EXCHANGE RATE PASS-THROUGH IN ARMENIA*

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Abstract – In this paper, we develop a semi-structural macroeconomic model to estimate the Exchange Rate Pass-through in Armenia using Bayesian estimation. The pass-through to both import prices and core inflation is somewhat lower than the average results for comparable emerging economies reported in the literature. As we calculate time-varying pass-through rates we also explore critical factors causing shifts over time. The macroeconomic view of exchange rate pass-through incompleteness, especially the monetary policy credibility factor, plays a significant role.

Keywords**:** Purchasing Power, Taylor Rule, Risk Premia, Exchange Rates, Exchange Rate Pass-through, Output Inflation, Bayesian Analysis, Econometric Modeling, Simulation.
JEL Classification: F31, E31, E37, C11

1. INTRODUCTION

Exchange rate pass-through (ERPT) has significant implications for monetary policy in an open economy model framework. Changes in the exchange rate may pass through to import prices as well as to domestic prices. However, this pass-through may not be complete, and prices may change by less than exchange rate changes. In a wide range of literature it is mainly defined as either the exchange rate pass-through (ERPT) to import prices or to domestic prices. Proper estimations of the latter are of importance, so are the reasons causing it. Therefore for better policy conduction purposes in this paper we attempt to estimate the Exchange Rate pass-through for Armenia coming from both direct and indirect channels including the demand side factors and mark-up changes. Generally ERPT refers to price response from exchange rate fluctuations generated from any shock. Hence, in this paper we define the ERPT from risk premium shock as a "plain"

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pass-through but also observe the pass-through coefficients from the rest of the shocks available in the model.

The assumption of a complete ERPT originated from the Law of One Price. However, as it is commonly known, the Law of One Price does not hold and hence leads to an incomplete pass-through. Economists have different views on the factors shaping this incompleteness. Some attribute it to microeconomic factors reflecting on the Pricing to Market theory. Others attribute it to macroeconomic factors such as low inflationary environment generated from the price stickiness assumptions. The key is to observe the price setting mechanisms.

In this paper, we attempt to estimate the Exchange Rate pass-through for Armenia originating from both direct and indirect channels, including the demand-side factors and mark-up changes. The results of our analysis show that the role of monetary policy credibility plays a big role in the dynamics of exchange rate pass-through. First, we find that the pass-through from monetary policy shock rises with the increase of monetary policy credibility, then it also reduces the pass-through from the risk premium shock. An interesting fact recorded during a risk premium shock is that the producers rise prices immediately as a result of the shock. Robustness check of the model shows that the model-generated risk premium shock is consistent with the observed risk premium shock measure. Furthermore, the dynamic pass-through coefficients of the risk premium and global monetary policy shocks are similar with the exception of the latter being more persistent.The pass-through coefficient is the smallest during the demand shock.

We present the general theoretical concepts in the next section as well as the appropriate techniques to measure ERPT, further using the cumulative response mode as the main method of calculating the pass-through and the elasticity approach as a robustness check. This is followed by the construction of a semi-structural model in Section 3. Bayesian analysis and appropriate impulse-response functions are presented, and the results discussed. The paper concludes in Section 4, with some stylized facts and estimates reported in the Appendix 1 and 2.

2. Exchange Rate Pass-Through: Theory and Evidence

2.1. **Theoretical Framework.**

The theoretical framework of our model reflects on the widely established view of pass-through incompleteness. When the Law of One Price (LoOP) holds, pass-through would be complete. More formally:

$$P = \epsilon P'$$

where ϵ denotes the exchange rate and P' is the price of a good in foreign currency while P is the price of the same good inside the country. In the presence of tariffs and transportation costs, complete pass-through is unattainable, and the LoOP does not hold in practice, i.e:

$$P = \epsilon P' + tariffs + transcosts$$

with *transcosts* denoting transportation costs.[1]

Two major approaches to explaining pass-through are considered in the literature: the microeconomic view and the macroeconomic concept. The first one mainly concentrates on demand elasticities, marginal costs, and mark-ups. Generally, the Pricing to Market theory developed by Krugman in 1980s is a way to explain the pass-through incompleteness from the microeconomic point of view as it attempts to find explanations for the deviation from the Law of one price. The range of the reasons includes excessive demand share of the importer in the total excessive demand, incomplete competition, marketing and other infrastructure costs, slow demand adjustments and some technical facts like demand curve shape. He literally defines the PTM as the phenomenon of foreign firms maintaining or even increasing their export prices to the US when the dollar rises.

In addition, Goldberg and Knetter (1996) point out market segmentation as a reason of incomplete pass-through. Their paper gives the impression of an adjusted PTM theory as

[1] Although there are some papers which try to prove that the Law of One Price holds, the general view according to majority of the existing papers is that it does not hold in practice.

their hypothesis of market segmentation coming from the third degree price discrimination nets the transportation and border costs. They define the segmentation as a lack of integration. Martson (1989) discusses the PTM theory with the help of a model where he states the important role of the constancy of the marginal costs as well as demand elasticities in the context of pass-through completeness. In addition, he argues that exchange rate depreciation can change the domestic price, but only if the marginal cost increases or decreases with output. In the case of varying mark-ups, the pass-through is incomplete and does not depend on the form of the marginal cost curves. Price stickiness is also a factor causing pricing to market in the case when the goods are differentiated, and the price setter decides the export price in foreign currency based on his expectations. Yet we have to pay attention to the fact that pricing to market and exchange rate incomplete pass-through while intersecting in a wide range of aspects are not the same. Pricing to market concentrates on the export and domestic price ratio (export-domestic price margin) and the elasticity of this ratio with respect to the exchange rate change. Meanwhile, the exchange rate pass-through is only about the export (import) price elasticity with respect to changes in exchange rates. This latter is an important point worth mentioning.

The macroeconomic approach is established around sticky prices and inflationary environment, and hence highlights the role of monetary policy credibility as well as exchange rate and inflation volatility. With his staggered price model, Taylor pioneered the macro approach. A firm decides to hold the same price of the product if it believes in monetary policy credibility, as the inflation will be low and the firm's marginal costs will not grow way too far. But when the monetary policy is not stable and inflation is high, the firms will change the prices at once. Furthermore, Devereux and Yetman (2002) state that there is a non-linear relationship between the estimated pass-through coefficients and inflation or exchange rate volatility. They construct a menu cost model to demonstrate that the pass-through is determined by the monetary policy regime. In the model, they show that price stickiness which causes the incomplete pass-through depends on the monetary policy credibility. As inflation rises, pass-through rises too but at declining rates. In addition, some empirical research shows that the pass-through coefficients are low in low inflation countries compared to the moderate inflation economies and the ERPT in these countries is smaller compared to the high inflation ones.[2] For the countries which have had a few inflation regimes, pass-through was smaller during moderate inflation regimes compared to high inflation periods.

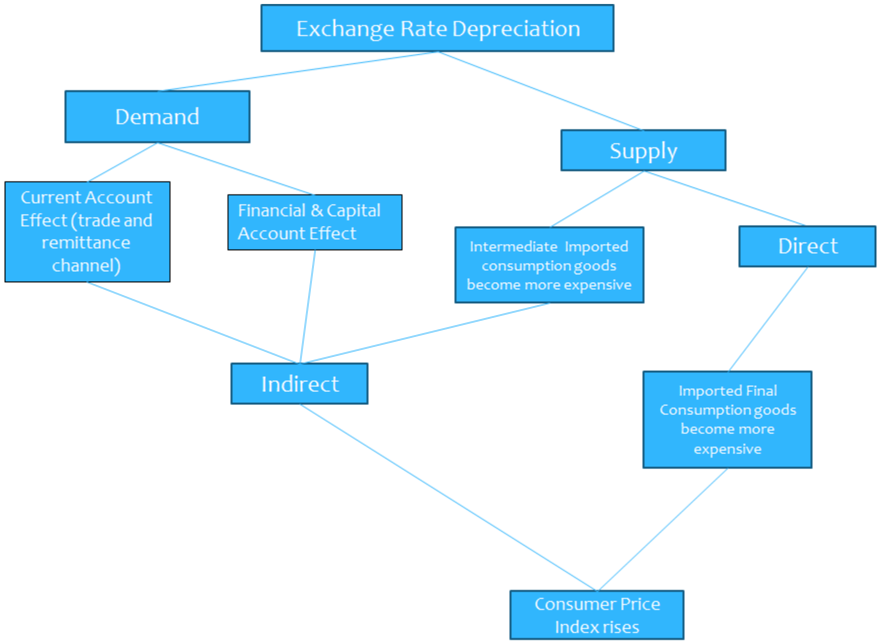
Moreover, the currency in which the producer decides to set its price is also of great importance. Specifically, local currency pricing principle is an equivalent of 0 pass-through as it is considered that the producer sets the price in the export destination country's currency hence absorbing the currency fluctuation risks. The case of the producer currency pricing is supposed to be par to the complete pass-through as the exchange rate fluctuation risk is now an additional cost or benefit for the buyers, and adds up to the price pushing it up or down.

