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ARDL Approach to the Demand for Disaggregate Imports: the case of Iran

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Abstract

In this article, demand equations for import of consumer, intermediate and capital goods, for the period 1971(2) to 1999(1), is estimated and analyzed, using the ARDL Pesaran & Shin method. The results show that the behavior of the different categories of imported goods in Iran is best explained by the parallel market exchange rate, implying this rate is a closer approximation for the opportunity cost of importers, despite their access to foreign exchange at official or controlled rates.

1- Introduction

In this article, model of demand for import of consumer, intermediate and capital goods based on ARDL Pesaran & Shin method will be estimated and analyzed, with the quarterly data for the period 1971:2-1999:1.

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1- Introduction

In this article, model of demand for import of consumer, intermediate and capital goods based on ARDL Pesaran & Shin method will be estimated and analyzed, with the quarterly data for the period 1971:2-1999:1.

Methodological considerations will be explained in the specification of the import demand functions and the variables which should have been included theoretically and the different ways of their measurement will be discussed. Then with the specification of empirical model of response of import to the determinant factors, long run and short run models will be estimated and analyzed. The conclusions will be useful for the conditional forecasts of fluctuations of those goods groups and the design, implementation and evaluation of macroeconomic policies.

Import goods are classified into three groups of consumer, intermediate and capital goods. Since behavior of demand of import and also supply of exports in the different groups of goods is different, estimations of aggregate import and export can be misguided as a matter of policy making which is known as aggregation bias in econometrics terminology.

The effect of three important relative price indices, constructed by using the parallel market exchange rate, weighted exchange rate and import prices of the different groups of imported and exported goods, will be compared. We will see that the behavior of different groups of imported goods in Iran has been based on the parallel market exchange rate, thus rendering the mentioned rate a closer approximation for the opportunity cost of imported goods.

The second section will handle the econometrics theory of the model and illustrate the ARDL Pesaran & Shin approach for the cointegration analysis. In the third section the trend of the share of different groups of goods during the sample period will be studied. The fourth section will explain the theoretical basis of the model (demand for imports and supply of exports). The model of long run and short run demand for imports will be estimated and analyzed, using appropriate criteria for each variable in the different groups. Each one of these models has been estimated with three variables, namely the parallel market exchange rate, the weighted market exchange rate, and wholesale price index of imports. The importance of each variable for explaining fluctuations (long run &

short run) of trading flows will be evaluated. In the 6th section conclusions will be drawn from the above noted discussions.

2- Basic econometrics of the model

We employ the single equation procedure advanced by Pesaran and Shin (1998) and Pesaran et al. (1996), which allows for a mix of I(1) and I(0) variables in the same cointegration equation.

In this method each trading equation is specified as follows:

$$\Phi(L,P)y_t = \sum_{i=1}^{k}\beta_i(L,q_i)x_{it} + \delta w_t + u_t$$

$$\Phi(L,P) = 1 - \Phi_1 L - \Phi_2 L^2 - \Phi_p L^p \qquad (1)$$

$$\beta_i(L,s) = \beta_{i0} + \beta_{i1}L + \ldots + \beta_{is}L^s$$

$$u_t \sim iid(0,^2)$$

in which y_t reflects the trading flow (group of import goods) and x_{it} the determinant factors of trading flow including relative prices and income. w_t is a deterministic variables vector like constant term, time trend and exogenous variables with fixed lags. In the ARDL method the model (1) is estimated for different values p = 0,1,2, … , m and q_i = 0, 1, 2 , … m , i = 1,2,...,k namely a total of $(m+1)^{k+1}$ different ARDL models. The maximum lag , m , is chosen by the user , and all the models are estimated on the same sample period, namely t=m+1 , m+2 ,… , n.

m is selected four in this study as we use quarterly data. In order to identify the true lag (p,q) for each variable one of the criteria of model selection like adjusted R^2 ,the Akaike information criterion(AIC), Schwarz Bayesian criterion(SBC), or the hannan-quinn criterion (HHQ) can be used. This study has used the SBC criterion, which gives the highest priority to parsimony of the model with respect to the fitness. The long run coefficients or elasticities for the response of Yt to a unit change in Xit are estimated by:

$$\hat{\Theta}_i = \frac{\beta_i(1,\hat{q}_i)}{\hat{\Phi}(1,\hat{p})}$$

where $\hat{P}$ and $\hat{q}$ (i= 1, ... k) are the selected (estimated) values of p and q_i,i=1,2,3,...,k. Similarly the long run coefficients associated with the deterministic or exogenous variables w_t are estimated by:

$$\hat{\psi} = \frac{\hat{\delta}(\hat{p}, \hat{q}_1, \hat{q}_2, ..., \hat{q}_k}{1 - \hat{\Phi}_1 - \hat{\Phi}_2 - ... - \hat{\Phi}_p}$$

the estimates of the asymptotic standard error of $\hat{\Theta}_1, \hat{\Theta}_2, ..., \hat{\Theta}_k$ and $\hat{\psi}$ are computed using the Bewley's regression approach.

