REVIEW OF INTERNATIONAL ECONOMICS

Manuscript No:＃1149, Acceptance date: March 4, 2012

Structural Change in the External Balances Response to Macroeconomic Policies: Perspective from a Two-Sector New Open Economy Macroeconomic Model*

Shugo Yamamoto

RRH: STRUCTURAL CHANGE IN THE EXTERNAL BALANCES RESPONSE TO MACROECONOMIC POLICIES

LRH: Shugo Yamamoto

Abstract

The response of the Japanese trade balance against expansionary macroeconomic policy shocks changed from positive to negative in the 1990s. With consideration of intratemporal (between tradable and non-tradable goods) and intertemporal elasticity of substitutions, we investigate this cause using two-sector New Open Economy Macroeconomics (NOEM). Application of empirical methods of Ogaki and Reinhart (1998) with considering structural change shows that before the break, intratemporal elasticity of substitution dominates, but subsequently the relation inverted and intertemporal elasticity became predominant. Therefore, according to the theory of Lee and Chinn (2006), the theoretical response of trade balance changed. Finally, we verify this theoretical implication empirically by impulse response analysis of structural VAR.

*Yamamoto: Faculty of Economics, Yamaguchi University, 1677-1 Yoshida, Yamaguchi 753-8514, Japan. Tel: +81-083-933-5500, E-mail: shugo610@gmail.com. This research has been supported by the Grant-in-Aid for Scientific Research in "Global Imbalance: Policy Response and Early Warning System" under Grant No. 23330106. I have had the support and encouragement of Seiichi Fujita, Toshiki Jinushi, Yoichi Matubayashi and Shigeyuki Hamori of Kobe University. Also, many thanks to an anonymous referee for the excellent suggestions. Needless to say, I am solely responsible for all errors.

JEL classification Numbers: F30, F31

Abbreviations: NOEM, VAR

Number of Figures: 2 Number of Tables: 3

Date: March 4, 2012

Address of Contract Author: Shugo Yamamoto, Tel: +81-083-933-5500,

E-mail: shugo610@gmail.com

1. Introduction

In recent years, because of the large scale of monetary easing policy adopted by the Bank of Japan, the consequences of monetary shock on the trade balance[1] have returned to the forefront of the economic policy debate in Japan and neighboring countries. Especially, to prevent prolonged domestic deflation and stagnation, the Bank of Japan supplies vast funds to the economy through a zero interest rate and quantitative easing policy.

It is widely reported that monetary policy has a strong impact on trade balance. For example, Lee and Chinn (2006) and Chinn and Lee (2009) empirically demonstrated the impact of a monetary shock on the trade balance using structural Vector Auto Regression (VAR). Among them, Obstfeld and Rogoff (1995) theoretically studied this topic by considering its microeconomic foundation, dynamic optimization, price stickiness, and monopolistic competition. This open macroeconomic model, named the New Open Economy Macroeconomics (NOEM), became a representative theoretical model in this field. According to the NOEM model, the impact of a monetary policy shock on the trade balance depends heavily on deep parameters such as the intertemporal and intratemporal elasticity of substitution between goods, the consumption elasticity of money demand, and the discount rate. Particularly, we applied a two-sector (tradable and non-tradable good) NOEM model of Lee and Chinn (2006). They reported that the transmission channel of a monetary shock depends on the substitute and complement relation between tradable and non-tradable good.[2] Strictly speaking, the response of the trade balance depends on the size of the intratemporal elasticity of substitution between tradable and non-tradable goods and whether this elasticity dominates or is dominated by the intertemporal elasticity of aggregate consumption.

However, recently, it has been established that the structure of the Japanese economy changed in the 1990s. For example, Hayashi and Prescott (2002) studied this topic from a supply side perspective. Furthermore, Kurita (2010) and Ogura (2011) empirically demonstrated that the demand system of Japanese household consumption changed in the mid-1990s. Therefore, the preference and some deep parameters of the economic agents might have also changed in the 1990s. Consequently, we can deduce that the intertemporal and intratemporal elasticities of substitution might have changed along with them. Furthermore, because the specification of household preference is crucial to any microeconomically founded model, the change of the deep parameters in the utility function will affect the model result. Consequently, the transmission channel of macroeconomic policy shocks might have changed around the 1990s.

The purpose of this paper is to investigate the change of the response of trade balance empirically with consideration of the NOEM model. Particularly, we will specifically examine the change of the sign of inequality between intertemporal and intratemporal elasticities of substitution between tradable and non-tradable goods. Subsequently by substituting the estimated values into the theoretical model of Lee and Chinn (2006), we can theoretically infer the response of trade balance to macroeconomic policy shocks before and after the break. Finally, we verify this theoretical inference empirically by estimating the impulse responses of the trade balance by structural VAR.