The fact that a number of factors and shocks can cause exchange rate shifts is thoroughly discussed by Forbes. She affirms and empirically shows that the ERPT is different when different shocks cause exchange rate changes. The explanation comes from the following formula. $p = \epsilon + mc + mkup$. While some kind of shock pushes the exchange rate up or down, it also might alter mark-ups and/or marginal costs. Hence, the ERPT of different shocks underlying in the base of the exchange rate fluctuations will be dissimilar.

To summarize the general theory directions, we define the concepts of intermediate importers and direct importers. The intermediate importers are the ones whose marginal costs in local currency have a significant share in total marginal costs because the goods they imported enter the production process as intermediate goods. The direct importers, on the other hand, do not possess such marginal costs or the costs have a somewhat small share. As far as we are concerned, the intermediate importers take the inflationary environment into account, but for the direct importers this cannot really hold as much of the costs is formed in importing country currency. Figure 2.1 completes the overall picture of our model framework.

[2]Choudhri and Hakura 2001, Devereux and Yetman 2002

FIGURE 2.1. Model Framework



2.2. **ERPT Measures.**

Different measures of exchange rate pass-through are suggested in the literature. One of them is simply the elasticity approach derived from the micro-foundations, which is represented by the following equation.

$$\gamma = \frac{\dot{P}_t^{m,j} / P_t^{m,j}}{\dot{E}_t / E_t}$$

where, P is the import price to the j-th country, E is the exchange rate, and the dotted variables denote percentage change. This is supposed to be the short-run pass-through elasticity. To obtain the long-run coefficient, we simply need to sum up the elasticity coefficients of all the lagged values.

The next common measure is the cumulative approach, which is considered to be a measure of long run pass-through only and mostly appears in VAR estimation literature. It can be described in the following formula.

$$PT_{t,t+i} = \frac{P_{t,t+i}}{E_{t,t+i}}$$

where, $PT_{t,t+i}$ is the cumulative exchange rate pass-through, $P_{t,t+i}$ is the cumulative response of prices to an exchange rate shock identified in some manner, and $E_{t,t+i}$ is the cumulative response of exchange rate to its own shock. And the third approach is described as a cumulative response of the price to an exchange rate shock per unit exchange rate shock in the period of the latter's occurrence represented by

$$PT_{t,t+i} = \frac{P_{t,t+i}}{E_0}$$

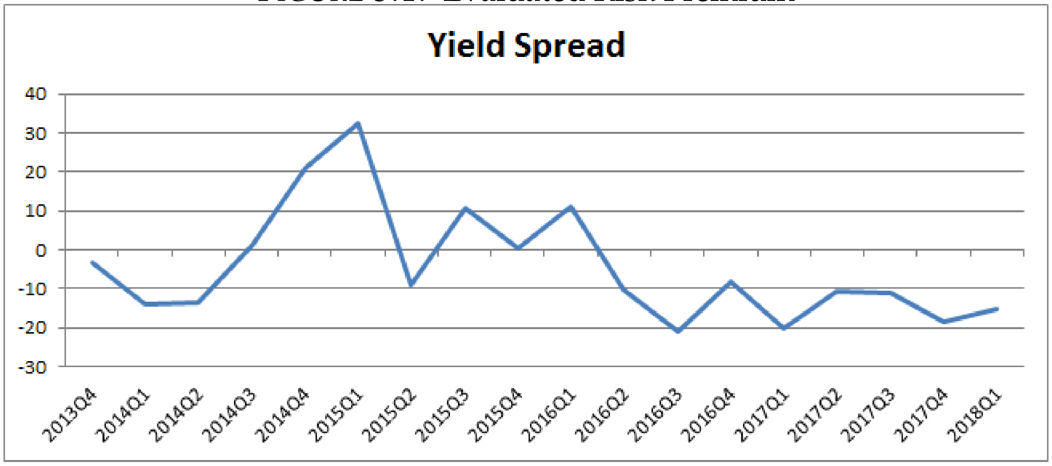
One may argue that the second approach is not the pure pass-through itself as it contains calculations of dynamic responses, which, in turn will be influenced by other shocks. Nevertheless, we believe that it does demonstrate a good measure of long-time pass-through, i.e. the final effect that the exchange rate has on the prices after policy and non-policy adjustments. We do not consider the use of the third approach, as, supposedly, it is not a good measure of dynamic responses. We employ the second approach, and use the first approach to help identify initial pass-through.

3. ERPT in Armenia

3.1. **Stylized Facts.**

Below we present some stylized facts typical to the Armenian economy, which are also guidelines for the data-choosing process. The broad outlook is the following. Monetary policy authority changed its strategy in 2006with its new inflation targeting regime. The Economy expanded rapidly beginning in the early 2000s, and then shrank by 14 percent during the Global Financial Crisis. Thereafter, the economy recovered slowly with low growth rates. At the end of 2014 and at the beginning of 2015, the country faced a risk premium shock in the form of national currency depreciation against the US dollar. This may have been attributed to a decline in money transfers. One can observe the latter effect from Figure 3.1, where the yield spread is the difference between Armenian Euro-bond's yield to maturity and the US dollar spread curve, with a maturity of 7 years.

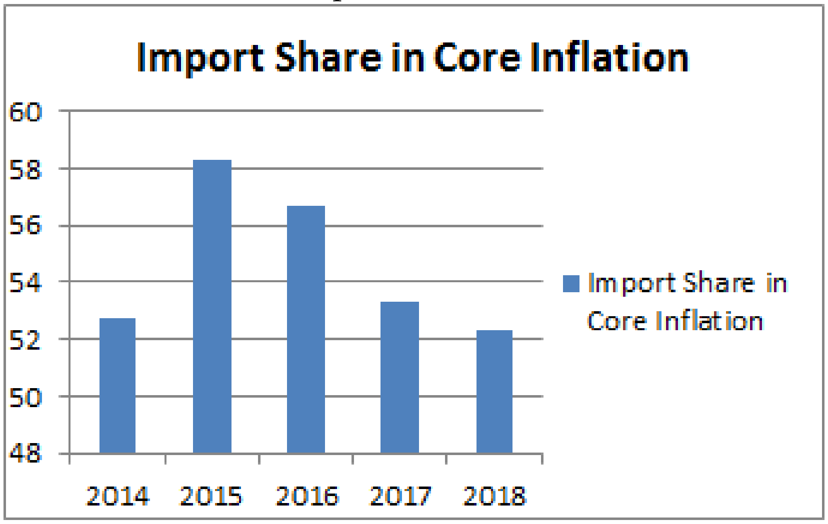
FIGURE 3.1. Evaluated Risk Premium



In addition, dollarization is another important indicator to look at in the context of evaluating exchange rate pass-through as it in some sense describes monetary policy credibility, which is one of the key components of imperfections in ERPT. The dollarization rate had declined to 35.1 percent in monthly bank deposits and to 36.9 percent for monthly credit through the beginning of 2008. But after the onset of the Global Financial Crisis, deposit dollarization immediately increased to over 70 percent. Credit dollarization ratio also increased, albeit at a slower pace; it rose to over 50 percent in 2009 and continued rising further. Dollarization moderated with a declining trend from 2012, however, with both indicators started to decrease only after 2015 and reached around 50 percent recently.

From the monetary policy point of view we are interested in exchange rate impact on core inflation as the latter is supposed to be the less volatile part of the overall inflation. The share of imported goods is larger in the core inflation being slightly less than 53 percent compared to its share in consumer price index which is around 40 percent; the dynamics of the import share change in core inflation is depicted in Figure 3.2. As the figures in the graph show, the share increased in 2015 compared to 2014, when the share of imported goods had risen and the share of core inflation has been declined. The further gradual decrease in the following years is caused by the increase of core inflation share in headline inflation, Meanwhile imported goods share remained relatively stable. Effective

FIGURE 3.2. Import Share In Core Inflation



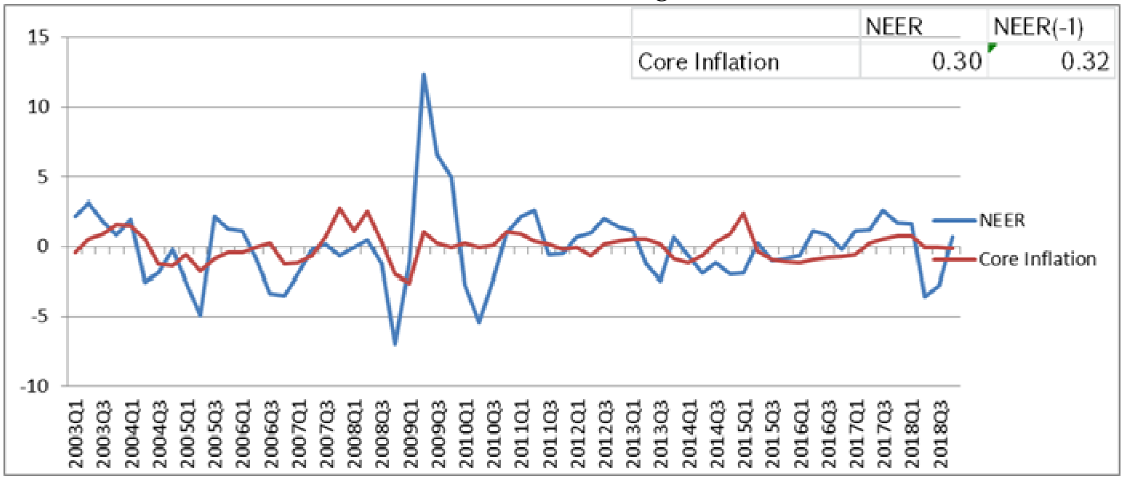
exchange rates are more important form monetary policy perspectives too, as they are relative index measures of the currency against a basket of partners' currencies.

