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Estimation of Trade Elasticities: An Application of Johansen's Cointegration Method to the Bangladesh Trade Data

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This paper employs Johansen's cointegration method to estimate import and export demand elasticities for Bangladesh. Based on the graphical display of the data in the log of levels, the cointegrating vectors were estimated assuming a linear trend in the non-stationary part of the model, both for the import demand and the export demand equations. Trace test as well as λ-max test suggest that only a single statistically significant cointegrating vector is present among the variables of the import demand and the export demand equations. Normalizing the cointegrating vector for the import demand with respect to the log of the import variable and the export demand with respect to the log of export variable the estimated elasticity with respect to price change originating from exchange rate movement were about –3 and 2.4 respectively, implying the comfortable fulfillment of the Marshall-Learner condition. So currency depreciation or devaluation, given relative prices and income, will improve trade balance for Bangladesh in the long run.

1. Introduction

In fixed exchange rate system government uses exchange rate as a policy tool to influence trade pattern favorably, whereas in a managed floating system government occasionally intervene in the currency market to change the exchange rate in the desired direction. Whatever may be the method the success of the government in influencing trade flow crucially depends on the trade elasticities. Measuring trade elasticities is not new, but in most cases the estimates are based on misspecified model or wrong methodology. Since time series data almost invariably show non-stationarity, estimates based on simple ordinary least square (OLS) method on level data may be misleading. Again differencing the data and running OLS on the resulting

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differenced series only is not also appropriate. By differencing we lose long-run information contained in the level data of the variables. The correct methodology here is to find if there exists any cointegrating relationship among the variables, and if so, combine the differenced and the level variables into an error-correction framework to estimate the desired coefficients. A common strategy is to follow the two-step Engle-Granger (1987) methodology. But when there are more than two variables, as will be case here, the above method is not able to detect the presence of multiple cointegrating vectors. Moreover, power of such tests in small samples has been found to be low. The present study employs maximum likelihood based technique of estimating cointegrating vectors as proposed by Johansen (1988), and Johansen and Juselius (1990). An attractive and useful feature of this model is that it can find out, and at the same time estimate, the multiple cointegrating vectors that may be present among the data series.

The paper is structured as follows. After briefly highlighting the objectives of the paper in section II, existing literature regarding the estimation of trade elasticities are reviewed in section III. Section IV discusses the methodological issues and analyzes the result. Summary and some concluding remarks are contained in the final section.

2. Objectives

Empirically modelling equilibrium relationship as well as determining the dynamic adjustment process toward equilibrium is important both for policy purpose and understanding the economic system in hand. From a set of variables that have theoretically meaningful relationship, the paper attempts to find out the number of cointegrating combinations among these variables and build empirical model to estimate short-run and long-run trade elasticities. These elasticity estimates are important in that they help us infer about the fulfilment of the Marshal-Learner condition and potential for improvement of trade balance through devaluation.

3. Literature Review

At the macroeconomic level the findings about the effects exchange rate changes on trade balance is not conclusive. Depending the type of methodology used researchers have reached mixed conclusions. Cooper

(1971) made some early theoretical contributions on the effects of devaluations in developing countries. The upshot of his analysis was that devaluations in developing countries are likely to be deflationary in the first instance and thus may make room for improvement in balance on goods and services. For a group of developing countries Kamin (1988) tried to explain some stylized facts of devaluation. He observed that immediately after devaluation, export growth tends to rise sharply, import growth continues to fall, and output growth remains more or less stable (short-run effects). Subsequently, export growth rises somewhat more before stabilizing, import growth rebounds to surpass the pre-devaluation rates, and output growth slowly rises to match its earlier performance (long-run effects). His result suited well for the average countries, but there were considerable discrepancies in the results when individual countries were considered.

Gylfason and Risager (1984) estimated the trade elasticities from a macro model and found that devaluations improve trade balance. On the other hand Marquez (1990) used band spectrum analysis and found that for the developing countries the sum of export and import elasticities is not sufficient for devaluations to improve trade balance.

Some literature in the context of Bangladesh is also available. Ball and Feldstein (1998) used a numerical analysis and inter temporal general equilibrium model to explain various macroeconomic shocks including devaluation using Bangladesh parameters. They got positive results for output from reduced government expenditure and a moderate devaluation. In a similar vein Ahammad (1995) used a computable general equilibrium model incorporating key institutional features of the Bangladesh economy. His simulation result, using the data for the year 1989, for different macroeconomic shocks including devaluation explained how the structure and growth of industries were affected by these shocks. Empirical analysis of exchange rate change on Bangladesh external sector using time series data is severely lacking. The present study is directed toward fulfilling that gap.

4. Data, Methodology, and Results

The analysis is based on a yearly dataset of the Bangladesh economy over the period 1973-2005. For most of the variables used in the study,

data comes from the International Financial Statistic (IFS) CD ROM, various issues of the Statistical Yearbook of Bangladesh, and the IMF online database. All the variables are in log form as we are assuming the presence of multiplicative effects among the variables. To estimate the relevant trade elasticities, import and export demand functions of the following forms, as suggested by Dornbusch, et. al. (2004), were considered:

$$\log M_t = \beta_{11} \log\left(\frac{P}{P^w}\right)_t + \beta_{12} \log E_t + \beta_{13} \log Y_t \qquad (1)$$

and

$$\log X_t = \beta_{21} \log\left(\frac{P_x}{P_x^w}\right)_t + \beta_{22} \log E_t + \beta_{23} \log Y_t^w \qquad (2)$$

A description of the relevant variables and their unit of measurement are given below the dataset in appendix A. The first equation assumes that import depends on relative price, nominal exchange rate, and home income, while in the second equation export depends on relative price, exchange rate, and world income. Since the United States is Bangladesh's major trading partner and world macroeconomic events are closely tied up with the US economy, the relevant US variables were used as proxies for the world variables. As regard signs of the coefficients, the price term (domestic price relative to import price) and the income term in the import demand function are expected have positive signs, whereas the coefficient on the nominal exchange rate is likely to have negative sign. For the export demand function, nominal exchange rate and income term are expected to have positive signs, and the price term (export price relative to world price) to have negative sign.

We want to find if there is any statistically significant long-run equilibrium relationship among all or some of the variables in equations (1) and (2). In both the equations, since there are more than two variables, there may exist more than one equilibrium relationship in the cointegrating space spanned by the multiple cointegrating vectors. Such additional relationships are often dictated by economic theory (King, et. al. 1991). For example, the cointegrating vector in equation (1) might be [0 β_{11}, β_{12}, 0] or [0 β_{21}, β_{22}, 0] in equation (2), which would indicate the purchasing power parity relationship.

The first step in our approach to cointegration is to test the relevant variables for stationarity. If all the variables are stationary then OLS method will be sufficient to extract the long-run relationship among the variables under consideration. Whereas if some or all of the variables are non-stationary, we need to find out if some linear combinations of them are stationary. Augmented Dicky-Fuller test was performed on each of the variables separately to determine whether they are individually non-stationary. The Dicky-Fuller test statistic values and the corresponding 5% and 1% asymptotic critical values are reported in table 1.

Table 1: Testing for stationarity of the variables

Variables	No. of lags*	Test values (τ)	5% Critical Values	1% Critical values
ln m	0	-3.39	-3.60	-4.38
ln x	0	-2.35	-3.60	-4.38
ln e	0	-2.97	-3.60	-4.38
ln (P/Pw)	0	-0.37	-3.60	-4.38
ln (Px/Pxw)	0	-2.68	-3.60	-4.38
ln Y	5	-3.82	-3.60	-4.38
ln YUS	2	-3.46	-3.60	-4.38

Note:

- Lag lengths are selected in such a way that Akaike Information Criterion (AIC) and Swartz Crieterion (SC) are minimized.
- Test values are the estimated coefficients (α_2) from the following equation:

$$\Delta x_t = \alpha_0 + \alpha_1 t + \alpha_2 x_{t-1} + \sum_{j=1}^{k} \Delta x_{t-j} + \varepsilon_t$$

i.e. the data are assumed to have a drift term and a time trend, and the critical values are obtained accordingly.

The decision rule here is if the computed absolute values of the τ-statistics (column 3 in table 1) exceed the Dicky-Fuller critical value, we reject the null hypothesis of non-stationarity and conclude that the data are stationary. Otherwise the data are treated as non-stationary. Except for ln Y, all the variables are non-stationary at 5% level of significance. But the above variable is non-stationary at 1% level of significance. The

non-stationary nature of the data, with shifting mean and/or variance, is also apparent in the plot of these data in appendix B. Hence we treat all the variables as non-stationary and try to find out if there are any long run relationships among these variables as specified in the import demand and export demand equations.

The Johansen's method starts with the p-variable vector autoregressive equation of the form:

$$X_t = \Pi_1 X_{t-1} + \cdots + \Pi_k X_{t-k} + \mu + \varepsilon_t \qquad (3)$$

Where X's are the vector of variables and k is the lag length, μ is the constant term, and $\varepsilon_t \sim N_p(0, \Lambda)$, i.e. the error term is a p-dimensional multivariate normal distribution with zero mean vector and covariance matrix, Λ. The above equation can be alternatively written as (see Johansen and Juselius, 1990)

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-1} + \mu + \varepsilon_t \qquad (4)$$

Where $\Gamma_i = -(I - \Pi_1 - \cdots - \Pi_i)$, i = 1,2, ….., k-1

and $\Pi = -(I - \Pi_1 - \cdots - \Pi_k)$

The key coefficient matrix in equation (4) is the Π matrix which contains information about the long-run relationship among the variables. There are three possibilities:

1. Rank (Π) = p implies that the vector process in equation (3) is stationary and we can run the model in level form.

2. Rank (Π) = 0 implies that model (4) without the ΠX_{t-1} term is appropriate, i.e. the vector autoregressive model in differenced form can be used.

3. 0 < Rank (Π) < p implies that the variables are non-stationary, but there are some long-run cointegrating relationship among them. Technically Π can be written here as $\Pi = \alpha\beta'$ where α and β are p×r matrices (r < p). The appropriate model to be used here should be in error correction form.

Therefore our main hypothesis is about the number of cointegating vectors (i.e. the value of r) in the β matrix. We maintain

H_0: r = p (in model 3), against

H_1: $\Pi = \alpha\beta'$ (i.e. r < p in model 4)

Where α and β are p × r matrices and r < p. If H_1 is accepted we estimate the model (4) under the hypothesis $\Pi = \alpha\beta'$ and the resulting model will be in vector error correction form. We should note that the r-vectors in the β matrix are not identified. The columns of β span the whole cointegrating space. Hence the data determine only the cointegrating space, and the space spanned by α. Since any non-singular transformation of a set of basis vectors represents another set of basis vectors for the same space we will present the result in normalized form.
The maximum likelihood estimation of the unrestricted model (4) involves two critical steps:
4. Regress ΔX_t on ΔX_{t-1}, …, ΔX_{t-k+1}, and 1. Then obtain the residuals R_{0t}
5. Regress ΔX_{t-k} on the same set of variables as above and obtain residuals R_{kt}
Now consider the following expression

$$S_{ij} = T^{-1}\sum_{t=1}^{T} R_{it}R'_{jt} \quad \text{(where i, j = 0, k)}$$

The S_{ij} matrix thus obtained is very useful in estimating the parameters in Π of equation 4 under the restriction H_0: $\Pi = \alpha\beta'$. Theorem 3.1 in Johansen and Juselius (1990) shows this to be

$$\widehat{\Pi} = S_{0k}S_{kk}^{-1} \qquad (5)$$

A Shazam procedure developed by Diana Whistler (2000) was used to get the estimates of equation (5) as well as the various other estimates derived later in this paper.

Table 1: Estimation of the Π matrix

Import Demand Equation				
log M	-1.1631	0.8168	-2.1708	5.0250
log ($^{P}/_{P^w}$)	-0.6481	0.3758	-1.2305	1.1829
log E	-0.0254	0.0326	-0.4830	0.2287
log Y	0.4366	-0.1364	-0.1241	-0.3510

Export Demand Equation				
log X	-0.1215	0.1954	0.1073	0.0913
log ($^{Px}/_{Px^w}$)	0.3372	-0.4054	0.3165	-0.6422
log E	-0.0993	0.0968	-0.7829	0.7501
log Y^*	0.0864	-0.0349	0.0669	-0.2525

The key feature of the Π matrix is that the rank of this matrix is equal to the number of linearly independent cointegrating vectors. If rank (Π) = r < p, there are r independent cointegrating vectors. The rank of this matrix can be found by testing for the number of nonzero characteristic values (or eigenvalues) it posses. If all the roots of the characteristic polynomial are zero, the rank of Π will also be zero and the variables will not be cointegrated. Rank (Π) > 0 would imply that at least one of the roots will be significantly different from zero and the corresponding eigenvectors associated with these roots would indicate the long-run relationship among the variables. All other eigenvectors (which are p-r in number) can be expressed as a linear combination of the eigenvectors associated with nonzero eigenvalues.

The Maximum Likelihood estimates of the cointegrating vectors β under the hypothesis $H_0 : \Pi = \alpha\beta'$ is obtained by first solving the following equation

$$\left|\lambda S_{kk} - S_{k0}S_{00}^{-1}S_{0k}\right| = 0$$

for various eigenvalues λ's and then for the corresponding eigenvectors $\hat{V} = (\hat{v}_1, \cdots, \hat{v}_p)$ which are normalized such that $\hat{V}S_{kk}\hat{V} = I$.

Testing for the Number of Cointegrating Vectors (r):

Two tests, namely the trace test and the λ-max test are performed to determine the number of cointegrating vectors. Both tests are based on the eigenvalues calculated above. The calculated eigenvalues and the corresponding eigenvectors are reported in table 2.

Table 2: Estimated Eigenvalues ($\hat{\lambda}$), Eigenvectors ($\hat{v}$), and Weights ($\hat{\alpha}$)

Import Demand Equation Eigenvalues, $\hat{\lambda}$ (0.0442 0.4018 0.5933 0.7649)								
	Eigenvectors ($\hat{v}$)				Weights ($\hat{\alpha}$)			
log M	-10.4761	5.9470	-14.2535	3.8553	0.0491	-0.0245	0.0371	0.0067
log (P/P^w)	7.0579	-5.6709	8.5408	2.1812	0.0766	0.0484	0.0118	0.0067
log E	-31.2452	24.2425	-1.2556	0.3292	0.0028	-0.0168	-0.0084	-0.0045
log Y	23.7721	-15.8944	12.8723	-1.2558	-0.0464	-0.0662	-0.0228	0.0049

Export Demand Equation Eigenvalues, $\hat{\lambda}$ (0.0287 0.2544 0.7153 0.7591)								
	Eigenvectors ($\hat{v}$)				Weights ($\hat{\alpha}$)			
log X	-2.7571	-4.0849	7.9541	2.5010	0.0098	0.0017	-0.0149	0.0125
log (P_x/P_x^w)	-0.0289	1.9647	-10.4234	2.9419	0.0242	-0.0241	0.0362	0.0069
log E	3.8644	-14.1116	-3.7895	2.9759	-0.0359	0.0456	-0.0010	-0.0015
log Y^*	3.3998	18.9443	-6.4382	-5.7784	-0.0125	-0.0107	0.0012	-0.0006

The likelihood ratio test statistic for H_1 in H_0 is

$$-2\ln\left(Q \mid H_1 \; in \; H_0\right) = -T\sum_{i=1}^{p}\ln\left(1-\hat{\lambda}_i\right)$$

Similarly, the likelihood ratio test statistic for testing $H_1(r)$ in $H_1(r+1)$ is

$$-2\ln\left(Q \mid H_1(r) \; in \; H_1(r+1)\right) = -T\sum_{i=1}^{p}\ln\left(1-\hat{\lambda}_{r+1}\right)$$

The calculated test statistics are reported in table-3 as trace test and λ-max test respectively. The 95% quantiles are taken from Johansen and Juselius (1990).

Table-3: Trace and λ-max test statistics with 95% quantiles
(Import Demand Equation)

Null, H_0	Alternative	Trace	95% quantiles	Null, H_1	Alternative	λ-max	95% Quantiles
r≤3	r=4	1.403	8.1	r≤3	r=4	1.402	8.1
r≤2	r≥3	17.332	17.3	r≤2	r=3	15.931	14.6
r≤1	r≥2	45.221	31.3	r≤1	r=2	27.889	21.3
r=0	r≥1	90.104	48.4	r=0	r=1	44.889	27.3

Trace and λ-max test statistics with 95% quantiles
(Export Demand Equation)

Null, H_0	Alternative	Trace	95% quantiles	Null, H_0	Alternative	λ-max	95% Quantiles
r≤3	r=4	0.904	8.1	r≤3	r=4	0.904	8.1
r≤2	r≥3	10.006	17.3	r≤2	r=3	9.102	14.6
r≤1	r≥2	48.949	31.3	r≤1	r=2	38.944	21.3
r=0	r≥1	93.070	48.4	r=0	r=1	44.121	27.3

If all the eigenvalues are near zero, the value of both the trace test $,-T\sum \ln\left(1-\hat{\lambda}_i\right)$, and the λ-max test, $-T\ln\left(1-\lambda_{r+1}\right)$, values will be close to ln(1) and hence to zero. The variables will not be cointegrated in this case. On the other hand, if one of the λ's (say λ_1) is in the range $0<\lambda_1<1$, then the first term of trace test will be negative, and when multiplied by –T will turn it into positive giving the trace statistic value which can be compared to the tabulated 95% quantiles to test for its statistical significance. The larger the value of λ, the larger will be the value of the test statistic. The difference between the two test is that while in case of trace test the alternative hypothesis is in general form (H_0: rank (π) =r against H_1: rank (π) ≤ r), the λ-max formulates the alternative in more specific form (H_0: rank (π) =r against H_1: rank (π) ≤ r+1).

Critical values of these tests are obtained by Monte Carlo simulation approach and have been reported in various places (see for example, Osterwald and Lenum, 1992, Johansen and Juselius, 1990, Enders, 2004). The theoretical distributions, and hence the critical values, depend on the number of non-stationary components under the null (i.e. p-r), and assumptions about the constant term μ in equation (3).

To test the null hypothesis H_0: r = 0, against the general alternative H_1: r ≥ 1, we use the trace test, whose value is found to be 90.104 from

the bottom of table 3. This value should be compared with the critical value obtained from a theoretical distribution which is constructed under the null hypothesis that there is a zero cointegating vector (i.e. p-r = 4) and that the constant term is unrestricted. The value thus obtained is 48.4 which is far below the test value indicating that the null is not binding (i.e. we reject the null) and encourages us to sequentially test for the second null H_0: r = 1, against H_1: r ≥ 2. Similar comparison this time also leads us to the rejection of the null indicating that there must be at least two cointegrating vectors among the variables used in the import demand function. Since in the third step the alternative is accepted we naturally reach the conclusion that there are two cointegrating vectors in the import demand equation. λ-max test also takes us to the same conclusion of two cointegrating vecors. Examining the results in the lower panel of table 2 also confirm us about the existence of two cointegrating vectors in the export demand equation.

Since there are two statistically significant cointegrating vectors one of the eigenvectors from table 2 could be used to represent the long-run import demand function. The first vector seems promising in this context and we normalize it so that the coefficient of the import variable becomes –1. The resulting relationship is

$$\log M_t = 0.6737 \log\left(\frac{P}{P^w}\right)_t - 2.9825 \log E_t + 2.2691 \log Y_t$$

Similarly the export demand function will have the representation (also choosing the first vector from the lower panel of table 2)

$$\log X_t = -0.0184 \log\left(\frac{P_x}{P_x^w}\right)_t + 1.4016 \log E_t + 1.3056 \log Y_t^w$$

All the estimated coefficients in both the long-run equations (import demand and export demand) are of appropriate sign. The coefficients of the log E_t term suggest that nominal devaluations, given relative prices, domestic and foreign income level, do affect trade flow favorably in the long-run. Moreover since the sum of the absolute values of the import and export demand elasticity coefficients is |-2.9825| + |1.4016| or 4.341 > 1, the Marshal-Learner condition for improving trade balance is satisfied comfortably.

So the message conveyed by the above analysis to the policymakers of Bangladesh is that whenever they are concentrating on improving trade balance through exchange rate management, success will depend on the following two circumstances:

1. While taking devaluation measure and maintaining it (i.e. not reversing the devaluation decision later), how well they can contain relative prices at the pre-devaluation level. Currency depreciation often lead to increase in domestic inflation if the country is import dependent and import demand elasticity is greater than one, which is the case here.
2. Changes in the world economic environment can also affect the ultimate effect of devaluation. If the outside world falls into recession world price is also likely to fall and world income will decline at the same time. Thus through relative price effect and income effect the positive effects of nominal devaluations may be concealed.

For completeness the above long-run analysis needs to be supplemented by short-run adjustment process. The adjustment coefficients are already reported in the right hand side of table 2. Since we found r = 2, we should have two linearly independent α_i vectors. The second vector in the adjustment coefficient matrix seems appropriate in explaining the import demand equation. With this vector the error correction model is

$$\Delta X_t = \alpha\beta' X_{t-1}$$

where $\Delta X_t = \left(\Delta \ln M_t \quad \Delta \ln \left(P / P_W \right)_t \quad \Delta \ln E_t \quad \Delta \ln Y_t \right)'$

and $X_{t-1} = \left(\ln M_{t-1} \quad \ln \left(P / P_W \right)_{t-1} \quad \ln E_{t-1} \quad \ln Y_{t-1} \right)'$

$\alpha = \left(-0.26 \quad 0.51 \quad -0.18 \quad -0.69 \right)'$ (after normalization. Note: Since β was normalized by dividing all of its elements by 10.4761, for consistency α has been normalized here by multiplying all its elements by 10.4761)

$\beta = \left(-1 \quad 0.6737 \quad -2.9825 \quad 2.2691 \right)'$ (normalized with respect to log import)

In detail the vector error correction model now becomes

$$\begin{bmatrix} \Delta \ln M_t \\ \Delta \ln \left(P / P_W \right)_t \\ \Delta \ln E_t \\ \Delta \ln Y_t \end{bmatrix} = \begin{bmatrix} -0.26 \\ 0.51 \\ -0.18 \\ -0.69 \end{bmatrix} \begin{pmatrix} -1 & 0.67 & -2.98 & 2.27 \end{pmatrix} \begin{bmatrix} \ln M_{t-1} \\ \ln \left(P / P_W \right)_{t-1} \\ \ln E_{t-1} \\ \ln Y_{t-1} \end{bmatrix}$$

Or

$$\begin{bmatrix} \Delta \ln M_t \\ \Delta \ln \left(P / P_W \right)_t \\ \Delta \ln E_t \\ \Delta \ln Y_t \end{bmatrix} = \begin{bmatrix} -0.26\ \beta' X_{t-1} \\ 0.51\ \beta' X_{t-1} \\ -0.18\ \beta' X_{t-1} \\ -0.69\ \beta' X_{t-1} \end{bmatrix}$$

The above system indicates that if actual import exceeds the equilibrium import some year, 26 per cent of the gap is closed in the next year. The second equation shows that import above equilibrium level induces relative price increases which may be attributed to the high import content of the Bangladesh GDP. The third equation implies that a million dollar excess import induces an 18 percent fall in the value of taka. Finally GDP also falls by 69 percent in a year in response to excess import in the previous year which also helps to restore import balance as import declines with falling income.

