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Estimating the Effect of Exchange Rate Fluctuations on Real Sectors of the Economy (Industry Sector)

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ABSTRACT

In this study, after calculating the index of real effective exchange rate index for industry, by Goldberg (2004), the relationship between this index and the real value added of the industry and real variables has been investigated for Iran. To evaluate the long-term effects of real effective exchange rate, the convergence normal vector is used; and for analyzing its impact on short-term, the impulse response functions and variance decomposition are used. The results show that the index of real effective exchange rate has positive and negative effects on the real value added of industry in the long run and short run, respectively. Also the results show the impact of real money supply shock on real value added of industry is permanent.

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INTRODUCTION

The difference in the economic sectors makes difference in the effects of exchange rate fluctuations on their outputs. Exchange rate fluctuations can directly affect on domestic prices of imported inputs of the firms and indirectly affect on the prices of other inputs. It can also affect the level of wages with respect to the impact on firms' profit margins; the total effect could be on price and value-added of the firm. The effects of exchange rates on the value added of the sectors of the economy could be quite different and heterogeneous. The factors that could be important for these heterogeneities include: 1) The openness degree of specific sector, 2) Characteristics of the production such as differentiation degree of the products, 3) The demand features such as price elasticity of demand and 4). The other factors affecting the degree of competition. Therefore, it is possible that some economic sectors are heavily influenced by exchange rate fluctuations, but in others, basically no changes could be seen. The effect of fluctuations could be completely different, so that while this effect might be instantly for some sectors, in the others it could be delayed much longer. However, to understand the effects of exchange rate fluctuations on the economy, it’s necessary to evaluate these effects in each of economic sectors, separately.

Recent studies, by calculating the trade weighted real exchange rate in macro-level, survey the effect of exchange rate on production, but this index has not enough features for the study of exchange rate effects on industrial sector. Since that macro index couldn’t show the real change of the currency in the industry. Therefore we calculate the Goldberg’s real effective exchange rate for industrial sector and then, according to ever-increasing importance of the industry in Iran; its effects on industrial real value added will be estimated.

Moreover, to prepare the better view of exchange rate fluctuations in industry and because of increasing importance of industrial sector in Iran, we analyze the long-run and short-run effects of the fluctuation of the exchange rate index on the value added of this sector.

Theoretical framework and Review of the literature:

Exchange rate shocks may have different effects on activity or prices of different sectors. Generally, an appreciation of the exchange rate should be expected to affect domestic production negatively as domestically produced goods become relatively more expensive to those produced abroad and domestic producer prices should decline on account of favorable price effects from imported inputs Important factors that are likely to determine the magnitude and speed of adjustment of output and prices in a sector to an exchange rate shock include the openness of the sector, i.e. the share of production that is exported, the degree of import competition

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and the share of imported inputs, product characteristics such as the degree of product differentiation, demand characteristics such as the price elasticity of demand, and other factors affecting the degree of competition in the market such as the degree of market segmentation, the existence of oligopolistic market structures or trade barriers. (Menon, 1995 and Hahn, 2007)

As regards the magnitude of the impact of an exchange rate shock on activity, in general, the higher the export share of a sector, the higher the share of imported competitor goods and the higher the price elasticity of demand, the stronger the output response that can be expected for that sector. By contrast, a higher share of imported inputs (via the cost effects involved), a higher degree of product differentiation (due to lower substitution effects) and generally factors that seems to reduce the degree of competition in the market(such as a higher degree of market segmentation) should tend to reduce the output response of a sector. With regard to the speed of adjustment of prices and production to an exchange rate shock, generally, it should be expected that the adjustment is faster for sectors with a highly exchange rate sensitive cost structure (i.e. a high share of imported inputs) and a lower degree of product differentiation. (Hahn, 2007)

According to Revenga (1992), both employment and real wages in U.S. manufacturing industries are significantly affected by the real exchange rate fluctuations. According to Gourinchas (1998), the real exchange rate appreciation reduces employment growth in the French manufacturing industries. In the study of Goldberg and Tracy (1999), the real exchange rate volatility has a significant effect on real wages and employment in manufacturing industries, particularly in industries that rely more onexport activity than on import activity.

Based on Goldberg and Tracy (1999) and Campa and Goldberg (2001), an industry's characteristics— i.e., a firm's pricing power in the market and the importance of external trade activity relative to a sector's size— determine how sensitive a sector's labor demand is to real exchange rate fluctuations. For example, the lower an industry's pricing power in the market (higher price of elasticity of demand and lower price-over-cost markups in an industry), the more the industry's demand for labor is to real exchange rate adjustments. Additionally, firms with greater export shares in their production are more likely to gain through real currency depreciation, whereas currency depreciation ends to restrain the work effort of firms that rely more on imported inputs. (Wan-Shin, 2009).

One of the most basic studies in this field is Goldberg and Tracy (2001), in which each period employment and wages are adjusted in response to exchange rate shocks that affected labor demand through the changes in marginal product of labor, and these process changes domestic and foreign products and also the cost of the imported inputs. Equilibrium employment response to the shock, the exchange rate effects on employment in export-oriented industry and also on domestic market is increasing and strengthening by industrial imported inputs, because domestic labor and imported inputs could be substitution or complementary in production function.

Kandil and Mirzaie (2003) show that unexpected real appreciation of dollar leads to deflationary effects-i.e., a reduced price level and a lower marginal product of labor-which in turn generate a negative effect on the growth of nominal wages in the manufacturing sector.

According to the Hahn (2007), the most substantial effect of exchange rate shock between the sectors in euro area, is on value added in industry (excluding construction), trade and transport services.