Because the real effective exchange rate is highly correlated with the nominal effective exchange rate, it is convenient to employ the nominal rate series for estimation of the model. In addition, the nominal effective exchange rate is more correlated with both headline and core inflation compared to the nominal exchange rate. We employ the seasonally adjusted series of the change in the nominal effective exchange rate and core inflation and estimate a correlation coefficient of 0.3 to 0.32 between core inflation and the first lag of the nominal effective exchange rate.

3.2. **The Data.**

Seasonally adjusted quarterly data are employed. In addition, all the series are stated in growth rates except Federal Reserve Effective Funds Rate and Interbank Repo Rate, which are in levels. The sample period range from the first quarter of 2003 and ends in the fourth quarter of 2018. The model includes seven variables, two of which are exogenous and represent the external sector. The remaining five variables capture the price dynamics, economic growth, monetary policy influence, as well as the exchange rate. Further,

FIGURE 3.3. Nominal Effective Exchange Rate and Core Inflation



an increase in the of Nominal Effective Exchange Rate (NEER) index determines depreciation and the vice versa. The influence of global monetary policy change is demonstrated by the Federal Reserve's Effective Funds Rate. We include this variable in the model in order to identify risk premium shock netting the effect of Fed Funds Rate in the exchange rate equation to obtain pure risk premium shock. An aggregated import price index in dollar terms illustrates the impact of foreign price dynamics on the domestic economy. This series captures the foreign price changes, and it is in dollar terms in consideration to net the effect of foreign price changes from the exchange rate pass-through effect. We use GDP quarter on quarter growth series to account for the demand-side factors and the Core Inflation series to account for the supply-side factors. In addition, the GDP deflator is employed as proxy for intermediate consumption goods prices. Monetary policy is approximated by the Interbank REPO rate. And the Nominal Effective Exchange Rate is used to measure exchange rate changes. We use the effective exchange rate as it accounts for the exchange rates of the partner countries which is more relevant from the policy point of view. The time trend of these variables is reported in Figure A1 of Appendix 1.

3.3. **The Methodology.**

We use a semi-structural macroeconomic model to estimate the exchange rate pass-through for Armenia, which generally can be interpreted as the following equations system below.

- $fedrate = F\{L(fedrate)\}$
- $imp\ price = F\{L(imp\ price)\}$

Exogenous Autoregressive

- $y = F\{L(y), L(imp\ price), L(fedrate), L(pi), L(ydef), L(i), L(exch)\}$
- $pi = F\{L(y), L(imp\ price), L(fedrate), L(pi), L(ydef), L(i), L(exch)\}$
- $ydef = F\{L(y), L(imp\ price), L(fedrate), L(pi), L(ydef), L(i), L(exch)\}$
- $i = F\{L(y), L(pi), L(i)\}$ **The Rule**
- $exch = F\{L(y), L(imp\ price), L(fedrate), L(pi), L(ydef), L(i), L(exch)\}$

The first two variables are exogenous to the system depending only on their lag values. Next, the interest rate equation is set following the Taylor rule. The rest of the equations involve the current and lag values of all the variables including the equation for nominal effective exchange rate. Next, to correctly identify the shocks, the system of the equations below has been calibrated to match the impulse-response directions of a standard DSGE model.

We estimate the parameters via the use of Bayesian estimation and depict the appropriate mode check plots as well as multivariate convergence in Appendix 2 (Figure A2.1-A2.9). We perform the estimation for 2 data sets to evaluate the pass-through both before and after the risk premium shock which occurred at the end of 2014 and at the beginning of 2015. The short data set which starts in 2003Q1 and ends in 2015Q1,and is supposed to express the less credible period for the Monetary policy. The long data estimation which is supposed to demonstrate the more credible estimation results starts on 2003Q1 and ends on 2018Q4. Furthermore, we identify 7 shocks for each of the variables and estimate the pass-through coefficients for some of the shocks. The resulting prior and posterior mean coefficients and the shocks of the long data estimation are shown in Table A2.1 of Appendix 2, where we observe that the values of the shocks are meaningful and consistent with economic theory.[3] The order of the shocks coincides with the order of the equations mentioned above. We label the pass-through measure from the risk premium shock to be

[3]See Smets and Wouters 2007, Christiano et al 1999, Forbes 2018 Online Appendix

TABLE 1. Exchange Rate Pass-Through

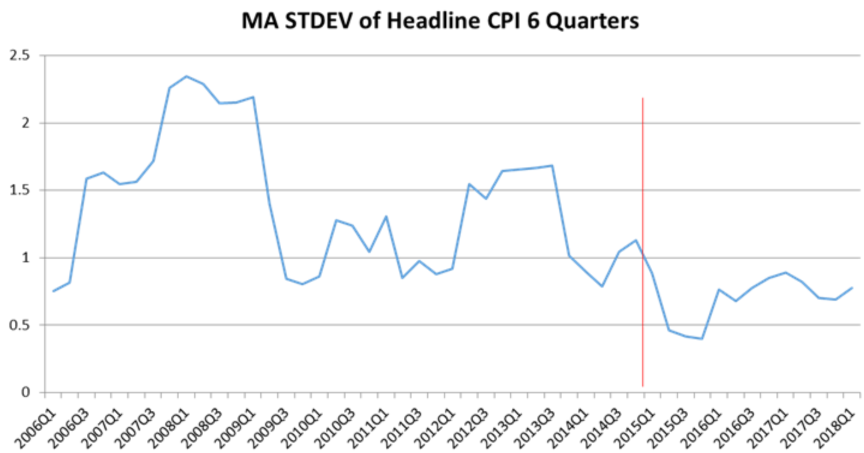
		Fed Shock	Supply Shock	MP shock	Risk Premium Shock
Long Data (2003Q1-2018Q4)	Core Inflation	0.31	0.70	-1.60	0.95
	Exchange Rate	2.10	2.10	-2.61	5.60
	Pass-through	0.15	0.33	0.61	0.17
Short Data (2003Q1-2015Q1)	Core Inflation	1.07	0.87	-2.54	2.35
	Exchange Rate	4.35	2.85	-5.34	10.29
	Pass-through	0.25	0.30	0.48	0.23

the "plain" pass-through, and the rest of them are just the pass-through measures from the rest of the shocks.

3.4. **Results.**

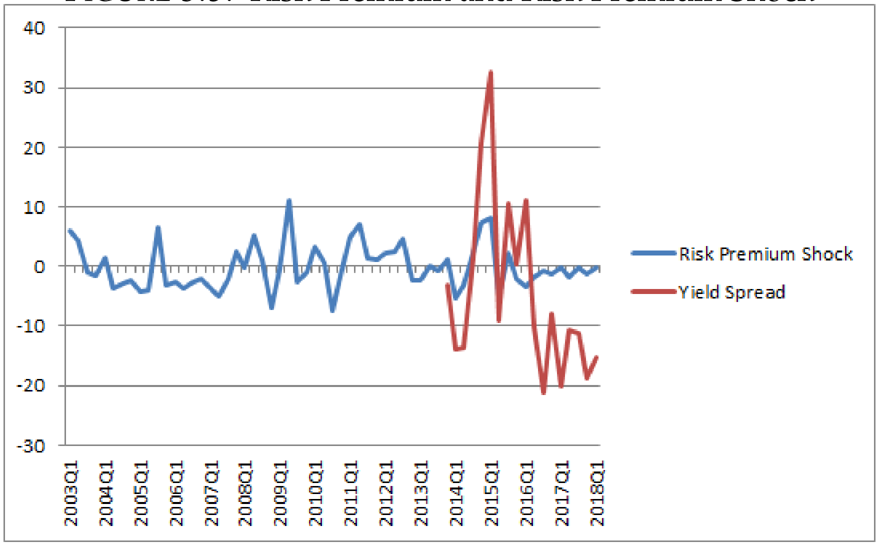
The estimation results are presented in Table 1 both for the short and long data. These coefficients are appropriate measures of long-run pass-through and are calculated with the use of the second formula illustrated under the Exchange Rate Pass-through Measures subsection. Hence the cumulative responses of the core inflation and exchange rate are depicted in Table 1 as well as their ratios as measures of the ERPT. According to the estimation the ERPT for the risk premium shock compiles to 0.17 for the long data and around 0.23 for the short data, which we attribute to being caused by the monetary policy credibility increase coming from the macroeconomic theory of incomplete pass-through and referring to monetary authority intervention to the risk premium shock occurred in 2014-2015. In fact this hypothesis can be proved to be right if we take a look at the share of the people having high or very high inflation expectations figured in Appendix 2 (Figure A2.10) before and after the risk premium shock. It is obvious from the graph that after the shock, inflation expectations declined significantly. Therefore, we attribute the long data pass-through decrease to monetary policy credibility increase. The six months moving average standard deviation also experiences decline starting from 2015 as it is shown in Figure 3.4. This claim of inflation volatility depending on monetary policy credibility is consistent with Taylor (2000).

FIGURE 3.4.