The error correction model associated with the ARDL model can be obtained through reparametrization of equation (1) in terms of the lagged levels and the first difference of y_t, Xit and w_t as follows:

$$\Delta y_t = -\Phi(1, \hat{p}) Ec_{t-1} + \sum_{i=1}^{k} \beta_{10} \Delta x_{it} + \delta' \Delta w_t - \sum_{j=1}^{p-1} \Phi_i^* \Delta y_{t-i} - \sum_{i=1}^{k} \sum_{j=1}^{q_i - 1} \beta_{ij}^* \Delta x_{i,t-j} + u_t \quad (2)$$

in which the correction term is defined as follows:

$$EC_t = y_t - -\sum_{i=1}^{k} \Theta_i x_{it} - \psi w_t$$

The term $\Phi(1, \hat{p})$ measures the importance of the coefficient of error correction term. The rest of the coefficients β_{ij}^*, Φ_j^* relate to the short run dynamics and the model convergence to equilibrium.

The short run equation can be simplified as follows:

$$\Delta y_t = \sum_{i=1}^{k} \alpha_i \Delta x_{it} + \alpha_0 \Delta w_t - \Phi_0 EC_{t-1} \quad (3)$$

in which:

$$\alpha_i = \frac{\sum_{i=0}^{q_i - 1} \beta_{ij}}{1 + \sum_{j=1}^{p-1} \Phi_j^*}$$

$$\alpha_0 = \frac{\delta}{1 + \sum_{j=1}^{p-1} \Phi_j^*}$$

$$\Phi_0 = \frac{\Phi(1,p)}{1 + \sum_{j=1}^{p-1} \Phi_j^*}$$

In fact equation 3 can be viewed as another illustration of the short run model for all three categories of goods.

In summary, the ARDL procedure involves two stages. At the first stage, cointegeration implying existence of a long run equilibrium relation between the variables of the model is tested. In case such a long run relation exists, the resultant residual term will be stationary even if some of the variables are non-stationary and integrated of degree one. In this case consistent and efficient estimations can be calculated from import elasticities with respect to price and scale variables. The existence of the long-run relation between the variables under investigation is tested by computing the F-statistic for testing the significance of the lagged levels of the variables in the error correction form of the underlying ARDL model. However, the (asymptotic) distribution of this F-statistics is non-standard, irrespective of whether the regressors are I(1) or I(0). Pesaran et al. (1996) have tabulated the appropriate critical values for different numbers of regressors (k), and whether the ARDL model contains an intercept and/or trend. They give two sets of critical values. One set assuming that all the variables are I(1). For each application, this provides a band covering all the possible classifications of variables into I(1) and I(1), or even fractionally integrated ones. If the computed F-statistic falls outside this band, a conclusive decision can be made without needing to know whether the underlying variables are I(0) or I(1), or fractionally integrated. If the computed statistic falls within the critical value band, the result of the inference is inconclusive and depends on whether the underlying variables are I(1) or I(0). It is at this stage in the analysis that the investigator may have to carry out uniy root tests on the variables.

Once the existence of one cointegerating vector is established, consistent estimations of long run elasticities will be obtained in the same framework. As it was described before, such estimates can be obtained from auto-regressive distributed lag (ARDL) regression based on levels of variables. Once orthogonalization between the residual term and the right-hand side variables is achieved (by including a sufficient number of auto-regressives), and residuals appear to be serially uncorrelated, one can use standard tests to establish the statistical significance of coefficients.