Shahabadi (1998), using Edwards model for a number of developing countries (India, Malaysia, Philippines, Sri Lanka, Thailand, Greece, Colombia, Occupied Palestine, El Salvador, South Africa and Yugoslavia) suggests that the impact of the nominal exchange rate depreciation on output is negative.

Izadi and Izadi (2008) evaluate the exchange rates fluctuations and its deviation from the equilibrium effects on industrial value added in 1959-2007 for Iran, and conclude that the effect of the exchange rate deviation from long run equilibrium path on industrial value added is significantly negative.

Asgari (2008) studies the effects of exchange rates on exports of selected industrial sectors according to ISIC two-digit code during the 1973(Q1)-2006(Q4) in Iran.

Azimi and Ahangari (2009) evaluate the impact of currency and trade policies on industrial development in Iran. The results show a significant negative relationship between the import effective exchange rate with industrial value-added and a significant positive relationship between the export effective exchange rate and manufactured export goods.

Recent studies mostly use the macro-real trade-weighted exchange rates; however this index can not have sufficient features. Since when an exchange rate innovation occurs, the macro-index may not show real exchange rate effects on industry. So, our main purpose is to calculate the real effective exchange rates of industrial sector that first introduces in Goldberg (2004). Then we examine the effects of this index besides the other important factors on the industry value added in Iran.

Methodology:

In this study, we use co-integration and VECM model and impulse-response function. Using the Kandil and Mirzaei's macroeconomic model (2003), we assume that the real value added of the industrial sector (Y) is a function of manufacturing sector real wage index (W), real money supply (M), real government expenditures

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(G) and the Goldberg real effective exchange rate index(q);

Y=f(W,M,G,q) (1)

The index of real effective exchange rate for industry is calculated based on Goldberg (2004), as:

$$q_t = \sum_c \left[\left[\frac{EX_t^c + IM_t^c}{\sum_c (EX_t^c + IM_t^c)} \right] * q_t^c \right] \tag{2}$$

Where EX_t^c and IM_t^c are export and import at time t, with each industrial trade partner of Iran and q_t^c is real exchange rate between Iran and each trade partners.

This study will examine the relationship between macroeconomic variables such as real effective exchange rate index of industry and real money supply, real government expenditure and industrial real wage index and industrial value-added. This will be done by the use of the VECM model. VECM model is a VAR model that is suitable for co-integration method to separate the short and long run effects. A Vector Error Correction Model (VECM) is an approach that combines the long-run co-integrating relationship between the level variables and the short-run relationship between the first difference of the variables. By using this method we can see how the macroeconomic variables respond to the specific shock and how much time will be spent for each variable to reach the new level. However VECM model has not adequate information about the dynamic structure of the model. For example, the model can not show how each variable reacts to various macroeconomic shocks. To overcome this defect, impulse response function analysis is used to tracking time path of exogenous shocks on industrial sector.

Data:

The data of quarterly real value added of the industrial sector (Y), is available from Central Bank of Islamic Republic of Iran (CBI) website from1993(Q1) to 2010(Q4). The industry real wage index (W) data is available quarterly from 1993(Q1) to 2007(Q4), therefore we forecast other periods from 2008(Q1) to 2010(Q4) using ARIMA model. To use all of these data in real amounts, Iran quarterly CPI (base year: 2004) from CBI website data has been used.

Exports and imports of each trade partner of Iran industry are available in the Islamic Republic of Iran Customs Administration (IRICA) website. Export and import data are in HS coding for each trade partner. It is noticeable that EX_t^c and IM_t^c have been divided into ISIC codes for 175 trade partners of Iran. So, we have extended the Goldberg Index based on two digit ISIC codes in Iran. For this purpose we have changed the HS codes of IRICA to the ISIC codes of industry, because the value added of industrial sector is based on ISIC codes, which their data are available n the website of CBI.

Using these data and quarterly data of market exchange rates and CPI index reported by CBI, the Goldberg real effective exchange rate index is calculated for Iran industry for 175 trade partners in period 1993 (Q1)-2010 (Q4). Figure 1 shows the calculated real effective exchange rates (Q) of this study compared to the market exchange rates (MER) and the real exchange rates (RER):

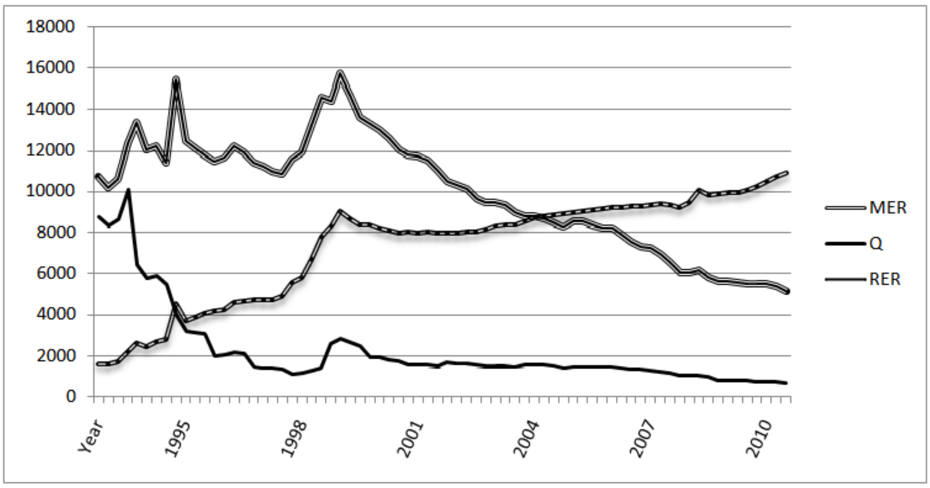

Fig. 1: Calculated effective exchange rate (Q) compared to RER and MER.