Indeed, the monetary policy shock share has risen for the long data estimation by 1 percent in variance decomposition of the exchange rate depicted in Figure A 2.18 of Appendix 2. The main changes in the shares of the shocks in exchange rate variance decomposition can be explained by the demand shock share rise from 18 to 29 percent, risk premium shock share drop for 9 percentage points from 35 to 26 percent, and to federal funds rate shock share cutback for 3 percentage points towards 2 for the long data estimation. The monetary policy role increase is easily detected from the pass-through coefficient of the monetary policy shock, which has increased for the long data as well. We also observe, that for the positive demand shock the pass-through coefficient is the smallest for the long data and for the short data as well. Obviously, the pass-through from demand shock with the long data estimation is the smallest in the range of all of the pass-through measures from different shocks, which coincides with the results of Forbes et al (2018). The magnitude of the absolute value of the latter can easily be explained with a negative demand shock which happened at the beginning of 2015 causing a big price decline. Generally, both demand shock and risk premium shock historically coincide with the events. This is visible from the demonstration of the historical risk premium shock given as the output of the model and risk premium measured by the difference of the Armenian yield curve and US dollar spread curve expressed in Figure 3.5. These two series have a correlation of 0.37 starting from 2013, as the Armenian Euro-bonds were issued since September of

FIGURE 3.5. Risk Premium and Risk Premium Shock



2013. Since 2003 and until 2008, we demonstrate a trending decrease in risk premium shock historical series, as the risk premium was declining under high growth rates of the economy. Furthermore, historical demand shock also matches the historical events and possesses a correlation coefficient of 0.26 with the first lag of remittance series (Figure A2.19). The correlation with the first lag of the series is conditional on the lag between receiving and spending.

To gain insights into the functioning of the model and the transmission channels of the shocks, next we discuss the impulse-response functions based on the posterior mean of the estimated coefficients and standard deviations of the shocks. The Federal Funds rate seems to be the most persistent shock on the grounds that it returns to its steady level after 30 periods. The global monetary policy shock (see Appendix 2, Figure A2.14) has an influence similar to risk premium shock as it devalues the exchange rate; because of the exchange rate depreciation, foreign goods become more expensive, which raises the inflation. By the same means, demand for domestic products increases because they become cheaper. To alleviate inflation, the monetary authority increases interest rates. This stimulates the exchange rate to be gradually appreciate and decreases inflation. GDP deflator decreases as a result of monetary policy intervention as both intermediate and internal consumption of goods declines.

The import price shock (Figure A2.15 in Appendix 2) leads to an increase in overall prices in the economy, thus decreasing demand for goods and services, leading GDP to decrease. The fact that the prices of intermediate goods increase promote GDP to decrease as well. The monetary authority pushes the interest rates downward as the demand went too far down from its steady state. The exchange rate depreciates initially in accordance with the monetary policy loosening of interest rates. And afterward, when the interest rates start to adjust up, the exchange rate starts to appreciate.

The demand shock is depicted via the rise of GDP in Appendix 2 by Figure A2.16. As soon as GDP accelerates, it generates an increase in prices according to the law of demand, monetary policy interferes with bringing inflation back, as a result of the capital inflow rise exchange rate appreciates. The decrease of GDP deflator refers to the intermediate goods price cut down on the grounds of exchange rate appreciation.

A supply shock is represented by a negative productivity shock accompanied by the rise of inflation and particularly by core inflation in this model exhibited by Figure A2.17 in Appendix 2. Generally, as productivity diminishes in the economy, this leads to an increase in marginal costs, thus increasing prices. As prices increase, people start to consume less and demand declines leading to a reduction in GDP. To restrain inflation, the central bank increases its interest rate. The exchange rate depreciates because of export drop despite of the fact that the monetary policy has raised interest rates. Generally, the literature does not suggest a certain direction for the exchange rate during a supply shock, it varies both in empirical and theoretical literature.[4] In addition, GDP deflator decreases as a response to monetary policy tightening.

When intermediate consumption goods become more expensive as demonstrated by an increase in GDP deflator (see Figure A2.18 in Appendix 2), it passes on to overall prices in the economy. This shock is similar to a negative productivity shock. Demand decreases as a result of price increases, and monetary policy constraints inflation with an

[4] See Forbes et al 2018.

augmentation in interest rates again. The exchange rate starts to appreciate after initial depreciation leading to export decline.

As a consequence of a monetary policy shock depicted in Figure A2.19 in Appendix 2, demand for commodities and services declines. The opportunity costs of consumption increase in a manner that one less unit of consumption now can generate more in the future if it is invested. As a result, producers start to decrease the prices of their goods and services. On the other hand, the exchange rate appreciates because of more capital inflows to the country.

The risk premium shock (Figure A2.20 in Appendix 2) is identified as the semi-structural shock of the exchange rate equation, so when there is a positive risk premium shock, the exchange rate depreciates. The latter causes an initial increase in GDP via an export growth, as domestic products become cheaper for the trading partners and they start to consume more of the goods. This leads to inflation. On the other hand, a balance-sheet effect, reflecting existing foreign currency debt, decreases demand. Furthermore the GDP deflator decline reduces export goods prices. To reduce inflation, the monetary authority increases the policy rate.

The dynamics of the pass-through coefficients from risk premium shock and federal funds shock calculated from the cumulative response approach for 30periods are captured in Figure 3.6. These also represent time-varying pass-through dynamics. Some interesting inferences can be gleaned from these figures. In the state of more credible monetary policy performance (i.e. with the long data estimation), we notice a smaller initial pass-through elasticity in both of the shocks. Also as alluded above, the long run pass-through measures are also smaller in the case of long data. We also detect a more rapid decline in the dynamics of pass-through in the case of long data. The latter is consistent with the framework of the macroeconomic view about the exchange rate pass-through.

Another important fact is that in both cases the initial pass-through decreases and the long run coefficient is lower as an outcome. From our point of view that is a consequence of price stickiness, because the prices adjust slower as long as some of their price setters do change the prices and some do not. And in addition, exchange rate movements are not limited as much as the price ability to go up or down. This is obvious from the impulse-response analysis of the shocks. It can even be observed in the responses of the core inflation to the federal funds and demand shocks.

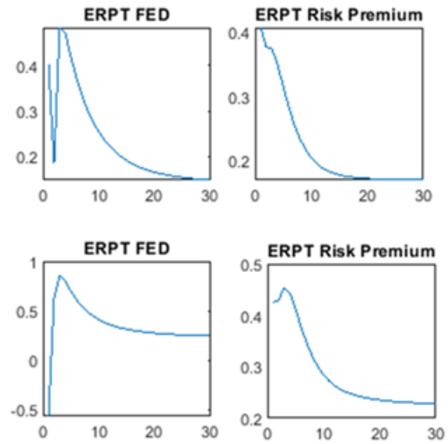
The absence of stickiness during the risk premium shock can be explained by the inflationary environment change related to inflation expectations based on the exchange rate volatility. In addition, an observation of the prices of product and service groups included in core inflation shows that a major part of them has increased during the risk premium shock recorded at the end of 2014 (Check Figure A2.21 in Appendix 2). Both the three-month and four-month average price inflation of those products and services starting from November of 2014 are significantly higher than the historical average and the share of the products and services with higher average rates for the 3-4 month period contributes 67.7% in 12 month period core inflation. So the final inference is that the fact that we do not notice price stickiness in the original phase of the risk premium shock may not be explained by poor estimation and perhaps more reflective of the state of the economy.[5]

4. CONCLUSIONS

We developed a semi-structural macroeconomic model to estimate the exchange rate pass-through from risk premium shock. The long run estimate for the latter is 0.17 which implies a long run estimate of pass-through to import prices around 0.32, as the imported goods share in core inflation is around 0.52. In addition, we calculate the pass-through coefficients for the remaining shocks to find out which of the shocks has the biggest pass-through coefficient both in short and long run periods.

[5]In addition, as a robustness check, we run a regression with the core inflation being the independent variable and the rest of the variables included as dependent variables. So the regression coefficient of the exchange rate is the appropriate pass-through according to the elasticity approach. The pass-through from the regression analysis is 0.12 and is significant. This result is consistent with the measures we obtained from the Bayesian analysis. Regression results are depicted in Appendix 2 Table A2.3.

FIGURE 3.6. ERPT For Long Data, followed by ERPT for Short Data



The results demonstrate that the least pass-through coefficient is recorded during the demand shock, consistent with the existing literature. The output also shows that the federal reserve shock is a persistent one, and as a look-alike to the risk premium shock in the sense of the effects on the economy, it in addition, brings pass-through measure closer to the one from the risk premium shock. One of the differences between the global monetary policy shock and risk premium shock is the diminutive price-stickiness during the risk premium shock. Furthermore, the results from the short data estimation show that for recent years monetary policy credibility played more of an important role in shaping the long run pass-through coefficients when compared to those from the long data. measures. Further research may explore the results using a full structural model.

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Appendix 1.

