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Shock Persistence and Current Account Dynamics

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Abstract

One-sector inter-temporal models of the current account predict that a transitory shock to the terms of trade will lead to improvement in trade balance, while a persistent (or permanent) one could result in trade balance deterioration. This paper reexamines this issue in a two-sector small open economy model with non-traded goods and show that the result may not hold, depending on the exchange rate regime.

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1. Introduction

The one-sector inter-temporal models of small open economies predict that a transitory shock to the terms of trade or productivity will lead to trade balance improvement, while a persistent (or permanent) one could result in the deterioration in the trade balance. Obstfeld and Rogoff (1995) provide an extensive review of the theoretical and empirical literature on the inter-temporal approach to the current account. They also discuss the theoretical importance of the degree of shock persistence.

In this paper, we reexamine this issue in a two-sector small open economy model with non-traded goods. We show that the predictions about shock persistence may not hold when a non-traded good sector is introduced. If prices are flexible, no matter whether the shock is transitory or persistent, the first response of the current account would be surplus, which is different from the prediction of one-sector models. When nominal rigidities are considered, the choice of exchange rate regime matters for the current account dynamics. A flexible exchange rate can fully replicate flexible prices equilibrium, so the response of the current account would be exactly the same as that under flexible prices. With fixed exchange rates, however, the response of the current account is similar to that predicted in the literature. The first response of current account should be to go from surplus to deficit when the shock is persistent enough.

Why does a two-sector model make a difference? Because a shock to the terms of trade will also cause a change of real exchange rate, which leads to substitution between non-traded goods and imported goods. When the price or the exchange rate is flexible, the substitution effect could be large, and this could revise the current account dynamics. However, when the price is rigid and the exchange rate is fixed, substitution will be more limited. In such a case, the predictions of a two-sector model will be consistent with those of one-sector models.

2. A Two-sector Sticky Price Model

In this section, we develop a two-sector sticky price small open economy model with non-traded goods, which follows Devereux, Lane, and Xu (2006)

2.1 Households

The representative household has preference given by

$$U = E_0 \sum_{t=0}^{\infty} \beta^t [\frac{C_t^{1-\sigma}}{1-\sigma} - \eta \frac{L_t^{1+\psi}}{1+\psi}], \tag{0.1}$$

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where $C_t = \frac{1}{a^a(1-a)^{1-a}} C_{Nt}^a C_{Ft}^{1-a}$ is the consumption aggregate of non-traded goods and import goods, and L_t is the labour supply. The consumer price index is $P_t = P_{Nt}^a P_{Ft}^{1-a}$, with P_{Nt} (P_{Ft}) defined as the time t price of the non-traded (import) good. For simplicity, $P_{Ft} = S_t P_{Ft}^*$, where P_{Ft}^* is the world price of imported goods and S_t is the nominal exchange rate.

Households have access to the domestic bond market (B_t) and the international bond market (D_t). Trade in international bonds is subject to small portfolio adjustment costs $\frac{\psi_D}{2}(D_{t+1} - \bar{D})^2$, where $\bar{D}$ is an exogenous steady state level of net foreign debt. The households' revenue flow in any period then comes from wage income WL_t, capital rental income $R_t K_t$, profits from the non-traded sector Π_t, and new loans. They use these to consume, invest, and repay debt as well as portfolio adjustment costs.

The households' budget constraint is thus

$$\begin{aligned} & P_t(C_t + I_t + \frac{\psi_D}{2}(D_{t+1} - \bar{D})^2) + (1 + i_t^*) S_t D_t + (1 + i_t) B_t \\ = \; & W_t L_t + R_t K_t + \Pi_t + S_t D_{t+1} + B_{t+1}. \end{aligned} \tag{0.2}$$