The next section briefly presents the theoretical model of Lee and Chinn (2006). In section 3, we describe estimation of the intratemporal and intertemporal elasticity of substitution with consideration of structural change. Sections 4 and 5 present an investigation of the impulse response of trade balance to macroeconomic policy shocks by application of structural VAR. Conclusions follow in section 6.

2. The Model of Lee and Chinn (2006)

This section briefly describes the essence of the model proposed by Lee and Chinn (2006). Different from a one-sector model, the two-sector model can incorporate interaction between tradable and non-tradable goods. Lane (2001) extended Obstfeld and Rogoff's NOEM model to two sectors and introduced a non-separability utility function. Then Lee and Chinn (2006) applied this methodology to assess the response of trade balance to monetary shock. All these models regard the sign of inequality between intertemporal and intratemporal elasticity of substitution as an important transmission channel of macroeconomic policy shocks.

This section, to conserve space, contains only an essence of the model, followed by some details that are critical to understand its monetary policy implication. A complete description can be found in Lee and Chinn (2006) and the essence can summarize as follows.

$$\breve{C}_T = \frac{(\sigma-\theta)\sigma(1+r)(1-\gamma)}{(\sigma-\theta)r(1-\gamma)\left[\sigma(r+\gamma)+\theta(1-\gamma)+1\right]+(1+r)\sigma}\hat{M} \qquad (1)$$

Equation (1) represents the relation between long-term monetary shock and short-term consumption of tradable goods.[3] Because the domestic supply of the tradable good is assumed to be constant, the trade balance equals a negative change of the short-term consumption of tradable goods. In this equation, $\breve{C}_T$ and $\hat{M}$ respectively denote short term consumption of tradable goods and long term money. Furthermore, σ denotes the intertemporal elasticity of substitution, which represents a consumption-smoothing effect, and θ denotes the intratemporal elasticity of substitution between tradable and non-tradable goods. And we are interested in these two parameters. Finally, γ signifies the share of tradable goods in aggregate consumption and r denotes the real interest rate. Lee and Chinn

(2006) show that the sign of inequality between $\sigma - \theta$ in the equation above serves an important role. If $\sigma < \theta$ (dominance of substitution effect), then the response of short-term consumption of tradable goods to expansionary monetary shock is negative and the trade balance will improve. However, if $\sigma > \theta$ (dominance of complementary effect), then the response of consumption of tradable is positive and the trade balance will deteriorate.

The essence of the model is to treat tradable and non-tradable sectors asymmetrically. The non-tradable sector is monopolistically competitive and the price of non-tradable goods is rigid in the short term. In contrast to this, the price of the tradable good is flexible also in the short term. Because aggregate demand shocks (monetary and fiscal shocks) are absorbed by a rise of the price of tradable goods, aggregate demand has only a direct influence on the consumption of non-tradable good. However, aggregate demand shocks can influence consumption of the tradable good indirectly by interaction between the non-tradable and tradable good. Therefore, if tradable and non-tradable goods have a substitutional relation, then an expansionary monetary shock will boost the consumption of non-tradable goods directly. Then by a substitutional effect, the consumption of the tradable goods decreases indirectly. Consequently, the trade balance is expected to improve. Conversely, if the relation is complementary, then rising consumption of non-tradable goods caused by expansionary monetary shocks will boost the consumption of tradable goods indirectly. Consequently the trade balance will deteriorate. The next section describes estimation of these two deep parameters with consideration of structural change and presents a comparison of the sign of inequality before and after the break.

3. Estimation of Intratemporal and Intertemporal Elasticities of Substitution

Estimation Procedure and Data

The two-step estimation procedure of Cashin and McDermott (2003), which is a modified version of Ostry and Reinhart (1992) and Ogaki and Reinhart (1998), is next applied to estimate the intratemporal and intertemporal elasticity of substitution. One feature of this methodology is to apply the cointegration method to estimate the intratemporal elasticity of substitution (θ) at step 1. Using estimated values at step 1, we will apply the GMM framework to estimate the intertemporal elasticity of substitution (σ) at step 2. Furthermore, to consider the structural change of these parameters, we will apply a Gregory–Hansen test (Gregory and Hansen, 1996) for the estimation of intratemporal elasticity (θ) at step 1.[4]

A description of the data follows. The variables used for this study are real consumption per capita of tradable (C_T) and non-tradable goods (C_N), a price deflator of tradable (P_T) and non-tradable goods (P_N) and a real interest rate (r). The definition of tradable goods is durable plus semi-durable consumption goods; the definition of non-tradable goods is services.[5] That is to say, to construct data of tradable goods, we add durables and semi-durable consumption goods. We construct the price deflator of tradable and non-tradable goods using the corresponding nominal and real values. The data of consumption are obtained from the *National Accounts* of Japan by the Cabinet Office and the format is in fixed-base method. The population data are from the *Monthly Report on Current Population Estimates* by the Ministry of Internal Affairs and Communications. We approximate the gross return by the real interest. This is constructed by the long-term nominal interest rate (government bond yield) minus GDP deflator (% change) and the data are from *International Financial Statistics* (IFS) of the IMF. All data except the real interest rate are seasonal adjusted. The sample period is from 1980Q1 to 2007Q4.