ARIMA Model to forecast wage index:

We must first check the time series index of wage (w) for degree of integration; as shown in table 1, by using the Dickey-Fuller and Phillips-Peron test statistic, we can see that the seasonal time series of industrial wage index is stationary at first difference:

Table 1: The Result of stationary test for quarterly wage index (1993-2007).

Symbol	Variable	Dickey-Fuller test	Philips-Peron test
W	Industrial wage index	-4.397 (Trend and intercept)	-15.446 (Intercept)

We use ARIMA model to forecast, so after determining the degree of integration (d), that is I (1), we find the number of autoregressive terms, AR (p), and moving average terms, MA (q). The results of Pesaran and Pesaran (1997) method and Schwarz-Bayesian criterion have show in following table:

Table 2: The number of AR and MA terms of ARIMA estimation.

q \ p	0	1	2	3	4	5	6
0	10.5705	8.1915	7.7877	7.8434	5.3178	5.1728	5.2075
1	9.9304	7.4053	7.4138	7.4333	5.2311	5.1965	5.2763
2	8.8471	6.9841	7.0228	7.0795	4.9014	4.928	4.9989
3	8.6987	7.3789	7.3107	6.8084	4.8214	4.8477	4.9505
4	8.4819	7.072	6.8109	6.4321	4.8381	4.9165	4.4564
5	8.3153	6.2484	6.7913	6.6708	4.8967	4.985	4.5605

Based on the results of table 2, ARIMA (6, 1, 4) is the best ranking selection to forecast wage index. Table 3 shows the summary of results:

Table 3: The results of ARIMA (6, 1, 4) estimation.

Variable	Estimated coefficient	Standard error
C	-14.6	11.53
AR (1)	0.35	0.3
AR (2)	0.32	0.2
AR (3)	-0.02	0.026
AR (4)	1.186	0.026 *
AR (5)	-0.396	0.26
AR (6)	-0.395	0.234 **
MA (1)	-0.093	0.38
MA (2)	0.812	0.247 *
MA (3)	0.56	0.423
MA (4)	-0.854	0.457 **
R-squared=0.9989	F=4186.821 *	

*, ** denotes significance at the0.05 and 0.1 levels, respectively.

Table 4: Heteroskedasti city test of ARCH model

F-Statistic Prob.	0.358
Chi-Square(1) Prob.	0.349

Table 4 shows that there is no ARCH effect and so we use ARIMA model to forecast wage index and logarithm of its real value (by using quarterly CPI, 2004 base year) for quarterly data from 2008 (Q1) to 2010 (Q4).

Model:

In this study, the aim is to find the relationship between industrial value-added and selected macroeconomic variables with VECM model from 1993 (Q1) to 2010 (Q4). This model turns out how the changes in selected variables affect the amount of other variables. So, we use the impulse-response analysis. Impulse response function coefficients in the vector error correction model allow following the time path of exogenous shocks in the industrial value added. The time path effect of shocks to different macroeconomic variables on Iran industry sector's value added would be shown graphically by using Impulse-response technique.

Impulse response functions will be appropriate if the innovations ε_t^i to the endogenous variables are uncorrelated. However, the innovations are usually correlated with each other. In order to make them uncorrelated, we can apply a transformation term (T^p)to the innovations; so that, uncorrelated innovations υ_t^i, can be used and $\upsilon_t^i = T^p \varepsilon_t^i \sim (\circ, D)$, where D in a diagonal covariance matrix. The transformation term chosen in this study is the one standard deviation, where the correlations in the VAR residuals will not be a problem because the method sets the impulses to one standard deviation from the residuals. Previous studies

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(Ewin, 2001;Koop *et al.*, 1996; Lutkenpohl, 1991; Pesaran& Shin, 1998) argue that results from the traditional impulse response functions may be subject to the ordering of the variables in the VAR. However, the generalized impulse response functions are used for the nonlinear models by simulation. The industrial value added model used in this paperisa log-linear model, so the traditional impulse response function is appropriate. This study employs impulse response analysis based on a VAR by ordering the independent and dependent variables in the following way:

LRY=f (LWFO, LRM,LRG,LQ) (3)

LWFO, LQ,LRM,LRG and LRY are the natural log of real industrial wage index, the natural log of real effective exchange rate index of industry, the natural log of real money stocks, the natural log of real government spending and the natural log of real industry value added, respectively. The series of each macroeconomic variable is quarterly and has 72 observations.

Empirical results:

Stationary and unit root tests:

To check whether the series generate a stationary process or a non-stationary process, this study employs both the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Table 5 presents results of unit root tests for all selected variables:

Table 5: The results of unit root test for model variables.

Symbol	Variable	ADF-test statistics	PP-test statistics
LQ	The natural log of real effective exchange rate index for industrial sector	-8.18 (Intercept) (1st difference)	-7.187 (Intercept) (1st difference)
LRG	The natural log of real government spending	-5.005 (Intercept) (1st difference)	-4.128 (Intercept) (level)
LRY	The natural log of real industrial value added	-3.3686 * (Intercept) (1st difference)	-18.1039 (Intercept) (1st difference)
LWFO	The natural log of real industrial wage index	-2.295 * (None) (1st difference)	-28.099 (Intercept) (1st difference)
LRM	The natural log of real money stocks	-3.2204 * (Intercept) (1st difference)	-10.5864 (Intercept) (1st difference)

An asterisk (*) denotes significance at the 5% level and others at 1% level.