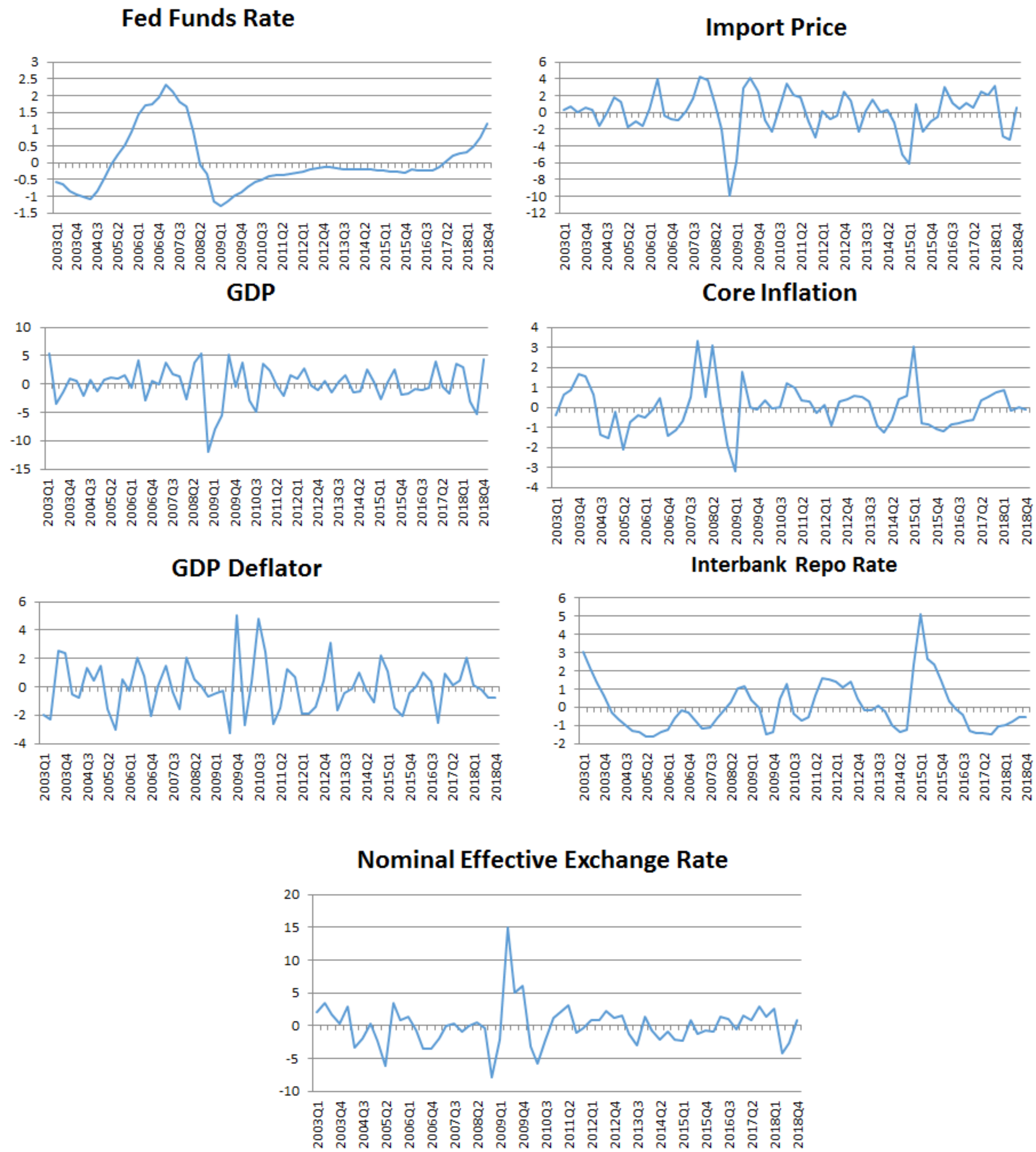

Figure A1, Input Data

Appendix 2.