5. Summary and Conclusion

The estimation framework and inference procedure used in the study is due to Johansen and his coauthors. The step begins with estimating a k-th order VAR in p-variables. The likelihood that there are r-cointegrating vectors, H(r), against p-cointegrating vectors, H(p), is tested using the so called trace test and the λ-max test. Larger value of the test is evidence against H(r) and for H(p>r), whereas small value of the test is not evidence against H(r) and the cointegrating rank is taken as equal to or less than r. Both methods suggest the presence of two cointegrating vector in both the export and import demand equations. We have chosen the vectors that theoraticlaly resembles these two functions The estimated long-run coefficients of the exchange rate

variables are encouraging for relying on exchange rate base measures for improving trade balance. The estiamated income elasticity coefficient of greater than unity is also consistent with the fact that Bangladesh is integrating with the world economy at a faster rate than the rate at which the country is growing.

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Appendix A: The Dataset

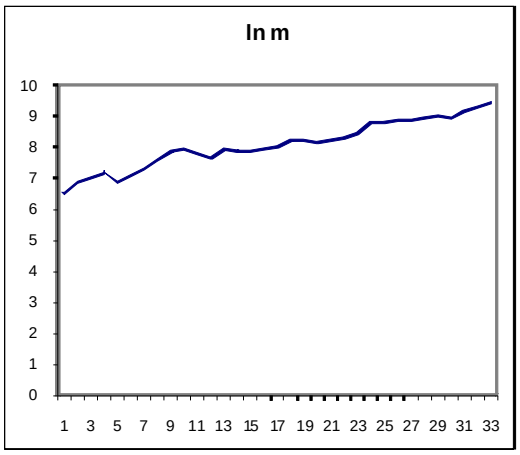
Year	E	P	PM	PX	X	M	Y	PXUS	YUS	PUS
1973	7.85	6.692	55.11	61.01	260.33	682.71	45.11	35.349	1382.73	25.797
1974	8.226	9.407	89.52	72.41	357.73	986.39	71.09	45.132	1499.98	28.643
1975	12.186	16.095	104.21	58.4	347.91	1078.42	125.74	50.483	1638.33	31.259
1976	15.399	12.253	89.52	64.92	327.24	1321.25	107.46	52.159	1825.28	33.052
1977	15.375	11.856	82.84	75.68	400.77	952.15	105.36	54.051	2030.92	35.196
1978	15.016	15.464	83.73	72.43	475.69	1163.12	146.37	57.78	2294.7	37.888
1979	15.552	17.462	76.13	82.77	548.47	1512.6	172.82	65.726	2563.3	42.156
1980	15.454	28.002	102.89	107.99	658.68	1908.36	280.78	74.644	2789.52	47.8513
1981	17.987	30.091	116.76	93.74	758.51	2598.96	322.14	81.508	3128.43	52.788
1982	22.118	33.514	122.12	80.67	790.63	2699.08	361.74	82.427	3255.02	56.04
1983	24.615	36.51	115.74	82.18	769.44	2463.87	408.31	83.292	3536.67	57.84
1984	25.354	42.021	114.09	96.98	724.5	2164.77	489.79	84.427	3933.17	60.337
1985	27.9946	46.483	117.27	117.49	931.43	2825.23	561.94	83.779	4220.25	62.486
1986	30.407	49.971	101.34	85.21	998.78	2542.35	632.69	84.589	4462.82	63.647
1987	30.95	55.169	92.5	88.34	879.92	2546.1	727.71	86.053	4739.47	66.028
1988	31.733	58.94	94.032	103.35	1067.09	2715.08	799.93	92.1113	5103.75	68.675
1989	32.27	64.008	100	100	1290.98	3041.42	890.6	94.522	5484.35	71.99
1990	34.569	67.625	105.97	103.24	1304.87	3650.36	1003.29	95.3878	5803.07	75.876
1991	36.596	72.086	110.49	110.04	1671.34	3618.1	1105.18	96.246	5995.92	79.089
1992	38.951	74.231	107.41	108.42	1688.84	3411.91	1195.42	96.3417	6337.75	81.485
1993	39.567	74.444	110.91	115.88	2097.84	3731.54	1253.7	96.883	6657.4	83.89
1994	40.212	77.252	114	122.35	2277.94	3994.16	1354.12	98.942	7072.23	86.077
1995	40.278	82.927	124.18	129.59	2660.74	4602.47	1525.18	103.925	7397.65	88.492
1996	41.794	86.438	149.1	149.02	3173.11	6501.54	1663.24	104.492	7816.82	91.086
1997	43.892	89.109	151.53	153.24	3297.23	6621.11	1807.01	103.075	8304.33	93.215
1998	46.906	93.809	162.99	168.04	3778.4	6898.41	2001.77	99.675	8746.98	94.662
1999	49.085	98.176	178.5	178.54	3831.27	6973.77	2196.97	98.417	9268.43	96.733
2000	52.142	100	180.07	178.46	3921.92	7694.39	2370.86	100	9816.97	100
2001	55.807	101.587	193.62	182.75	4690.68	8359.92	2535.46	99.158	10127.9	102.826
2002	57.888	104.834	208.18	187.06	6102.36	7780.13	2732.01	98.175	10469.6	104.457
2003	58.15	109.58	224.31	191.74	7050.13	9491.99	3005.8	99.733	10960.7	106.828
2004	59.513	114.227	240.24	199.51	8150.68	11157.1	3329.73	103.575	11712.5	109.688
2005	64.328	119.958	256.29	200	9186.22	12291.7	3684.76	106.875	12455.8	113.41

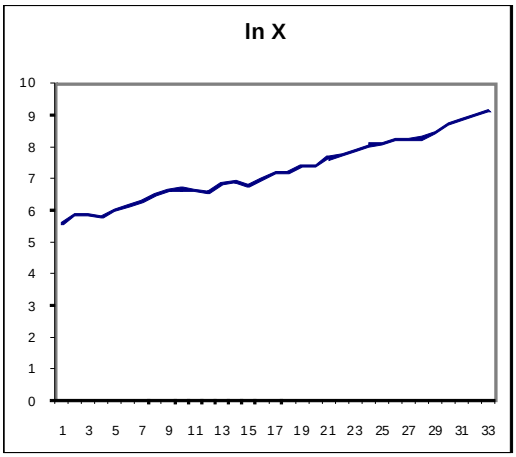
Variable Description:

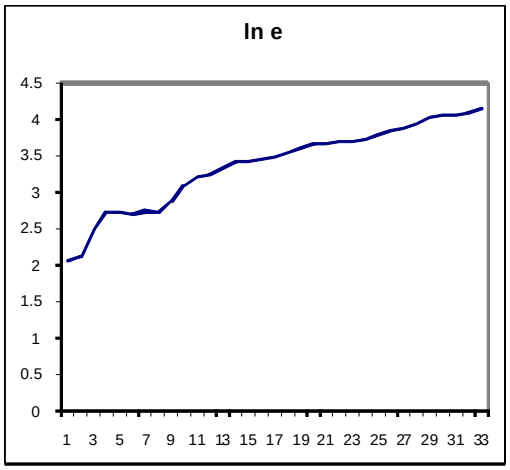
E=Exchange Rates, taka per us dollars
P=GDP deflator (2000=100) of Bangladesh
PM=Import Price Index
PX=Export Price Index
X=Export (millions of us dollars)
M=Import (millions of US dollars)
Y=GDP of Bangladesh (billion taka)
PUS=Consumer Price Index of the USA, (used as proxy for world price P^W)
PXUS=Export Price Index of the USA (used as proxy for world export price $P_X{}^W$)
YUS=US GDP (billions of US dollars) (used as proxy for world income Y*)

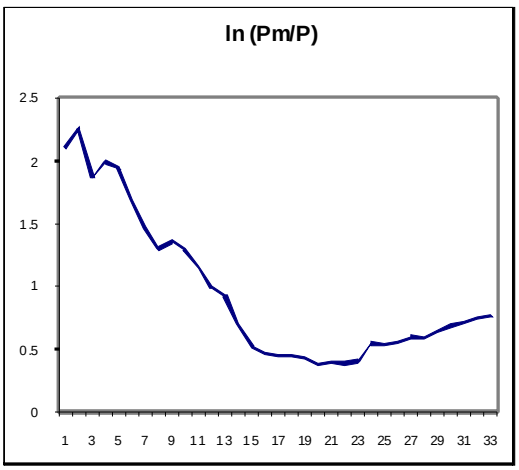
Appendix B

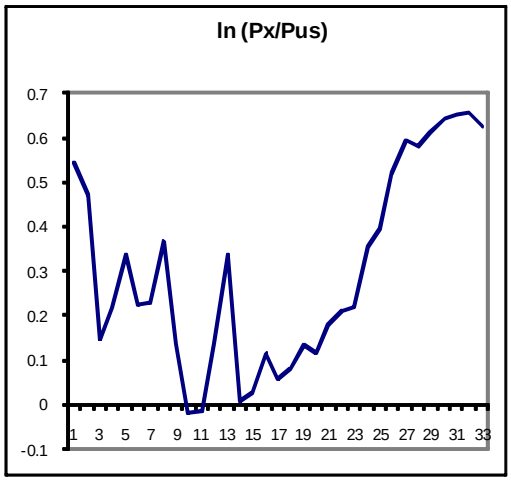
Plot of the Series

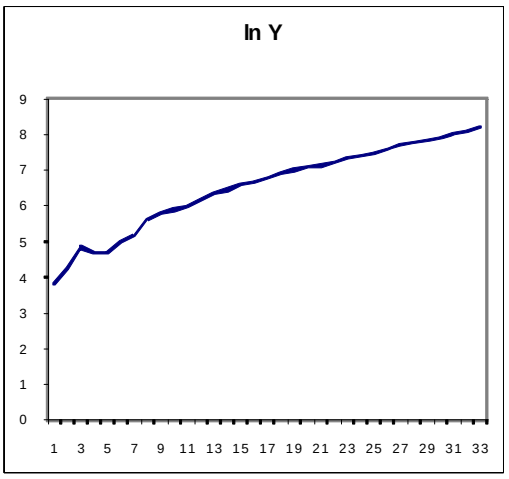


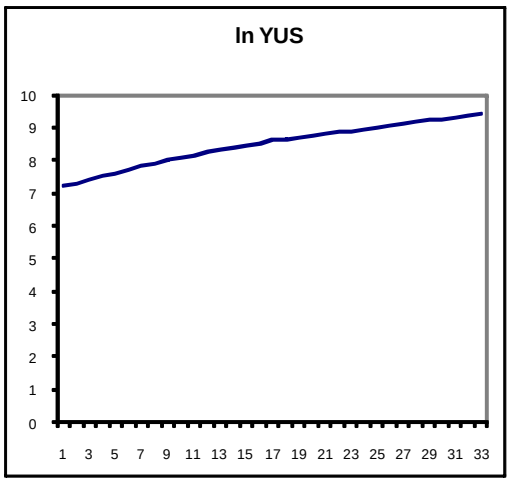







ln (Px/Pus)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33


ln Y
9
8
7
6
5
4
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33


ln YUS
10
9
8
7
6
5
4
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33

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Exchange Rate Determination: Empirical Evidence from the Monetary Model in Malaysia

Wong Hock Tsen[1]

This study examines the determination of exchange rate in Malaysia using the monetary model. The results of the autoregressive distributed lag (ARDL) approach shows that there is a long-run relationship between exchange rate and its determinants, namely relative money supply, relative demand, interest rate differential, and oil price. More specifically, an increase in relative money supply or interest rate differential will lead to a decrease in exchange rate in the long run. Conversely, an increase in oil price will lead to an increase in exchange rate in the long run. The results of the generalised forecast error variance decompositions show that oil price is relatively least important than relative money supply in the determination of exchange rate in Malaysia.

1. Introduction

The determination of exchange rate is an important issue in international finance. However, this issue remains open and little consensus exists on factors that influence exchange rate. One of the models used in the determination of exchange rate is the monetary model.[2] Many empirical studies show the monetary model to have a better power of out-of-sample prediction than the random walk model (Zhang, Lowinger, and Tang, 2007). Loria, Sanchez, and Salgado (2009) examine the Mexican peso against the United States (US) dollar using the monetary model. The results of the cointegrated structural vector autoregressive (SVAR) model show that there are robust short and long-run relationships between exchange rate and its determinants. Fundamental shocks influence changes in exchange rate. Husted and MacDonald (1999)

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[2] See Copeland (2008) for other models of exchange rate determination.

show that fundamentals influence changes in exchange rates of many Asian countries. Baharumshah and Masih (2005) examine the determination of Singaporean dollar and the Malaysian ringgit against Japanese yen, respectively using the monetary model augmented by current account balance. The results show that the model fits the data well. Moreover, the model produces good in-sample and out-of-sample forecasts. Baharumshah, Siti Hamizah, and Ahn (2009) examine the predictive power of the monetary model for the Malaysian ringgit against the US dollar. The out-of-sample forecasts show that the monetary model outperforms the random walk model. The monetary model does well at the four to eight quarters horizon.

Chen and Chen (2007) show that there is a link between real oil price and real exchange rate in the G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) using a monthly panel. Moreover, the panel predictive regression suggests real oil price has significant forecasting power. The out-of-sample prediction performances demonstrate greater predictability over longer horizons. Furthermore, the results show real interest rate differential and productivity differential to have important impact on real exchange rate. Bergvall (2004) shows amongst others that demand factor accounts for most of the long run variance in real effective exchange rate for Finland and Sweden whilst terms of trade and real oil price are found to be the most important determinant of long-run movement in real effective exchange rate for Norway and Denmark. On the other hand, Huang and Guo (2007) show amongst others that an increase in real oil price will lead to a minor appreciation of real effective exchange rate in the long run as China depends less on imported oil. The world oil price has been characterised by high volatility, high intensity jumps, and strong upward drift rather than to fall above the expected mean (Askari and Krichene, 2008: 2134; Dvir and Rogoff, 2009: 9). Askari and Krichene (2008: 2135) find that oil price volatility measured by implied volatility was excessively high, that is, in the range of 30 percent. This implies that oil price was facing uncertainty regarding future price development and sensitive to small shock and to news. Thus exchange rate may be volatile as well.

This study examines the determination of exchange rate in Malaysia using the monetary model augmented by oil price. Oil price is said to be volatile and to have a significant impact on exchange rate. Thus it is

important to examine the impact of oil price on exchange rate. Malaysia is a net-oil exporting country. Oil price could have different impact on exchange rates of the net-oil exporting and importing countries. Generally, an increase in oil price could appreciate exchange rate of the net-oil exporting country whilst could depreciate exchange rate of the net-oil importing country (Bergvall, 2004: 327). Previous studies focus mostly on the impact of oil price on exchange rate in the net-oil importing country (Chen and Chen, 2007; Bagchi, Chortareas, and Miller, 2004). The Pesaran, Shin, and Smith (2001) (PSS) bounds testing approach is used to examine the long-run relationship of variables in the monetary model. The PSS bounds testing approach does not impose restrictive assumption that all the independent variables are to be integrated of the same order. The relative importance of oil price with other variables in the monetary model is examined using the generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998).

The rest of this study is structured as follows. The next section describes the monetary model to exchange rate determination. This is followed by explaining the data and methodology used in this study and then empirical results and discussions. The last section includes some concluding remarks.

2. The Monetary Model to Exchange Rate Determination

The monetary model shows how exchange rate and monetary factor interact in the long run. The model is based on amongst others purchasing power parity (PPP) and a stable money demand function.

Purchasing Power Parity (PPP)

Purchasing power parity (PPP) states that exchange rate between two counties is the ratio of prices between the two counties:

$$E_{H/F} = \frac{P_H}{P_F} \tag{1}$$

where $E_{H/F}$ is exchange rate of home currency for foreign currency, P_H is home price, and P_F is foreign price.

Equation (1) can be rearranged to obtain:

$$P_H = E_{H/F} P_F \tag{2}$$

PPP implies that home price and foreign price are equal when measured in terms of the same currency.

The Monetary Model to Exchange Rate

Money market is in equilibrium when model demand is equal to money supply:

$$M_d = M_s \tag{3}$$

where M_d is money demand and M_s is money supply. Real money demand can be expressed in the following function:

$$\frac{M_d}{P} = L(Y, R) \tag{4}$$

where P is price level, Y is income, and R is interest rate. Money demand theory predicts that an increase income will lead to an increase in real money demand whilst an increase interest rate will lead to a decrease in real money demand.

Price level can be expressed in terms of money demand and money supply. In home country, domestic price can be expressed by assuming money market is in equilibrium and money demand function is given in equation (4) as:

$$P_H = \frac{M_{s,H}}{L(R_H, Y_H)} \tag{5}$$

where the subscript H denotes home country. In foreign country, foreign price can be expressed in a similar way as in home country as:

$$P_F = \frac{M_{s,F}}{L(R_F, Y_F)} \tag{6}$$

where the subscript F denotes foreign country.

Under PPP, exchange rate can be expressed as:

$$E_{H/F} = \frac{\frac{M_{s,H}}{M_{s,F}}}{\frac{L(R_H, Y_H)}{L(R_F, Y_F)}} \quad (7)$$

The monetary model makes a number of specific predictions about the long-run impacts of changes in money market on exchange rate changes. An increase in home (foreign) money supply will lead to an increase in exchange rate or home (foreign) currency is said to be depreciated (appreciated) as more money supply will lead to higher price in the economy. An increase in interest rate in home (foreign) country will lead to an increase in exchange rate or home (foreign) currency is said to be depreciated (appreciated). An increase in home (foreign) output will lead to a decrease in exchange rate or home (foreign) currency is said to be appreciated (depreciated) (Copeland, 2008: 149-173).

3. Methodology

A vector of variables, namely exchange rate, relative money supply, relative demand, relative interest rate, and oil price is examined. Moreover, a dummy variable, that is, one for the period of 1997, quarter II to 1998, quarter IV and the rest are zero to capture the influence of the Asian financial crisis, 1997-1998 is included in the estimation. An increase in relative money supply, relative demand, and interest rate differential will lead to an increase in exchange rate in the long run. An increase in oil price will lead to a transfer of wealth from the net-oil importing country to the net-oil exporting country. Moreover, a change in oil price will lead to a change in relative price of the commodities. More specifically, an increase in oil price will lead to an increase in relative price of the commodities in the net-oil exporting country more than an increase in the net-oil importing country. Thus exchange rate will appreciate in the net-oil exporting country. Nonetheless, the impact of oil price on exchange rates depends on the composition of imports of the net-oil importing country and also on preferences of portfolio of both the net-oil-importing and net-oil-exporting countries (Huang and Guo, 2007: 405).

The Elliot, Rothenberg, and Stock (1996) (ERS) and Phillips and Perron (1988) (PP) unit root test statistics are used to examine the stationarity of the series. The ERS unit root test statistic is shown to have a higher power for small sample size. The PSS bounds testing approach is used to examine the long-run relationship of the series. The PSS bounds testing approach does not impose restrictive assumption that all the independent variables are to be integrated of the same order. In other words, independent variable could be I(0), I(1) or mixture of I(0) and I(1) variables. More specifically, the bounds testing approach is conducted in the following way. The unrestricted error correction model is specified as:

$$\Delta \log ER_t = \beta_{10} + \beta_{11} Trend + \beta_{12} D_t + \sum_{i=1}^{p} \beta_{13i} \Delta \log ER_{t-1} + \sum_{i=0}^{p} \beta_{14i} \Delta \log M_{t-1}$$

$$+ \sum_{i=0}^{p} \beta_{15i} \Delta \log Y_{t-i} + \sum_{i=0}^{p} \beta_{16i} \Delta R_{t-i} + \sum_{i=0}^{p} \beta_{17i} \Delta \log O_{t-i}$$

$$+ \beta_{18} \log ER_{t-i} + \beta_{19} \log M_{t-i} + \beta_{110} Y_{t-i} + \beta_{111} \log R_{t-i}$$

$$+ \beta_{112} \log O_{t-i} + u_{1,t} \qquad (8)$$

where Δ is the first difference operator, log is the natural logarithm, *Trend* is a time trend, ER_t is exchange rate, D_t is the dummy variable to capture the influence of the Asian financial crisis, 1997-1998, M_t is relative money supply, Y_t is relative demand, R_t is interest rate differential, O_t is oil price, and $u_{1,t}$ is a disturbance term. The Wald or F-statistic is computed to test the null hypothesis, H_0: $\beta_{18} = \beta_{19} = \beta_{110} = \beta_{111} = \beta_{112} = 0$ against the alternative hypothesis, H_a: $\beta_{18} \neq \beta_{19} \neq \beta_{110} \neq \beta_{111} \neq \beta_{112} \neq 0$. The critical bounds values can be obtained from Pesaran, Shin, and Smith (2001). If the Wald or F-statistic falls outside the upper bound, the null hypothesis of no cointegration is rejected. In other words, log ER_t, log M_t, log Y_t, R_t, and log O_t are said to be cointegrated. However, no conclusive inference could be made for the Wald or F-statistic falls inside the critical bounds, unless the order of integration of the independent variables is known. If the Wald or F-statistic falls below the lower bound, the null hypothesis of no cointegration cannot be rejected.