Estimation of Intratemporal Elasticity of Substitution

Next we estimate the intratemporal elasticity of substitution (θ) by application of cointegration framework to the following equation (2). This equation is based on log-linearized intratemporal choice condition for the tradable and non-tradable goods of Lee and Chinn (2006). After several modifications conducted by Cashin and McDermott (2003), we derive the following equation.

$$\ln\left((1+r_t)\frac{P_{T,t}}{P_{N,t+1}}\right) = \mu + \frac{1}{\theta}\ln\left(\frac{C_{N,t+1}}{C_{T,t+1}}\right) + e_t \qquad (2)$$

First, this equation indicates a long-term relation between the relative price of tradable to non-tradable goods and the relative consumption of non-tradable to tradable goods. Thereby we can expect the existence of a cointegration relation. However, as described in section 1, the demand system of Japanese household consumption changed in the mid-1990s. Therefore, we will check the stability of the equation (2) by application of the Gregory–Hansen test.

We begin empirical testing by considering the stationarity of the variables by implementing two types of unit root tests. Namely, Augmented Dickey–Fuller (ADF) test and a general least squares (DF-GLS) test (Elliot, Rothenburg and Stock, 1996). Unit root tests are run with an intercept. According to the unit root tests, we confirm that both variables are non-stationary at *I(1)*. To save space, we do not report the results but available on request.

As the next step, to test the long-term stability of the equation (2), we use a Gregory–

Hansen test for structural changes in the cointegration relation. Particularly, we test the model considering both a change in the level and the slope of the coefficients of the long-term relation: the so-called regime-shift (C/S) model. Table 1 shows the Gregory–Hansen test statistics. We can reject the null hypothesis of no cointegration at significance of 5% with a possible break at 1997Q2.

"INSERT Table 1 here"

However, because the power of the Johansen test is better than that of the Engle–Granger test, we will strengthen the cointegration relation described above using the Johansen maximum likelihood approach. Given that 1997Q2 is the break point, we divide the period to two sub-periods according to the break point. Both the trace and maximum eigenvalue test statistics indicate that a cointegration rank of one is present for each sub-period, which implies the existence of a single long-term stationary relation for each sub-period. But to save space, we do not report the results but available on request.

From the empirical test described above, the coefficients $1/\theta$ of the equation (2) might have been changed by the structural change. Therefore, as the next step, we will check this cointegration coefficient before and after 1997Q2 by application of Dynamic OLS. The result is described in Table 2. These estimated values are significantly different from zero at the 1% level. However, it is noteworthy that the parameter that we estimate is $1/\theta$ and not θ. Finally, we can say that the intratemporal elasticity of substitution (θ) declined from 1.05 to 0.51 after 1997Q2.

"INSERT Table 2 here"

Estimation of Intertemporal Elasticity of Substitution

At step 2, we will estimate the intertemporal elasticity of substitution (σ) by application of the GMM framework to the following equation (3).

$$E_t\left[\frac{(1+r_t)P_{T,t}}{P_{T,t+1}}\left[\frac{\gamma^{\frac{1}{\theta}}C_{T,t+1}^{\frac{\theta-1}{\theta}}+(1-\gamma)^{\frac{1}{\theta}}C_{N,t+1}^{\frac{\theta-1}{\theta}}}{\gamma^{\frac{1}{\theta}}C_{T,t}^{\frac{\theta-1}{\theta}}+(1-\gamma)^{\frac{1}{\theta}}C_{N,t}^{\frac{\theta-1}{\theta}}}\right]^{\frac{\sigma-\theta}{\sigma(\theta-1)}}\left[\frac{C_{T,t+1}}{C_{T,t}}\right]^{\frac{-1}{\theta}}\right]=\frac{1}{\beta} \tag{3}$$

Equation (3) is derived as a partially differentiated equation of lifetime utility function of Lee and Chinn (2006) with respect to the consumption of tradable goods and is then substituted to the Euler equation of the tradable good. In estimating equation (3), we use estimation results from the step 1. Because we demonstrate the structural change of the intratemporal elasticity of substitution (θ) empirically in step 1, we impose $\theta = 1.05$ before 1997Q2; after that period, we impose $\theta = 0.51$ to equation (3). The weight of the consumption of tradable goods ($\gamma^{\frac{1}{\theta}}$) is calculated as the ratio of the tradable good to total consumption by the actual data and we impose 0.25. This value is the period average from 1980Q1 to 2007Q4 and the stable value throughout the period. In addition, because the discount factor is a very stable parameter, β is fixed to 0.990 and 0.995. The instrument variables comprise a constant, different lags of $C_{T,t-1}/C_{T,t-2}$, $C_{N,t-1}/C_{N,t-2}$, $P_{T,t-1}/P_{T,t-2}$, $P_{N,t-1}/P_{N,t-2}$ and r_{t-1} . We estimated the intertemporal elasticity of substitution (σ) by dividing the entire sample period to two sub-periods according to 1997Q2.