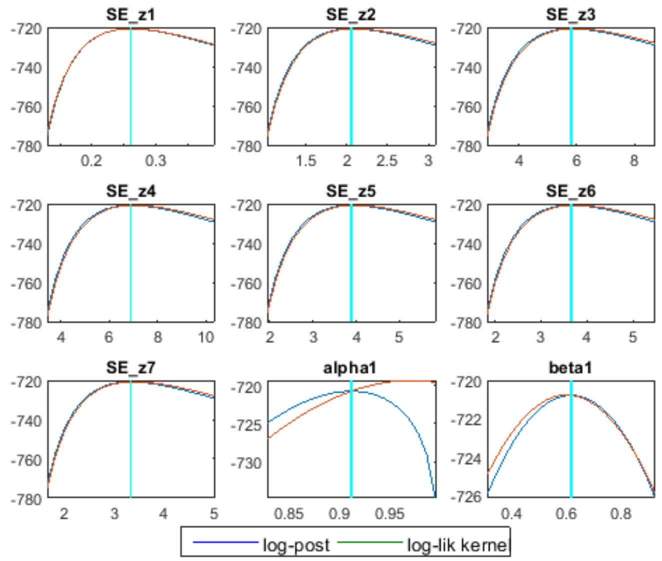

Figure A2.1, Mode Check Plot 1

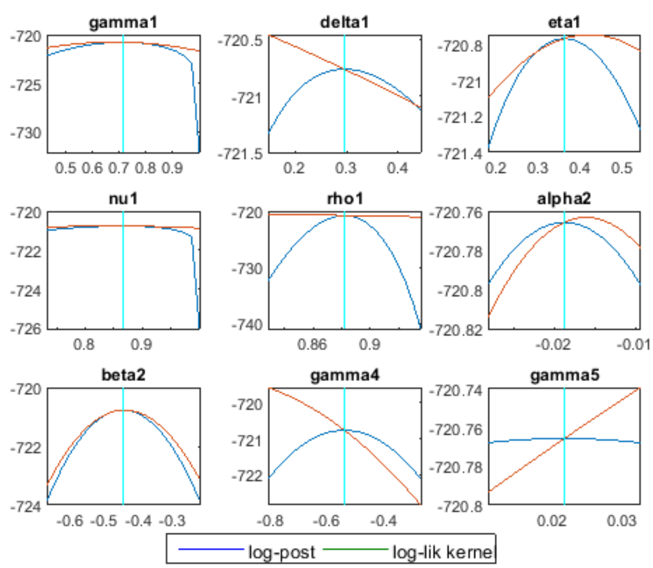

Figure A2.2, Mode Check Plot 2

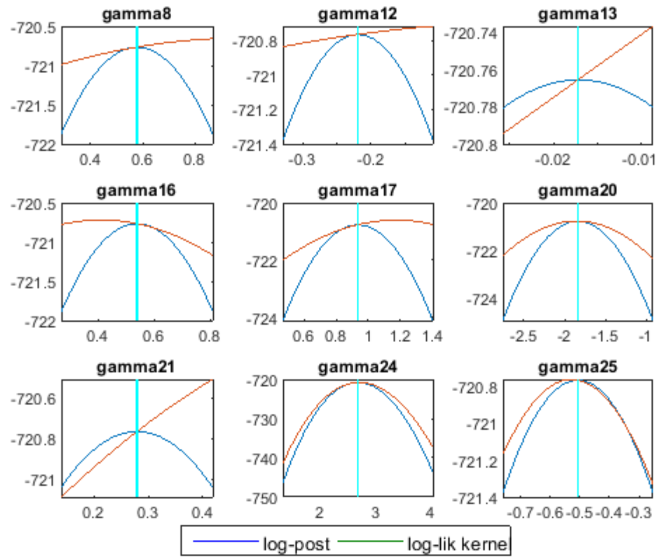

Figure A2.3, Mode Check Plot 3

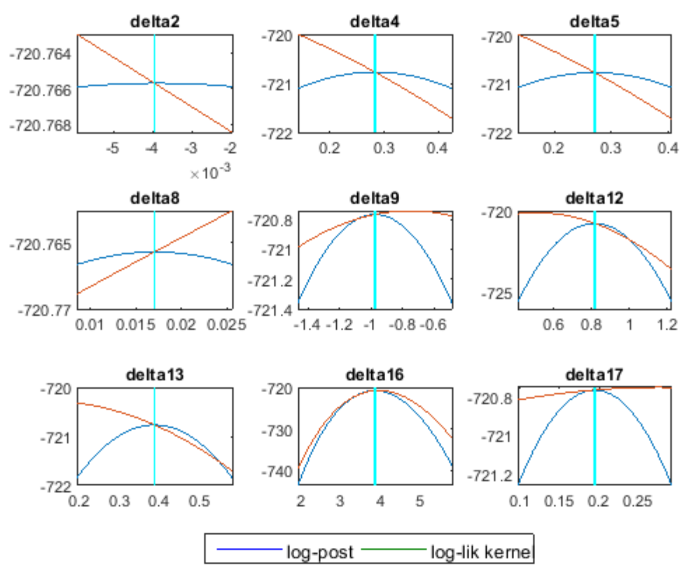

Figure A2.4, Mode Check Plot 4

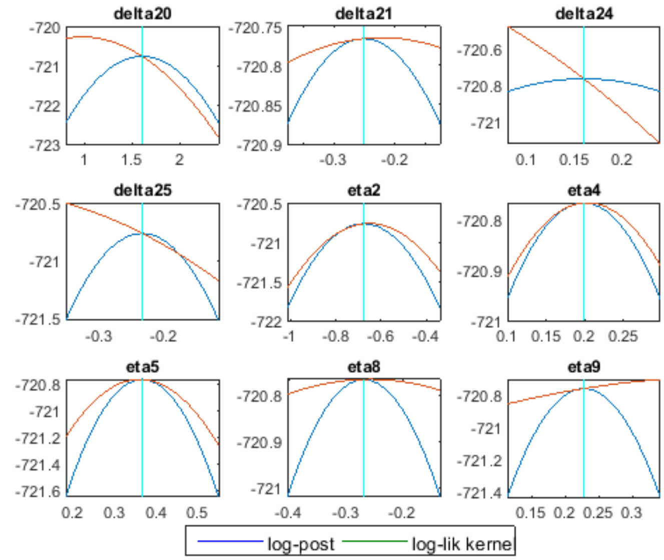

Figure A2.5, Mode Check Plot 5

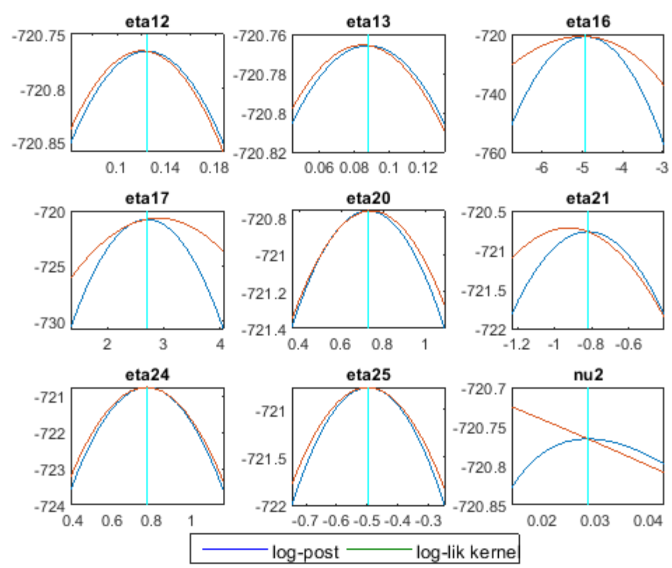

Figure A2.6, Mode Check Plot 6

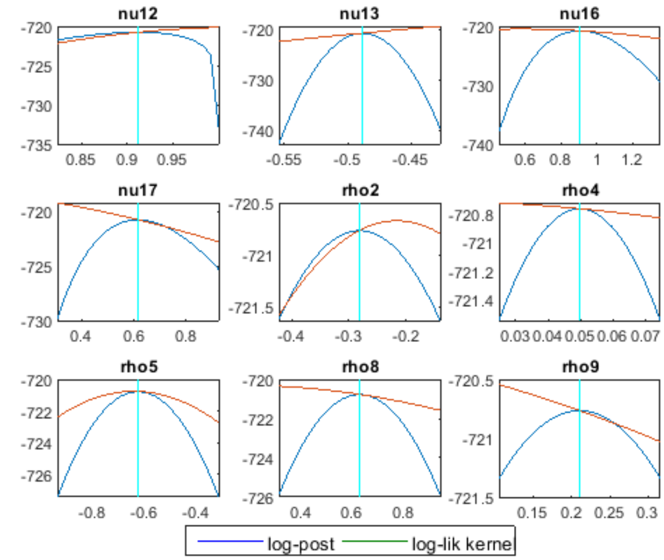

Figure A2.7, Mode Check Plot 7

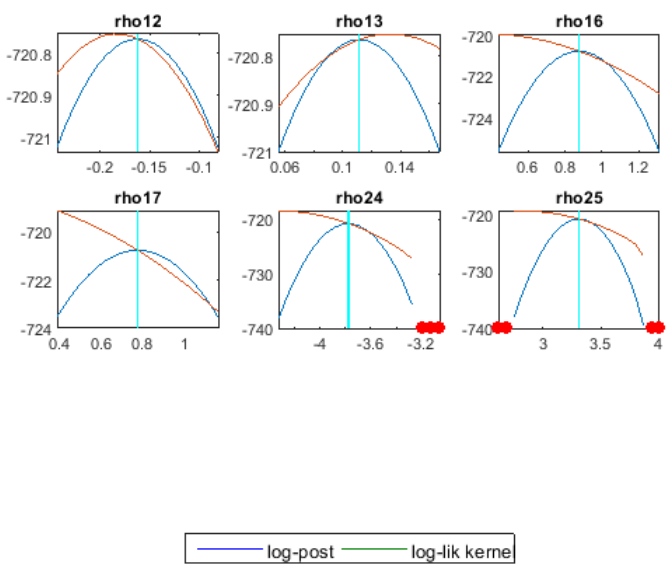

Figure A2.8 Mode Check Plot 8

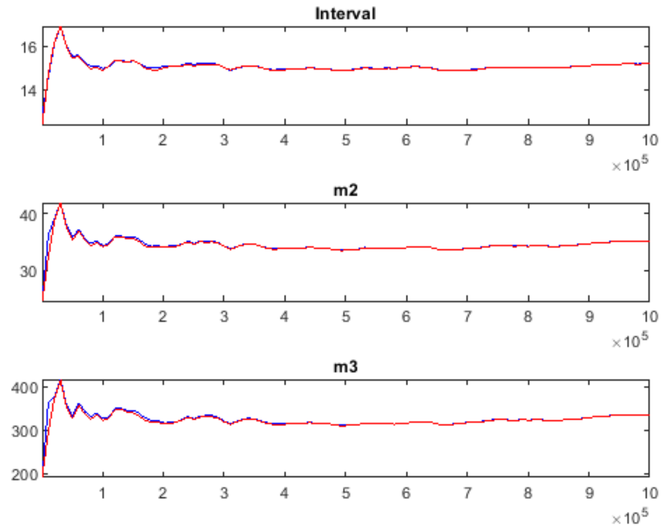

Figure A2.9, Multivariate Convergence

parameters						
	prior mean	post. mean	90%	HPD interval	prior	pstdev
α1	0.75	0.8979	0.8409	0.9566	beta	0.08
β1	0.647	0.6118	0.4406	0.7853	beta	0.2
γ1	0.662	0.676	0.44	0.9333	beta	0.18
δ1	0.394	0.3423	0.1033	0.5735	beta	0.156
η1	0.379	0.3902	0.1154	0.651	beta	0.174
υ1	0.715	0.7482	0.5207	0.9965	beta	0.189
ρ1	0.882	0.8818	0.8657	0.8985	beta	0.01
α2	-0.094	-0.0093	-0.0912	0.073	norm	0.2
β2	-0.462	-0.4429	-0.5999	-0.2814	norm	0.2
γ4	-0.297	-0.5327	-0.8136	-0.2492	norm	0.2
γ5	-0.078	0.0255	-0.2642	0.3164	norm	0.2
γ8	0.556	0.5819	0.2607	0.8964	norm	0.2
γ12	-0.224	-0.2228	-0.3834	-0.0625	norm	0.1
γ13	-0.025	-0.0187	-0.1007	0.0633	norm	0.05
γ16	0.569	0.5329	0.2217	0.837	norm	0.2
γ17	0.882	0.9338	0.6388	1.2395	norm	0.2
γ20	-1.829	-1.8421	-2.3978	-1.281	norm	0.4
γ21	0.195	0.2771	-0.0408	0.5954	norm	0.2
γ24	2.611	2.7698	2.3029	3.2138	norm	0.4
γ25	-0.426	-0.5203	-0.957	-0.0781	norm	0.5
δ2	0.01	-0.0033	-0.1692	0.1592	norm	0.1
δ4	0.527	0.3031	0.0074	0.6053	norm	0.2
δ5	0.529	0.2883	-0.0165	0.5907	norm	0.2
δ8	0.002	0.0122	-0.3074	0.3431	norm	0.2
δ9	-1.031	-1.005	-1.7605	-0.2564	norm	0.5
δ12	0.91	0.8312	0.6041	1.0615	norm	0.15