Co-integration test:

To perform Johansen co-integration test, we need to determine the lag length. Table 6 lists the SC values in different lags. The Schwartz criterion (SC) shows the optimal lag is 3.

Table 6: Optimal lag length selection.

Lags length	Schwarz Criteria (SC)
1	-9.144
2	-9.139
3	-9.670
4	-9.17
5	-8.35

Table 7 shows that there are 3 co-integrating equations at 5 percent significance.

Table 7: Johansen Cointegration test results.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.700724	155.0560	69.81889	0.0000
At most 1 *	0.467595	73.02152	47.85613	0.0000
At most 2 *	0.264515	30.15769	29.79707	0.0454
At most 3	0.118546	9.266384	15.49471	0.3413
At most 4	0.010038	0.686003	3.841466	0.4075
Trace test indicates 3 cointegratingeqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

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The result of long run relationship:

The normalized co-integration equation shows the following result:

Table 8: Normalized co-integrating equation results.

Variable	LRY	LRG	LRM	LWFO	LQ
Normalized co-integrating coefficients	1.00	-3.84	-0.077	0.397	-0.686
Standard Error	-	1.07	0.67	0.64	0.23

Based on this result, an increase in real money supply increases the value added of the industrial sector. The government spending has positive effect on industrial value added, too, that is because of providing economic infrastructures such as transports, and public services; on the other hand, the increase of government expenditure would cause economic growth which increase demand for industrial products. Increase in real wage index has negative effect on the value added of this sector in the long-term. The real Effective exchange rate index has long-term positive effect on the value added in this sector.

VECM Model and Impulse-Response function:

As discussed, in this paper we use VECM model and impulse-response (IR) function to analyze the the short run behavior of the model.

The result of VECM model is in the appendix which shows that the equation can explain about 80% of the total variance of industrial value added.

Now, by using VECM model, we can analyze the effects of real money supply and calculated real effective exchange rate index shocks on the other macroeconomic variables. To do this, we use the impulse response analysis. Figure 2 and 3 show the results.

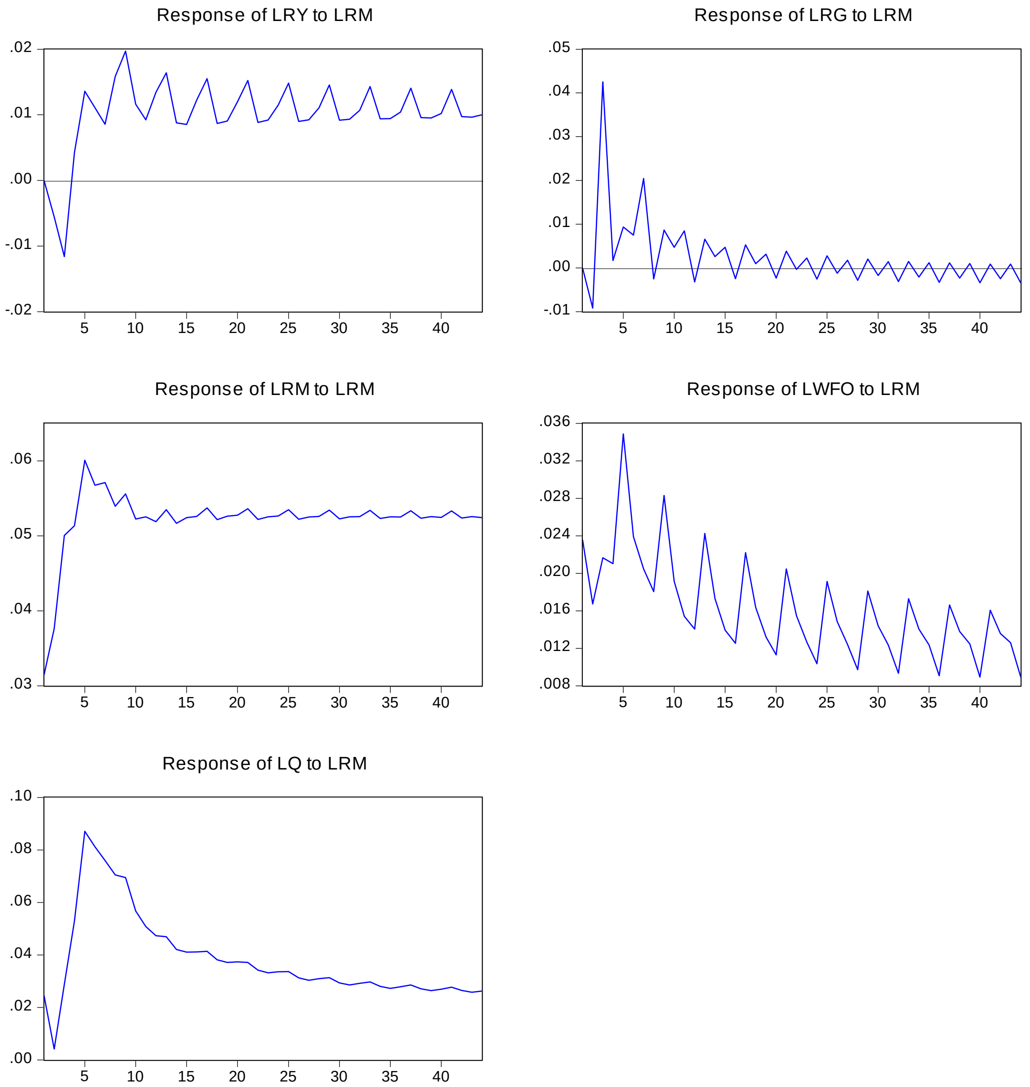

Fig. 2: Response to one S.D. innovations in LRM.