If there is evidence of cointegration of the variables examined, the long-run model of the autoregressive distributed lag (ARDL) approach can be estimated as:

$$\log ER_t = \beta_{20} Trend + \sum_{i=1}^{q} \beta_{21i} \log ER_{t-1} + \sum_{i=0}^{q} \beta_{22i} \log M_{t-1} + \sum_{i=0}^{q} \beta_{23i} \log Y_{t-i}$$

$$+ \sum_{i=0}^{q} \beta_{24i} R_{t-i} + \sum_{i=0}^{q} \beta_{25i} \log O_{t-i} + u_{2,t} \qquad (9)$$

where $u_{2,t}$ is a disturbance term. The model is estimated by using the ordinary least squares (OLS) estimator.

The error correction model of the ARDL approach can be estimated as:

$$\Delta \log ER_t = \beta_{30} + \beta_{31} D_t + \sum_{i=1}^{q} \beta_{32i} \Delta \log ER_{t-1} + \sum_{i=0}^{q} \beta_{33i} \Delta \log M_{t-1} + \sum_{i=0}^{q} \beta_{34i} \Delta \log Y_{t-i}$$

$$+ \sum_{i=0}^{q} \beta_{35i} \Delta R_{t-i} + \sum_{i=0}^{q} \beta_{36i} \Delta \log O_{t-i} + \beta_{37} EC_{t-1} + u_{3,t} \qquad (10)$$

where EC_{t-1} is one period lag of the error correction term and $u_{3,t}$ is a disturbance term. The error correction term is derived from the error term of equation (9). The coefficient of the error correction term is expected to be negative and measures the speed of adjustment towards the equilibrium in the long run.

The generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998) are used to examine the relationship of variables in a system. The generalised forecast error variance decomposition identifies the proportion of forecast error variance in one variable caused by the innovations in other variables in a system. Thus the relative importance of a set of variables that affect a variance of another variable is identified. The generalised impulse response function traces the dynamic

responses of a variable to innovations in other variables in a system. A key feature of the generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998) is that they are invariant to the ordering of the variables in the vector autoregressive (VAR) system. Thus they provide robust results than the orthogonalised method of Sims (1980). Moreover, they allow for meaningful interpretation of the initial impact response of each variable to shocks to any of the other variables because they do not impose orthogonality (Wang and Dunne, 2003).

Let x_t is an $m \times 1$ vector of jointly determined dependent variables, which are assumed to be I(1) series, respectively. The infinite moving average representation of Δx_t can be written as:

$$\Delta x_t = \sum_{i=0}^{\infty} C_i \varepsilon_{t-i} + \sum_{i=0}^{\infty} C_i \Pi \Lambda w_{t-i} \text{ , } t = 1, 2, \ldots, T \qquad (11)$$

where C_i is $m \times m$ coefficient matrices, $\prod = \alpha' \beta$ (α and β are $m \times m$ matrices of full rank r, that is, rank ($\prod$) = r), Λ is an $m \times g$ matrix of unknown coefficients and w_t is an $q \times 1$ vector of deterministic and or exogenous variables.

The generalised impulse response function, which measures the effect of the shock to the j-th equation in (11) on Δx_{t+n} can be written as:

$$\Psi_{\Delta x_j}(n) = \sigma_{jj}^{-1/2} C_n \Sigma e_j \text{ , } n = 0, 1, 2, \ldots \qquad (12)$$

where σ is standard error, Σ is $m \times 1$ covariance matrix, and e_j is an $m \times 1$ selection vector with unity as its j-th element and zeros elsewhere.

The generalised forecast error variance decomposition is given by:

$$\theta_{ij}(n) = \frac{\sigma_{ii}^{-1} \Sigma_{l=0}^{n} (e_i' C_l \Sigma e_j)^2}{\Sigma_{l=0}^{n} (e_i' C_l \Sigma C_l' e_i)}, \; i, j = 1, \ldots, m \qquad (13)$$

Generally, the sum of the generalised forecast error variance decomposition is not one, that is, $\sum_{j=1}^{m} \theta_{ij}(n) \neq 1$ as the non-zero covariance between the original (non-orthogonalised) shocks.

4. Data

All the data were obtained from *International Financial Statistics*, the International Monetary Fund (IFS, IMF). Exchange rate is expressed by nominal effective exchange rate (2000 = 100). Relative money supply is expressed by ($M_{d,t}$ / $M_{w,t}$), where $M_{d,t}$ is the monetary aggregate M2 in Malaysia and $M_{w,t}$ is the monetary aggregate M2 in the world, which is expressed by the monetary aggregate M2 in the US. Relative demand is expressed by ($Y_{d,t}$ / $Y_{w,t}$), where $Y_{d,t}$ is the industrial production index (2000 = 100) in Malaysia and $Y_{w,t}$ is the industrial production index in the world, which is expressed by the industrial production index (2000 = 100) in the US.[3] Interest rate differential is expressed by the difference between the domestic interest rate and the world interest rate, that is, ($r_{d,t}$ - $r_{w,t}$), where $r_{d,t}$ is the money market rate in Malaysia and $r_{w,t}$ is the money market rate in the world, which is expressed by the money market rate in the US. Oil price is expressed by the world oil price (2000 = 100). The data are quarterly and the sample period is from 1975, quarter I to 2006, quarter IV. All data were seasonal adjusted and transformed into the natural logarithms before estimation, except interest rate differential.

Figure 1 shows the plots of the natural logarithms of exchange rate and oil price. Generally, these series, namely exchange rate and oil price moved in the same direction. Thus these series tended to be cointegrated. For the period of 1975, quarter I to 2006, quarter IV, the coefficient of correlation between nominal effective exchange rate and oil price was -0.1104. The standard deviations of those series were 17.1326 and 42.3702, respectively (IFS, IMF). They were closely related and oil price was more volatile than nominal effective exchange rate. Figure 2 shows the scatter plots of exchange rate against relative money supply, relative demand, interest rate differential, and oil price,

[3]Baharumshah, Siti Hamizah, and Ahn (2009) also use the industrial production index as the proxy to measure the income in their study.

respectively. Generally, there is no clear pattern can be concluded from the figure about the relationship of exchange rate against relative money supply, relative demand, interest rate differential, and oil price, respectively.

Figure 1 The Plots of the Natural Logarithms of Exchange Rate (log ER_t) and Oil Price (log O_t)

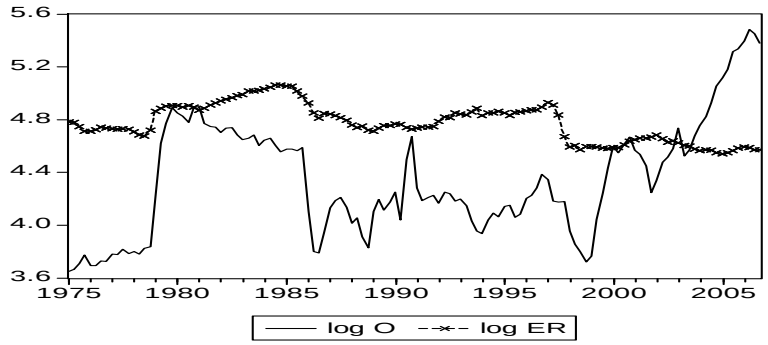
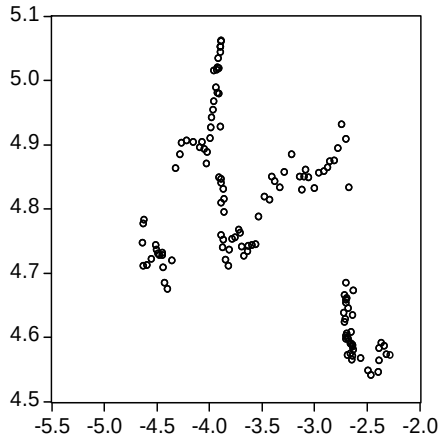
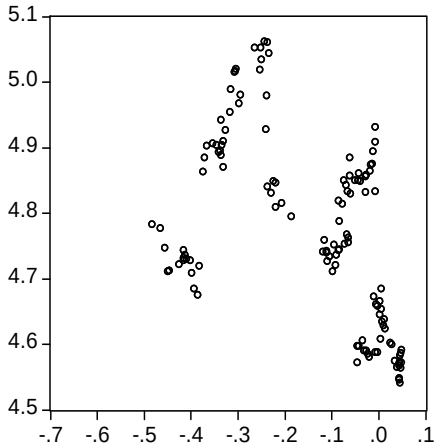


Figure 2 The Scatter Plots of the Natural Logarithms of Exchange Rate (log ER_t) against Relative Money Supply (log M_t), Relative Demand (log Y_t), Interest Rate Differential (R_t), and Oil Price (log O_t)

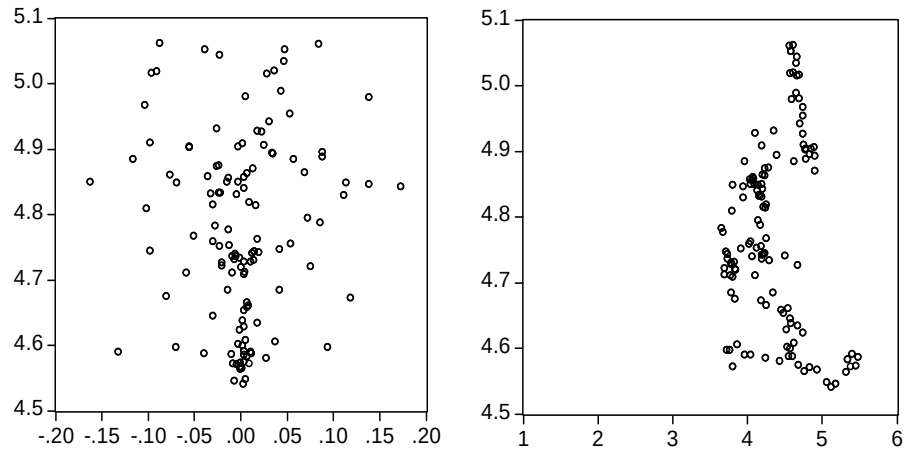
log ER_t and log M_t



log ER_t and log Y_t



log ER_t and R_t log ER_t and log O_t



5. Empirical Results and Discussions

The results of the ERS and PP unit root test statistics are reported in Table 1. The lag length used to estimate the ERS unit root test statistics is based on the Akaike Information Criterion (AIC). The lag length used to compute the PP unit root test statistics is based on the Newey-West Bandwidth, with the maximum lag length is set to eight. The results of the ERS and PP unit root test statistics show that all the variables are non-stationary in their levels but become stationary after taking the first difference, except relative money supply and interest rate differential. For relative money supply, the ERS unit root test statistic (Trend) shows no evidence of a unit root whilst the PP unit root test statistic (Trend) shows that it is a non-stationary series. For interest rate differential, the ERS unit root test statistics (No Trend, Trend) show that it is non-stationary series whilst the PP unit root test statistics (No Trend, Trend) show that it is a stationary series. Thus the variables examined could be the mixture of I(1) and I(0) variables.

Table 1 The Elliott, Rothenberg, and Stock (1996) (ERS) and Phillips and Perron (1988) (PP) Unit Root Test Statistics

	ERS (No Trend)	PP (No Trend)	ERS (Trend)	PP (Trend)
$\log ER_t$	-1.6718(1)	-1.2670(3)	-2.1833(1)	-2.0980(3)
$\Delta \log ER_t$	-6.8360**(0)	-6.6518**(7)	-6.8708**(0)	-6.6329**(7)
$\log M_t$	1.0628(6)	-0.3459(7)	-2.9466(6)	-1.7086(7)
$\Delta \log M_t$	-2.7870**(5)	-6.7505**(2)	-2.4108(5)	-6.7219**(2)
$\log Y_t$	1.1641(8)	-2.0379(8)	-0.6770(8)	-1.4828(8)
$\Delta \log Y_t$	-2.5309*(8)	-9.7811**(8)	-4.0346**(8)	-9.9451**(8)
R_t	-1.1412(6)	-31.7904**(8)	-2.6350(6)	-32.1004**(8)
ΔR_t	-4.3323**(8)	-52.5835**(8)	-4.7081**(8)	-52.3255**(8)
$\log O_t$	0.7930(8)	-1.4109(1)	-1.1138(8)	-1.7164(1)
$\Delta \log O_t$	-4.8281**(7)	-8.3830**(4)	-4.8891**(7)	-8.3512**(4)

The result of the PSS bounds testing approach is reported in Table 2. The choice of the lag used in the estimation of the test statistic is based on the AIC. The F-statistic is found to be outside the upper bound and statistically significant at the 1 percent level. Thus there is a long-run relationship among exchange rate, relative money supply, relative demand, interest rate differential, and oil price. In other words, these variables are moving together and would not move too far from each other in the long run.

Table 2 The Result of the Pesaran, Shin, and Smith (2001) (PSS) Bounds Testing Approach for Cointegration

F-Statistic
4.6507**

Notes: The critical values for bounds testing approach are from Pesaran, Shin, and Smith (2001). The critical values for unrestrictive intercept and restricted trend case with six regressors at the 1% level are 3.27 for lower critical bound, I(0) and 4.39 for upper critical bound, I(1). ** denotes significance at the 1% level.

The long-run and short-run coefficients of the ARDL approach are reported in Table 3. The long-run coefficients are estimated using

ARDL (3, 2, 0, 3, 0) selected based on AIC. The order of the variables is exchange rate, relative money supply, relative demand, interest rate differential, and oil price. In the long run, an increase in relative money supply or interest rate differential will lead to a decrease in exchange rate whilst an increase in oil price will lead to an increase in exchange rate in the long run.[4] There is no significant impact of relative demand on exchange rate in the long run. The short-run coefficients are estimated using the error correction model.

Table 3 The Long-Run and Short-Run Coefficients of the Autoregressive Distributed Lag (ARDL) Approach

	Long Run	Short Run
log M_t	-0.6353*	0.1681
log Y_t	0.4598	-0.2593
R_t	-48.7612	8.0184$^{@@}$
log O_t	0.6104**	0.0298
D_t	-	-0.0323**

Notes: $^{@@}$ denotes significance of the Wald test at the 1% level. ** (*) denotes significance of the t-test at the 1% (5%) level.

The result of the error-correction model is reported in Table 4. The error correction model fulfils the condition of no-autocorrelation. The result of the OLS estimator with White's Heteroscedasticity adjusted standard error is discussed when the test of heteroscedasticity is found to be significant. Figure 3 shows the plots of cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ). The plot of CUSUM shows no evidence of instability of the error correction model whilst the plot of CUSUMSQ shows some evidence of instability of the error correction model. Nonetheless, the error correction model can be said to be stable. The adjusted r-squared (R^2) is high, that is, 0.3516. In the short run, interest rate differential and oil price are found to be important in the determination of exchange rate.[5] Moreover, the Asian financial crisis is found to have a significant impact on exchange rate.

[4]The coefficient of interest rate differential is found to be statistically significant at the 10 percent level.

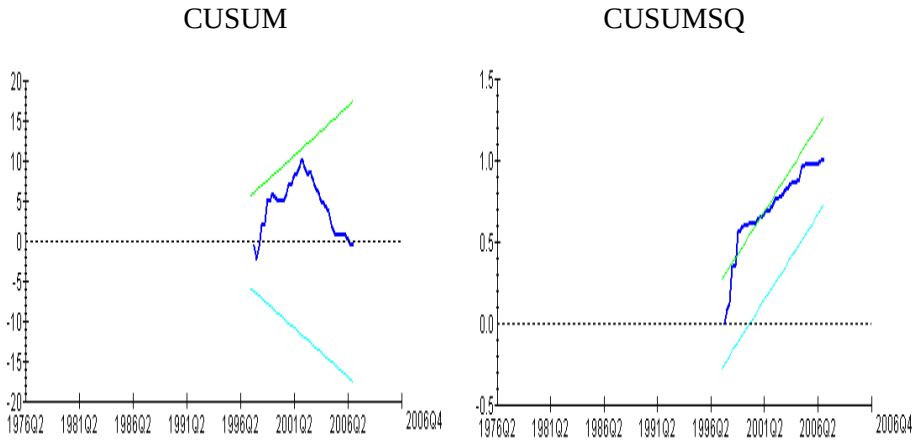
[5]The coefficient of oil price is found to be statistically significant at the 10 percent level.

Table 4 The Result of the Error Correction Model

	OLS	OLS – White
constant	0.0003	0.0003
	(0.0051)	(0.0057)
$\Delta \log M_{t-1}$	0.1681	0.1681
	(1.6982)	(1.4669)
$\Delta \log Y_{t-3}$	-0.2593	-0.2593
	(-1.4011)	(-1.6347)
ΔR_t	-0.2601	-0.2601
	(-3.0502)**	(-2.3679)*
ΔR_{t-1}	0.2372	0.2372
	(3.1418)**	(2.5406)**
ΔR_{t-3}	-0.1660	-0.1660
	(-3.0201)**	(-2.9680)**
ΔR_{t-4}	-0.1254	-0.1254
	(-2.2265)*	(-2.0963)*
$\Delta \log O_{t-2}$	0.0298	0.0298
	(1.6392)	(1.9173)
$\Delta \log ER_{t-1}$	0.3925	0.3925
	(4.4603)**	(3.3682)**
$\Delta \log ER_{t-2}$	-0.1840	-0.1840
	(-2.0551)*	(-1.6365)
$\Delta \log ER_{t-4}$	-0.2016	-0.2016
	(-2.5880)*	(-1.9624)
EC_{t-1}	-0.0174	-0.0174
	(-3.6648)**	(-3.0698)**
D_t	-0.0323	-0.0323
	(-2.9957)**	(-2.2060)*
Trend	-0.0001	-0.0001
	(-0.1816)	(-0.2119)
Diagnostic tests:		
Adj. R^2	0.3516	-
LM	1.4863	-
Reset	5.6483*	-
Normal	45.0249**	-
Hetero	15.5115**	-

Notes: Adj. R^2 is the adjusted R^2. LM is the Lagrange multiplier test of disturbance term serial correlation. Reset is the test of functional form. Normal is the test of the normality of disturbance term. Hetero is the test of heteroscedasticity. OLS denotes the results of the OLS estimator. OLS – White denotes the result of the OLS estimator with White's Heteroscedasticity adjusted standard error. Values in parentheses are the t-statistic. ** (*) denotes significance at the 1% (5%) level.

Figure 3 Plot of Cumulative Sum of Recursive Residuals (CUSUM) and Plot of Cumulative Sum of Recursive Residuals (CUSUMSQ)



Note: The straight lines represent critical bounds at the 5% level.

The coefficient of the error correction term, that is, the speed of the adjustment is found to be negative and statistically significant at the 1 percent level. Thus the condition for a long-term stable equilibrium is satisfied. The coefficient is -0.0174. The half-life period of shock is -40.1816. Thus the difference between the actual exchange rate and the equilibrium exchange rate is reduced by half, about 40 quarters or about 10 years after an exogenous shock.[6]

The generalised forecast error variance decomposition identifies the proportion of forecast error variance in one variable caused by the innovations in other variables in a system. Therefore the relative importance of a set of variables that affects a variance of another variable is identified. The results of the generalised forecast error variance decomposition are reported in Table 5. The results of the generalised forecast error variance decomposition, which are reported, are based on the 1-5, 10, 15, and 20 horizon periods. The result shows that relative money supply is the most important contributor to the forecast error variance of exchange rate. This is followed by interest rate

[6]The half-life period is calculated as log (0.5) / log (1 - α), where α is the coefficient of the error correction term (Bergvall, 2004: 329).

differential, oil price, and relative demand. Productivity differential accounts for about 3.5 percent of the forecast error variance of exchange rate whilst interest rate differential, oil price, and relative demand account for about 2.7, 0.9, and 0.6 percent, respectively.

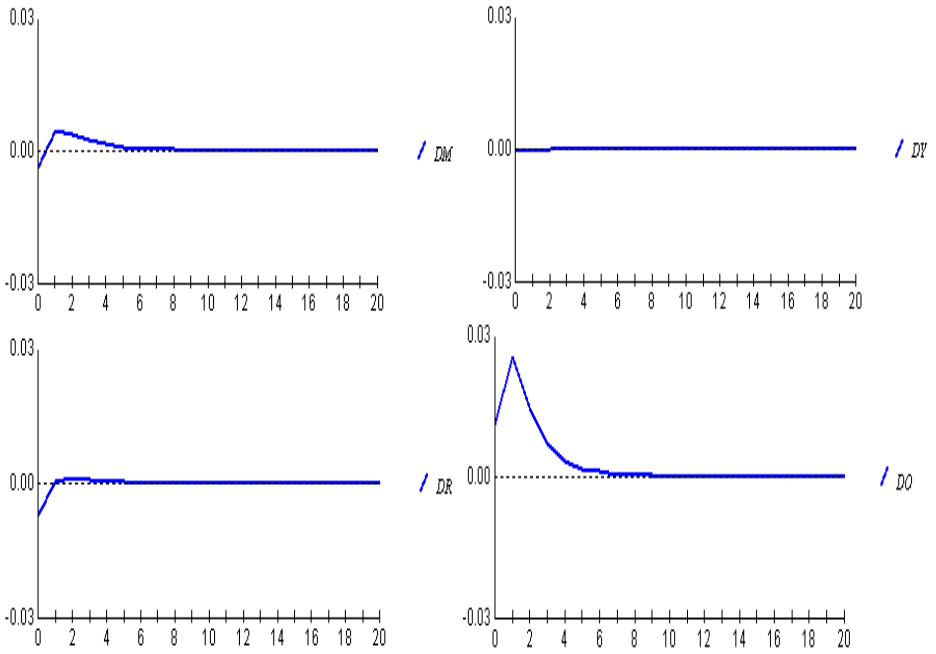
Table 5 The Generalised Forecast Error Variance Decomposition

Horizon	$\Delta \log ER_t$	$\Delta \log M_t$	ΔY_t	ΔR_t	$\Delta \log O_t$
0	1.0000	0.0358	0.0012	0.0272	0.0082
1	0.9891	0.0325	0.0063	0.0265	0.0098
2	0.9843	0.0337	0.0067	0.0264	0.0098
3	0.9823	0.0345	0.0067	0.0265	0.0098
4	0.9816	0.0349	0.0066	0.0266	0.0098
5	0.9813	0.0350	0.0066	0.0267	0.0098
10	0.9812	0.0351	0.0066	0.0267	0.0098
15	0.9812	0.0351	0.0066	0.0267	0.0098
20	0.9812	0.0351	0.0066	0.0267	0.0098

Note: The estimation is biased on VAR=1.