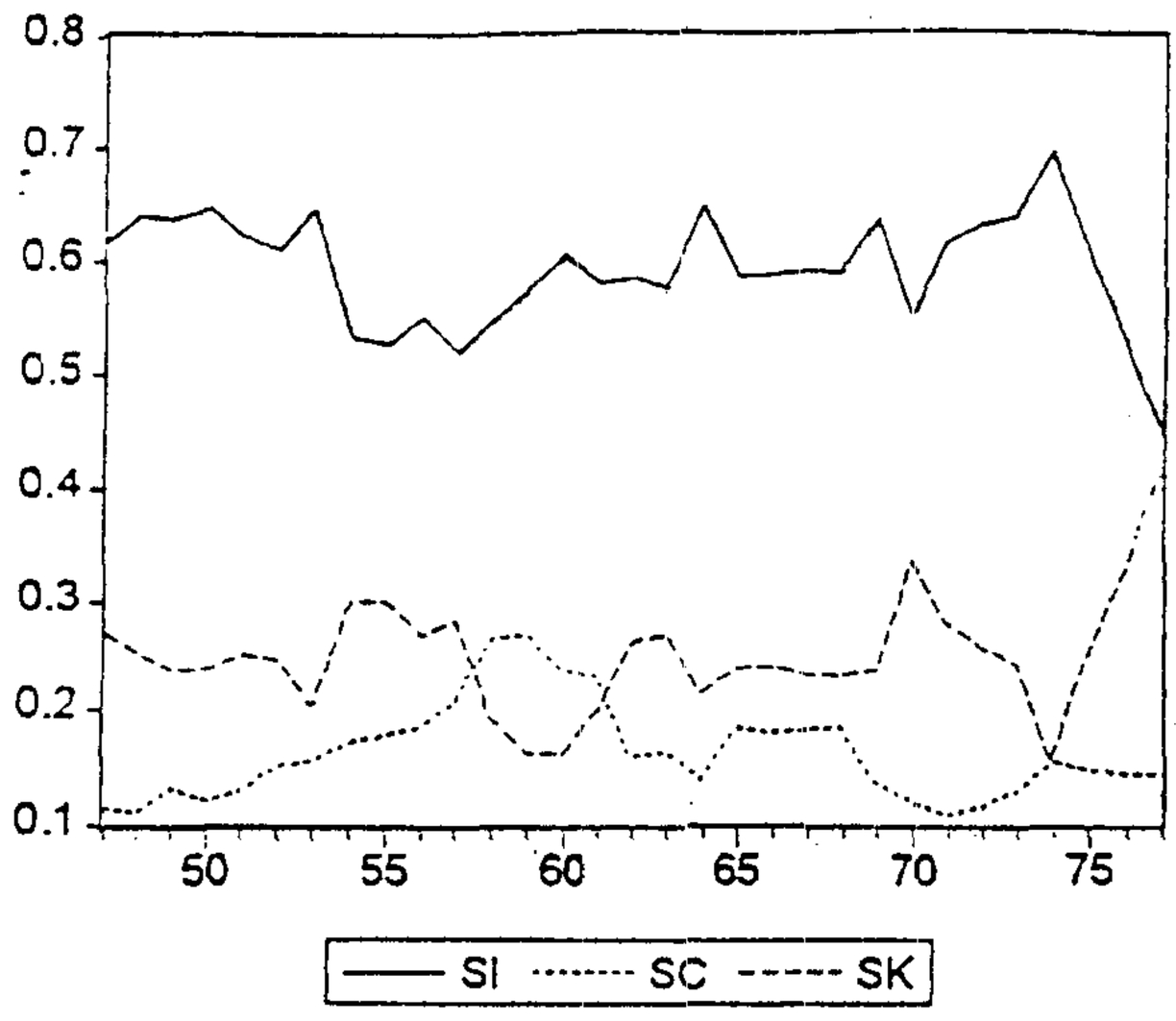
After estimating a set of long run elasticities or coefficients, the second step of analysis of cointegeration consists of modeling underlying short run dynamics leading to the long run level equilibrium equation. As shown by Engel and Granger (1987), existence of a long run equilibrium relationship among a set of variables implies at least one error correction equation, which shows how endogenous variables adjust to return to long run equilibrium. The statistical inferences on coefficients in the second step are valid and have asymptotic efficiency.

3- Trends of share of consumer, intermediate and capital imports during the sample period

In this study, imports are classified into 3 groups: consumer, intermediate and capital goods. The share of each group in total imports during the sample period (1963-98) is demonstrated in the graph (1). As can be seen, the share of intermediate goods is more than the share of capital and consumer goods in all of the periods because of import substitution industrialization policy. This share fluctuates from a low of 44% in 1998 to a high of 69% in 1995. Following the development of basic industry in the first and second plans, the share of intermediate imports has started to decrease from 1996 and at the end of the period reaches 44% (to the profit of capital goods) which reflects the country's changing industrial structure.

After intermediate goods, capita goods with an average share of 25% in the sample period account for the second highest share of total imports. The share of capital imports after the revolution decreased substantially up to 1981 when it reached 16%, mostly due to decrease of capital imports in the mining

and industrial sectors. But after that the mentioned share gradually increased and in 1984 reached 27% and stabilized around 23% for the period 1985-90. Share of capital imports in the year 1991 increased to maximum 33%, due to entry of foreign capital and the start of the reconstruction period. This share declined to 15% in 1995 because of critical foreign exchange conditions and debt repayments. Then from the year 1996 an upward trend started reaching 42% by the end of the period (1998). The increase of this share simultaneously with a decrease of the intermediate goods share due to foreign exchange constraints of 1998 indicate a basic revolution in the productive structure of the country in the direction of decreased dependency on imports of intermediate goods.



Graph 1 relative share of different group of import goods

Consumer goods have the least share with the average of 25% of imports, which shows that the productive structure of the country is based on importing capital and intermediate goods in order to produce consumer goods. Until the year 1980 we see a growing trend of the share of consumer goods due to introduction of new consumer goods to Iran's market, specifically after the oil shock of 1974. But the share of consumer goods in imports has had a decreasing trend since 1980, which results from continuing import substitution policies during the sample period.