Table 3 shows the GMM estimation results obtained from the pre-break and post-break sub-periods. The estimated values of intertemporal elasticity of substitution (σ) of pre-break period is 0.30–0.33. However, after the break, the estimates of σ increased to 1.94–3.57. Furthermore, in both cases, the estimated value is significantly different from zero at the 1% level and *J*-tests are unable to reject the overidentifying restrictions. In addition, the levels of these estimated values are in line with preceding studies that have been conducted in Japan.[6]

"INSERT Table 3 here"

Interpretation of the Empirical Results

A summary of the empirical results are as follows. The intratemporal elasticity of substitution (θ) decreased from 1.05 to 0.51 after 1997Q2. The intertemporal elasticity of substitution (σ) increased from 0.30–0.33 to 1.94–3.57 after the break. Moreover, these estimated values indicate that before the break, the intratemporal elasticity of substitution (θ) was larger: $\sigma < \theta$. In contrast, after the break, the intratemporal elasticity of substitution became smaller, namely, $\sigma > \theta$.

Next, we will substitute these estimated values to the theoretical model of Lee and Chinn (2006). According to equation (1) of section 2, the coefficient of the long-term monetary shock, $\hat{M}$, depends strongly on the term $\sigma - \theta$. Therefore, using the empirical results presented above, we can say that the coefficient of $\hat{M}$ changed from negative to positive after the break. As described previously, the negative relation between the trade balance and consumption of the tradable good indicates that the response of trade balance to expansionary monetary shock was positive before the break. It then inverted to negative after the break.

Finally, we will investigate the cause of the change of the estimate values briefly. According to empirical estimations, because the change of the value of intertemporal elasticity of substitution was larger than intratemporal, we will mainly specifically examine the increase of intertemporal elasticity of substitution. Similarly with this study, the representative studies which investigate the increase of intertemporal elasticity of substitution and its impact on macroeconomic policy shock is Bilbiie, Meier and Muller (2008). According to their study, in the United States in the 1980s, deregulation, liberalization, and innovation in the financial sector might have widened private access to asset markets, consequently reducing the number of households failing to smooth their consumption (in response to macroeconomic policy shocks). Therefore, the intertemporal elasticity of substitution increases. In Japan, falling behind the United States, the liberalization and deregulation of the Japanese financial sector had accelerated in 1996 by the so-called financial "Big Bang" and reformed financial systems to free, fair, and global markets. Therefore, after liberalization of the finance system, consumers increased the opportunity to smooth their consumption intertemporally and enhance the intertemporal elasticity of substitution. Because these actual events in Japan are consistent with our empirical results, one can safely state that of the direct cause of the increase of intertemporal elasticity of substitution was the financial "Big Bang" that occurred in 1996.

In addition to this, the increase of personal wealth in Japan played an important role. According to Atkeson and Ogaki (1996) and Ogaki and Atkeson (1997), the intertemporal elasticity of substitution has a positive relation with personal wealth. In Japan, the level of the personal financial asset, namely the proxy of personal wealth, is increasing steadily. Therefore, we might say that because of increase of personal wealth, the intertemporal elasticity of substitution increased along with it.

4. Impulse Response of the Trade Balance to Monetary Shock

Here, we will verify the theoretical implication of previous section empirically by application of structural VAR. We will assess whether the actual impulse response of trade balance to expansionary monetary shock changes from positive to negative after the break, or not. To identify the monetary shock, we followed the structural VAR models of Lee and Chinn (2006) and Chinn and Lee (2009). Based on the standard NOEM model, they applied Blanchard–Quah decomposition and regarded the temporary shock to real exchange rates as a monetary shock and permanent shock to the real exchange rate as productivity (Balassa–Samuelson effect) and preference shock.

The model is bi-variate VAR, consisting of the first-differenced real exchange rate (Δq_t) and trade balance (tb_t) as follows.

$$\begin{bmatrix} tb_t \\ \Delta q_t \end{bmatrix} = B(L)\begin{bmatrix} tb_t \\ \Delta q_t \end{bmatrix} + \begin{bmatrix} \eta_t^{tb} \\ \eta_t^{q} \end{bmatrix} = B(L)\begin{bmatrix} tb_t \\ \Delta q_t \end{bmatrix} + B(0)\begin{bmatrix} \varepsilon_t^{T} \\ \varepsilon_t^{P} \end{bmatrix} \tag{4}$$

Therein, temporary shocks are denoted as ε_t^T, and permanent shocks as ε_t^P. The following standard assumptions are made: $E(\varepsilon_t)=0$, $E(\varepsilon_t \varepsilon_t^{'})=I$, and $E(\varepsilon_t \varepsilon_s^{'})=0$ when $t \neq s$. In a conventional VAR analysis, equation (4) will be identified by assuming that $B(0)$ is a lower triangular matrix. We impose the long-term restriction that the long-term impact of a temporary shock to the real exchange rate is equal to zero.