The generalised impulse response function traces the dynamic responses of a variable to innovations in other variables in a system. The results of the generalised impulse response function are shown in Figure 4. The results of the generalised impulse response function are plotted over the 20 horizon periods or equivalent to five year periods. The responses of exchange rate to one standard error shock in relative money supply are positive over the 0-6 horizon periods and then die out. The responses of exchange rate to one standard error shock in interest rate differential are negative over the 0-1 horizon periods and then die out. The responses of exchange rate to one standard error shock in oil price are positive over the 0-9 horizon periods and then die out. Finally, the responses of exchange rate to one standard error shock in relative demand are almost zero over the whole period. Generally, the impact of relative money supply, relative demand, interest rate differential or oil price on exchange rate is short, mostly less than two years.

Figure 4 Plots of the Generalised Impulse Response Functions to One Standard Error Shock in the Equation for the First Difference of the Natural Logarithm of Exchange Rate ($\Delta \log ER_t$)



Note: $DM = \Delta \log M_t$, $DY = \Delta \log DY_t$, $DR = \Delta DR_t$, and $DO = \Delta \log O_t$.

Generally, relative money supply, interest rate differential, and oil price are found to have a significant impact on exchange rate. However, there is no strong evidence that relative demand is found to have a significant impact on exchange rate. Another proxy for the relative demand may be tried in the estimation in the future. Baharumshah and Masih (2005) and Baharumshah, Siti Hamizah, and Ahn (2009), amongst others, show the importance of the monetary model in the determination of exchange rate in Malaysia. Chen and Chen (2007) show the importance of real oil price and real interest rate differential in the determination of real exchange rate. Bagchi, Chortareas, and Miller (2004), and Bergvall (2004) also show the importance of real interest rate differential in the determination of real exchange rate.

Money supply is important to influence exchange rate especially in the long run. An increase in money supply will lead to a decrease in exchange rate. Thus monetary policy is useful to influence exchange

rate. A strong currency may have difficult to promote exports especially exports are competitive in prices in the world markets. On the other hand, a weak currency may encourage more exports. However, imported inflation may be more difficult to check with a weak currency especially imports are important for economic growth.

Oil price is important in the determination of exchange rate. Thus change of oil price in the world market could have a significant impact on exchange rate. Oil price is characterised by high volatility, high intensity jumps, and strong upward drift (Askari and Krichene, 2008). This implies that exchange rate will be volatile. Thus there is a need to smooth down the volatility of oil price on Malaysian economy. The policy of the central bank of Malaysia on ringgit exchange rate is let it to be determined by market forces. Interventions are carried out from time to time to smooth down the excessively volatile of ringgit (Bank Negara Malaysia, 1999).

A relatively high interest rate could be used to influence exchange rate in the long run. The Asian financial crisis is found to have a negative impact on exchange rate in Malaysia. After the crisis, Malaysia has devalued its currency against the American dollar with the aim to promote exports and thus economic growth. There is no strong evidence to conclude relative demand to have a significant impact on exchange rate in the long run.

6. Concluding Remarks

This study has examined the determination of exchange rate using the monetary model augmented with oil price. The results of the PSS bounds testing approach show that the variables examined are cointegrated. The result of ARDL approach shows that an increase in relative money supply or interest rate differential will lead to a decrease in exchange rate in the long run whilst an increase in oil price will lead to an increase in exchange rate in the long run. Interest rate differential, oil price, and the Asian financial crisis are found to have a significant impact on exchange rate in the short run. The results of the generalised forecast error variance decompositions show that oil price is relatively least important than relative money supply in the determination of exchange rate. Monetary policy can be used to influence exchange rate in Malaysia.

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The Extent of Trade Mis-Invoicing in Turkey: Did Post-1990 Policies Matter?

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We analyze the extent and the direction of trade misinvoicing in the context of the new policy environment that has affected the Turkish economy in the post 1990 period. Utilizing bilateral partner country statistics between Turkey and its major trading partners, we observe persisting export overinvoicing and an oscillating pattern of import misinvoicing at the aggregate level. Country-specific data reveal different patterns. As opposed to the general trend in misinvoicing, exports to China are underinvoiced and imports are overinvoiced. We also analyze how the liberalization policies and the customs union agreement with the European Union countries affect trade misinvoicing. We find that, with trade liberalization policies, import misinvoicing has decreased at the aggregate level. However, contrary to the expectations, customs union agreement did not help decrease the extent of trade misinvoicing in Turkey.

1. Introduction

Intuitively, when two countries trade with each other, the data reported by exporter country should mirror the data reported by the importer country after cif/fob adjustment. However, this is often not the case for several reasons. One explanation for the discrepancies in bilateral trade data is trade misinvoicing. Exporters can engage in export underinvoicing to bring less foreign exchange into the country than they actually earn or overinvoice export earnings in order to take advantage of export subsidies. Importers, on the other hand, have a tendency to overinvoice to gain access to greater foreign exchange than required and they can underinvoice to avoid tariffs. This practice was particularly

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common during the 1970s and 1980s because of the protectionist trade policies of that time. This resulted in a number of studies examining the effects of these policies on the discrepancies in foreign trade data (Bhagwati,1964; Naya and Morgan, 1969; Morgenstern, 1963; Pitt, 1984; McDonald, 1985).

The issue of inaccuracies in the trade data remains in the trade literature to the present day. By analyzing trade data based on product categories, Yeats (1990) argues that trade data between African countries and their partners indicate large-scale smuggling activities. Fisman and Wei (2004) consider the case of China and conclude that underreporting of import values and mislabeling of higher taxed products as lower taxed are widespread practices. Beja (2008) estimates the amount of trade misinvoicing for China between 2000 and 2005 as US $1.4 trillion. Hsiah and Moretti (2006) show that the government of Iraq, under the "oil for food" program underinvoiced its oil exports. Berger and Nitsch (2008) examine the relation between the level of corruption and foreign trade data discrepancies for the world's five largest importers between 2002-2006 and conclude that the discrepancies increase with the level of corruption. Farzanegan (2009) examines smuggling in Iran using a structural equation approach in order to investigate the causes of illegal trade. Buehn and Eicler (2009) analyze the determinants of trade misinvoicing and find that black market premium and high tariff rates are the main factors causing illegal reporting. Patnaik et al. (2009) examine the link between trade misinvoicing and capital account liberalization and argue that opening of the capital account leads to a decline in trade misinvoicing.

Misleading declarations of trade data have been noted as "very common" in trade activities in Turkey. Bhagwati (1964) provides an early assesment of such activities and argue that the discrepancies between the import data of Turkey and the export data of her partner countries were caused by import duties higher than the black market premium on foreign exchange. Celasun and Rodrik (1989) suggest that the reason of the increase in Turkish exports after 1980 was export overinvoicing to take advantage of export subsidies. Tokdemir and Gunluk-Senesen (1997) compare official records of Turkish export and import data with data of major OECD trade partners for the period 1970 and 1991 and conclude that trade misinvoicing has not disappeared with the liberalization of the trade regime.

In this study, our objective is to update and extend the earlier studies on this subject in view of the new policy environment that has affected the Turkish economy since the 1990s. One issue that needs to be adressed in particular is the relation between capital account openness and trade misinvoicing. Since trade misinvoicing is motivated by the desire to avoid capital controls, the incentive for trade misinvoicing is expected to decrease with an open capital account (Patnaik et al.,2009). Another important policy change since 1990 has been the Customs Union agreement with the European Union, which came into effect in 1996. This agreement strengthened the trade relations with the European Union countries and Turkey has begun to increase its trade volume rapidly. The trade literature emphasizes the role of high tariffs and custom duties for trade misinvoicing. Therefore, the reduction in custom duties after the adoption of Customs Union agreement is expected to decrease the motivation for trade misinvoicing. In addition to these changes in the policy framework, the changing composition of Turkey`s trading partners should also be taken into account. Some new countries such as Russia and China has emerged as new trade partners with increasing importance in the recent years and the pattern of discrepancies in trade data with these countries requires a thorough examination.

The estimates of the size of trade misinvoicing in Turkey vis-a-vis the world during the period between 1970 and 2007 reveal that 25,776 US$ billion left Turkey through trade misinvoicing practices. We also examine the country specific patterns and identify China, Netherlands, Germany, Switzerland and Russia as the major misinvoicing partners of Turkey. Turkey`s exports to China is underinvoiced while its exports with the other partners are usually overinvoiced. The picture is somewhat different for imports. Turkey reports a higher import value than the exports reported by Switzerland and Russia. Imports are underinvoiced with Germany and Netherlands and the extent of underinvoicing has been increasing in recent years. This implies that the reductions in custom duties after the Custom Union agreement with EU countries did not help mitigate trade misinvoicing. Our findings also suggest that Turkish residents have been transferring capital to China, Switzerland and Russia through misinvoicing practices.

The remainder of the paper is structured as follows: In the next section, we explain the method for estimating trade misinvoicing. In the third section, we offer statistical evidence in support of trade misinvoicing in Turkey and discuss the main determinants of misinvocing considering macroeconomic framework. This is followed by the identification of major misinvoicing partners of Turkey. Finally, we outline a number of policy implications and conclude.

2. The Method for Estimating Trade Misinvoicing

We estimate trade misinvoicing by comparing country`s export and import data to those of its trading partners by using the method pioneered by Morgenstern (1963) and later developed by Bhagwati (1964)[2]. However, direct comparison of data between the countries provides inaccurate results because exports are reported on a f.o.b. (free on board) basis, whereas imports are reported on a c.i.f. basis (cost, freight, insurance). Thus, in order to measure trade more precisely, c.i.f. value of exports must be converted into f.o.b. value using a c.i.f/f.o.b ratio (C.I.F), which has been used widely in the literature as a measure of transportation costs. Although freight and insurance costs vary with the distance and the type of the product, it is common in the literature to assume that freight and insurance component of imports averages to about 10 per cent of export value (De Wulf, 1981, p.305). Therefore, following the general practice, the standard C.I.F.of 1.1 is used for data conversions in this study.

To calculate trade misinvoicing, the first step is to compute export discrepancies with the trading partners as follows:

$$XD_t = PX_t - (X_t * CIF_t) \quad (1)$$

Here, *PX* is the value of imports reported by partner countries, *X* is exports to other countries reported by Turkey, and *CIF* is the c.i.f/f.o.b. factor, which represents the cost of freight and insurance. While a negative sign on *XD* represents export overinvoicing, a positive sign on *XD* indicates the existence of export underinvoicing.

[2] In order to calculate trade misinvoicing vis-a-vis the world, we used data obtained from IMF Direction of Trade Statistics. For country level analysis, we gathered data from UNCOMTRADE database.

Import discrepancies with the trading partners (DM) are subsequently computed using the following equation:

$$DM_t = IM_t - (PM_t * CIF_t) \tag{2}$$

where *IM* is the imports reported by Turkey and *PM* is the exports reported by partner countries. A positive sign on *DM* indicates a net overinvoicing of imports, while a negative sign indicates a net underinvoicing. If official figures on Turkey`s imports are greater than the exports reported by the partner countries, then the agents engage in import overinvoicing.

The total trade misinvoicing *TTM* is obtained as the sum of export and import discrepancies.

$$TTM = XD_t + DM_t \tag{3}$$

Here, a positive value of TTM suggests a net underrecording in trade statistics and an outflow of capital, while a negative value means overreporting and an inflow of capital.

By adding absolute values, the absolute trade misinvoicing can be calculated as follows:

$$|TTM| = |XD_t| + |DM_t| \tag{4}$$

It should be noted that the discrepancy in trade data is not always attributable to trade misinvoicing. Incorrect identification of source or destination country, time lags between the arrival and departure of shipment, valuation of goods at different prices at the source and the destination country, and the differences in commodity classification can also lead to discrepancies (Berger and Nitsch, 2008). The differences in trade data can also be because of the mistakes in recordkeeping. Although the export data reported by Turkey and import data reported by partner countries are expected to be different because of the above mentioned reasons, we follow the standard rule in the literature and only

consider the discrepancies above 10% as an evidence of significant trade misinvoicing.

It should also be pointed out that combinations of incentives may actually be selfdisguising in the sense that, if the partners recognize their mutual interests in such false reporting and collude in it, the data may look quite consistent (Yeats, 1990, p.2). This can be seen in terms of abusive transfer pricing by multinational corporations, who vary invoices to move profits and capital abroad (Kar and Cartwright-Smith, 2008).

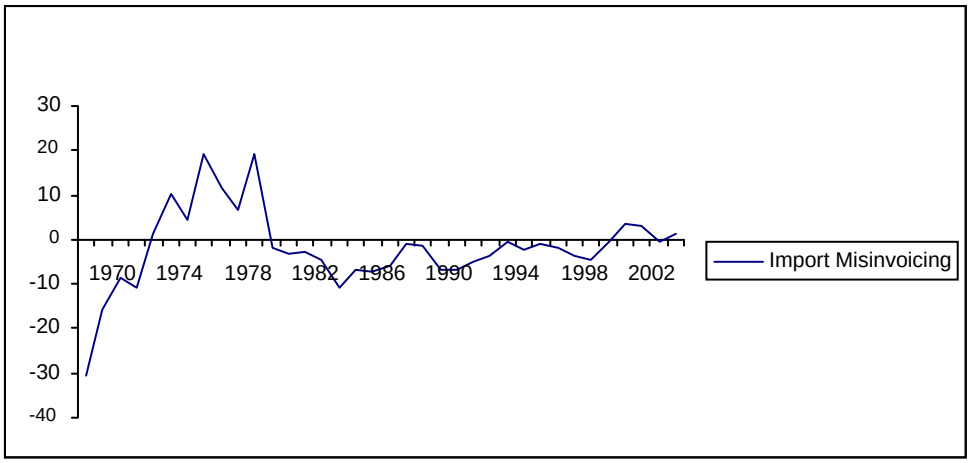
3. Trade Misinvoicing vis-à-vis The World

By focusing on the salient features of Turkey's trade regime between the years 1970 and 2005, we attempt to explain the changes in the direction of trade misinvoicing. However, before explaining the trends in trade misinvoicing, we will briefly review the determinants of trade misinvoicing in the literature to identify the driving factors of misinvoicing practices.

One of the most important causes of trade misinvoicing is high tariffs and custom duties, which cause agents to underinvoice imports (Bhagwati, 1964; Lessard and Williamson, 1987; Boyce and Ndikumana, 2001). Outright export embargo on some goods as well as export taxes and export quotas can also lead to misreporting of trade data (Fisman and Wei, 2007). Some authors argue that black market premium for foreign exchange is an important determinant of trade misinvoicing as well (Pitt, 1984; Biswas and Marjit, 2007; Buehn and Eichler, 2009). A higher black market premium is also expected to increase export underinvoicing as the entrepreneur can sell the illegal export revenues at a higher price in domestic currency. Further, it is argued by Berger and Nitsch (2008) that, since the authorities can use information on firm`s export activities to infer on their production, some firms can choose to hide exports for hiding output in order to evade domestic taxes. In addition, Buehn and Eichler (2009) claim that a real depreciation increases the optimal amount of export underinvoicing. People can also involve in trade misinvoicing in order to prevent loss of wealth due to nationalization or confiscation of wealth, therefore dejure capital controls can also be a factor leading to an increase in trade misinvoicing (Patnaik et al., 2009).

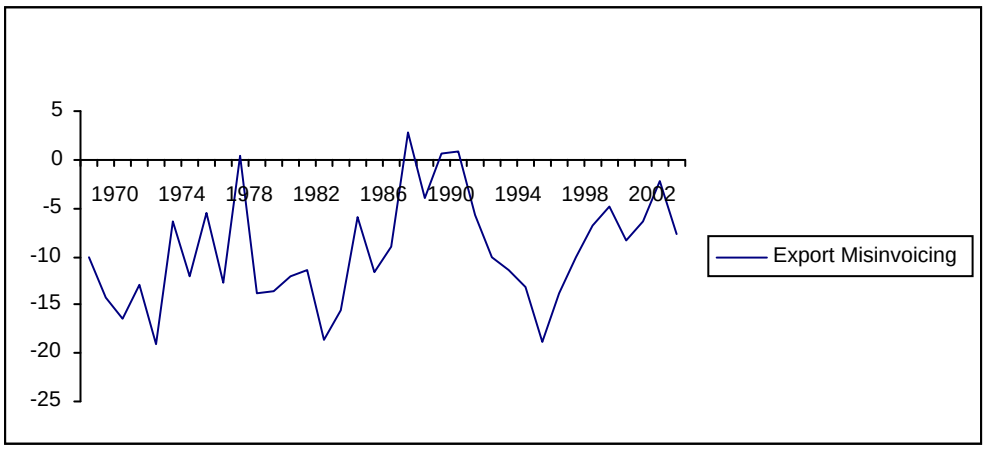
Figure 1 traces the path of Turkey's import misinvoicing vis-à-vis the world calculated using the method outlined in the previous section.Turkey followed an import-substitution industrialization (ISI) strategy until 1980. The main features of the trade regime during this period were high tariff rates, quantitative restrictions, overvalued exchange rates, and rationing on foreign exchange, which resulted in a tremendous incentive for import underinvoicing to evade high tariff rates. In 1970, Turkey was experiencing import misinvoicing worth of 40 per cent of total imports. The extent of underinvoicing decreased steadily between 1970 and 1973 as crisis conditions in the economy countered tariff evasion motive. After this period, there was a reversal in the trend of import misinvoicing and imports were overinvoiced until 1980 since the residents were trying to move capital abroad under deteriorating conditions in the domestic economy with the expectation of depreciation of domestic currency.

Figure 1: Import Misinvoicing as a Percentage of Imports (1969-2005)



Source: Authors'calculations based on IMF Direction of Trade Statistics, various years.

Figure 2 : Export Misinvoicing as a Percentage of Exports (1969-2005)



Source: Authors'calculations based on IMF Direction of Trade Statistics, various years.

In the late 1970s, after experiencing a severe balance of payments crisis, Turkey implemented a new stabilization program, which comprised the liberalization of foreign trade regime, the removal of exchange controls, expansion of export incentives and subsidies, reduction in custom duties, tariff rates, and quantitative restrictions. Therefore, Turkey began to witness import underinvoicing after 1980. The rate of underinvoicing increased after 1981 reaching its peak in 1985. In 1985, 11% of total imports were underinvoiced. After the announcement of the new import regime in 1984, import liberalization gained impetus. The import regime was based on the classification of commodities into three groups: "prohibited list", "imports subject to permission list", and "liberalized list". With the changes announced in 1984, around 60% of 1983 imports were no longer subject to restrictions. The number of commodities in the prohibited list, which was around 500 in 1984, was reduced to almost zero by 1985 and the commodities in the subject to permission list were reduced to 22% in 1986 and 6% in 1988 (Özler and Yılmaz, 2009). Moreover, the tariff rates were reduced on imports of intermediate and capital goods (İzmen and Yılmaz, 2009). The output weighted average nominal tariff rate for the manufacturing industry declined to 40% in 1990 from 76.9% in 1984 (İzmen and Yılmaz, 2009). As a result of trade liberalization, import underinvoicing started to decrease with the changes in tariff structure.

The most important change in the trade regime of Turkey was Customs Union agreement with the European Union countries, which came into effect in 1996. With this agreement, Turkey eliminated the tariffs on imports originating from the European Union countries, and based on the "Common External Tariff Rule", reduced the tariffs against imports from the third countries. The reduction in tariff rates is expected to cause a decline in import underinvoicing. However, in order to compensate the loss in tariff revenue from implementing the customs union, the VAT rates were increased and VAT evasion became the main motive of underinvoicing (Harrison et al., 1997). Therefore, there was a slight decline in the magnitude of import underinvoicing after 1996. However, the trend has reversed after 2001 and imports were overinvoiced again since the residents were trying to take capital out of the country because of the worsening conditions in the domestic economy caused by 2001 financial crisis.

In sum, we show that import misinvoicing has followed an oscillating pattern. During the import substitution phase, imports were heavily underinvoiced because of the protectionist trade policies. Trade liberalization policies were useful in reducing the extent of misinvoicing during the 1980s at the aggregate level. Interestingly, however, import overinvoicing has been increasing in recent years since the residents have been moving capital abroad through misinvoicing practices. Thus, contrary to the expectations, import overinvoicing did not disappear with capital account liberalization policies.

Figure 2 shows that, due to high subsidies and export promotion schemes, Turkey has consistently experienced export overinvoicing between 1970 and 2005 with few exceptions. In late 1970s, exports were overinvoiced due to the high black market premium. However, export overinvoicing was greater between 1981 and 1988, which was characterized by export-led growth strategies. In order to encourage exports, corporate tax allowances, tax exemptions on imported goods and preferential and subsidized export credits were provided. Moreover, direct payments were made to the exporters through tax rebates and cash premia from extra budgetary funds. During this period, the total subsidy rate received by the exporters of manufactured goods reached 23% of export value (Milanovic, 1986). These generous export subsidies given during this period encouraged overinvoicing of exports and even

resulted in the so-called "phantom export" transactions that are designed to illegally take advantage of the generous export subsidies. Export overinvoicing reached its peak in 1984 but started to decrease after that year as reductions in tax rebates took place in the following years because the European Parliament accused Turkey of unfair competition because of its export promotion incentives (Müftüler, 1995). In 1989, all monetary incentives to exports had been lifted but the government adopted new measures to encourage exports such as performance and pre-shipment credits, fund refunds, corporate income tax exclusion and premium payments. After the reductions in monetary export subsidies, exporters overinvoiced the value of exports in 1991 and 1992. During these years, currency was perceived as overvalued and the exporters tended to overinvoice to realize a greater amount of domestic currency for a given amount of foreign exchange receipts in case of a depreciation. After 1993, the extent of overinvoicing in Turkey has steadily increased reaching its peak in 1997. However, it has shown a decline over the five years that followed.