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Despite the initial negative effect of one S.D. shock to the real money supply on industrial value added, it has positive effect in long run and converges to a new steady level. The effect of this shock on real government expenditure is random walk on its initial level. However, the money supply innovation has positive, but decreasing effect on industrial wage index. Moreover, the effect of money shock on trade-weighted industrial real effective exchange rate is always positive, but due to inflation effects the exchange rate index is decreasing in long run.

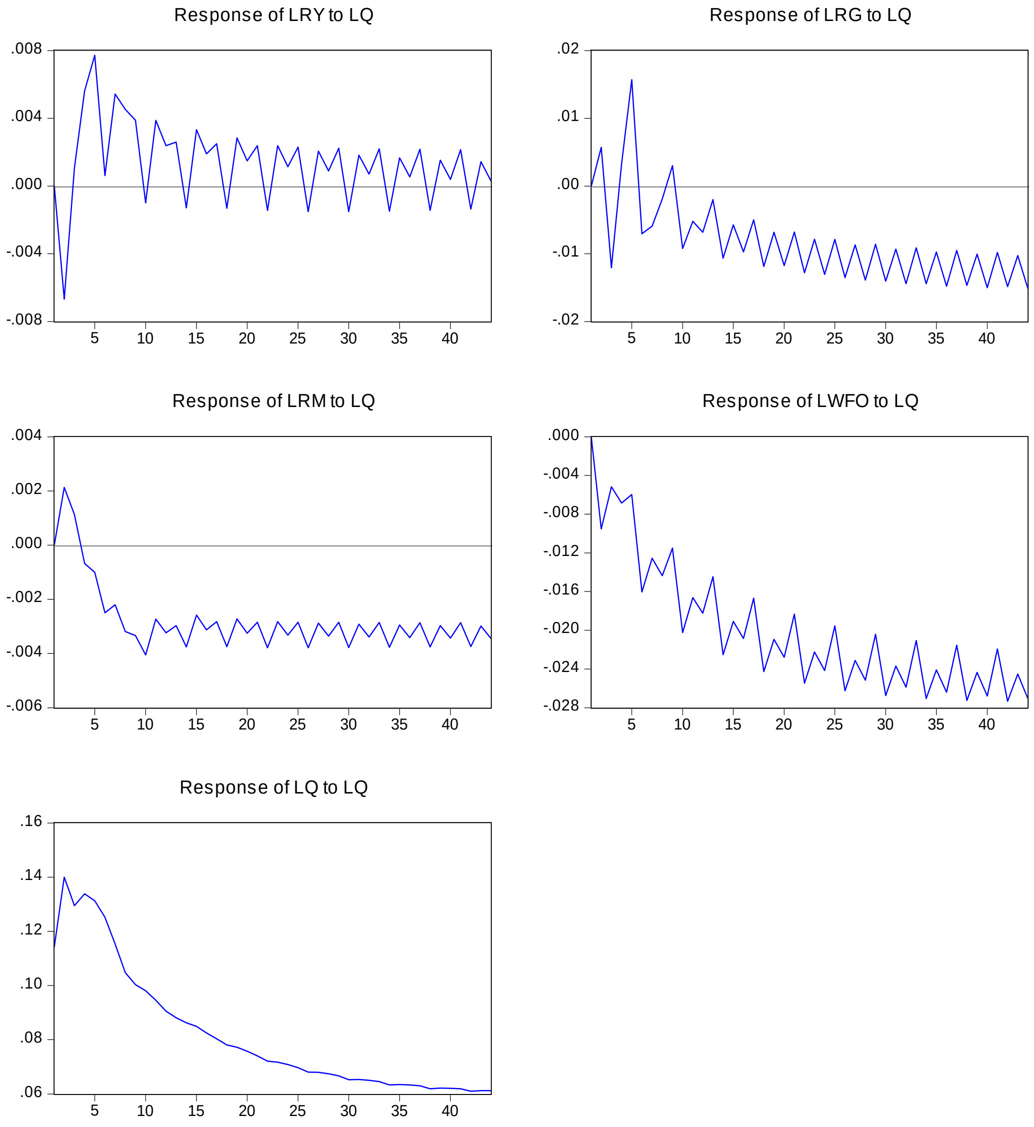

Fig. 3: Response to one S.D. innovations in LQ.

As figure 3 shows, one S.D. shock in exchange rate index has positive effect on industrial value added. The effects of this shock on real government expenditure and real money supply initially are positive and then after some fluctuations, due to inflationary effects, become negative. The effect of this shock on the real industrial wage index is negative. Also, the effect of this shock on itself is positive but decreasing in long run.

Variance Decomposition results:

While impulse response functions trace the effects of a shock to one endogenous variable onto the other variables in the VECM model, variance decomposition separates the variation in an endogenous variable into the different shocks to the model. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the model. Variance decomposition is an instrument for analyzing short run dynamic performance.

The tables 9 and 10 show the result of Variance decomposition for 11 years (44 seasons).The second column of the tables, named SE, called forecast error, which source from the changes in current and future shocks on endogenous variables in the model. All of the other columns show the percentage of the forecast variance of each shock.