δ13	0.468	0.3983	0.1748	0.6188	norm	0.15
δ16	3.633	4.1112	3.2494	4.9812	norm	0.6
δ17	0.191	0.1945	0.0366	0.3569	norm	0.1
δ20	2.171	1.6391	0.8317	2.4339	norm	0.6
δ21	-0.258	-0.2552	-0.7232	0.2021	norm	0.3
δ24	0.52	0.1912	-0.1833	0.5735	norm	0.3
δ25	-0.205	-0.2306	-0.3887	-0.0724	norm	0.1
η2	-0.726	-0.6808	-1.101	-0.2674	norm	0.4
η4	0.188	0.163	-0.1983	0.5297	norm	0.3
η5	0.372	0.3599	0.0753	0.6338	norm	0.2
η8	-0.27	-0.2825	-0.6011	0.0321	norm	0.2
η9	0.221	0.2256	0.0735	0.3842	norm	0.1
η12	0.255	0.2116	-0.1327	0.5482	norm	0.88
η13	0.169	0.119	-0.2022	0.4464	norm	0.79
η16	-4.862	-5.0344	-5.4867	-4.5815	norm	0.3
η17	2.558	2.6856	2.1213	3.2439	norm	0.4
η20	0.637	0.5568	-0.2672	1.3756	norm	0.89
η21	-0.594	-0.7224	-1.3659	-0.0643	norm	0.5
η24	0.815	0.801	0.4234	1.181	norm	0.5
η25	-0.481	-0.5138	-0.8571	-0.1698	norm	0.4
υ2	0.129	0.1022	0.0002	0.2111	beta	0.1
υ12	0.762	0.8797	0.7857	0.9811	beta	0.12
υ13	-0.491	-0.4877	-0.5041	-0.4715	norm	0.01
υ16	0.932	0.9248	0.7622	1.0909	gamma	0.1
υ17	0.683	0.6313	0.4821	0.7762	gamma	0.1
ρ2	-0.345	-0.2891	-0.4679	-0.1093	norm	0.15
ρ4	0.051	0.0489	0.0163	0.0813	norm	0.02
ρ5	-0.619	-0.62	-0.7653	-0.4743	norm	0.1
ρ8	0.647	0.6292	0.4697	0.7921	norm	0.1
ρ9	0.234	0.2121	0.0517	0.3721	norm	0.1
ρ12	-0.117	-0.1742	-0.3718	0.0202	norm	0.2
ρ13	0.1	0.1137	-0.0225	0.2493	norm	0.1
ρ16	0.95	0.8799	0.6452	1.1098	norm	0.15
ρ17	0.95	0.7737	0.4934	1.0488	norm	0.18
ρ24	-3.694	-3.7818	-3.9383	-3.6275	norm	0.1
ρ25	3.37	3.3059	3.1459	3.4612	norm	0.1
standard	deviation	of	shocks			
	prior mean	post. mean	90%	HPD interval	prior	pstdev
z1	0.5	0.2693	0.2286	0.3093	invg	3
z2	1.5	2.1211	1.8083	2.4296	invg	5
z3	1.5	6.1767	4.9589	7.3508	invg	5
z4	1.1	7.543	5.6985	9.3715	invg	4.2
z5	1.3	4.3564	3.5441	5.1424	invg	4.5
z6	0.8	3.6817	3.0753	4.2775	invg	3
z7	1.2	3.4562	2.9218	3.9746	invg	4.5