Some of the earlier studies on trade misinvoicing mention export promotion instruments and the availability of low interest credits as the main factor of export overinvoicing (Celasun and Rodrik, 1989; Gunluk-Senesen, 1997). However, in recent years we see also the emergence of other elements affecting the direction of trade misinvoicing. One such factor is the establishment and rising importance of free trade zones. A free trade zone (FTZ) is an area of a country where some trade barriers such as tariffs and quantity restrictions are eliminated in order to attract foreign investments. In Turkey, the idea of establishing free trade zones go back to as early as 1927, but the most important developments took place in 1985, when "Free Trade Zones Law" was issued "to increase exports, reduce unemployment, accelerate the inflow of foreign capital, and to increase the utilization of external finance" (Kibritcioglu, 1996). Free trade zones provide many opportunities for exporters such as less bureaucracy, lower tax burden, and better job environment. Production companies in an FZT are exempt from corporate and income taxes. Goods imported from abroad are exempt from customs duty and goods purchased in Turkey by companies located in an FTZ are exempt from VAT as well. Because of these advantages of FTZs, the number of FTZs has been increasing rapidly since 1987. It is estimated that in 2007, the volume of trade in FTZs was 24 billion US$, which constituted 8% of total trade volume (Kocaman, 2007). While free trade zones provide

many benefits to the host country and the exporters, they also encourage export overinvoicing and fictitious exports. Although an FTZ is within the boundaries of the Republic of Turkey, it is treated as if it were a territory abroad, thus the products sent to free trade zones are considered as exports. Furthermore, the units in FTZs may divert duty-free raw materials in the domestic area and overinvoice exports to fulfill export obligations. Indeed, there is a growing literature on the relation between free trade zones and increasing corruption in foreign trade transactions. Free trade zones which are associated with trade liberalization policies may increase false reporting of trade values. Pitt (1981) argues that the greater the legal trade, the easier it is to hide smuggling from enforcement activities, and one way the import underinvoicing can be realized is through free trade zones. Another criticism against FTZs is that, while free trade zones is a way of attracting multinational companies increasing job opportunities and investment, they also lead to an increase in transfer pricing practices. Transfer pricing refers to misinvoicing engaged in by related parties in different countries such as different branches of a multinational corporation (Wang, 2007). With this practice, these companies can shift profits out of the host country to low tax countries and avoid higher tariffs. Overall, we suggest that one reason for the growing export overinvoicing in Turkey in recent years is the illegal activities in free trade zones and transfer pricing practices of multinational companies.

4. Major Trade Misinvoicing Partners of Turkey

Estimating trade misinvoicing at the aggregate level gives us some idea about the direction of misinvoicing but it does not tell about the whole picture. Distinguishing major misinvoicing partners of Turkey and examining country-specific patterns can help us analyze the changes in the direction of trade misinvoicing in detail. The previous studies on trade misinvoicing in Turkey focused on the bilateral data discrapencies with the European Union countries since these countries have always been the major trading partners of Turkey. However, there have been some changes in the composition of trade partners in recent years and this fact should also be taken into consideration when examining trade misinvoicing[3]. Today, with the Customs Union agreement, Turkey

[3] The changing composition of Turkey's trade partners is shown on Table 1 on the Appendix.

strengthened the trade relations with the EU countries. While trade with the EU-27 accounted for 55 per cent of Turkey`s exports in 1996, this share steadily increased to 58 % in 2004. In recent years, however, the share of the EU countries in total trade has declined as the trade with some other countries increased. Among the countries as newly emerging trade partners, China attracts the most attention. China's accession to the WTO in 2001 led to an important change in the structure of Turkey's imports. The share of imports from China continuously increased after 2001. While the share of imports from China was around 2% in 1996, this share jumped to 7.5 % in 2007. China is now one of the most important trade partners. The share of Pan-European partners in Turkish trade has also increased from 4% in 1985 to 9 % in 2003 and and 11% in 2008. The expansion in exports to Romania and Bulgaria are especially notable (Kaminsky and Ng, 2007). Turkey has also increased its trade with Russia in recent years with Turkey's increased exporting of construction services and importing of natural gas in return. As a result, the Russian Federation has emerged as the fifth major market for Turkish exports in the second half of the 1990s, and the share of exports from Russia reached its peak in 1997.

In order to identify major trade misinvoicing partners, we calculate net and absolute trade misinvoicing for the 10 countries[4] with which Turkey`s trade volume is the largest. The bulk of the total trade takes place with these 10 countires, comprising about 60 percent of total trade volume[5]. The results are presented in Table 1. Between 1990 and 2007, Turkey`net unrecorded trade amounts to US$ 25,776 billion, while the amount of absolute unrecorded trade is US$ 145,735 billion between 1990 and 2007. Based on the results in Table 1, Turkey`s major trade misinvoicing partners are identified as Germany, China, Russia, Netherlands and Switzerland. The other trade partners have relatively little trade misinvoicing. Turkey has usually understated its bilateral trade with Switzerland, China and Russia, while it has overstated its trade with Netherlands.

[4] These countries are France, Germany, Italy, UK, Russia, Spain, China, USA, Switzerland and Netherlands.

[5] Details of the calculations are available in the Appendix. Although United Arab Emirates and Iraq have also become important trade partners of Turkey in recent years, we did not include these countries because of data limitations.

Table 1 : Trade Misinvoicing with Partners, US$ Billion, 1990-2007

Turkey's trade partner	Net	Absolute
China	9,40	9,69
France	1,23	4,52
Germany	-24,45	32,85
Italy	-8,61	10,24
Neth.	-14,43	15,36
Russia	4,22	26,24
Spain	0,30	4,41
Switz.	9,80	14,23
UK	-0,01	9,63
USA	0,92	11,99

Source: Authors'calculations based on UNCOMTRADE database.
Note: Figures are sums for 1990-2007. A positive sign indicates a capital outflow and a negative sign indicates a capital inflow.

Next, we turn to examine the direction of export and import misinvoicing between Turkey and the countries identifed above in order to find out if certain trade partners indicate exceptional patterns in trade misinvoicing contrary to the usual trend at the aggregate level, which is export overinvoicing and import underinvoicing in most of the cases. Table ٢ presents the percentage of export misinvoicing in total exports for major trade partners. It can be seen from the table that the export-import data discrepancy between Turkey and USA, UK, France, Germany and Italy is lower than 10 % in most of the years except a few exceptions. The country specific patterns indicate the existence of export overinvoicing as was the case in aggregate data except for the case of China. Following the 10% rule, we can conclude that export misinvoicing is greatest with Russia, Netherlands and Switzerland. Turkey overstated its exports with these countries throughout the whole period. While the percentage of overinvoiced exports with Russia has decreased over time, it has shown an increasing trend for the case of Switzerland and Netherlands although there have been some oscillations. The pattern for Switzerland and Netherlands imply that the expectation of a decrease in discrepancies in the liberal period did not take place. This result is similar to the one obtained by Tokdemir and Gunluk-Senesen (1997). The existence of discrepancies can be

explained by the commodity type. Export overinvoicing with Switzerland was especially high for the commodities classified under BEC 2 (industrial supplies) and BEC 7 (goods not classified elsewhere)[6]. Re-exports of goods from Switzerland, such as processed inputs for textiles, can be another contributing factor to overinvoicing (Tokdemir, 1987).

An interesting pattern can be observed in trade with China where, as opposed to the general trend, exports were usually underinvoiced. One explanation for this is the treatment of China`s entrepot trade through Hong Kong differently by two countries. Indeed, China`s entrepot trade has been cited as one of the most important reasons of the large trade data discrepancies between China and its partner countries. China`s trading partner countries including Turkey consider the value of goods to Hong Kong as exports to China without making any adjustments to the data. Moreover, Turkish statistics do not make any reconciliations for the mark-ups charged by unrelated party Hong Kong middleman for their re-export activities. As a result, exports to China are usually understated. However, due to the accession of China to World Trade Organization, the discrepancies seem to normalize after 2001.

Table 3 presents the trends in import misinvoicing. The general tendency has been import underinvoicing for most of the countries, although there are some exceptional destinations as well and China is one of these countries. Imports from China were overinvoiced throughout the whole period, which suggests the possibility of overinvoicing of Turkish imports from China or under-invoicing of Chinese exports to Turkey. It can be argued that there is not much incentive for Turkish importers to overinvoice imports to China since this will increase the custom duties they need to pay. On the other hand, Chinese exporters may have the motivation to underinvoice exports to avoid Chinese taxation and the restrictions on capital outflows. This practice is called “roundtripping,” which is a trade-tax investment

[6] Trade misinvoicing is calculated for Broad Economic Categories as well in order to give information about the foreign trade regime specific to each commodity. Trade Misinvoicing estimates calculated according to BECs are given in the Appendix. The BEC categories are BEC-1 food and beverages, BEC-2 industrial supplies, BEC 3 fuels and lubricants, BEC 4 capital goods, parts and accessories except for transport equipment, BEC 5 transport equipment, parts and accessories, BEC 6 consumption goods not elsewhere classified, and BEC 7 goods not elsewhere classified.

strategy to move capital out of China through misinvoicing. This domestic capital abroad then returns to the country in the form of foreign direct investment. The roundtripping activities in China have been one of the main causes of the trade data discrepancies in the recent years.

Table 2 : Percentage of Export Misinvoicing in Total Exports, 1990-2007

	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA
1990	30	10	3	7	-21	-	14	-52	21	9
1991	130	14	4	-3	-23	-	25	-46	-4	8
1992	-36	6	10	-7	-9	-23	30	-38	-9	27
1993	-13	-4	0	-4	-14	21	17	-43	-18	20
1994	21	0	4	-1	-13	-61	7	-32	-3	1
1995	105	1	0	-4	-10	-66	1	-20	-1	17
1996	35	4	-1	-1	-7	-71	13	-29	5	6
1997	35	2	-2	-1	-5	-71	16	-41	3	1
1998	2	13	1	-1	2	-71	6	-16	1	10
1999	19	12	-1	4	0	-57	3	-17	2	3
2000	29	11	0	6	-1	-55	13	-8	0	-5
2001	6	7	-1	6	-3	-54	-1	-3	6	-6
2002	6	10	2	7	-5	-48	10	-7	5	4
2003	-4	2	-1	8	-13	-42	3	-18	59	-2
2004	41	1	3	-4	-28	-44	7	-14	-1	0
2005	3	5	0	-24	-26	-38	9	-21	-3	4
2006	1	5	9	-9	-24	-28	10	-51	-2	4
2007	14	0	0	-12	-32	-22	16	-34	-4	7

Source: Authors'calculations based on UNCOMTRADE database.
Note: Positive numbers mean export underinvoicing, while negative numbers mean overinvoicing.

Another exceptional trade partner is Switzerland. The reported import data by Turkey is in general higher than the reported export data by Switzerland. This can be attributed to capital flight from Turkey, as residents report higher import values in order to move capital to Switzerland, which has always been a destination for transfer of capital thanks to its special banking conditions. We would expect that overinvoicing of imports, which is a vehicle for the transfer of capital abroad, decrease with the liberalization of capital account. However, far from decreasing, import overinvoicing has been increasing in recent

years suggesting that capital account liberalization did not help mitigate import overinvoicing.

Imports with Germany, Netherlands and the United States in some years are underinvoiced. The pattern for Netherlands is rather interesting. Imports have been consistently underinvoiced and the percentage of underinvoiced imports has been increasing over time reaching %115 in 2007. This increase of the percentage of underinvoiced imports is mainly based on the commodities classified as BEC-5 (transport equipment, parts and accessories) and BEC-6 (consumption goods not elsewhere classified categories)[7]. These large figures of import underinvoicing indicate that the expectation of a decrease in trade misinvoicing after the adoption of customs union agreement did not realize in Turkey.

Table 3: Percentage of Import Misinvoicing in Total Imports, 1990-2007

	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA
1990	78	-5	-27	-8	-15	-	2	-20	-18	-9
1991	65	-3	-46	-5	-14	-	11	-8	-23	-20
1992	56	-11	-24	-15	12	31	-12	26	-12	-15
1993	29	-7	-23	-14	-3	23	-20	1	7	-13
1994	21	-4	58	-5	4	0	-11	5	-3	-25
1995	12	-1	-26	-11	-1	14	-14	-8	4	19
1996	19	-5	-10	-11	12	2	-3	10	-89	3
1997	22	-6	-5	-8	-11	0	-7	0	-15	10
1998	14	-3	-10	-6	9	1	-8	0	0	3
1999	22	-7	-8	-2	2	24	-16	-4	5	-14
2000	10	-4	-17	-6	-26	12	-29	-5	-10	-6
2001	20	6	-7	-8	-32	-4	-3	36	7	-5
2002	12	4	-9	0	-29	4	-9	44	13	-11
2003	13	5	-17	-5	-48	3	-9	53	18	9
2004	31	8	-29	-11	-75	9	-9	48	-6	22
2005	32	-7	-28	-9	-94	8	-4	55	5	13
2006	17	2	-28	-6	-112	12	3	49	2	-30
2007	13	0	-27	-7	-115	37	-2	54	5	11

Source: Authors'calculations based on UNCOMTRADE database.
Note: Positive numbers mean import overinvoicing, while negative numbers mean import underinvoicing.

[7] See Appendix for calculations of trade misinvoicing for Broad Economic Categories (BEC).

5. Conclusion and Policy Implications

Utilizing bilateral partner country statistics, we estimate the size of trade misinvoicing in Turkey between 1970 and 2007. We find that overinvoicing is the main export misinvoicing trend. Import misinvoicing, however, exhibit an oscillating pattern. The reversals in the direction of import misinvoicing are mainly related to the changing conditions in the macroeconomic environment and capital flight motives as well as the liberalization of current and capital account.

We also estimate trade misinvoicing between Turkey and its major trade partners and find that Turkey`s net unrecorded trade amounts to US$ 8.91billion, while the amount of absolute unrecorded trade is US$ 145,735 billion between 1990 and 2007, meaning that US$ 8,91 billion left the country through trade misinvoicing. We examine country specific trends in the direction of trade misinvoicing as well and identify China, Germany, Russia, Switzerland, and Netherlands as the main misinvoicing partners. At the country-level analysis, export overinvoicing is still the main tendency except the case of China. On the import side, China and Switzerland emerge as the exceptional trade partners. Trade misinvoicing with the EU countries has been increasing in recent years meaning that the Customs Union agreement did not help trade misinvocing diminish.

The large and persistent discrepancies in foreign trade data have important policy implications. First of all, trade misinvoicing may facilitate capital flight because the agents can move capital abroad by misreporting their trade transactions.[8] In this sense, trade misinvoicing represents “lost resources” since these resources leave the country without the control of the domestic authorities leading to a decrease in the funds necessary for growth and development. Trade misinvoicing has also adverse affects on the wealth distribution of the society as some citizens evade higher taxation by transferring funds abroad. This eventually erodes the domestic tax base and reduces government revenue (Farzanegan, 2009). Thus, an important policy challenge for

[8] For further discussion of trade misinvoicing as a channel of capital flight, the reader is referred to Claessens and Naude (1993), Boyce and Ndikumana (2001) and Patnaik (2008).

Turkey is to prevent capital from fleeing abroad through trade misinvoicing and implement policies to facilitate capital repatriation so that these resources can be utilized to increase domestic investment. When considering the mechanisms to prevent capital flight, we should question the role of capital account liberalization. After capital account liberalization, we expect to experience a fall in trade misinvoicing since the agents can transfer capital in legal ways (Patnaik et al., 2009). However, this expectation did not realize for Turkey.

Misreported trade data can cause policy prescriptions based on these statistics to be misleading. Baldwin (2006) for example, stated that the effect of VAT fraud was so large that the United Kingdom had to restate its national accounts. Biswas and Marjit (2005) consider the consequences of the devaluations in India on exports and imports and conclude that the impact of a devaluation on exports and imports will be overestimated in the existence of large amounts of trade misinvoicing. Furthermore, errors in developing country trade data could affect government policies relating to investment, balance of payments, initiatives for the liberalization of trade barriers and exchange rate policy (Yeats, 1990). In order to decrease trade misinvoicing, one measure is to eliminate all the incentives that lead agents to misinvoice. The implementation of regulatory mechanisms can also prevent misreporting of trade data. Finally, sound trade management policies and tough penalties can be used (Beja, 2008). In this respect, a close collaboration between Turkey and its trading partners is required.

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DATA APPENDIX

Table 1 : Export Shares of Major Trade Partners of Turkey (1990-2007)

	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA	Total
1990	0,29	5,69	23,81	8,54	3,36	-	1,54	2,26	5,75	7,47	58,68
1991	0,15	5,07	25,11	7,15	3,49	-	1,75	1,81	4,97	6,72	56,22
1992	1	5,5	24,88	6,41	3,4	3	2,03	1,51	5,41	5,88	59,01
1993	3,34	5,02	23,81	4,89	4,05	3,29	1,3	1,41	5,44	6,43	58,96
1994	1,96	4,7	21,73	5,71	3,43	4,53	1,29	1,32	4,91	8,4	57,98
1995	0,31	4,78	23,3	6,74	3,41	5,7	1,67	1,1	5,25	7	59,27
1996	0,28	4,52	22,35	6,24	3,32	6,48	1,59	1,19	5,41	7,01	58,4
1997	0,17	4,43	20,02	5,29	2,97	7,84	1,67	1,21	5,76	7,72	57,08
1998	0,14	4,84	20,27	5,79	3,29	5,01	1,92	0,91	6,36	8,29	56,83
1999	0,14	5,92	20,59	6,33	3,51	2,21	2,87	1,01	6,88	9,17	58,62
2000	0,33	6,01	18,81	6,39	3,17	2,33	2,56	0,87	7,36	11,18	59,01
2001	0,64	6,05	17,13	7,47	2,85	2,95	3,03	0,77	6,94	9,98	57,81
2002	0,7	5,94	16,32	6,6	2,92	3,27	3,12	0,81	8,41	9,26	57,33
2003	1,07	5,98	15,84	6,76	3,23	2,89	3,79	0,76	7,77	7,94	56,03
2004	0,62	5,81	13,85	7,35	3,39	2,95	4,15	0,7	8,78	7,68	55,29
2005	0,75	5,18	12,87	8,58	3,36	3,24	4,1	0,76	8,05	6,68	53,56
2006	0,81	5,38	11,32	7,89	2,97	3,79	4,35	1,06	7,97	5,92	51,46
2007	0,97	0,97	0,97	0,97	0,97	0,97	0,97	0,97	0,97	0,97	0,97

Source: Undersecretariat of the Prime Ministry for Foreign Trade of Turkey, 2008

Table 2 : Import Shares of Major Trade Partners of Turkey (1990-2007)

	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA	Total
1990	1,1	6,01	15,81	7,74	2,57	-	1,55	2,41	4,55	10,23	52,0
1991	0,82	5,83	15,36	8,77	3,05	-	1,53	2,32	5,54	10,72	53,9
1992	0,75	5,91	16,42	8,39	3,05	4,55	1,4	3,01	5,19	11,37	60,0
1993	0,87	6,64	15,4	8,69	2,96	5,24	1,46	2,21	5,25	11,39	60,1
1994	1,11	6,27	15,67	8,63	3,18	4,49	1,63	2,03	5,03	10,44	58,5
1995	1,51	5,59	15,54	8,94	3,04	5,83	1,66	2,29	5,12	10,43	60,0
1996	1,28	6,24	17,66	9,89	3,3	4,43	2,3	2,62	0,57	7,66	56,0
1997	1,62	6,1	16,51	9,19	3,06	4,48	2,63	2,27	5,68	8,91	60,4
1998	1,84	6,61	15,92	9,22	3,15	4,69	2,78	2,21	5,84	8,81	61,1
1999	2,2	7,69	14,45	7,85	3,23	5,84	3,1	1,84	5,38	7,57	59,1
2000	2,44	6,49	13,23	7,98	2,91	7,18	3,08	1,64	4,99	7,18	57,1
2001	2,24	5,52	12,89	8,42	2,52	8,3	2,58	2,96	4,62	7,88	57,9
2002	2,66	5,94	13,68	8,06	2,55	7,53	2,71	4,17	4,74	5,98	58,0
2003	3,76	6,01	13,63	7,89	2,39	7,86	2,89	4,28	5,05	5,04	58,8
2004	4,59	6,36	12,83	7,04	1,96	9,26	3,34	3,49	4,43	4,86	58,2
2005	5,9	5,04	11,68	6,48	1,84	11,05	3,04	3,47	4,02	4,6	57,1
2006	6,93	5,19	10,58	6,21	1,55	12,76	2,75	2,88	3,68	4,49	57,0
2007	7,78	4,62	10,31	5,86	1,56	13,82	2,55	3,1	3,22	4,8	57,6

Source: Undersecretariat of the Prime Ministry for Foreign Trade of Turkey, 2008

Table 3 : Export Misinvoicing with Selected Countries, US$ Millions

Turkey with…	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA
1990	11,1	72,54	81,5	81,12	-89,87	-	27,51	-151,62	159,76	90,65
1991	26,53	93,49	132,32	-24,72	-111,33	-	59,68	-113,69	-29,63	70,34
1992	-52,84	49,25	360,13	-66,97	-46,8	-103,02	88,47	-85,27	-72,92	231,91
1993	-65,57	-30,39	5,88	-31,34	-84,45	105,19	33,74	-91,99	-151,46	194,89
1994	73,51	-0,21	150,98	-14,55	-81,61	-502,21	15,2	-76,17	-29,52	20,19
1995	70,23	11,82	21,45	-61,99	-70,46	-813,25	2,91	-47,55	-15,1	261,81
1996	22,52	41,21	-49,18	-8,22	-52,67	-1055,4	46,01	-79,88	62,5	104,57
1997	15,71	22,25	-93,42	-17,75	-41,12	-1467,6	72,02	-129,68	46,95	14,92
1998	0,93	166,29	72,95	-16,45	15,95	-963	33,08	-38,56	21,59	225,96
1999	7	184,98	-34,92	62,26	-2,6	-334,91	22,83	-46,62	37,25	80,82
2000	26,28	182,27	-1,61	102,44	-5,93	-353,59	90,67	-19,9	5,03	-143,3
2001	11,63	133,69	-80,08	132,01	-24,32	-495,57	-12,99	-6,62	131,48	-183,6
2002	13,91	214,87	99,26	174,47	-50,71	-556,58	107,22	-18,86	157,74	118,65
2003	-22,42	67,42	-89,58	252,93	-205,87	-578,19	57,99	-63,92	2176,08	-67,16
2004	160,64	33,85	251,62	-172,13	-588,35	-817,42	175,38	-60,83	-69,69	-11,69
2005	17	208,39	34,02	-1502,7	-637,48	-893,58	272,75	-118,38	-173,99	182,6
2006	3,61	227,67	847,42	-636,77	-602,28	-906,78	362,29	-458,02	-142,36	206,89
2007	148,8	-2,11	21,84	-902,81	-962,97	-1027,6	743,63	-318,85	-352,85	301,7

Source: Authors'calculations based on UNCOMTRADE database.