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By looking at the variance decomposition of money supply (Table 9),it is apparent that real industrial wage and real effective exchange rate indexes do not explain a large part of its variations. However, the variance in domestic money supply is significantly explained by its own variance, which accounts for approximately 91%in the 1st period and about 82% in the 11thyear (44th period).The contribution of real industrial value added amounts to about 11.58% in the 2th period, this accounts for about 4.47% in the 1st period and exactly about 3% in the 14th period. This reveals the in significant portion of real industrial value added on the variability of money supply. Similarly, the contribution of real government expenditure accounts for about 4.6% in the 1st period and exactly14.9% in the 16th period.

Table 10 shows the result of variance decomposition of real exchange rate index. Real industrial value added does not explain a large part of its variations. However, the variance in LQ is significantly explained by its own variance, which accounts for approximately 82.39% in the 1st period and about 38.26% in the 11thyear (44th period).The contribution of real industrial value added amounts to about 8.82% in the 10th period, this amount for about 1.1% in the 1st period is rising to 8.82% in the 10th period, and then decreasing exactly to about 3.34% in the 44th period. This reveals the insignificant portion of real industrial value added on the variability of LQ. The contribution of real government expenditure is insignificant from first period to 10th period but increasing to about 46.87% in the 44th period. Also, the contribution of real industrial wage index is decreasing from 12.72% in the first period to 2.33% in the 44th period.

Table 9: The Variance Decomposition of LRM.

Period	S.E.	LRY	LRG	LRM	LWFO	LQ
1	0.032970	4.473465	4.608180	90.91836	0.000000	0.000000
2	0.055194	11.58263	7.971800	78.89784	1.398979	0.148752
3	0.078189	7.605027	11.24376	80.28614	0.770151	0.094918
4	0.097171	5.579804	13.93825	79.88457	0.531056	0.066324
5	0.117231	4.317076	14.13246	81.13189	0.365692	0.052880
6	0.133016	3.982490	14.33969	81.21903	0.382461	0.076329
7	0.147186	3.527357	14.68301	81.38692	0.317972	0.084745
8	0.158878	3.249668	14.98917	81.37012	0.278013	0.113035
9	0.170185	3.146889	14.88165	81.58706	0.247376	0.137020
10	0.179790	3.139993	14.88418	81.54035	0.261925	0.173552
11	0.188907	3.048278	14.94329	81.58962	0.240703	0.178110
12	0.197387	2.970094	14.97572	81.63893	0.225263	0.189993
13	0.205959	2.979060	14.89133	81.72481	0.209491	0.195309
14	0.213803	2.991307	14.89609	81.67831	0.222149	0.212144
15	0.221495	2.948528	14.92620	81.70414	0.209869	0.211264
16	0.228919	2.892181	14.92621	81.76418	0.200967	0.216466
17	0.236416	2.898279	14.87120	81.82311	0.190198	0.217214
18	0.243392	2.905470	14.87819	81.78883	0.198810	0.228707
19	0.250221	2.880897	14.89583	81.80485	0.190193	0.228227
20	0.256845	2.838088	14.88869	81.85608	0.184488	0.232648
21	0.263521	2.843031	14.84714	81.90051	0.176619	0.232707
22	0.269795	2.851362	14.84938	81.87483	0.182682	0.241745
23	0.275951	2.838767	14.85859	81.88485	0.176234	0.241557
24	0.281948	2.806379	14.85088	81.92492	0.172557	0.245260
25	0.288011	2.810471	14.81770	81.96060	0.166399	0.244830
26	0.293760	2.818767	14.81675	81.94172	0.170808	0.251954
27	0.299420	2.812362	14.82183	81.94835	0.165715	0.251749
28	0.304945	2.786724	14.81576	81.97933	0.163352	0.254827
29	0.310546	2.789556	14.78872	82.00928	0.158304	0.254137
30	0.315889	2.796896	14.78612	81.99552	0.161536	0.259926
31	0.321160	2.793904	14.78901	82.00003	0.157346	0.259706
32	0.326311	2.773111	14.78466	82.02400	0.155879	0.262351
33	0.331540	2.774948	14.76220	82.04969	0.151608	0.261552
34	0.336552	2.781215	14.75877	82.03964	0.154001	0.266369
35	0.341505	2.780332	14.76035	82.04273	0.150453	0.266138
36	0.346349	2.763217	14.75737	82.06134	0.149619	0.268456
37	0.351271	2.764303	14.73849	82.08367	0.145920	0.267610
38	0.356006	2.769530	14.73473	82.07635	0.147707	0.271677
39	0.360695	2.769988	14.73547	82.07847	0.144635	0.271432
40	0.365281	2.755718	14.73356	82.09298	0.144257	0.273494
41	0.369944	2.756227	14.71757	82.11258	0.140995	0.272633
42	0.374444	2.760499	14.71376	82.10729	0.142339	0.276106
43	0.378907	2.761824	14.71393	82.10877	0.139631	0.275851
44	0.383273	2.749804	14.71281	82.12009	0.139583	0.277708

Table 10: The Variance Decomposition of LQ.