The composition of imports reflects a growth trend in the country's productive structure, based on a high degree of dependence on intermediate and capital goods over an extended period. The main reason for the high share of intermediate and capital good imports is an import substitution industrialization policy. But this policy was weakened during the period (1974-78) because of a sudden increase in foreign exchange earnings and a resultant surge in imports of consumer goods. Since the start of the first post-revolution development plan in 1989, two opposing tendencies have been at work. On the one hand, increased local production of intermediate goods and raw materials reduced the need of existing industries for imported inputs. On the other hand, the development and expansion of industrial activities and new investment, created new import needs. Thus on balance there was increased demand for import of capital and intermediate goods.

4- model of import demand under conditions of constrained foreign exchange availability

Traditionally, the model of demand of imports under conditions of imperfect substitution, where imports and domestic productions are not perfect substitutes for each other, with the assumption of homogeneity of zero degree in prices, is specified as follows:

$$M_t = f(Y_t, PR_t) \qquad (4)$$

In which M_t is imports, Y_t is a scale variable and PR_t the relative price variable. With the assumption of infinite supply elasticity, the mentioned function can be estimated without the need of modeling of the import supply (from the supplier's side). This assumption makes sense since we know that foreign prices are not affected by the amount of import in Iran's economy. Equation 4 generally is specified in the form of Lin-log, In fact Italiner (1987) calculates imports as a function of the multiplier of the related explanatory variables, thus finding the least cost option. Empirical tests have also accepted Lin-log specifications based on Cox-Box transformations over other alternatives. In order to render the variables stationary in variance, generally economic variables need to undergo logarithmic transformations before they are used for estimations.

Hemphil (1974) has used the classical models of imports in his empirical studies of developing countries and has concluded that this model is not acceptable for the majority of undeveloped countries because of commercial and foreign exchange constraints. He infers that in these countries a considerable amount of imports are made up of capital and intermediate goods for which there are not any domestic substitutes. Therefore considering the limitations of foreign exchange reserves economic policy makers tend to expand quantitative restrictions on imports, in response to reductions in export earnings.

Hemphil's model leads to the following equation under certain assumptions:

$$M_t = f(F_t, \Delta F_t, R_{t-1}) \qquad (5)$$

in which F_t stands for foreign exchange earnings in constant prices and R level of international reserves. Also Moran (1989) using a combination of classical and Hemphil models, specifies imports equation as a function of relative price of imports, income and the indices of accessibility to foreign exchange containing reserves and foreign earnings in the state of disequilibrium and foreign exchange constraints.

Pritchett (1987) based on standard model (4) estimates demand for imports for about 50 developing countries. The results show that there is not any stable relation between imports and income and relative price for about 44% of countries. He concludes that there are other factors that determine the demand of imports for these countries. Quantitative restrictions are one of these factors. On

the assumption that the amount of quantitative restrictions has a negative relation with the access of a country to foreign exchange, foreign exchange reserves or earnings have been substituted for foreign exchange limits in the demand for imports equation. In Pritchett's study, the above mentioned solution is used for countries where the standard demand function for imports was not able to produce reliable estimates. In the Pritchett's sample most OPEC countries and other oil exporters including Libya, Nigeria, Algeria, Egypt, Ecuador, Venezuela and Mexico do not have stable imports functions.

Amongst oil exporters, the tests of coefficients stability have been accepted only for Indonesia and Gabon. Cointegeration analysis for the standard model of demand of imports in Iran's economy shows that income (real demand) and relative prices are not able by themselves to explain the fluctuations of imports in the sample period. Cointegeration tests in most cases have failed and coefficient of determination R^2 for the short run error correct model is unacceptably low.

This result was not unexpected and shows that policy makers have controlled imports at times of foreign exchange shortage, by changing the exchange rate or imposing tariff or non-tariff constraints. We thus use Moran's model with a little variation for explaining the behavior of imports in different categories of goods. It can be assumed that the amount of foreign exchange reserves has an inverse relation with import controls. In order to include import controls in the demand of imports model, we use the variable ratio of foreign exchange reserves (banking system) to imports (r) as a substitute for the mentioned effects. However, as the net foreign exchange reserves of banking system are negative in some periods we cannot use logarithmic transformations. Therefore, in order to make this variable (exchange reserves) stationary in variance we divide it by imports and use the result in the model. The mentioned ratio is the number of periods (seasons) for which banking systems' reserves can cover import needs. Therefore the vector of variable's system for the i^{th} group's import is:

$$X_t' = \{m_i, yd, rp\} \qquad i = 1,2,3$$

in which m_i stand for dollar imports of ith group of goods which is transformed to constant prices using the indices of prices of OECD countries and value of

dollar in SDRs. Imports are classified in three groups of consumer goods mc, intermediate goods mi and capital goods mk. y_d variables are real demand (sum of non oil output and imports) and rp is a relative price index for imports (all of the variable are in logarithmic form). We use three price indices in the demand of imports equation, which probably contains common trends with imports.