Table 4 : Import Misinvoicing with Selected Countries, US$ Millions

Turkey with…	China	France	Germany	Italy	Neth.	Russia	Spain	Switz.	UK	USA
1990	192,41	-70,2	-954,2	-129,74	-87,09	-	6,62	-107,96	-179,5	-196,73
1991	111,31	-35,05	-1475,7	-99,45	-92,08	-	36,02	-39,28	-268,4	-458,93
1992	96,55	-146,99	-898,67	-281,46	87,25	326,91	-37,39	179,15	-145,1	-402,29
1993	72,95	-130,43	-1061,8	-353,43	-29,94	356,52	-84,93	8,17	112,97	-426,31
1994	54,86	-63,64	2123,9	-94,24	31,19	1	-40,49	25,43	-37,45	-599,53
1995	65,25	-22,09	-1447,5	-362,89	-5,58	287,17	-85,43	-67,43	65,44	724,01
1996	104,02	-129,22	-748,3	-467,5	175,59	45,65	-28,91	107,03	-2192,1	112,86
1997	174,98	-183,38	-401,52	-369,59	-169,89	-7,41	-94,3	-2,46	-425,86	436,26
1998	121,09	-101,65	-766,89	-267,13	128,25	24,56	-108,28	3,55	-5,1	130,88
1999	194,55	-216,61	-478,76	-50,38	22,7	580,22	-199,17	-28,71	105,04	-436,68
2000	135,94	-125,22	-1239,2	-273,03	-409,17	478,85	-490,41	-42,33	-268,7	-217,13
2001	184,21	148,16	-363,47	-279,87	-329,41	-135,26	-28,54	442,35	124,66	-156,06
2002	167,99	111	-617,6	12	-382,41	168,97	-121,84	951,28	313,98	-349,4
2003	338,64	207,84	-1591,7	-274,48	-803,24	163,11	-185,01	1585,7	631,71	302,38
2004	1372,66	525,03	-3645,1	-749,61	-1439,3	848,88	-302,39	1637,99	-260,59	1048,06
2005	2206,3	-389,27	-3842,7	-680,66	-2028,6	980,03	-132,35	2242,09	249,19	674,18
2006	1635,5	163,94	-4093,2	-497,19	-2414,9	2087,24	102,95	1982,91	115,22	-1885,5
2007	1710,9	11,2	-4676,7	-739,91	-3044	8776,59	-102,79	2850,39	292,76	922,57

Source: Authors'calculations based on UNCOMTRADE database.

Table 5: Trade Misinvoicing, According to Broad Economic Categories, 1998-2007, US$

*XD=PX–(X*CIF)*	BEC1	BEC2	BEC3	BEC4	BEC5	BEC6	BEC7	Total
Germany	-0,025	-1,507	-0,033	-8,068	-6,383	-1,761	-3,537	-21,315
Russia	0,318	5,045	18,868	-0,543	-0,310	-0,067	22,600	45,910
China	-0,078	1,849	-0,126	5,941	-0,214	0,799	-0,103	8,068
Switzerland	0,006	13,597	-0,027	-0,032	-0,171	-1,753	0,005	11,625
Netherland	-0,145	-0,833	0,101	-5,209	-1,864	5,897	-0,251	-2,304
Total	0,077	18,151	18,783	-7,911	-8,943	3,115	18,713	41,984

*DM=IM-(PM*CIF)*	BEC1	BEC2	BEC3	BEC4	BEC5	BEC6	BEC7	Total
Germany	1,210	0,080	-0,074	1,178	-1,876	0,432	0,170	1,121
Russia	-0,927	-2,809	-0,071	-0,598	-0,014	-2,497	-0,011	-6,927
China	-0,035	0,943	0,016	0,045	-0,087	0,074	-0,589	0,367
Switzerland	-0,001	-1,129	-0,105	0,005	0,072	0,010	-0,003	-1,151
Netherland	-0,903	-1,500	-0,419	0,179	-9,030	-11,341	0,051	-22,962
Total	-0,655	-4,414	-0,652	0,809	-10,935	-13,321	-0,382	-29,551

TTM=XD+DM	BEC1	BEC2	BEC3	BEC4	BEC5	BEC6	BEC7	Total
Germany	1,185	-1,427	-0,107	-6,890	-8,259	-1,329	-3,368	-20,194
Russia	-0,609	2,236	18,797	-1,142	-0,324	-2,565	22,589	38,983
China	-0,112	2,792	-0,111	5,985	-0,301	0,873	-0,692	8,435
Switzerland	0,005	12,468	-0,132	-0,026	-0,099	-1,743	0,002	10,475
Netherland	-1,047	-2,333	-0,318	-5,030	-10,895	-5,443	-0,201	-25,266
Total	-0,578	13,736	18,130	-7,102	-19,878	-10,207	18,331	12,433

Source: Authors' calculations based on UNCOMTRADE database.
Note: Figures are sums for 1998-2007.

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Trade and Intra-regional Integration: Is Arab Region A Potential Candidate for Economic Union?

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The existing economic/currency unions such as the 'Dollar Zone' and the 'Euro Zone' have spurred academic and political dialogues regarding the economic integration in the Arab region. This paper analyzes recent inter- and intra-Arab trade trends and its regional patterns of trade, based on the standard gravity model of international trade.

As the conventional gravity model has predicted, countries with closer distance significantly trade more than otherwise in the Arab region. However, higher GDP per person weakens the intra-Arab exchange. Possible explanatory factors include the different levels of economic development in Arab, sub-grouping trade arrangements between individual Arab countries (e.g. "Maghreb Union") and the European counterparts, and the Gulf oil exporters' trade with the non-Arab developed nations around the world. It is found that Arab countries with bilinguals (i.e. Arabic and French) and/or dual religious beliefs (i.e. Islam and Christianity) tend to significantly diverge their bilateral trade. Particularly, such alternative in reality offers Arab countries greater trade option inter-regionally. Given these findings, it is suggested that creating an intra-Arab economic union is currently infeasible, and a needing caution is essential for any pursuit of such integration.

1. Introduction

In the contemporary world with highly-emphasized globalization, the existing economic/currency unions such as the 'Dollar Zone' and the 'Euro Zone' have spurred intellectual and political dialogues with respect to the possible economic integration in the Arab region. As

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debated in these dialogues, to have a regional integration may much likely assist Arab to strengthen its economic competitiveness and global citizenship in the world economy.

Studying the intra-Arab growth and trade trends may seem somewhat depressing. Without startling and sustainable growth like that in its neighboring East Asian region, the overall Arab regional growth experience reveals to be unpleasant and unstable between 1960s and early 2000, with the average regional growth rate equivalent to 1.24%, and the individual country's growth rate ranging from around -6% (e.g. -6.5% of Kuwait in 1970~80; -5.7% of Saudi Arabia in1980~90) to 8% (7.9% of Saudi Arabia in 1970~80; 6.4% in Syria1970~80) across different decades (see Noland and Pack, 2007). Such fluctuating growth may be attributed to different levels of national development among which the high-income oil exporters such as Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates (UAE) are able to resourcefully develop their economies through export revenue, while the low-income nations such as Mauritania, Somalia, Sudan, Yemen, Djibouti, and Morocco are endowed with comparably low natural resources for foreign trade and fail to commit a governmental export-led strategy.

As to the international trade performance, the Arab region has evidently "undertraded" in manufacturing exports both intra- and inter-regionally with less than US$20 billion per annum between 1980 and early 2000, as compared to over US$1,200 billion traded by the group of East-Asian economies in 2004. Such Arab under-trade is reflected by the higher level of trade protection with an average tariff rate in 23% relative to its East-Asian counterpart which sets the preferential trade tariff lower than 10% (see Noland and Pack, 2007). Although more and more Arab economies have their interests in preferential scheme through tariff elimination on merchandise trade, the "free(r)-trade" commitment could be still far from adequacy to promote the intra-Arab integration, given that the service and financial/investment sectors remain heavily regulated in the region.

To study the likelihood and/or appropriateness of intra-Arab integration, various approaches can be employed. In this paper, the bilateral trade effects are evaluated using the conventional "gravity" model of international trade. It may be recommendable for further integrating

efforts, if the empirical results disclose a strong trade gravity pulling toward the region. Nevertheless, an incompatible trade pattern in the region would rather suggest the non-readiness of the intra-Arab economic unionization, *ceteris paribus*.

The paper is organized as follows. After the first section of introduction, Section (*II*) summarizes the literature of the intra-Arab integration. Section (*III*) provides a preliminary analysis centered on the recent intra-Arab trade trend and Arab countries' fundamental comparison. Section (*IV*) outlines the theoretical framework and methodology. Section (*V*) reports the empirical findings. The entire study is then concluded in the final section.

2. Literature Review

Political and intellectual interests in building an Arab economic zone have been raised in around fifty years ago. However, these interests were hardly put into effective actions. As studied in Konan (2003), the potential regional economic integration ought to be desirable and its resulting benefits may be substantial. Using the empirical study of Egypt and Tunisia, he referred that *deepening integration* among Arab economies, involving regulatory reform and services liberalization, may yield larger regional welfare gains than the *shallow integration*, namely the elimination of tariff and non-tariff trade barriers. He recommended especially the scheme of service sector liberalization in the Arab region for significant economic payoffs. Laabas and Liman (2002) supported with a similar result of the welfare gain from the creation of a sub-regional currency union centered on the oil-producing Gulf Cooperation Council (GCC) countries.

In terms of the feasibility of economic integration among Arab countries, many academic debates focus on the political and economic divergence, despite common factors such as religion, language, customs and traditions adopted among these countries. Noland and Pack (2007), Zineldin (1998), and Fawzy (2003) agreed that although over the past decades, there were series of attempts for intra-Arab regionalization including the early 1950s Arab League, Treaty for Joint Defense and Economic Cooperation, Arab Economic Unity Agreement; the 1960s endeavors of creating an Arab common market; the recent advent of

Gulf Cooperation Council, the Arab Cooperation Council, the Arab Maghreb Union, and the interests in forming an Arab free trade area in late 1990s, the results of these efforts were short-lived and negligible. Evident reasons consist of, across most of the Arab economies, non-existence or underdevelopment of capital markets, low trade complementarity explained by the classical Heckscher-Ohlin patterns of trade, distinct levels of economic development and the wide intra-regional income gap (between the lowest per capita income of US$610 in Sudan and the highest of US$12,710 in Kuwait), over-protected trade policy leading to de-prioritized exports and lack of global competitiveness, and the over-sized governments which marginalize and even crowd out the economic capability of private sectors. From the political point of view, Fawzy (2003) stated that the Arab governments believed that the regional integration is rather politically undesirable due to their belief under which the expected political costs of integration most likely outweigh its benefits. The fear of loss of national sovereignty, lack of commitment to form the supranational or supra-regional institution, and the insufficiency and involuntary acceptance of regional leadership make these governments reluctant to formally integrate themselves (also see Aarts, 1999).

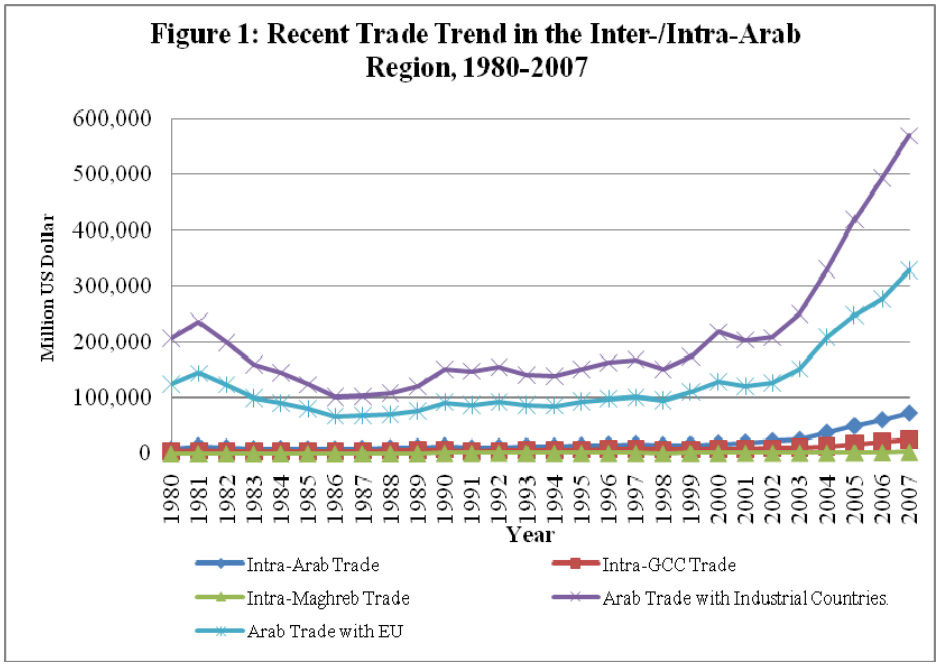
3. Preliminary Analysis: Intra-Arab Trade Trend and Intra-regional Country Comparison

In this section, first, Figure 1 offers the recent inter- and intra-Arab trade outlook. As observed, trade in the intra-Arab region including those of the Gulf Cooperation Council (GCC) and the Maghreb Union has been trivial and stagnant between 1980s and late 1990s. Since early 2000, due to some renewal and increasing interests of preferential scheme between/among the Arab nations, the aggregated regional trade volume started to increase, even if it is not yet evident in the Maghreb group.

On the contrary, for the comparison purpose, it is unambiguous to trace a greater inter-regional trade between the Arab economies and the EU, as well as their trade with the industrial countries including some major OECD members (the U.S., U.K., Germany, and Japan). Both trade trends move consistently and a significant growth is especially notable after the advent of millennium.

Quite obviously, the intra-Arab region is “undertraded” due to the fact that its trade with the rest of the world somewhat diverges its own

regional exchange. Given that a fair proportion of intra-regional trade is crucial to the economic integration, the Arab economies are in need to intensify their bilateral exchange before the integration could effectively proceed further.



Covering twenty Arab economies, Table 1 tabulates the multinational comparison with respect to the levels of economic development, types of government, official language (with or without other common languages/dialects), religion, and the colonial history. These fundamentals can be used to measure some pre-conditions for the possible formation of the regional economic island. Other things being equal, if they are synchronized across countries, the next step for the potential intra-Arab regionalization may be worth to pursue.

In the level of economic development, following the *World Development Indicators* of the World Bank, most Arab economies including Algeria, Djibouti, Egypt, Iraq, Jordan, Morocco, Sudan, Syria, and Tunisia are classified as the lower-middle income countries, with the Gross National Income (GNI) per capita in 2008 ranging from US$936 to US$3,705. To appropriately compare, these countries' 2008

Gross Domestic Product (GDP) per capita adjusted to Purchasing Power Parity (PPP) are also reported. Lebanon and Libya are listed as the upper-middle income countries with their GNI per capita falls between US$3,706 and US$11,455, where Lebanon's GDP (PPP) per person is comparable but slightly lower than that of Libya at around US$12,000.

The Gulf countries, also known as the Arab oil producers, including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates (UAE) are categorized as the high-income (non-OECD) economies. Their GNI per person is higher than US$11,456; meanwhile, the highest GDP (PPP) per person is realized in Qatar at US$86,669, followed by Kuwait, the United Arab Emirates, and Bahrain over US$30,000. In contrast, Somalia and Yemen were ranked in the low income group with their GNI per person less than US$935. The average GDP (PPP) per capita of Yemen is approximately US$2,500, which is four-fold to that of Somalia.

Having preliminarily evaluated these statistics, one could find that the levels of most Arab countries' economic advancement are somewhat dichotomous into the high/upper-income group and the low/lower-middle income group, rather than reaching a converging/synchronized economic development.

In the political structure across Arab, slightly more than half (11 of 20) of the sample nations are in the system of *republican* government. Bahrain, Jordan, Morocco, Oman, and Saudi Arabia, on the other hand, build their government based on the *constitutional/monarchy* system after their independence (except for Saudi Arabia without colonization history). A similar structure of monarchy, namely *emirate*, is adopted by Kuwait, Qatar, and United Arab Emirates. In rather different form, Libya is currently under the political regime of *Jamahiriya*.

In short, the overall political system in the Arab world is observed to be in a prevalence of undemocratic regimes (see Noland and Pack, 2007). Although to establish an economic bloc emphasizes preferential economic and political liberalization (to the degree of democracy), such prevalence may in fact bring in the political convergence in Arab, which in turn forms the consensus in the pursuit of political reform toward liberalization.

The language and religion components are in the highest level of parity. Most Arab dwellers speak Arabic, the official and most popular lingo. In addition, Islam widely spreads across the sample nations. The convergence of them may serve as a favorable mean for the entire region in any future economic integration.

The last column of Table 1 shows the colonial history across the Arab nations. Majority of the sample nations were politically colonized by one of the two colonizers, namely United Kingdom and France. Libya and Oman were once governed by Italy and Portuguese, respectively. It is believed that countries colonized by the same colonizer tend to share similar colonial experience. Thus, it might be less problematic to integrate these nations in the Arab area, at least to the socio-economic level, given their common colonial history, *ceteris paribus.*

Table 1: Intra-Arab Country Comparison

Country	Level of Economy / GDP Per Capita 2008 (PPP; US$)	Government	Language	Religion	Colonizer
Algeria	Lower-Middle Income / $6,927	Republic	Arabic, French	Islam	France
Bahrain	High Income / $33,988	Constitutional Monarchy	Arabic	Islam, Christian	UK
Djibouti	Lower-Middle Income / $2,400	Republic	French, Arabic	Islam, Christian	France
Egypt	Lower-Middle Income / $5,904	Republic	Arabic	Islam, Christian	UK
Iraq	Lower-Middle Income / $4,000	Republic	Arabic, Kurdish, Turkman	Islam, Christian	UK
Jordan	Lower-Middle Income / $5,171	Constitutional Monarchy	Arabic	Islam, Christian	UK
Kuwait	High Income / $40,943	Emirate	Arabic	Islam	UK
Lebanon	Upper-Middle Income / $12,063	Republic	Arabic	Islam, Christian	France
Libya	Upper-Middle Income / $14,593	Jamahiriya	Arabic	Islam	Italy
Mauritania	Low Income / $2,108	Republic	Arabic, French	Islam	France
Morocco	Lower-Middle Income / $4,432	Constitutional Monarchy	Arabic, French	Islam	France
Oman	High Income / $26,094	Monarchy	Arabic	Islam	Portuguese
Qatar	High Income / $86,669	Emirate	Arabic	Islam, Christian	UK
Saudi Arabia	High Income / $24,119	Monarchy	Arabic	Islam	--
Somalia	Low Income / $600	Republic	Arabic, Somali	Islam	UK, Italy
Sudan	Lower-Middle Income / $2,335	Republic	Arabic, Nubian	Islam, Christian, Indigenous	UK
Syria	Lower-Middle Income / $4,668	Republic	Arabic	Islam, Christian	France
Tunisia	Lower-Middle Income / $8,020	Republic	Arabic, French	Islam	France
UAE	High Income / $39,076	Emirate	Arabic	Islam	UK
Yemen	Low Income / $2,404	Republic	Arabic	Islam	UK

Source: International Monetary Fund, http//imf.org; CIA World Factbook; World Bank.

4. Theoretical Framework and Methodology

To appropriately evaluate the intra-Arab economic integration, the conventional "gravity" model of international trade is used. Intellectual modeling of the "gravity" analysis has appeared in many studies of the currency/monetary union and economic integration across different regions (Rose, 2000; Rose and Engel, 2002; Frankel and Rose, 1998; Sharma and Chua, 2000; Baxter and Kouparitsas, 2005; Kalbasi, 2001; Gilbert, Scollay, and Bora, 2001). However, while different econometric methods have been applied in various intra-Arab research (Bolbol and Fatheldin, 2005; Laabas and Limam, 2000; Boughanmi, 2008; Buiter, 2008, and Al-Atrash and Yousef, 2000), the gravity model examining the recent trade trend across wide-ranging Arab economies has not yet been explored.