The entire period is segmented to two sub-periods according to 1997Q2. After identification, we calculated the impulse responses of trade balance to expansionary monetary shock for each sub-period. Figure 1 portrays the results.[7] It is apparent that before the break, the impact of expansionary monetary shock improves the trade balance significantly. However, after the break, the response of trade balance is inverted to negative. Consequently, this impulse response corresponds with the theoretical implications described in the previous section. Therefore, we can say that the change of the response of trade balance after the break agrees with the theoretical model of Lee and Chinn (2006) combined with the change of the estimated values presented in section 3.

"INSERT Figure 1 here"

5. Additional Investigation: The Impact of a Fiscal Shock

Because monetary and fiscal shocks are similar aggregate demand shocks, similar methodology can applied to the cases of fiscal shocks. In this section, we investigated the response of trade balance to expansionary fiscal shock before and after the break by referring the theoretical model of Tervala (2007).

Based on two-sector NOEM model of Lane (2001), Tervala (2007) investigated the response of the trade balance to fiscal shock with consideration of intratemporal and intertemporal elasticity of substitution and derived a similar conclusion to that reached by Lee and Chinn (2006). When government spending rises, consumption of the non-tradable good increases. If $\theta > \sigma$, then consumption of the tradable good decreases and the trade balance improves. In another case, if $\theta < \sigma$, then a rise of non-tradable consumption by government spending will increase the consumption of the tradable good and the trade balance will deteriorate.[8] To confirm this theoretical implication, we empirically investigated the impulse response of the trade balance to an expansionary fiscal shock before and after the break.

We assume that the bi-variate VAR consists of government consumption and the trade balance. To identify an exogenous government spending shock, it is assumed that government spending does not respond contemporaneously to changes in the other variable in the VAR. This assumption, based on Blanchard and Perotti (2002), is widely used in the VAR literature. Specifically, this identification methodology is implemented by Choleski decomposition of the VAR covariance matrix. Therefore, in the first specification, given that government spending is the first variable in order, government spending will respond to the other variable with a delay of one quarter. The second variable, namely the trade balance, will respond simultaneously to both variables. Finally, we divide all periods to two sub-periods according to 1997Q2. After identifying the government spending shock, we will check the impulse response of the trade balance before and after the break.

The impulse responses of the trade balance to expansionary fiscal shocks are described in Figure 2.[9] According to this figure, before the break, the response of the trade balance is positive, but it turned negative after the break. Therefore, we can confirm the theory of Tervala (2007) combined with a change of the estimated value of section 3. Consequently, the change of the sign of inequality of intratemporal and intertemporal elasticity of substitution not only changed the impact of the monetary shock; it also changed the impact of the fiscal shock. Therefore, according to the two-sector NOEM model, we might reasonably conclude that the response of the trade balance to an expansionary macroeconomic policy shock changed from positive to negative after 1997Q2 in Japan.

"INSERT Figure 2 here"

6. Conclusion

This paper presents an investigation of the change of the response of the trade balance to a monetary shock by application of a two-sector New Open Economy Macroeconomics (NOEM) with estimation of intratemporal (between tradable and non-tradable goods) and intertemporal elasticities of substitution.

Because this framework depends on the relative magnitude of intratemporal and intertemporal elasticities of substitution, by application of the empirical method of Ogaki and Reinhart (1998), we estimated these parameters with consideration of structural change. Herein, we demonstrated that before the break, the intratemporal elasticity of substitution was larger, but after the break, the intertemporal elasticity of substitution became larger. In other words, the relation between two goods changed from substitutional to complementary after 1997Q2. Therefore, as inferred from results obtained using the two-sector NOEM model of Lee and Chinn (2006), the theoretical implication of the response of trade balance changed from positive to negative after the break. Finally, by application of impulse response analysis of structural VAR, we verify this theoretical implication empirically. That is to say, the actual response of trade balance to expansionary monetary shock was positive before the break. Subsequently it inverted to negative. We may therefore reasonably conclude that, from the perspective of two-sector NOEM model combined with the change of the intratemporal and intertemporal elasticity of substitution, the response of trade balance to an expansionary monetary shock changed from positive to negative after 1997Q2 in Japan.

In addition, in further investigation, because monetary and fiscal shocks are both the same aggregate demand shocks, we apply the same empirical procedure to investigate the impact of fiscal shocks. And we show that, before the break, the response of the trade balance to expansionary fiscal shocks was positive, but subsequently it became negative. Namely, the change of the intratemporal and intertemporal elasticity of substitution played an important role also in that transformation of fiscal shock.