Period	S.E.	LRY	LRG	LRM	LWFO	LQ
1	0.125895	1.097175	0.005587	3.789567	12.71893	82.38874
2	0.194141	0.484477	0.023512	1.638843	11.20915	86.64402
3	0.241336	1.980921	0.934084	2.477860	9.754297	84.85284
4	0.289624	5.745030	0.860844	5.063684	8.049926	80.28052
5	0.336857	7.689824	0.636605	10.42796	6.714353	74.53126
6	0.373008	7.805576	0.524216	13.24631	6.366114	72.05778
7	0.401794	8.159540	0.455123	14.99208	6.048046	70.34521
8	0.425019	8.636306	0.615481	16.14793	5.659489	68.94079
9	0.446238	8.875011	1.119357	17.07297	5.334869	67.59780
10	0.464459	8.824727	1.815859	17.25184	5.249062	66.85851
11	0.480990	8.744474	2.708553	17.19952	5.142091	66.20536
12	0.496612	8.645422	3.925522	17.04109	4.961458	65.42651
13	0.511971	8.466576	5.357698	16.87451	4.777864	64.52336
14	0.526703	8.231736	6.841212	16.58118	4.700591	63.64528
15	0.541243	8.012700	8.372945	16.27747	4.604105	62.73278
16	0.555647	7.799619	10.02272	15.99216	4.457795	61.72771
17	0.569831	7.551672	11.72991	15.73282	4.306009	60.67959
18	0.583643	7.297350	13.42712	15.42258	4.220914	59.63203
19	0.597444	7.068144	15.11947	15.10464	4.126748	58.58100
20	0.611266	6.851769	16.84767	14.80165	4.002164	57.49675
21	0.624928	6.616973	18.58046	14.51477	3.872633	56.41516
22	0.638314	6.385745	20.27644	14.19949	3.789372	55.34895
23	0.651706	6.176555	21.93058	13.88066	3.703732	54.30847
24	0.665155	5.981539	23.57135	13.57917	3.598960	53.26898
25	0.678491	5.778356	25.18453	13.29662	3.489420	52.25108
26	0.691581	5.581549	26.74289	13.00232	3.413850	51.25939
27	0.704633	5.402274	28.23989	12.71055	3.339375	50.30790
28	0.717718	5.236044	29.70134	12.43695	3.252410	49.37326
29	0.730709	5.067077	31.12389	12.18261	3.160713	48.46572
30	0.743462	4.904516	32.48992	11.92392	3.094719	47.58692
31	0.756137	4.755203	33.79276	11.66960	3.031373	46.75107
32	0.768817	4.616760	35.05521	11.43131	2.959621	45.93710
33	0.781411	4.478030	36.27864	11.21037	2.883149	45.14981
34	0.793779	4.344800	37.45139	10.98817	2.826522	44.38911
35	0.806043	4.221422	38.56658	10.77040	2.773095	43.66850
36	0.818288	4.106777	39.64339	10.56602	2.713904	42.96991
37	0.830455	3.992851	40.68494	10.37675	2.650039	42.29542
38	0.842409	3.883377	41.68368	10.18755	2.601746	41.64365
39	0.854245	3.781256	42.63270	10.00228	2.556715	41.02705
40	0.866047	3.686080	43.54772	9.827905	2.507711	40.43059
41	0.877777	3.591960	44.43236	9.666500	2.454122	39.85506
42	0.889310	3.501344	45.28199	9.505689	2.412919	39.29806
43	0.900719	3.416273	46.08978	9.348100	2.374813	38.77104
44	0.912084	3.336739	46.86842	9.199249	2.334003	38.26158

As a result, for the real effective industrial trade-weighted exchange rate shock in 11-year,the largest contribution is from the volatility of the real government expenditure and then respectively: the real effective exchange rate, real money and industrial value added. But for monetary shock the largest contribution is from the volatility of real money supply, real government spending and real value added of the industrial sector.

Discussion and Conclusions:

In this study, we have investigated the relationship between the calculated industrial real effective exchange rate index and real industrial value added by using three methods. First, by using normal co-integrating equation, we find that the real effective exchange rate index has long run positive effect on real industrial value added, since when exchange rates increase, the export will rise and real value added in the sector will rise. As a result of variance decomposition in 44 periods for the volatility of the real industrial trade-weighted exchange rate; real government spending, real money supply and the real value added of industrial sector have the largest contributions on LQ shock, respectively. But volatility of the money supply, real government spending and real value added of the industrial sector has the largest contributions for the monetary shock.

The impulse-response analysis has showed that despite the initial negative effect of one S.D. shock to the real money supply on industrial value added, it has positive effect in long run and converges to a new steady level. The effect of this shock on real government expenditure is random walk on its initial level and on industrial wage index is positive, but decreasing. Moreover, the effect of money shock on LQ is always positive, but due to inflation effects this exchange rate index is decreasing in long run. Similarly, one S.D. shock in

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exchange rate index has positive effect on industrial value added in long run and initially has positive effects on real government expenditure and real money supply that after some fluctuations, due to inflationary effects, become negative. The effect of this shock on the real industrial wage index is negative and finally on itself is positive but decreasing in long run.

Increasing the exchange rate index on the one hand, reduces the industry production due to inflationary expectations (rising prices of imported intermediate inputs). But due to lower prices of domestic goods and services respect to foreign produced goods, there would be an increased tendency from foreigners and domestic people to purchase domestic goods, so that we can see the increased value added in the long run.

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Appendix: VECM Model Estimation

Vector Error Correction Estimates					
Date: 11/11/13 Time: 09:37					
Sample (adjusted): 1373Q1 1389Q4					
Included observations: 68 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
CointegratingEq:	CointEq1				
LRY(-1)	1.000000				
LRG(-1)	-3.835918				
	(1.07254)				
	[-3.57648]				
LRM(-1)	-0.076372				
	(0.66775)				
	[-0.11437]				
LWFO(-1)	0.396788				
	(0.63847)				
	[0.62147]				
LQ(-1)	-0.685629				