In this paper, the gravity analysis is employed in light of the framework of Rose and Engel (2002).

$$ln(X_{ij}) = \beta_0 + \beta_1 ln(D_{ij}) + \beta_2 ln(Y_i Y_j / Pop_i Pop_j) + \beta_3 Adjacency_{ij} + \beta_4 Religion_{ij} + \beta_5 Language_{ij} + \beta_6 Colonizer_{ij} + \beta_7 GCC_{ij} + \beta_8 Maghreb_{ij} + \varepsilon_{ij}$$

where the endogenous variable, X_{ij}, is the bilateral trade flows between country i and country j. In addition to the intercept term, β_0, eight exogenous variables are included in the model. D_{ij} is the distance between countries i and j. It is measured by the distance of the capital cities between two countries. Variable $Y_i Y_j / Pop_i Pop_j$ captures the GDP per capita of country i and country j. $Adjacency_{ij}$ is the first binary dummy variable which is unity if countries i and j share the same border and zero otherwise. $Religion_{ij}$ is the second dummy variable. Given that all the sample nations have their first religion in Muslim (Islam), this variable measures their second religious belief, namely Christianity, which equals to one if people in countries i and j share it in common and zero otherwise. The third dummy, $Language_{ij}$, takes the same consideration where, across Arab, Arabic is the official and most common lingo. Since many Arab dwellers (such as the Maghreb Union) also popularly communicate in French due to some of their colonial background, this language dummy thus takes to quantify the effect of French language on the bilateral trade. It reckons the value of one if both

countries *i* and *j* converse French (additionally to Arabic), and zero otherwise.

$Colonizer_{ij}$ denotes the colonial dummy in the intra-Arab region. Based on individual national history, if both country *i* and *j* were colonized by the same colonist, their colonial tie will assume a value of one, and zero for the non-common colonizers. Above and beyond, there are two membership dummies employed here; GCC_{ij} designates the first membership dummy in the model. It takes the value "one" if both country *i* and j are affiliated with GCC in the Gulf area, and "zero" for non-members. On the other hand, $Maghreb_{ij}$, represents the status of Maghreb membership between country *i* and *j*. A unity is assigned if both countries are members of the Maghreb Union, and zero otherwise. Lastly, ε_{ij} denotes the residuals of the model with its expected value equal to zero.

The object of interest is the coefficients β from the OLS operation. A negative β_1 would indicate that two countries with shorter geographical distance tend to trade more. A direct relationship between the GDP per capita of any two Arab countries and their trade flows is expected to show in a positive β_2. That is, countries with higher personal income would tend to result in a greater trade. Countries with close adjacency are inclined to trade more, represented in a positive β_3. β_4 remains positive if countries sharing the same second religion (i.e. Christianity) trade more. A positive sign of β_5 indicates that countries would trade intensively when French is used as another common lingo in addition to Arabic. β_6 in a positive value implies that a common colonizer between two Arab countries would assume a higher volume of bilateral trade. Lastly, the membership in GCC and/or in the Maghreb Union is to expand the bilateral exchange in the region, which is secured in the positive value of β_7 and β_8.

Data for the bilateral trade are collected from the *Direction of Trade* CD-Rom of International Monetary Fund, while the per capita GDP statistics are retrieved from the World Bank data source. For the geographic distances between two Arab countries (measured by their capital cities), they are imported from the *http://www.chemical-ecology.net/java/capitals.htm* site. Statistics for the *Adjacency*, *Religion*, *Language*, and the *Colonizer* dummies are compiled from the CIA

World Factbook. Lastly, the membership statistics for both *GCC* and *Maghreb* are imported from Noland and Pack (2007).

5. Empirical Findings

Table 2 reports the empirical results of the Arab "gravity" analysis. First, a negative distance coefficient (-2.313) suggests that countries being closer geographically tend to trade more in the intra-Arab region, with its significance level equivalent to 1%. Second, higher GDP per person in the Arab economies suggests a significantly lower bilateral trade. It could be explained by some primary factors as follows: (1) in terms of the level of economic development, the oil-rich/exporting countries, such as Algeria, Kuwait, Libya, Oman, Qatar, Saudi Arabia, and United Arab Emirates with comparably higher development and growth, bilaterally trade more between/among themselves as a sub-group than to other counterparts in the region. (2) Many Arab economies including Algeria, Libya, Mauritania, Morocco, and Tunisia – the so-called "Maghreb Union" – involve in individual trade arrangements with European countries such as France, England, and Italy, thanks to some of their common historical/colonial ties. (3) The Gulf primary oil exporters internationally trade with non-Arab developed nations around the world; meanwhile, some of the Arab "Mashreq" countries (i.e. Egypt, Jordon, Iraq, Syria, and Lebanon) recently have engaged in more trade agreements with the United States and the European Union. In short, these factors enlighten why the higher (per capita) income nations somewhat diverge the intra-bilateral trade in the region.

As to the parameter of *Religion*, it is evident that Arab nations with Christianity as a secondary religion appear to significantly and negatively affect bilateral trade in Arab. It is reasonably believed that most Arab nations with the Islamic faith would be inclined to trade more among themselves. However, for those with both Islam and Christianity beliefs (such as Bahrain, Djibouti, Egypt, Iraq, Jordan, Lebanon, Qatar, Sudan, and Syria), they presumably face greater trade options inter- and intra-regionally. As reflected in Figure 1, since 1999, a higher trade volume is observed between the Arab countries and European Union as a group than that in the intra-Arab region. This been said, the Arab countries could simply trade more with their European counterparts given the mutual religious belief. Here, one point worth-noting is that

among the "Mashreq" countries, many of them have relatively high Christian population, which may also imply an increase of their trade linkage with other Christian-countries and/or the rest of the world.

For the *Language* component, it is found that the Arab countries speaking French in addition to Arabic do not necessarily trade more (at the 5% significance level) with their neighboring countries of which Arabic is the *only* spoken language. Instead, these bilingual Arab nations expand their trade with the other region such as the European Union and/or the rest of the world. In reality, such attempt has been detected in the Maghreb Union which has increasingly augmented its trade with the Western world.

A total of four parameters are without robust impacts on the bilateral trade in the intra-Arab region. Although the impacts are not momentous, the signs of these parameters are as expected. First, the positive value of *Adjacency* suggests that the closer the border, the greater the bilateral trade may be assumed. This result is consistent with the finding in *Distance* which retains an opposite sign (i.e. the shorter the distance between countries, the higher volume the bilateral trade). Second, Arab nations with the same colonizer is liable, but insignificantly, to trade more. Likewise, for the membership status, both GCC and Maghreb membership are assumed to be advantageous for the growth of mutual exchange in Arab, other things being equal. Such positive but insignificant relationship between the sub-group membership and the bilateral trade in the Arab world can, to some extent, be shed lights to a claim in Fawzy (2003), in which she asserted that the sub-regional grouping could result in a slower regional integrating progress due to the fact that these sub-groups likely to intensify trade between/among themselves at the expense of trading with other non-sub-group members within the region.

Table 2: Regression Results of Gravity Model for Intra-Arab Region, 1998~2007

Dependent Variable: Bilateral Trade

Parameters	Estimates	Standard Error	t-value
Constant	7.5295**	1.7016	4.4250
Distance	-2.3133**	0.4384	-5.2772
GDP per Capita	-0.2320**	0.0931	-2.4926
Adjacency	0.0180	0.3582	0.0501
Religion	-0.7530**	0.2888	-2.6070
Language	-0.9859*	0.5060	-1.9485
Colonizer	0.0253	0.2333	0.1085
GCC	0.6485	0.5122	1.2660
Maghreb	0.6711	0.7553	0.8886
Overall standard error	1.3674		
Number of observations	190		
F-test	10.1927*		
R^2	0.3106		
Adjusted R^2	0.2801		

**: 1% of the significant level; *: 5% of the significant level.

6. Concluding Remarks

The original attempts and interests of Arab regional integration were dated back in the early 1950s, although it was chronically underdeveloped and compared unfavorably with those of other economic blocs. Owing to the growing emphasis of globalization, the renewal integration interests in the intra-Arab region have been progressively reaffirmed among Arab governments and intellectual units.

In this study, the unveiled recent intra-Arab trade has not shown a striking pattern. The majority of Arab economies remain trading less-intensively with their neighbors within the region. Instead, their trade with the European Union and the rest of the world has revealed a

substantial growth especially after the advent of millennium. The intra-Arab trade divergence is coincided in Figure 1 and Table 1, in which many Arab nations such as the Maghreb group inter-regionally trade more with their European counterparts at the expanse of their intra-regional exports and imports, on account of the advantage of alternative languages and religions, and the common colonial tie across their histories.

From the empirical findings, as the conventional gravity model has predicted, countries with closer distance significantly trade more than otherwise in the Arab region. Nevertheless, higher GDP per person in fact weakens the intra-Arab trade. It could be explained by the different levels of economic development in Arab, sub-grouping trade arrangements between individual Arab countries (such as the "Maghreb Union") and the European counterparts, and the Gulf oil exporters' trade with the non-Arab developed nations around the world. On the other hand, it is found that Arab countries with bilinguals (i.e. Arabic and French) and/or dual religions (i.e. Islam and Christianity) tend to significantly and negatively affect their bilateral trade. In general, with an alternative language and/or religious belief, they most likely face greater trade options inter- and intra-regionally.

Four parameters in the empirical model generate insignificant impacts on the intra-Arab bilateral trade, even though their signs are as anticipated. First, the positive value of *Adjacency* suggests that the closer the border, the greater the bilateral trade could be assumed. Second, Arab nations with the same colonizer are liable to trade more bilaterally. Lastly, for the membership status, both GCC and Maghreb membership are assumed to be potentially beneficial for the growth of mutual exchange in Arab, other things being equal.

Although the above findings are suggestive rather than decisive, given that these results are indirect and not immediately advantageous, it is believed that the creation of an intra-Arab economic union is currently infeasible, and a needing caution is essential for any pursuit of such regional integration.

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Credit Risk and Financing Structure of Malaysian Islamic Banks

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This study examines the impact of financing structure on Islamic banks' credit risk exposure via four measures: 1) real estate financing; 2) financing specialization; 3) short-term financing structure stability; and 4) medium-term financing structure stability. While controlling the bank-specific variables, our findings indicate that real estate financing and financing structure stability to some extent influence credit risk exposure. However, the significant effects disappear when we incorporated the macroeconomic variables in the framework. This implies that the impact of financing structure on credit risk exposure may be misleading when one ignores the role of macroeconomic fundamentals. Hence, it is hoped that our findings will help the policy makers as well as practitioners do make accurate judgements in the decision making process.

1. Introduction

Many theoretical research have shown that Islamic banks have additional risks on top of the standard risk spectrum faced by the conventional banks [Iqbal and Mirakhor (2007); Harrington and Niehaus (2003), Greuning and Bratonovic (2000)]. In general, Islamic banks are exposed to several types of risk such as the systematic risk, credit risk, liquidity risk, investment risk, insolvency risk, hedging risk, displaced commercial risk and *shariah* non-compliance risk. Systematic risks such as market risk, mark-up risk and exchange rate risk arise from unfavourable price movements of benchmark rates, foreign exchange rates, and commodity prices. On the other hand, credit risk mainly arises from the inability or unwillingness of borrowers to repay monthly

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instalments in timely and full accordance to the agreed terms. Credit risk can be diversified, but cannot be completely eliminated since a portion of it may be resulted from the systematic risk.

Credit risk exposure has received much attention in the banking literature and the recurring financial crisis has heightened intention in the subject [Chiesa (2008); Drehman et al. (2009), Agoraki et al. (2009), Wendel et al.(2009), Chalupka and Kopecsni (2009), Liao et al. (2009)]. According to the Basel Committee (2000), credit risk continues to be the leading source of problems in banking institutions all over the world. In fact, credit risk is the largest source of risk for the Malaysian banks as a result of financing portfolios being the institutions' largest component of asset and the main source of revenue [Central Bank of Malaysia (2001)]. The unique features of the Islamic financial contracts contribute to additional credit risk faced by Islamic banks. In the case of *murabahah* transactions, the Islamic banks have a potential credit risk that it delivers the asset to the client without receiving the payment in time. In the case of a non-binding *murabahah*, the client has a right to reject the delivery of the product acquired by the bank; thus, further rendering the banks to the price and market risk. With regards to *bay' al-salam* or *istisna'* transactions, if the bank fails to supply on time or to supply the quality of goods as specified in the contract or to supply at all, it is also exposed to credit. In the case of *mudarabah* investment, not only does the bank expose itself to the typical principal-agent problem, it also renders to an enhanced credit risk given to the *mudarib*. This is due to the nature of *mudarabah* contract that prohibits the bank to participate in the management of the project, thus creating the difficulty in assessing and managing credit risk. The bank lacks monitoring devices in deciding whether the claims of losses come from *mudarib* negligence. The high information asymmetry and low transparency in financial disclosure by the *mudarib* strengthens the risk of the Islamic banks.

Furthermore, other externalities complicate the credit risk of the Islamic banks. For instance, in the case of default, Islamic banks are not allowed to charge any penalty unless in the case of intentional delay. In current practice of Malaysian Islamic banks, for real estate lending, the defaulted borrower is only charged for the legal and administration fees if he fail to pay the installments for more than three months consecutively. If he defaults only for one to two consecutive months,

there is no legal action to be taken. This practice can be misused by unethical borrowers who delay the payment intentionally. While excessive growth of financing exposes bank to credit risk, many studies reveal that financing structure is of crucial importance [Hanson et al. (2008), Blasko and Sinkey Jr. (2006), Norhayati and M. Ariff (2003) and Madura et al. (1994)]. Given the fact that credit risk is the largest source of risk for the Malaysian banks and the role of financing structure on bank's credit risk exposure, the objectives of this study is to examine the relationship between financing structure and credit risk exposure of the Islamic banks in Malaysia. This study adds value to the current literature by investigating four financing structure models, adopted with modification from Mansor and Ruzita (2004) and Amin and Ferrantino (1997; 1999) and Aisyah et al. (2008a and b).[3] The four models are: 1) the real estate financing, 2) specialization index, 3) short term financing structure stability, and 4) medium term financing structure stability.

The remainder of this paper is organized as follows: the next section outlines the literature review of risk determinants. Section 3 highlights the research design, followed by the analysis of the findings in section 4. Finally section 5 concludes.

2. Literature Review

The unique characteristics of the Islamic financial contracts, arises from the composition assets and liabilities of the banks, contribute to additional credit risk faced by Islamic banks. Credit risk is strongly bundled together at different stages of the contracts. Prior studies suggest that credit risk is the highest in *mudarabah* and *musyarakah* financing in Islamic banks (Khan and Ahmed, 2001; Nor Hayati and Shahrul Nizam, 2004; Van Greuning and Iqbal, 2007). For instance, in the case of *mudarabah* financing (investment), besides exposing bank to the typical principal-agent problem, it also renders to an enhanced credit risk given to the *mudarib* (say, firm). This is due to the nature of *mudarabah* contract that prohibits the bank to participate in the management of the project, thus creating the difficulty in assessing and managing credit risk. The bank lacks monitoring devices in deciding whether the claims of losses come from *mudarib* negligence or not. The

[3] Even though those studies focus on export structure, the objective is however similar; that is to examine how the structure of one variable influences the other variable.

high information asymmetry and low transparency in financial disclosure by the *mudarib* strengthens the risk of the Islamic banks. Thus, it is important for Islamic banks to place serious attention to identify, measure and mitigate credit risk. What is more important is that banks should hold adequate capital as cushion to absorb the risks. Indeed, Tajuddin et al (2009) has empirically supported the significant impact of financing growth, capital buffer, financing to risky sector, and size on credit risk exposure of the Islamic banks.

With respect to financing structure, Hanson et al. (2008) suggest that if the financing portfolio comes from different sectors, there will be further scope for credit risk diversification by changing the portfolio weights, even in the case of sufficiently large portfolio. Also, Blasko and Sinkey Jr. (2006) provide empirical evidence for the case of the U.S by showing that concentration in real estate financing challenges the capability of banks to manage interest rate risk, especially during rising climate. They emphasize that without proper regulatory supervisions, banks which lend heavily to real estate sector could shift their risks onto the government safety net, particularly if they were established to fulfil government objectives or society needs. In contrary, Madura et al. (1994) find that real estate financing increases the implied risk exposure of the U.S. depository institutions, but not the commercial banks.

For the Malaysian context, focusing on the depository institutions, Nor Hayati and M. Ariff (2004a) reveal that financing to risky sectors increases the market risk exposure. As the depository institutions in Malaysia comprise commercial banks, merchant banks, and finance companies, the finding for commercial banks is still unknown. With respect to Islamic banking, Nor Hayati and Shahrul Nizam (2004b) find that risky sector financing does not influence credit risk exposure. They focus on six anchor banks for the period of study from 1996 to 2002. With a limited number of observations, they adopt the pooled OLS regression model without controlling the 1997 Asian financial crisis. Not only the method ignores the unique characteristics of the full-fledged Islamic banks as well as the Islamic subsidiaries (of conventional banks), the study only examines one aspect of financing structure, leaving others such as financing specialization and financing structure stability.

Meanwhile, studies on the determinants of bank risk exposure *per se* are very limited. So far, only Madura et al. (1994), Nor Hayati and M. Ariff (2004a), and Nor Hayati and Shahrul Nizam (2004b) examine the determinants of risk exposure. Firstly, Madura et al. (1994) examine the determinants of the implied risk exposure for the case of deposit-taking institutions and commercial banks in the U. S. Their findings for the depository institutions are however not consistent with the findings for the commercial banks. With regards to the depository institutions, real estate lending and real estate owned are positively related to risk; while non-interest income and capital buffer are inversely related. For the case of the commercial banks, the significant role of real estate lending disappears while the influence of real estate owned and capital buffer remains. Secondly, Nor Hayati and M. Ariff (2004a) investigate factors affecting risks for the case of Malaysia using a single-factor CAPM. In contrast to Madura et al. (1994), they only focus on the deposit-taking institutions. They find various types of risk have different risk determinants. For market risk exposure, the determinants are loan default, cost of fund, financing growth, and financing concentration. With regards to unsystematic risk, the first two variables hold while short-term interest rate replaces financing growth and financing concentration. For the case of total risk exposure, the result is similar to unsystematic risk exposure plus an additional factor, financing growth. Meanwhile, the determinant for equity risk is the regulatory capital. Finally, Nor Hayati and Shahrul Nizam (2004b) analyze the determinants of credit risk for the Islamic banks in Malaysia.[4] They find that the determinants of credit risk for the Islamic bank are management efficiency, size, and risk-weighted asset.

As the theoretical framework for risk has not yet established, most studies include the bank-specific variables (BSV, hereafter) when investigating a specific issue. Studying the ownership structure, Saunders et al. (1990) takes into account equity capital, fixed asset, and size as control variables. In a later study, Anderson and Fraser (2000) apply a slightly different specification for the equity capital. As oppose

[4] The 3 capital variables are: 1) LEV (Tier 2/Tier 1 capital); 2) REGCAP (Tier 1/ total asset); 3) RWA (Risk-weighted asset/total asset). The 3 credit variables are: 1) RISKY (risky sector lending/total loan); 2) LLP (loan loss provision/total loan); and 3) LD (total loan/fixed deposit + negotiable instrument deposit). The 2 business variables are: 1) size (log of total asset) and 2) management efficiency (earning asset/total asset). The only interest rate variable is cost of fund (interest expense + non-interest expense)/total asset.

to Saunders et al. (1990) who employ the ratio of total equity to total asset (TE/TA), they introduce, '*frequency*', which is the ratio of an average daily share volume traded to number of shares outstanding as an alternative proxy for capital buffer.[5] While the aforementioned studies analyze for the case of the U.S., Konishi and Yasuda (2004) examine the same issue for the Japanese market. Other than size, they include three BSV related to capital. They are (TE/TA), '*frequency*', and capital constraint dummy. In a recent study, Pathan (2009) includes an additional variable, namely '*Charter Value*', based on Keeley's Q, measured by the sum of market value of equity plus the book value of liabilities divided by the book value of total asset. To summarise, studies on ownership structure includes variables that are related to business operations and capital buffer as BSV.

Despite that, studies on loan sales embrace other BSV. Hassan (1993) includes variables related to credit, interest rate, and business operations. The credit related variables are loan specialization, loan expansion, and loan default. The interest rate related variable is the absolute GAP.[6] The business related variables are size and dividend payout ratio. In another study, Cebenoyan and Strahan (2004) adopt BSV related to capital, liquidity, and credit. While the standard measure applies for capital and credit variables, they employ short term investment securities to measure liquidity risk. In conclusion, studies on loan sales take into consideration the variables related to credit, interest rate, liquidity, capital, and business operations.

Focusing on the role of mutual fund, Gallo et al. (1996) incorporates BSV related to credit, investment, capital, and business operations. Meanwhile, a study of real estate lending by Brewer et al. (1996) include one BSV that is related to capital. In contrast, a study on regulatory restriction by Gonzales (2004) incorporates BSV related to credit, investment, and business operations.

[5] This is due to the fact that it denotes the speed of which new info is captured in stock price and correlated to variances in bank balance sheet and off-balance sheet portfolio.
[6] GAP is RSA-RSL. RSA is rate sensitive asset and RSL is rate sensitive liability.

3. Research Design

3.1 Estimation model, data and hypotheses

As the theoretical and empirical framework for risk exposure have not yet established, this study incorporates all BSV that are relevant to the development of Islamic banks in Malaysia. By using an unbalanced panel data, the regression model is based on Generalized Least Squares (GLS) estimation. Three models are tested namely, none effect (ordinary least squares - OLS), fixed effect, and random effect models, respectively. The best model is selected based on Likelihood Ratio and Hausman test.[7] Financial information of 14 Islamic banks is collected for the year 1994-2008. Initially, we hypothesize that credit risk is a function of financing structure and BSV. We also include a crisis dummy to control for the 1997/1998 financial crisis as shown in Equation 1:

$$\textit{Credit risk} = f(\textit{Financing Structure, BSV, Crisis}) \quad \text{Eq. (1)}$$

Credit risk is measured by the ratio of non-performing loan to total loan. It has been adopted by Rose (1996), Berger and De Young (1997), Corsetti et al. (1998), Nor Hayati and Shahrul Nizam (2004b), and Ahmad Azam and Mohd Sollehudin (2009), as a proxy to credit risk exposure. Our four alternate financing structure variables are: real estate lending (BPS and RISKY), Specialization Index (SPEC), Lending Composition Change (LCC), and Variance of Traditionality Index (VART) that will be discussed in detail in the next section.