Especially in recent years, to prevent prolonged domestic stagnation, the Bank of Japan has supplied vast funds to the economy. The government of Japan is conducting a massive and continued fiscal stimulus. Because Japan is an open economy, these aggressive macroeconomic policy shocks strongly affect Japan and neighboring countries. Consequently, our empirical result presents important policy implications for policymakers of Japan and those neighboring countries.

Table 1. Gregory–Hansen Test

Model	Statistic Value	Break Point
Regime shift (C/S)	-5.237 ** (0)	1997 Q2

Note: ** denotes statistical significance of 5% as the critical value of regime shift. The critical values were obtained from Gregory and Hansen (1996). Lag length, which is chosen using the AIC, is shown as enclosed in parentheses.

Table 2. Estimation of Intratemporal Elasticity of Substitution (θ)

Period	Variables	Dynamic OLS
1980Q1–1997Q2	$1/\theta$	0.955 (0.126) ***
1997Q3–2007Q4	$1/\theta$	1.949 (0.279) ***

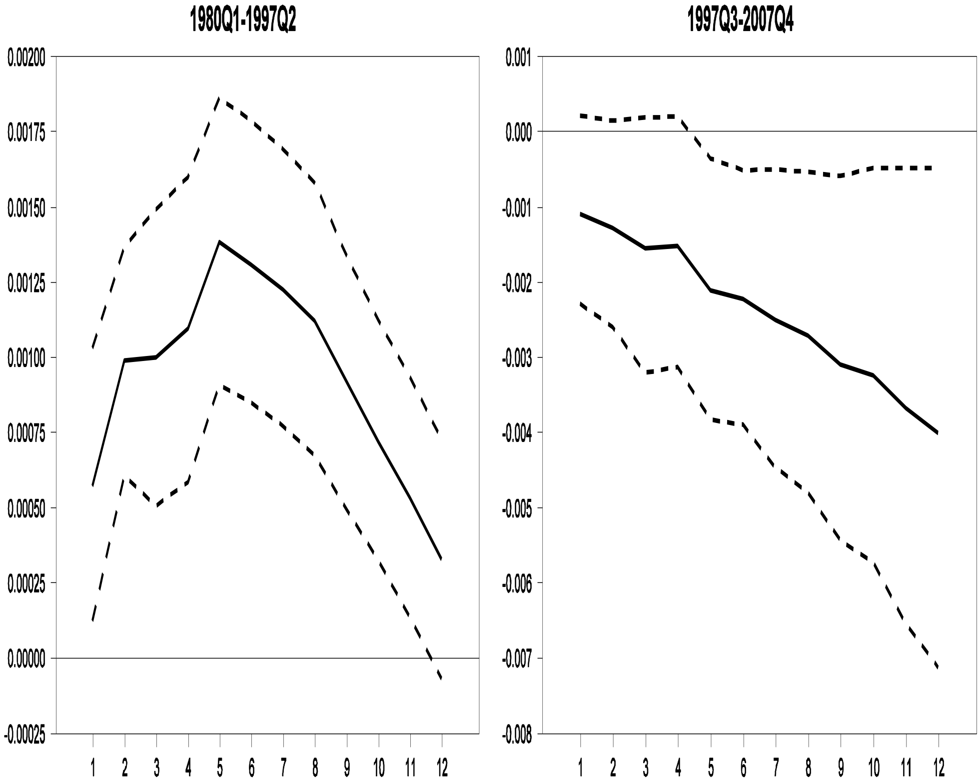
Note: *** denote statistical significance at the 1% level. Standard errors are enclosed in parentheses. We use 4 leads and lags. It is noteworthy that this reciprocal value is intratemporal elasticity of substitution (θ) because we estimated $1/\theta$.

Table 3. Estimation of Intratemporal Elasticity of Substitution (σ)

Period	β	lags	σ	J-Stat
1980Q1–1997Q2	0.990	1–4	0.313 (0.038)***	29.616 [0.076]
		1–5	0.332 (0.058)***	31.275 [0.180]
	0.995	1–4	0.284 (0.047)***	29.724 [0.074]
		1–5	0.298 (0.047)***	31.335 [0.178]
1997Q3–2007Q4	0.990	1–4	3.570 (0.437)***	26.170 [0.160]
		1–5	3.304 (0.234)***	26.845 [0.364]
	0.995	1–4	2.280 (0.327)***	26.451 [0.151]
		1–5	1.935 (0.181)***	27.448 [0.334]

