation (Economic freedom)

Sector	**Proxy for the Degree of Deregulation**
Research & Development and Testing Services	Protection of intellectual property rights
Travel services	Hidden import barriers
Education and training services	Country overall rating of economic freedom by Fraser institute
Financial services	Access to sound money
Telecommunication services	Freedom to exchange with foreigners
Air freight services	Regulatory trade barriers
Ocean freight services	Regulatory trade barriers
Business, professional and technical services	Restriction on foreign capital transactions

FDI: Mirrored sectoral foreign direct investment (US$mn) is collected from US the Bureau of Economic Analysis. FDI includes the initial transaction between two entities and all subsequent financial transactions between them and among affiliated enterprises,

both incorporated and unincorporated. Position of total and sectoral US foreign direct investment abroad is used to calculate a ratio as follows;

$$FDI = \frac{FDI_i}{FDI_t}$$

where FDI_i is the position of US foreign direct investment in South Africa in sector *i*, FDI_t is the position of US total foreign direct investment in South Africa.

Appendix 2.3 Measure for Relative Differences in Per Capita Income and Market Size

In line with Balassa and Bauwens (1987), absolute differences between the two country's per capita incomes and market size are not used because they are subject to a change of unit in measurement and may suffer from a size bias. In line with Balassa and Bauwens (1987) and Li et. (2003), the following formula is used to determine relative difference in per capita incomes and market size between South Africa and United States;

$$ID = 1 + \frac{w\ln(w) + (1-w)\ln(1-w)}{\ln(2)}, ID \in (0,1)$$

where;

ID=Relative measure which takes a value 0 to 1

w=South Africa characteristic/(United States characteristic + South Africa characteristic)

This variable exhibits a number of characteristics. First, as w approaches ½, ID approaches 0 while as w tends towards either 1 or 0, ID will take the value close to 1. Second, this variable is symmetrical with respect to country characteristics; it is not affected by a change in the unit of measurement and is a convex function of w.