After testing Eq. 1, we believe that the performance of real estate sectors may depend on the economic cycles as well. Hence, to test the robustness of our finding, we add the macroeconomic variables (MAV, hereafter) as in Eq. 2.

$$\textit{Credit risk} = f(\textit{Financing Structure, BSV, MAV, Crisis}) \quad \text{Eq. (2)}$$

Studies that incorporate MAV do not directly examine credit risk exposure *per se*, but the banking sector distress and credit cycles.

[7] Refer to Beaver et al. (1989), Hsio (2002), Gujarati (2003), Shahida (2006) and Roza Hazli (2007) for further details on panel data regression techniques.

Following Koopman et al. (2009), we distinguish three blocks of macroeconomic variables that represent economic cycle, bank-lending condition, and financial market condition. Our model captures both micro and macroeconomics variables as in Eq. (2). The business cycle block contains gross domestic product growth (GDP) and term spread (SPRD). According to Koopman et al (2009), Bangia et al. (2002), Kavvathas (2001), and Nickell et al. (2000), GDP and SPRD have a record for predicting default rate variation over stages of the business cycle. As a signal of current economic condition, we expect that both to be inversely related to credit risk exposure. For the bank lending condition, we include the growth rate of inflation (CPI) and money supply (M3). According to Koopman et al. (2009), Blank et al. (2009) and Mannasoo & Mayes (2009), aggregate money supply can either directly or indirectly affect monetary policy and private demand for credit. They hypothesize that lower money supply reduces credit supply by banks, and leads to higher default intensities. Hence, we expect M3 to be negatively related to credit risk. Also, higher inflation rate is associated to higher interest rate, causing more expensive for firms to take fresh credit, which may end up to higher default rates. Thus we expect that CPI to be positively related to credit risk. For the financial market condition, Koopman et al. (2009) opine that stock market return is a good predictor for output growth, thus, we expect KLCI is negatively related to credit risk exposure.

The BSV are the loan expansion (TL), capital buffer (TE), risk-weighted asset (RWA), regulatory capital (REG), financial leverage (LEV), cost of fund (INT), and size (TA). Meanwhile, the MAV are output growth (GDP), financing spread (SPRD), inflation (CPI), money supply (M3) and stock market return (KLCI). The measurements and expected coefficient signs for BSV and MAV are shown in Table I.

Previous research shows that loan expansion is positively related to risk. Hassan (1993) argues that heavy reliance on loans is considered as having a high degree of financial leverage; thus increases the bank financial risk. Besides, Madura et al. (1994) highlight that giving loans is riskier than investing in financial securities as banks are allowed to invest only in good investment grade securities. Further, Gallo et al. (1996) suggest that loans are relatively illiquid besides subject to default risk.

For capital related variables, equity is perceived to provide a buffer against loss. Hence, TE should be inversely related to risk. Nor Hayati and Shahrul Nizam (2004b) opine that risk-weighted asset has significant influence on credit risk exposure since the weighted capital required is based on the level of asset risk. Risky asset is weighted higher, thus, RWA should be positively related to credit risk. They also believe that well-capitalized banks can better absorb temporary financial difficulties as it takes into account prudential regulation constraints. Conceptually, Islamic banks do not in dire need to have large capital buffer since the risks and losses can be absorbed by the investment depositors and equity holders. With this in mind, REG is expected to be inversely related to credit risk. With respect to financial leverage, financial risk increases with leverage. As banks use leverage to generate shareholder's wealth, failure to do so will destroy shareholder's value. Hence LEV is expected to be positively related to credit risk exposure.

With regards to cost of fund, Madura et al. (1994) argue that bank risk depends on the proportion of funds obtained in the deposit account (measured by interest expense). They opine that the higher the deposit, the higher the interest expense, the higher the liability that the bank has to pay to the debtors. To maintain the profit margin, bank may embark into risky activities (such as providing financing to less creditworthy customers) in order to obtain higher returns. Hence, INT is expected to be positively associated to credit risk exposure.

With respect to size, many argue that the greater the size, the greater will be the potential to diversify business risk from various perspectives. Saunders et al. (1990) mention that the larger the bank, the more information is likely to be gathered, thus reducing information risk. They also believe that regulators are unwilling to let big banks fail, hence big banks is synonymous with low risk. In a similar vein, Hassan (1993) justifies that banks with larger assets are more able to diversify; but instead of looking at information risk, he highlights the operating risk associated with the product lines. He believes that larger banks are more able to utilize personnel skill, particularly when engaging in off-balance sheet activities. From a different angle, Anderson and Fraser (2000) believe that bigger banks are more flexible to adjust unexpected liquidity and capital shortfall. Thus if loan composition is the same but differ only in term of asset size, bigger banks should have lower risk as compared to smaller banks, conjecturing an inverse relationship between

size and risk. However, if the loan portfolio composition is different, the big banks overall risk might be higher than the smaller ones. According to them, this is due to the fact that big banks have a tendency to hold riskier loan or to embark in off-balance sheet activities, thus leading to a higher overall risk. Similarly, Gonzales (2004) points out that with the existence of the economy of scale, increase market power, and the 'too big to fail' policy for big banks, big banks tend to enter into risky activities, which suggests a positive relationship between the two. Against this background, it is expected that TA be either positively or negatively related to credit risk exposure, depending on the banking characteristics.

3.2 Specification for lending structure

a) Real estate Financing

Several studies have attempted to investigate the impact of real estate lending on bank risk, but there is no standard definition of the real estate sector *per se.* To be comparable with previous studies, this study examines the ratio of broad property sector lending to total loan (BPS) and the ratio of risky sector lending to total loan (RISKY).[8]

b) Lending composition change (LCC)

The LCC captures the short-run stability in lending composition.[9] The LCC is computed as follows:

$$LCC = \sum_{i=1}^{12} \min\left(s_{it}, s_{it-1}\right) \qquad \text{Eq. (3)}$$

[8] Madura et al. (1994) and Blasko & Sinkey Jr. (2006) focus on loan given specific to real estate sector (RE), which comprise of residential, non-residential properties, and real estate. In Malaysia, broad property sector (BPS) comprises of RE and construction sector. Roza Hazli (2007) employs BPS as a proxy for real estate lending. Meanwhile, Nor Hayati & M. Ariff (2004a) and Nor Hayati and Shahrul Nizam (2004b) employ RISKY sector lending. Their RISKY sector comprises of loan given to BPS, purchased of securities and consumption credit. All measures are ratios to total loan.

[9] Twelve sectors are employed to construct lending indices representing characteristics of bank lending compositions. The twelve sectors are agriculture, hunting, forestry and fishing; mining and quarrying; manufacturing; electricity, gas and water; broad property sectors; wholesale, retail trade, restaurants and hotels; transport, storage and communication; finance, insurance and business services; purchase of securities; purchase of transport vehicles; consumption credit; and others.

where s_{it} is the share of sector i in total lending in year t. It takes on a maximum value of 1 if there is no change in lending composition and a minimum value of 0 if the portfolio of lending by sector loan was not loaned in the previous year. Thus, a high value of LCC suggests short-run stability of lending composition.

c) Specialized index (SPEC)

Similar to the Herfindahl-Hirschman index, SPEC is constructed as follows:

$$SPEC = \sum_{i=1}^{12} s_{it}^2 \qquad \text{Eq. (4)}$$

where, s_i is the lending share of industry i in total lending. A score approaching 1 suggest a high degree of loan concentration while a score approaching 0 indicates a high degree of diversification.

d) Variance of traditionality index (VART)

VART measures changes in the lending composition over an intermediate term. It is a variance of traditionality index (*TI*), which is calculated using five-year intervals for each sector. The *TI* for the year 1995 is computed using data from 1993 to 1997; for 1996, using data from 1994-1998, and so on. The *TI* formula is as follows:

$$TI_{it} = \frac{\sum_{l=-2}^{l=2} c_{i,t-1}}{5} \qquad \text{Eq. (5)}$$

where the cumulative lending experience (C_{it}) for each industry is calculated as:

$$c_{it} = \frac{\sum_{i=t_0}^{t} e_{it}}{\sum_{i=t_0}^{t_1} e_{it}} \qquad \text{Eq. (6)}$$

where t_0 and t_1 are initial and terminal periods of the data and e_{it} is lending of industry i in year t. Since VART is a variance of TI across sector, a high variance indicates an episode of divergent pattern of lending during the 5 year period. Meanwhile a low variance suggests a stability of lending composition.

4. Findings and Discussion

Table I shows the descriptive statistics of the mean, skewness, kurtosis, standard deviation, and the Jarque-Bera test of the variables employed in this study. Since all variables have significant Jarque-Bera values, skewness ≠ 0, kurtosis ≠ 3, and, we believe that the variables are not normally distributed; thus, GLS estimation is more appropriate. Table II presents the correlation matrix of the BSV and macroeconomic variables. As all variables posit the values less than 0.8, we believe that multicollinearity is not a serious problem[10]. Table III and IV reports the results of the GLS fixed effect model, which is the best estimations in this study.[11] Table III presents the results for financing structure with BSV while Table IV shows the results of financing structure with both BSV and macroeconomic fundamentals. From Table III, we can see that risky sector financing and both financing structure stability in short and medium-term period show significant results. While increasing in risky sector financing and stability of financing structure increases the credit risk exposure, the instability of financing structure in the medium term period increases the credit risk exposure as well. Interestingly, the significant effect of all our financing structure variables disappears when we include the macroeconomic variables in the regression model. This infers that the interpretation regarding the role of financing structure in determining credit risk might be misleading if one ignores the fluctuation of macroeconomic fundamentals. Hence, we provide empirical evidences showing that financing structure does not significantly influence credit risk exposure for the Islamic banks in Malaysia when micro and macro fundamentals are taken into account.

[10] Gujarati (2005) set a cut-off point of 0.8. He mentions that the variables are highly correlated if the coefficient matrix exceeded 0.8; thus either one of them must be excluded to avoid multicollinearity problem.

[11] Based on the Likelihood ratio and Hausman test, our results show that fixed effect model is better than none effect and random model. In addition, we adopt the approach by Baltagi (1995) who suggest that a random effects model is not appropriate if the sample is not randomly taken from a large population. In this study, all available data are gathered covering 90 percent of the Islamic banks in Malaysia. Moreover, the results for the R-squared test and D.W statistics of the fixed effect models are much better than the random effect model. Therefore, the fixed effect model seemed to be the best model for this study. The results for none effect model, random effect model, and the criterion selection tests will be provided upon request.

With regards to the other credit risk determinants, our findings show that the credit, capital, interest, and business operation related variables are the significant internal factors. All microeconomic variables except RWA and REGCAP have consistent coefficient signs with previous studies. For RWA, in contrast to Berger and De Young (1997) and Nor Hayati and Shahrul Nizam (2004b), our findings show an inverse relationship. This can be due to the prudential regulatory capital requirement imposed by the central bank of Malaysia via risk-weighted asset assessment. For REGCAP, our findings show a positive relationship. This may imply that the mechanism for investment depositors and equity holders to absorb the risk and losses in the case of default has not yet been materialized, hence forcing the regulatory capital to absorb the risk.

For the macroeconomic variables, both business cycles and bank-lending conditions are the significant. All significant variables except SPRD and M3 show consistent signs with our expectation. SPRD and M3 are positively related to credit risk. As SPRD is the difference between long-term government securities and money market rate, we believe that the increasing long-term interest rate financing may be associated to increasing financing to risky borrowers, which intensifies credit risk exposure. While M3 is the measure for credit supply, an increase in M3 means higher credit supply. Hence, without prudent financing system, the banks may lend excessively to risky sectors, which increases the credit risk exposure.

5. Conclusion

Even though financing structure to some extent plays a significant role in the micro perspective, its power diminishes when macroeconomic variables are incorporated in the framework. Our findings offer empirical evidences that the significant role of financing structure, which has been theoretically proposed by Hanson et al. (2008) and has been empirically supported by studies that only control for microeconomic variables, does not hold for small-open developing economies like Malaysia when macroeconomic variables are taken into consideration. Although real estate financing [model 1(a) and (b)] does not significantly influence credit risk exposure in this particular study, we should be aware of the high level of non-performing loans in BPS that may lead to high credit risk exposure. As in June 2008, the monthly

aggregate data for the Malaysian commercial banks recorded that the highest non-performing loans comes from the BPS, which is around 50 percent of total non-performing loans. With the ongoing global financial crisis, the Malaysian Islamic banks should continuously strategize on their financing structure as there is an increasing number of real estate properties' auction as advertised either in the streets or newspapers. Moreover, mitigating credit risk remain the main concern of banks' management due to the fact that by minimizing credit risk, profit can be maximized.

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Table I: Descriptive Statistics

Variables	Expected Coefficient sign	Mnemonic	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Credit Risk exposure		NPL	0.039	3.331	17.645	0.064	1564.05
Lending Structure							
Ratio of BPS to total loan		BPS	0.416	0.335	1.068	4.489	50.324
Ratio of risky sector to total loan		RISKY	0.493	0.326	1.298	6.225	56.438
Degree of specialization of lending		SPEC	0.006	0.017	4.143	22.859	1524.23
Change of lending composition		LCC	0.825	0.165	-1.994	7.701	125.13
Variance of traditionality index		VART	0.041	0.032	1.645	6.5	76.014
Bank-Specific Variables:							
a) Credit related Variables							
Ratio of total loans to total asset	+	TL	0.659	1.206	8.275	71.994	16570.9
b) Capital Related Variables							
Ratio of total equity to total asset	-	TE	0.086	0.054	2.086	7.834	134.231
Ratio of risk-weighted asset to total asset	+	RWA	0.68	0.321	0.712	4.122	10.83
Ratio of Tier 1 capital to total asset	-	REGC AP	0.104	0.124	4.61	26.681	2125.81
Ratio Tier 2 capital to Tier 1 capital	+	LEV	0.206	0.255	2.251	6.896	116.749
c) Interest Rate Related Variables							
Ratio of income distributed to depositors and shareholders' fund to total asset	+	INTEXP	0.026	0.054	8.238	71.401	16294.4
d) Business Operation Related Variables							
Log of total asset	+/-	LTA	6.466	0.578	-0.79	2.95	8.244
Macroeconomic Variables:							
a) Business Cycle Block							
Growth of Gross Domestic Product	-	GDP	0.107	0.027	-1.154	8.776	127.398
Difference between the 5 year Malaysian Government Bond rate and the Kuala Lumpur overnight rate	-	SPRD	0.742	0.579	0.65	3.602	6.769
b) Bank-Lending Conditions							
Growth of consumer price index	+	CPI	2.136	0.976	0.727	2.715	7.239
Growth of Broad Money	-	M3	0.015	0.01	-0.059	1.447	7.977
c) Financial Market Conditions							
Return of Kuala Lumpur Composite index	-	KLCI	2.928	0.796	2.701	13.691	472.321

Notes: All Jarque-bera variables are significant at 1 percent, inferring the variables are not normally distributed, thus GLS estimation is more appropriate as compared to OLS estimation.

Table II: The Results of Correlation Matrix

	TL	TE	RWA	REGCAP	LEV	INTE	XP	LTA	GDP	SPREAD	CPI	M3	KLCI
TL	1												
TE	0.032	1											
RWA	0.007	0.131	1										
REGCAP	0.737	0.367	0.029	1									
LEV	0.193	-0.3	-0.07	-0.048	1								
INTEXP	0.969	0.012	-0.06	0.721	0.175	1							
LTA	-0.21	-0.44	0.071	-0.425	0.156	-0.286	1						
GDP	0.038	0.053	0.025	0.095	-0.11	0.005	-0.06	1					
SPREAD	-0.11	0.145	0.218	0.073	-0.21	-0.104	-0.03	0.303	1				
CPI	0.19	-0.06	-0.28	0.037	0.266	0.14	0.324	0.005	-0.498	1			
M3	0.163	-0.15	-0.25	-0.029	0.356	0.126	0.395	-0.25	-0.376	0.69	1		
KLCI	0.075	0.033	-0.17	0.054	0.093	0.079	0.127	-0.37	-0.447	0.56	0.26	1	

Notes: Correlation matrix is based on common sample

Table III: Result for GLS Fixed Effect Model with Microeconomic Variables

(Dependent variable: Credit Risk Exposure)

Variables	Expected Coefficient Sign	Model 1(a)	Model 1(b)	Model 2	Model 3	Model 4
C		0.227	0.211	3.267	0.223	0.004
		-0.957	-0.645	-0.017	-1.638	-0.088
BPS		0.001				
		-0.258				
Risky			0.008**			
			-2.127			
SPEC				-0.233		
				(-0.960)		
LCC					0.003**	
					-2.426	
VART						0.417***
						-3.527
TL	+	0.038***	0.037***	0.020**	0.040***	0.001
		-3.15	-3.21	-2.614	-3.734	-1.588
TE	-	-0.088**	-0.085**	-0.103***	-0.095***	0.062
		(-2.618)	(-2.368)	(-3.964)	(-2.807)	-1.071
RWA	+	-0.009***	-0.010***	-0.008	-0.010***	-0.012**
		(-3.200)	(-4.044)	(-1.276)	(-3.312)	(-1.864)
REGCAP	-	0.093***	0.100***	0.106***	0.091***	0.135***
		-6.886	-9.813	-15.359	-6.836	-2.911
LEV	+	0.021*	0.028***	0.013***	0.018***	0.070**
		-1.9742	-3.241	-2.726	-4.202	-2.63
INTEXP	+	0.773***	0.860***	0.941***	0.751***	0.749**
		-3.777	-5.111	-7.432	-3.982	-2.445
LTA	+/-	-0.018	-0.013	-0.014***	-0.020**	-0.002
		(-1.663)	(-1.391)	(-2.799)	(-2.451)	(-0.314)
CRISIS	+	-0.013**	0.01	0.012	0.009	-0.036
		(-2.040)	-0.479	-0.848	-0.374	(-0.897)
Adj R^2		0.788	0.828	0.901	0.811	0.715
S.E. reg		0.031	0.031	0.0313	0.031	0.033
F-stats		13.783***	17.606***	29.112***	15.376***	9.231***
D.W stat		2.034	2.056	2.217	2.028	1.606

Notes: Regressions are based on White cross-section standard errors and covariance (d.f. corrected). Values in parentheses are *t*-statistics. ***, **, * denote significant at 1%, 5% and 10% confidence level, respectively. All D.W statistics except for model 4 are beyond the upper bound (dL), indicating no positive first order serial correlation at 5 % level of significant. D.W statistic for model 4 lies between the lower (dU) and upper limit (dL) or in the indecisive zone), indicating there is inconclusive evidence regarding the presence or absence of positive first order serial correlation.

Table IV: Result for GLS Fixed Effect Model with Micro and Macroeconomic Variables
(Dependent variable: Credit Risk Exposure)

Variables	Expected Coef. sign	Model 1(a)	Model 1(b)	Model 2	Model 3	Model 4
C		-0.039	-0.487	0.022	0.133	0.044
		(-0.024)	(-0.034)	-0.103	-1.193	-0.822
BPS		-0.008				
		(-1.003)				
Risky			0.001			
			-0.018			
SPEC				-0.271		
				(-0.709)		
LCC					-0.001	
					(-0.225)	
VART						0.212
						-1.56
TL	+	0.024**	0.024***	0.0176*	0.023**	0.014***
		-3.065	-3.231	-1.907	-2.254	-4.583
TE	-	-0.089**	-0.078*	-0.090***	-0.075**	-0.017
		(-2.303)	(-1.896)	(-2.850)	(-2.283)	(-0.259)
RWA	+	-0.011***	-0.011***	-0.009	-0.011***	-0.011
		(-4.879)	(-5.255)	(-1.612)	(-4.25)	(-0.821)
REGCAP	-	0.086***	0.090***	0.105***	0.086***	0.130***
		-9.571	-11.036	-11.994	-7.435	-3.215
LEV	+	0.014	0.021**	0.015***	0.021***	0.074***
		-1.244	-2.231	-3.354	-2.909	-2.857
INTEXP	+	0.831***	0.834***	0.940***	0.768***	1.1007**
		-5.019	-4.966	-8.07	-3.97	-2.582
LTA	+/-	-0.029**	-0.025**	-0.014**	-0.028***	-0.005
		(-2.319)	(-2.289)	(-2.155)	(-2.755)	(-0.462)
GDP	-	-0.195***	-0.170***	-0.0769	0.099	-0.703**
		(-3.174)	(-3.149)	(-0.630)	-0.827	(-2.194)
SPREAD	-	0.011***	0.009***	0.005*	0.017***	0.007
		-3.97	-5.24	-1.842	-6.166	-1.587
CPI	+	0.001	0.001	0.001	0.001	-0.003
		-0.718	-0.546	-0.54	-0.72	(-0.631)
M3	-	0.794**	0.824***	0.6501	1.541***	1.017**
		-2.399	-2.857	-0.904	-4.408	-2.052
KLCI	-	0.005	0.004	0.005	0.015**	-0.001
		-1.46	-1.425	-0.855	-2.459	(-0.085)
CRISIS	+	-0.003	-0.006	-0.008	-0.034**	-0.044
		(-0.351)	(-0.613)	(-0.589)	(-2.119)	(-0.690)
Adj R^2		0.783	0.791	0.874	0.79	0.69
S.E. reg		0.03	0.03	0.031	0.03	0.028
F-stats		11.186***	11.705***	18.608***	11.402***	6.962***
D.W stat		2.105	2.089	2.298	2.031	1.59

Notes: Regressions are based on White cross-section standard errors and covariance (d.f. corrected). Values in parentheses are *t*-statistics. ***, **, * denote significant at 1%, 5% and 10% confidence level, respectively. All D.W statistics except for model 4 are beyond the upper bound (dL), indicating no positive first order serial correlation at 5 % level of significant. D.W statistic for model 4 lies between the lower (dU) and upper limit (dL) or in the indecisive zone), indicating there is inconclusive evidence regarding the presence or absence of positive first order serial correlation.