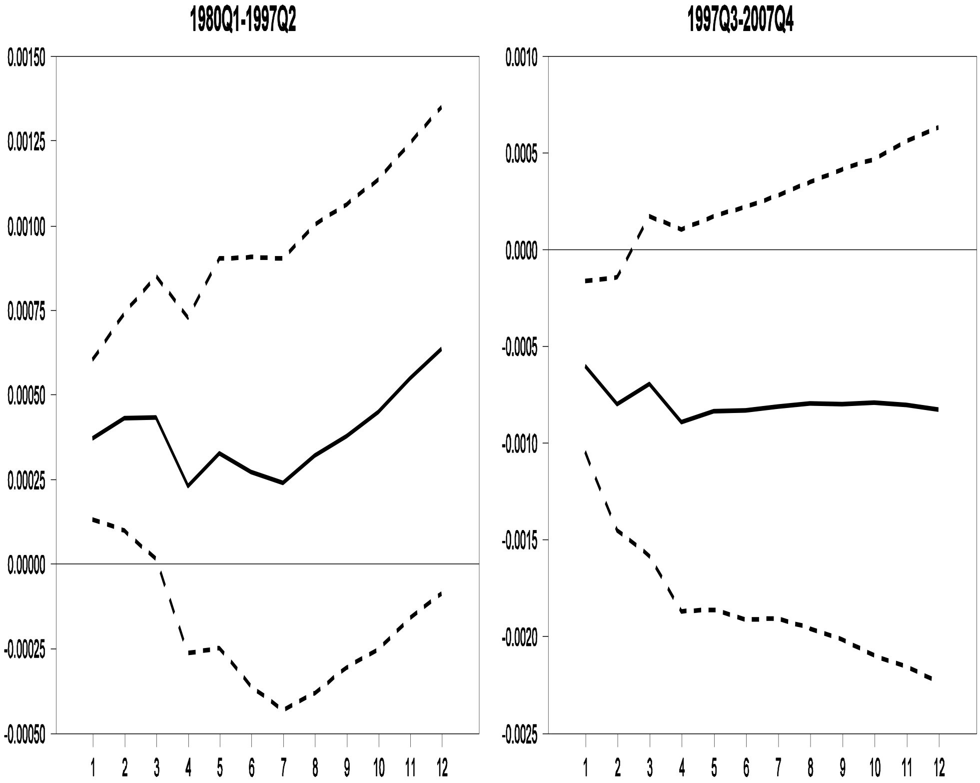
Note: *** denotes statistical significance at the 1% level. Standard errors are enclosed in parentheses. The instrument variables consist of constants, different lags of $C_{T,t-1}/C_{T,t-2}$, $C_{N,t-1}/C_{N,t-2}$, $P_{T,t-1}/P_{T,t-2}$, $P_{N,t-1}/P_{N,t-2}$ and r_{t-1}. P-values of the J-test are in the square brackets.

Figure 1. Response of Trade Balance to a Monetary Shock.



Note: The responses of trade balance to an expansionary monetary shock are described in the figure. The solid line is a point estimate and dotted lines are one standard deviation bands, as computed by Monte Carlo integration. We separate the sample period before and after 1997Q2. The lag length is fixed to 4, and different lags of 1–4 do not alter the results.

Figure 2. Response of the Trade Balance to a Fiscal Shock.



Note: The trade balance responses to a fiscal shock (government consumption) are shown in the figure. The solid line is a point estimate and dotted lines are one standard deviation bands, as computed by Monte Carlo integration. We separate the sample period before and after 1997Q2. The lag length is fixed to 4, and different lags of 1–4 do not alter the results.

References

Atkeson, Andrew and Masao Ogaki, "Wealth-Varying Intertemporal Elasticities of Substitution: Evidence from Panel and Aggregate Data," *Journal of Monetary Economics* 38 (1996):507-34.

Bilbiie, Florin O., Andre Meier and Gernot J. Muller, "What Accounts for the Changes in U.S. Fiscal Policy Transmission?," *Journal of Money, Credit and Banking* 40 (2008):1439-69.

Blanchard, Olivier and Roberto Perotti, "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *Quarterly Journal of Economics* 117 (2002):1329-68.

Cashin, Paul and McDermott, John C., "Intertemporal Substitution and Terms-of-Trade Shocks," *Review of International Economics* 11 (2003):604-18.

Chinn, Menzie D. and Lee, Jaewoo, "Three Current Account Balances: A Semi-Structuralist Interpretation," *Japan and the World Economy* 21 (2009):202-12.

Elliott, Graham, Thomas J. Rothenberg and James H. Stock, "Efficient Tests for an Autoregressive Unit Root," *Econometrica* 64 (1996):813-36.

Esteve, Vicente and Juan Sanchis-Llopis, "Estimating the Substitutability between Private and Public Consumption: The case of Spain," *Applied Economics* 37 (2005): 2327-34.

Fuse, Masasaki, "Estimating Intertemporal Substitution in Japan," *Applied Economic Letters* 11 (2004):267-69.

Gregory, Allan W. and Bruce Hansen, "Residual-Based Tests for Cointegration in a Model with Regime Shifts," *Journal of Econometrics* 70 (1996): 99-126.

Hayashi, Fumio and Edward C. Prescott, "The 1990s in Japan: A Lost Decade," *Review of Economic Dynamics* 5 (2002):206-35.