These three indices are constructed using the parallel market exchange rate (e), weighted exchange rate (we), and wholesale import goods price index (pm). We use the consumer price index (cpi) to adjust for nominal variables and the international export price index (p*) to calculate the real parallel market exchange rate and weighted real exchange rate. The three relative prices are calculated as follows:

$$rer = e + p^* - cp_i$$

$$wrer = we - p^* - cp_i$$

$$rpm = pm - cp_i$$

In most empirical studies an index, which gives the best fit, is used. A similar approach has been adopted in this study and the contribution of the mentioned indices in improving the fit has been evaluated. Meanwhile using relative prices in short run and long run demand function of imports presupposes homogeneous limit of demand on the domestic and external prices. This is needed in order to decrease system dimensions and simplify the model. In fact, given high colinearity between domestic and imports prices, the reliability of coefficients is reduced substantially in the absence of the above mentioned constraint.

5- Estimating import demand functions for different categories of goods

We now proceed to estimate and analyze long run and short run demand functions for imports of consumer goods (mc), intermediate goods (mi) and capital goods (mk), using the cointegration method of Pesaran & Shin. Cointegeration analysis, including the test of long run equilibrium relationship and estimation of long run and short run coefficients, requires the unit roots test.

The results of unit root tests of the model's variables are presented in table 1. As can be seen in most cases statistics of Dicky- Fuller tests are near to its critical values thus implying lack of any definitive evidence of some relative prices, foreign exchange reserves and yd being stationary or I(1). These results demonstrate the virtue of using the Pesaran & Shin ARDSL method for cointegeration analysis. This latter methodology can produce reliable standard statistical inferences, for variables that are either I(0) or I(1). Results of cointegeration tests of long run and short run demand functions for consumer goods (mc), intermediate goods (mi) and capital goods (mk), based on the degree of integration of variables, are presented in tables 2,3 and 4 respectively. Cointegeration tests are performed on the parallel market exchange rate, as it provides a better fit than other relative prices.

The results of cointegeration tests given in section A of the tables reflect a long run relationship amongst the model's variables including imports (consumer, intermediate and capital goods), real demand, real parallel market exchange rate and foreign exchange reserve ratios. In addition, cointegeration tests based on other relative prices (weighted exchange rate and import price index) are soundly refuted.

The above results are the first indications of the greater importance of the parallel market exchange rate compared to other explanatory relative prices in explaining the behavior of imports. In fact as we will see, other relative prices (controlled) face many limitations in forecasting the long run (and short run) behavior of imports.

Section B tables 2-4 show the long run coefficients for the equations of (consumer, intermediate, and capital) imports. Use of the SBC criteria for choice of optimum lag resulted in an ARDL (0,2,1,2) model. The chosen optimum lag is not sensitive to relative price criteria used in the model and the category of goods (consumer, intermediate or capital). The results can thus be easily compared with each other.

The parallel market exchange rate has a true sign and a high degree of statistical significance in the long run imported consumer goods demand equation in table 2. Even though this coefficient is relatively low (-0.58), but based on the offered standard deviation, the coefficient is estimated with a high degree of precision.

The other price indices (the average real exchange rate and relative wholesale import prices) in this equation, which are affected by the controlled official rates, do not have the expected sign and are not valid predictors. In other words, the parallel market exchange rate explains the behavior of consumer good imports (long and short run) better than official rates. The above result indicates that although a considerable share of consumer good imports benefit from foreign exchange allocations at controlled rates, the behavior of importers is based on the real opportunity cost of foreign exchange, which is the parallel market exchange rate. Therefore, in section C the table of the estimated values of short run error correction equation has been calculated based on the parallel market exchange rate (rer). In addition, using other price indices will result in greater instability of short run coefficients. In fact the stability tests of structural coefficients based on cumulative sum of residuals or CUSUM test and CUSUMSQ imply greater instability of models that use the weighted rate exchange and wholesale price index (the results are not given for the sake of simplicity). Short run price elasticity (based on rer) and impact price elasticity are estimated respectively at 0.09 and 0.139, which are much lower than the long run price elasticity. This conclusion is consistent with our theoretical expectations about inertia or short run rigidity of consumer behavior and costs of adjusting consumer good imports in response to price shocks. It shows that the substitution or price effects on consumer good imports operate in a gradual manner.