Table A2.1, Prior and Posterior Estimation Results

Figure A2.10, Inflation Expectations

Standard Deviation of Headline Inflation (Q/Q)	
2006Q1-2014Q4	2015Q1-2019Q1
1.42	0.82
Standard Deviation of Headline Inflation (Y/Y)	
2006-2014	2015-2019Q2
3.06	2.16

Table A2.2 Standard Deviation Of Headline Inflation

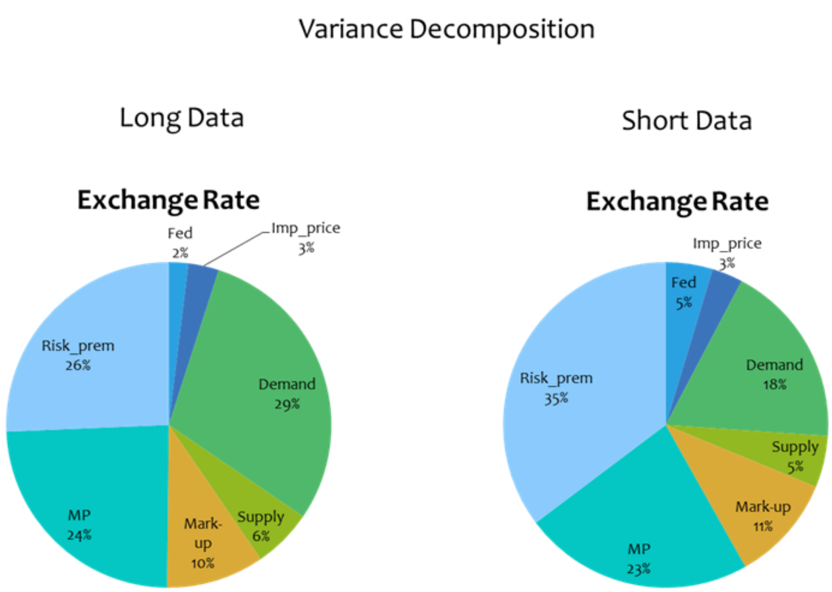

Figure A2.11, Variance Decomposition

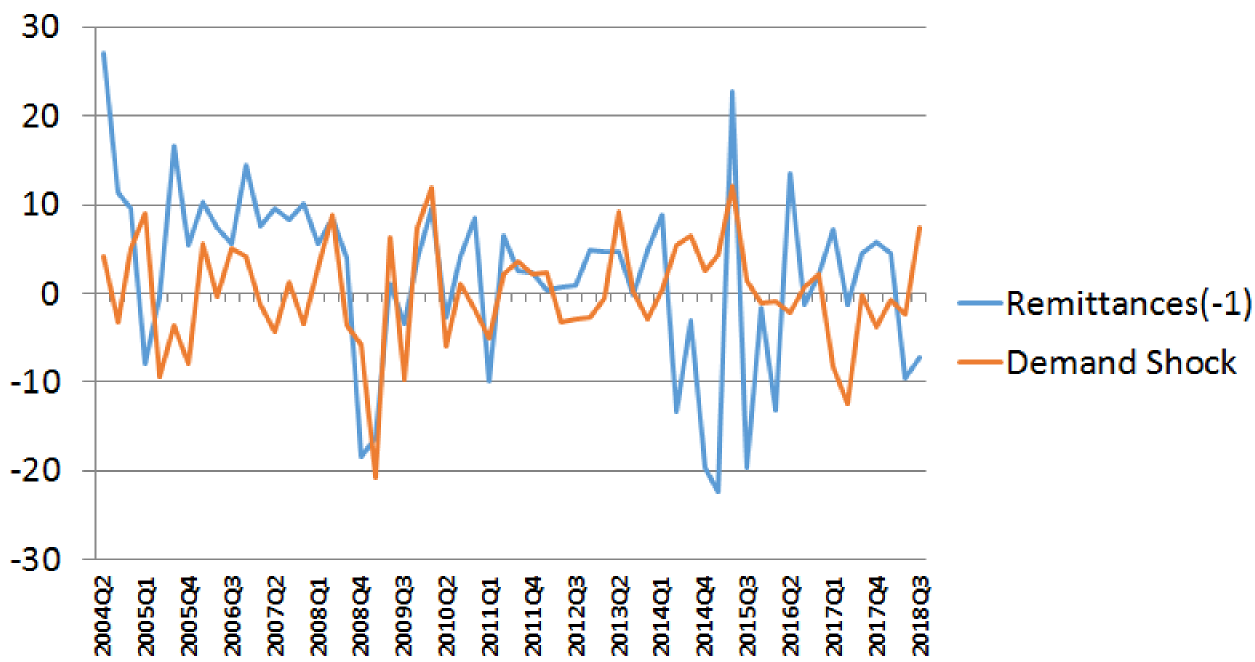

Figure A2.12, Demand Shock and Remittances

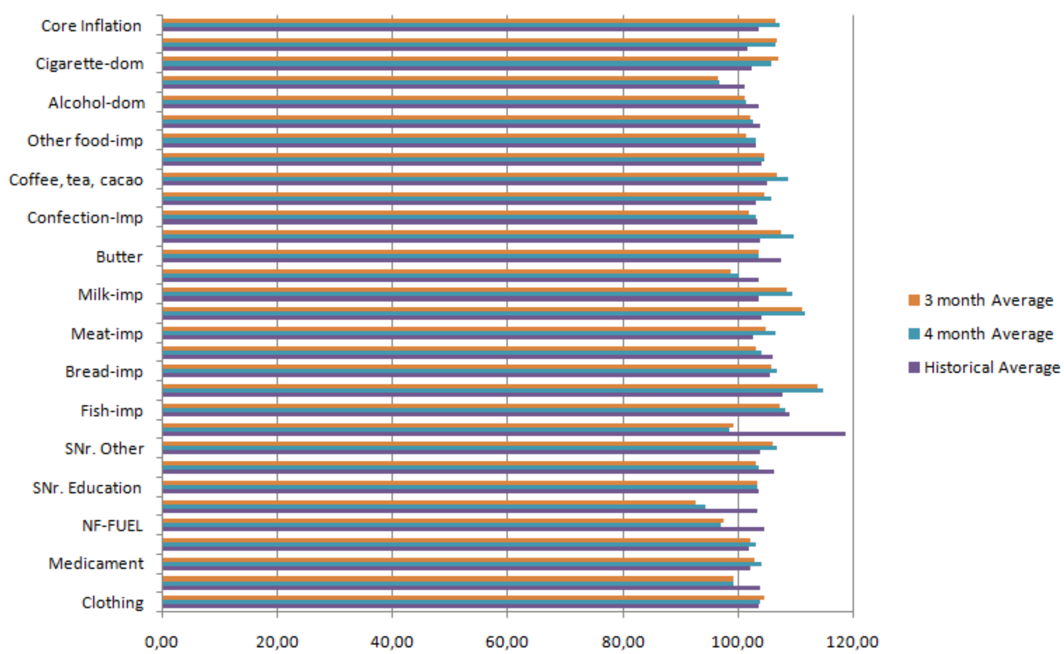

Figure A2.13, Price Response to a Risk Premium Shock

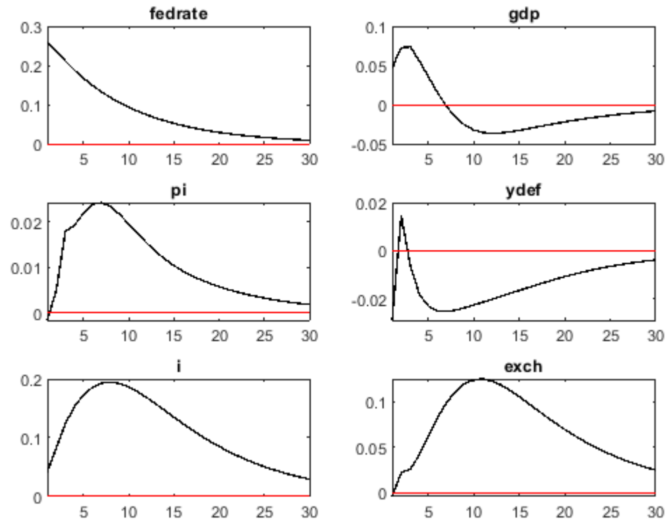

Figure A2.14, Federal Fund's Shock

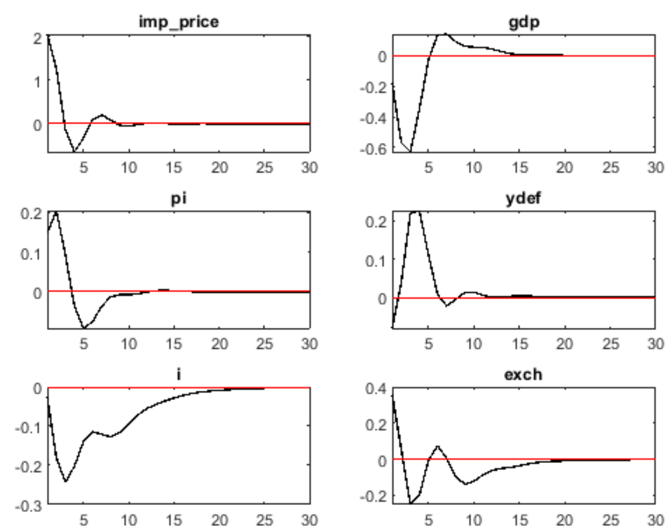

Figure A2.15, Import Price Shock

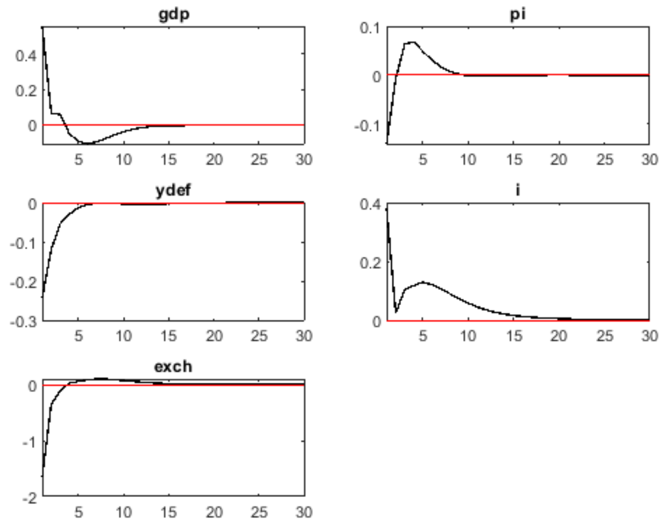

Figure A2.16, Demand Shock

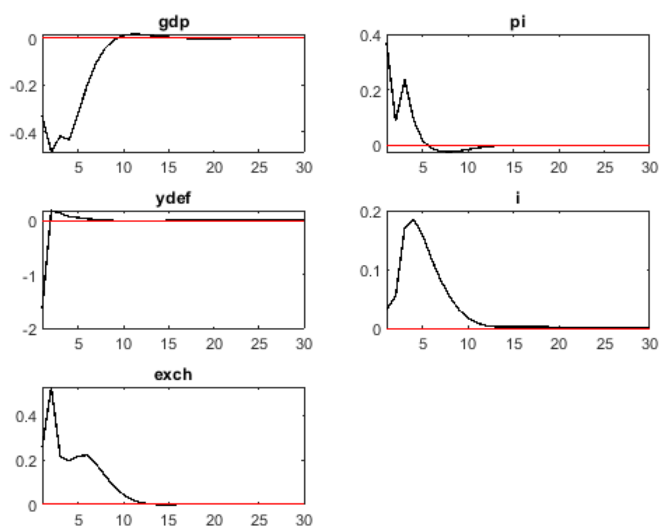

Figure A2.17, Supply Shock

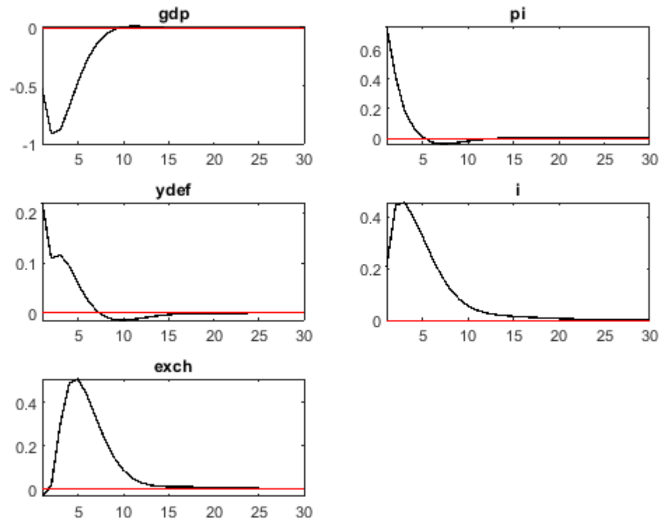

Figure A2.18, Intermediate Consumption Shock

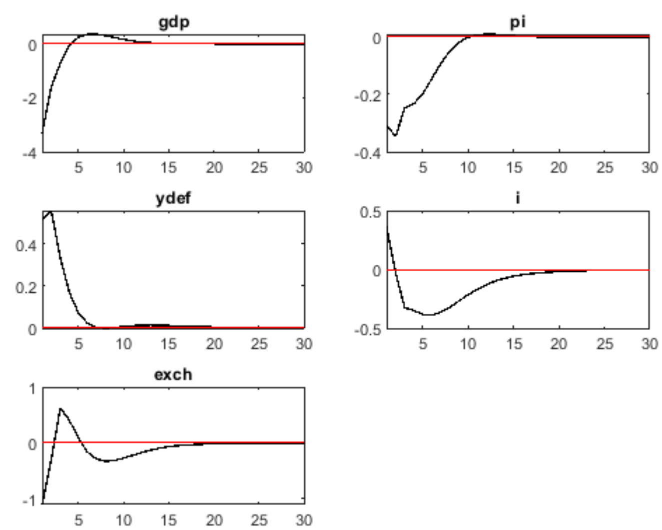

Figure A2.19, Monetary Policy Shock

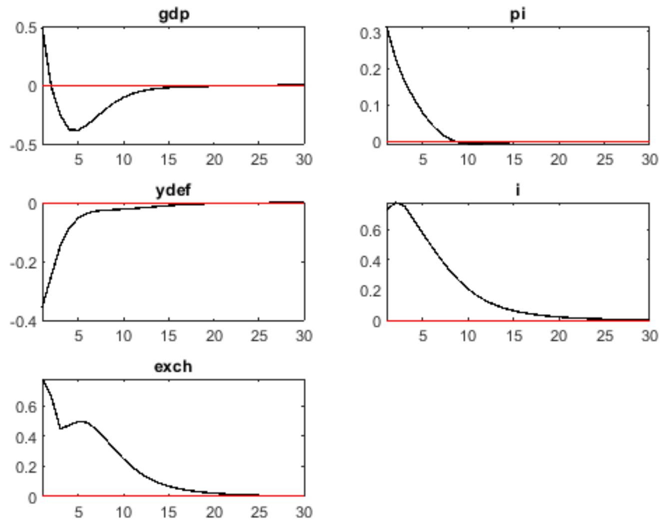

Figure A2.20, Risk Premium Shock

Dependent Variable: PI_OBS
Method: Least Squares
Date: 06/12/19 Time: 18:55
Sample (adjusted): 2003Q2 2018Q4
Included observations: 63 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH_OBS	0.124509	0.050976	2.442505	0.0178
FEDRATE_OBS	0.191807	0.135426	1.416319	0.1622
GDP_OBS	0.011334	0.038828	0.291913	0.7714
I_OBS	0.190873	0.095234	2.004243	0.0499
IMP_PRICE_OBS	0.057011	0.064911	0.878297	0.3835
YDEF_OBS	0.077711	0.059799	1.299531	0.1991
PI_OBS(-1)	0.483845	0.111896	4.324078	0.0001

R-squared	0.477890	Mean dependent var	0.006216
Adjusted R-squared	0.421950	S.D. dependent var	1.035878
S.E. of regression	0.787574	Akaike info criterion	2.464721
Sum squared resid	34.73531	Schwarz criterion	2.702847
Log likelihood	-70.63872	Hannan-Quinn criterion	2.558377
Durbin-Watson stat	1.928695		

Table A2.3, ERPT From Regression Analysis