Kurita, Takamitsu, “Co-breaking, Cointegration, and Weak Exogeneity: Modelling Aggregate Consumption in Japan,” *Economic Modeling* 27 (2010):574-84.

Lane, Philip, “Monetary Shocks and the Current Account,” in Dornbusch, Rudiger., Maurice Obstfeld and Guillermo A. Calvo (eds), *Money, Capital Mobility, and Trade: Essays in Honor of Robert A. Mundell,* Cambridge: MIT Press (2001): 385-411.

Lee, Jaewoo and Chinn, Menzie D. “Current Account and Real Exchange Rate Dynamic in the G7 Countries,” *Journal of International Money and Finance* 25 (2006): 257-74.

Muller, Gernot J., “Understanding the Dynamic Effects of Government Spending on Foreign Trade,” *Journal of International Money and Finance* 27 (2008):345-71.

Obstfeld, Maurice and Kenneth S. Rogoff, “Exchange Rate Dynamics Redux,” *Journal of Political Economy* 103 (1995):624-60.

Ogaki, Masao and Atkeson, Andrew, “Rate of Time Preference, Intertemporal Elasticity of Substitution, and Level of Wealth,” *Review of Economics and Statistics* 79 (1997):564-72.

Ogaki, Masao and Carmen M. Reinhart, “Measuring Intertemporal Substitution: The Role of Durable Goods,” *Journal of Political Economy* 106 (1998): 1078-98.

Ogura, Manami, “Testing for Structural Break in Japanese Demand System after the Bubble Era,” *Structural Change and Economic Dynamics* 22 (2011):277-86.

Okubo, Masakatu, “Intratemporal Substitution between Private and Government Consumption: The case of Japan,” *Economic Letters* 79 (2003):75-81.

Ostry, Jonathan David and Carmen M. Reinhart, “Saving and Terms of Trade Shocks: Evidence from Developing Countries,” *IMF Staff Papers* 39 (1992):495-517.

Tervala, Juha, “Fiscal Policy and the Current Account in a Small Open Economy,” *Finnish Economic Papers* 20 (2007):108-20.

Notes

1. Because we investigate the external balance from the perspective of the investment–saving relation, we focus on the trade balance, which excludes the income account and transfer balance from the current account.

2. Two goods (A and B) are said to be Edgeworth substitutes, independent, or complement, respectively, depending on whether the cross derivative of the utility function is negative ($U_{A,B} < 0$), zero ($U_{A,B} = 0$), or positive ($U_{A,B} > 0$).

3. When price rigidity is introduced into the model, we must distinguish long-term (the old to the new steady state) and short-term effects (the old steady state to a transitional value).

4. We followed the same empirical procedure as that described by Esteve and Llopis (2005); we applied the Gregory–Hansen test in the framework of Ogaki and Reinhart (1998).

5. Because non-durable consumption goods are not genuine tradable goods in Japan, we exclude this good from classifications. The non-durable consumption goods mainly consist of food, tobacco, alcohol, fuel, and published matter. In Japan, customs duties and taxes on grain, tobacco, alcohol, and fuel are very high and the regulations are very strict. Therefore non-durable consumption goods consist of a mixture of tradable and non-tradable goods. For that reason, it is hard to classify these goods as genuine tradable goods. Therefore, to classify tradable and non-tradable goods rigidly, we exclude ambiguous non-durable consumption goods.

6. For example, Okubo (2003) uses government and private consumption and estimates intratemporal elasticity as 1.4 and intertemporal elasticity as 2–5. Fuse (2004) uses durable and non-durable goods and estimates intratemporal elasticity as 0.48 and intertemporal elasticity as 4.

7. The real exchange rate is a log-linearized real effective exchange rate based on the consumer price index and from IFS of IMF. The trade balance (net export of goods) is

measured as the ratio of GDP in real terms, seasonally adjusted and taken from the National Account of Japan by the Cabinet Office. Because the trade balance includes negative values, we log-linearized only real effective exchange rate. The sample period is from 1980Q1 to 2007Q4. The lag length criteria of AIC showed different lag lengths before and after the break. Because we want to estimate VAR in the same condition, we fixed the lag length to 4. This impulse response is robust to any lag of 1–4.

8. Using domestic and foreign tradable goods, Muller (2008) investigates the impact of fiscal shock to export and import with considering the intratemporal and intertemporal elasticity of substitution.

9. Both government consumption and the trade balance (net export of goods) are measured as the ratio of GDP. The data are in real terms, seasonally adjusted and taken from National Accounts of Japan of the Cabinet Office. Because the trade balance includes a negative value, we only log-linearized government consumption. The sample period is from 1980Q1 to 2007Q4. The lag length criteria of AIC showed different lag length before and after the break. Because we want to estimate VAR in the same condition, we fixed the lag length to 4. This impulse response is robust to any lag of 1–4.