In addition, (long run, short run) price elasticity for consumer goods is greater than for intermediate and capital goods. As Winbergen (1986) and Islam (1984) have shown, generally intermediate and capital good imports in developing countries are either complementary to domestic products or there are limited substitution possibilities with domestic products. Limited price elasticity can be due to the existence of quantitative restrictions on imports. In fact Fainni ***el.al***. (1992) have shown that with the assumption of pure substitution between domestic and imported products, import price elasticity under conditions of quantitative restrictions is lower than the expected actual level. Therefore they are called constrained elasticities, as they measure the responsiveness of imports (which are partly controlled) to variations in relative prices. In the absence of controls import price elasticities are greater. In their empirical studies they found

that the degree of openness of an economy or share of foreign trade is positively correlated with price elasticity of demand for imports. Given the extensive controls on imports during the sample period (due to exchange shortages and industrial policies), we cannot use the estimated price elasticities to evaluate impact of devaluation of the national currency combined with trade liberalization. In other words, during periods of foreign exchange restrictions or foreign trade regimes, which effectively limit the flow of imports, the effect of price or income variables on imports will be underestimated. Thus, when the national currency is devalued and trade liberalized as part of a structural adjustment policy, the effect on the demand for imports is greater than what the empirical results would forecast.

Long run income elasticity of demand for consumer goods does not significantly differ from one. Therefore, it appears that there is a close long run relationship between income growth and consumer good imports during the sample period. Short run income elasticity of demand for consumer good imports (0.22) and impact income elasticity (0.312) are lower than long run elasticity, due to the gradual adjustment of consumer good imports to income variations (respective coefficients have high statistical significance too). The above result is consistent with the inertia and rigidity of consumer behavior and it's gradual adjustment to income shocks. In addition, the results show that Iran's economy has not managed to reduce its dependence on consumer good imports in the long run compared to the short run. Elasticity of long run demand for consumer good imports with respect to external reserves is, as expected, estimated positive and significant (o.17). Therefore, if the coverage of the banking system reserves for imports increases for one period (season), imports are expected to increase by about 17% in the long run. But external reserves coefficient in the short run is negative (-17%). Given the significance of government receipts as a share of exchange earnings and government control on foreign trade, this result shows that policy makers have controlled imports in the short run in order to maintain a desired level of foreign exchange reserves. In addition, the importance of external reserves as a measure of foreign exchange limitations in the long run consumer good imports equation is greater than for intermediate and capital good imports. Thus, in the long run exchange restrictions have been a more important limiting factor for consumer good

imports than for intermediate and capital goods. The disequilibrium coefficient term (ecm (-1)) was also estimated at (-0.24) in error correction terms, which shows the fairly rapid adjustment of consumer good imports to the above noted disequilibrium. In each period, about one fourth of the disequilibrium (following a shock to the long run equilibrium relation) is corrected through the adjustment of imports towards the desired level. In addition, the adjustment coefficient is close to the estimated value for other countries. (As an example see Giorgianni & Milesi -Ferreti 1997)

Table 2 reflects the results of cointegeration tests and estimates of long run and short run coefficients for the intermediate goods import equation. The results of Pesaran & Shin cointegeration test confirm the hypothesis of a long run equilibrium relationship amongst intermediate good imports, real exchange rate in the parallel market, real demand and the ratio of external reserves. (Even though the hypothesis of cointegeration based on wholesale price index of imports and weighted exchange rate can be accepted with difficulty). All price indices (relative wholesale price of imports and real parallel and weighted exchange rates) have the correct sign in intermediate goods import equations. But, the magnitude and statistical significance of the parallel market exchange rate is more than the weighted rate and relative price of imports. Although the sign of the weighted exchange rate coefficient is true and its value is not insignificant, the main price variable that affects the behavior of demand for intermediate good imports is the parallel market exchange rate. Therefore it can be seen that despite a multiplicity of exchange rates and exchange controls, decisions on intermediate good imports have been based on the parallel market exchange rate and to a lesser degree the weighted exchange rate. The value and statistical significance of the real parallel market exchange rate coefficient for demand of intermediate good imports is lower than for consumer good imports. This reflects the more limited substitution possibilities for intermediate good imports. The relative price coefficient in the short run intermediate goods import equation is estimated at -0.03, which is lower in absolute value than the long run one. This reflects the greater difficulty of adjusting intermediate good imports in the short run, in response to a devaluation, while there are greater possibilities for decreasing dependence on intermediate good imports in the long run. It

should be noted that the short run price elasticity of intermediate good imports at -0.03 is less than for consumer goods (-0.09).

Long run income elasticity for demand for intermediate good imports does not significantly differ from one and can be estimated with a high degree of precision. Short run intermediate good imports' elasticity and impact income elasticity are estimated at 2.59 and 3.63 respectively, (as opposed to the case of consumer good imports) which are much greater than its long run elasticity. Income elasticities have higher statistical importance, reflecting strong short run income effect, while it takes a long time for price effects to work through. The lower intermediate good imports income elasticity in the long run reflects the ability of the country's industrial structure to adjust in longer time horizons. In other words, Iran has had greater success in reducing its dependence on imported intermediate goods in response to external shocks in the long run as compared to the short run.