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	(0.22937)				
	[-2.98914]				
C	22.83919				
Error Correction:	D(LRY)	D(LRG)	D(LRM)	D(LWFO)	D(LQ)
CointEq1	0.021244	0.029226	0.002179	0.061150	0.021828
	(0.01412)	(0.02169)	(0.00668)	(0.00820)	(0.02549)
	[1.50428]	[1.34733]	[0.32647]	[7.45891]	[0.85630]
D(LRY(-1))	0.133556	0.538141	0.146405	0.198362	0.222304
	(0.15588)	(0.23943)	(0.07369)	(0.09049)	(0.28137)
	[0.85676]	[2.24755]	[1.98685]	[2.19206]	[0.79007]
D(LRY(-2))	-0.293086	-0.344300	-0.205424	0.024481	-0.610333
	(0.16806)	(0.25814)	(0.07944)	(0.09756)	(0.30335)
	[-1.74393]	[-1.33379]	[-2.58583]	[0.25093]	[-2.01197]
D(LRY(-3))	-0.114610	-0.078133	0.012156	-0.047928	-0.651241
	(0.18783)	(0.28850)	(0.08879)	(0.10903)	(0.33903)
	[-0.61019]	[-0.27083]	[0.13692]	[-0.43957]	[-1.92089]
D(LRG(-1))	0.012833	-0.264388	0.046422	0.158467	0.172539
	(0.09781)	(0.15023)	(0.04623)	(0.05678)	(0.17655)
	[0.13120]	[-1.75985]	[1.00406]	[2.79097]	[0.97730]
D(LRG(-2))	0.079743	-0.495785	0.055187	0.152122	0.317478
	(0.07618)	(0.11701)	(0.03601)	(0.04422)	(0.13750)
	[1.04679]	[-4.23715]	[1.53256]	[3.43996]	[2.30887]
D(LRG(-3))	0.054160	-0.048575	0.037691	0.062650	0.040404
	(0.08108)	(0.12453)	(0.03832)	(0.04706)	(0.14634)
	[0.66801]	[-0.39007]	[0.98347]	[1.33115]	[0.27609]
D(LRM(-1))	0.466839	0.112268	0.320461	0.650729	-1.016316
	(0.33829)	(0.51961)	(0.15991)	(0.19638)	(0.61062)
	[1.37998]	[0.21606]	[2.00398]	[3.31363]	[-1.66439]
D(LRM(-2))	-0.397990	1.245441	0.266856	0.385418	1.006191
	(0.32119)	(0.49334)	(0.15183)	(0.18645)	(0.57975)
	[-1.23911]	[2.52451]	[1.75763]	[2.06713]	[1.73556]
D(LRM(-3))	0.893746	-0.780469	-0.084702	0.570395	0.303591
	(0.32942)	(0.50599)	(0.15572)	(0.19123)	(0.59461)
	[2.71306]	[-1.54247]	[-0.54394]	[2.98277]	[0.51057]
D(LWFO(-1))	-0.803952	-0.600760	-0.185135	-1.090014	0.250529
	(0.15877)	(0.24386)	(0.07505)	(0.09216)	(0.28658)
	[-5.06369]	[-2.46351]	[-2.46683]	[-11.8268]	[0.87421]
D(LWFO(-2))	-0.145791	0.526086	0.127766	-0.816452	0.420457
	(0.17676)	(0.27150)	(0.08356)	(0.10261)	(0.31906)
	[-0.82478]	[1.93767]	[1.52910]	[-7.95676]	[1.31780]
D(LWFO(-3))	-0.360047	-0.480252	-0.103330	-0.899412	0.435401
	(0.20807)	(0.31958)	(0.09835)	(0.12078)	(0.37556)
	[-1.73045]	[-1.50275]	[-1.05060]	[-7.44658]	[1.15934]
D(LQ(-1))	-0.043804	0.069954	0.020123	-0.041396	0.240060
	(0.07368)	(0.11317)	(0.03483)	(0.04277)	(0.13299)
	[-0.59452]	[0.61812]	[0.57776]	[-0.96784]	[1.80504]
D(LQ(-2))	0.032849	-0.145796	-0.026008	0.016880	-0.077364
	(0.07301)	(0.11215)	(0.03451)	(0.04238)	(0.13179)
	[0.44991]	[-1.30006]	[-0.75356]	[0.39827]	[-0.58703]
D(LQ(-3))	0.038380	0.155974	-0.009161	-0.021994	0.044389
	(0.06899)	(0.10597)	(0.03261)	(0.04005)	(0.12454)
	[0.55628]	[1.47181]	[-0.28090]	[-0.54916]	[0.35643]
C	0.013805	0.008256	0.008978	-0.007587	-0.038397
	(0.01241)	(0.01907)	(0.00587)	(0.00721)	(0.02241)
	[1.11201]	[0.43296]	[1.52988]	[-1.05275]	[-1.71355]
R-squared	0.801625	0.850303	0.633212	0.962408	0.365436
Adj. R-squared	0.739389	0.803340	0.518141	0.950614	0.166358
Sum sq. resids	0.248099	0.585320	0.055437	0.083605	0.808323
S.E. equation	0.069747	0.107130	0.032970	0.040488	0.125895
F-statistic	12.88054	18.10554	5.502799	81.60371	1.835637
Log likelihood	94.36893	65.18574	145.3208	131.3518	54.21044
Akaike AIC	-2.275557	-1.417228	-3.774140	-3.363288	-1.094425
Schwarz SC	-1.720680	-0.862351	-3.219263	-2.808411	-0.539548
Mean dependent	0.018551	0.005870	0.018131	0.007875	-0.040839
S.D. dependent	0.136625	0.241576	0.047496	0.182191	0.137885
Determinant resid covariance (dof adj.)		6.86E-13			
Determinant resid covariance		1.63E-13			
Log likelihood		518.7218			
Akaike information criterion		-12.60946			
Schwarz criterion		-9.671881			