The magnitude and statistical significance of the foreign reserves ratio coefficient in the long run intermediate imports equation (0.063) is less than for consumer (and capital) goods. The external exchange constraints index (r) has a lesser role in predicting the behavior of intermediate good imports. In other words, foreign exchange constraints have had less impact on intermediate good imports than the other groups. Therefore, intermediate good imports account for a greater share of imports during periods of foreign exchange shortage (at least in the long run). This reflects the priorities of government foreign exchange policies for financing raw material and intermediate import needs of firms (probably because of its short run effect on production). The external reserves ratio coefficient (-0.172) is significant in the short run, suggesting that increased imports in the short run requires a decrease in the exchange reserves ratio of the banking system. In fact, given the limitation of balance of payments, foreign exchange reserves are negatively correlated with imports. But foreign exchange reserves, as a measure of foreign exchange constraint are positively correlated with imports. It appears that the first effect is dominant in the short run and the second one in the long run. Intermediate good imports adjust to disequilibrium (deviation from the long run trend) fairly rapidly, like consumer good imports with a -0.24 coefficient. This implies that any deviation from long run equilibrium relation is corrected after about one year.

Based on results given in table 3 the hypothesis of cointegration amongst capital good imports, the real parallel exchange rate, real demand and the foreign exchange reserves ratio of the banking system is accepted. In this model, the hypothesis of existence of a long run equilibrium equation is rejected only in the case that the model has been specified based on the import price index (rpm). The results of long run equation estimations are given in section B. The relative price index coefficient in the long run import equation is close to zero and has lower statistical significance, but the parallel market real exchange rate coefficient (rer) is estimated at -0.41 and has greater statistical significance than the other price indices. Although the weighted exchange rate coefficient (wrer) has a correct sign and its numerical value (-0/725) is greater than the parallel market rate coefficient but these coefficients were estimated with less precision. Therefore, like case of other imported goods, the parallel market exchange rate (and after that the weighted exchange rate) is the most important index for forecasting (long run and short run) capital good imports. The long run price elasticity of capital good imports is less than consumer goods, and faces limited substitution possibilities like intermediate good imports.

Price elasticity of capital good imports, like the other groups, is less in the short run –(0.05) than the long run, reflecting the costs of rapid adjustment of imports in the short run in response to price shocks. Income elasticity of capital good imports is also not significantly different from unity. This allows us to study the long run ratio of imports to production (or demand) in order to identify factors that influence it. Thus the previous analysis, and similar ones in the future, about the long run behavior of imports can also be used for the ratio of imports to production. But, based on results given in section C of the table, income elasticity of capital good imports in the short run (3.614) is much greater than for the long run. Therefore, changes in income strongly affect short run capital imports just like for intermediate good imports. This goes to confirm that Iran's economy has had the ability to make the needed long run adjustments to reduce dependence on capital good imports (just like intermediate good imports). The external reserves ratio coefficient in the long run capital imports equation is estimated at 0.11, which is less than the coefficient for consumer good imports but more than that of intermediate good imports. This demonstrates that governmental exchange restrictions on capital good imports

have been less than for consumer good imports but more than for intermediate good imports in long run. The value of this coefficient in short run capital goods import equation is -0.16 similar to the other groups. Thus, although in the long run external reserves (r) is an indicator of greater access to foreign exchange earnings, in the short run balance of payments constraints require a substitution of exchange reserves for imports.

6- Conclusion

In this article, a demand for import model for different groups of commodities based on Pesaran and Shin (1997) cointegration approach is evaluated. The demand for imports of consumer, intermediate and capital goods is specified as a function of scale variable, relative prices and ratio of foreign reserves to imports. Three relative prices based on the parallel exchange rate, the weighted exchange rate and the wholesale import price index are compared in the import demand functions. The results show that the relative prices based on the wholesale price index and the weighed exchange rate are not able to explain import behavior satisfactorily. However, use of the parallel exchange rate in cointegration tests produces acceptable results and improves the fit considerably. Thus, even though importers had access to foreign exchange at official rates for considerable amounts of imports during most periods, decisions on imports were based on the parallel exchange rate as the real opportunity cost of imports.

Long run price elasticity for intermediate good imports (-0.58) and capital good imports (-0.31) is less than consumer good imports (-0.16) implying more limited substitution possibilities for intermediate and capital goods. Import price elasticity in the short run is much less than the long run for all groups, implying that import adjustment to relative price shocks (at least in the short run) faces many limitations. But it should be noted that quantitative restrictions on imports lead to underestimation of the effect of price and income variables on imports. Thus, when devaluation is accompanied by trade liberalization policies, the impact on imports would be greater than expected from the above empirical study. The long run income elasticity of demand for imports is not significantly different from one in all groups, but in the short run income elasticity of demand for capital (3.61) and intermediate (2.59) good imports are much higher,

reflecting strong income effects for these goods in the short run. These results show that Iran's economy has been able to establish industrial structures that reduce dependency on imports in the long run. The coefficient of foreign reserves ratio (as a measure of foreign exchange limitations) in long run equation for intermediate good imports (0.06) is less than for capital good imports (0.11) and consumer good imports (0.17). Thus foreign reserves limitations have had the greatest impact on imported consumer goods followed by capital goods. This result is probably due to the priority given in foreign trade policies to intermediate good imports due to their immediate impact on output (with minimal need for foreign exchange). In addition, based on estimated coefficients of error correction, imports, especially of consumer and intermediate goods, adjust toward equilibrium (or desired) levels with relatively high speed. It thus appears that the costs of disequilibrium in imports are considerable.

Table 1: unit root tests

ADF without trend*	ADF including trend*	Variable name
-2.68	-2.89	mc
-2.84	-3.1	mi
-2.52	-2.48	mk
-2.29	-2.89	yd
-2.07	-2.42	r
-1.63	-0.983	rer
-0.86	-1.64	wrer
-0.88	-0.61	rpm

* Critical values for the 95% significant level is –3.45 in case the model includes trend and –2.88 if the model doesn't. The correct lag has been selected according to SBC criteria.

Table 2: demand function for consumer imports: cointegration analysis.

(A): ARDL Pesaran and Shin test for cointegration based on rer

	F-statistic	95% critical value (upper limit)
Without trend	4.81	4.378
Including trend	5.32	5.119

(B): long run coefficient's based on ARDL (0, 2, 1, 2)

dependent variable: consumer import

	yd	**r**	**rer**	**wrer**	**rpm**
(B.1)	1.248 (0.174)	0.171 (0.046)	-0.579 (0.206)	-	-
(B.2)	0.243 (0.705)	(0.192) (0.088)	-	0.671 (0.915)	-
(B.3)	0.712 (0.048)	0.241 (0.096)	-	-	1.559 (1.058)

(C): error correction representation

dependent variable: first difference of consumer import

Δmc(-1)	**Δyd**	**Δr**	**Δr(-1)**	**Δrer**	**ecm(-1)**	**R^2**	**D.w**
-0.455 (0.082)	0.312 (0.069)	-0.159 (0.017)	-0.099 (0.023)	-0.139 (0.048)	-0.240 (0.058)	0.706	2.11

Short run coefficients:

$$\Delta mc = 0.218\Delta yd - 0.177\Delta r - 0.095\Delta rer - 0.165ecm(-1)$$

Table 3: demand function for intermediate import: cointegration analysis.

(A): ARDL Pesaran and Shin test for cointegration based on rer

	F-statistic	95%critical value (upper limit)
Without trend	4.75	4.378
Including trend	5.81	5.119

(B): long run coefficient's based on ARDL (0, 2, 1, 2)

dependent variable: intermediate import

	yd	r	rer	wrer	rpm
(B.1)	1.093 (0.163)	0.068 (0.048)	-0.167 (0.101)	-	-
(B.2)	1.046 (0.331)	(0.061) (0.055)	-	-0.129 (0.129)	-
(B.3)	0.951 (0.030)	0.063 (0.059)	-	-	-0.029 (0.504)

(C): error correction representation

dependent variable: first difference of intermediate import

Δmc(-1)	Δyd	Δr	Δr(-1)	Δrer	ecm(-1)	$\bar{R}$	D.w
-0.403 (0.086)	3.632 (0.841)	-0.163 (0.173)	-0.079 (0.023)	-0.041 (0.047)	-0.244 (0.068)	0.683	2.077

Short run coefficients:

$$\Delta mi = 2.589yd - 0.172\Delta r - 0.029\Delta rer - 0.174ecm(-1)$$

Table 4: demand function for capital import: cointegration analysis.

(A): ARDL Pesaran and Shin test for cointegration based on rer

	F-statistic	95%critical value (upper limit)
Without trend	5.19	4.378
Including trend	5.85	5.119

(B): long run coefficients based on ARDL (0, 2, 1, 2)

dependent variable: capital import

	yd	r	rer	wrer	rpm
(B.1)	1.152 (0.277)	0.107 (0.083)	-0.306 (0.212)	-	-
(B.2)	1.359 (0.507)	(0.067) (0.089)	-	-0.725 (0.560)	-
(B.3)	0.797 (0.062)	0.114 (0.117)	-	-	-0.005 (0.903)

(C): error correction representation

dependent variable: first difference of capital import

Δmc(-1)	Δyd	Δr	Δr(-1)	Δrer	ecm(-1)	R^2	D.w
-0.398 (0.084)	5.052 (0.877)	-0.155 (0.019)	-0.069 (0.023)	-0.066 (0.055)	-0.163 (0.052)	0.639	1.986

Short run coefficients:

$$\Delta mk = 3.614\Delta yd - 0.160\Delta r - 0.047\Delta rer - 0.116ecm\ (-1)$$

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