The capital accumulation is described by:

$$K_{t+1} = (1 - \delta) K_t + I_t. \tag{0.3}$$

The optimization conditions for households' bonding holding, investment, and labor supply can be characterized by the following conditions:

$$\frac{1}{1 + i_{t+1}^*}\left[1 - \frac{\psi_D P_t}{S_t}(D_{t+1} - \bar{D})\right] = \beta E_t\left[\frac{C_t^\sigma P_t}{C_{t+1}^\sigma P_{t+1}} \frac{S_{t+1}}{S_t}\right] \tag{0.4}$$

$$\frac{1}{1 + i_{t+1}} = \beta E_t\left(\frac{C_t^\sigma P_t}{C_{t+1}^\sigma P_{t+1}}\right) \tag{0.5}$$

$$1 = E_t\{\beta \frac{C_t^\sigma}{C_{t+1}^\sigma}[1 - \delta + \frac{R_{t+1}}{P_{t+1}}]\} \tag{0.6}$$

$$\frac{W_t}{P_t} = \eta L_t^\psi C_t^\sigma. \tag{0.7}$$

The combination of Equation (0.4) and (0.5) gives the representation of interest rate parity for this model.

2.2 Firms

Both traded and non-traded goods are produced by combining labour and capital. The production technology for a firm in the non-traded good sector is given by $Y_{it} = (\frac{K_{it}}{\alpha_{it}})^{\alpha_{it}}(\frac{L_{it}}{1-\alpha_{it}})^{1-\alpha_{it}}, \quad i = N, X$, where K_{it} and L_{it} are the labor and capital used by firms in sector i, respectively, and α_i is the share of capital in production. Cost minimizing then implies that:

$$K_{it} = \alpha_{it}(\frac{R_t}{MC_{it}})^{-1}Y_{it}, L_{it} = (1-\alpha_{it})(\frac{W_t}{MC_{it}})^{-1}Y_{it}, \qquad i = N, X \tag{0.8}$$

where $MC_{it} = R_t^{\alpha_{it}}W_t^{1-\alpha_{it}}$ is the marginal cost for sector i. Equations (0.8) then characterize cost minimization in the non-traded good sector and the export good sector. Note that we have assumed that the law of one price holds in the trade good price so that $P_{Xt} = S_t P^*_{Xt}$, where P^*_{Xt} is the world price of the traded goods. Since the export sector is competitive, $P_{Xt} = MC_{Xt}$. Movements in P^*_{Xt} , relative to the import price P^*_{Ft}, represent terms of trade shocks for the small open economy.

The non-traded good sector is monopolistically competitive and contains a unit interval [0,1] of firms indexed by j. Each monopolistically competitive firm j produces a differentiated non-traded good with an elasticity of the substitution, λ. The demand faced by each individual non-traded good, j, is $Y_N(j) = (\frac{P_N(j)}{P_N})^{-\lambda}Y_N$, where Y_N is the aggregate of non-traded goods and $\frac{P_N(j)}{P_N}$ is the relative price of each variety with respect to the aggregate price index, P_N, which is given by $P_N = (\int_0^1 P_N(j)^{1-\lambda})^{\frac{1}{1-\lambda}}$.

Assuming a standard Calvo pricing technology. A given firm may reset its price with probability $1-\omega$ each period. When allowed to reset its price, a firm j will choose $P^o_{Nt}(j)$ to maximize its weighted expected profit:

$$E_t \sum_{l=0}^{\infty}[(\beta\omega)^l \frac{\Lambda_{t+l}}{\Lambda_t}\frac{\Pi_{t+l}(j)}{P_{t+l}}], \tag{0.9}$$

where $\Pi_{t+l}(j) = (P^o_{Nt}(j) - MC_{Nt+l}(j))Y_{Nt+l}(j)$ is the non-traded firm j's profit in period $t+l$, $\Lambda_t = C_t^{-\sigma}$ is the marginal utility of consumption for the representative household, and $MC_{Nt}(j)$ represents the marginal cost for non-traded good firms. The optimal price for the non-traded good firm is

$$P^o_{Nt} = \frac{\lambda}{\lambda-1}\frac{E_t\sum_{l=0}^{\infty}(\beta\omega)^l\frac{\Lambda_{t+l}}{P_{t+l}}MC_{Nt+l}P^{\lambda}_{Nt+l}Y_{Nt+l}}{E_t\sum_{l=0}^{\infty}(\beta\omega)^l\frac{\Lambda_{t+l}}{P_{t+l}}P^{\lambda}_{Nt+l}Y_{Nt+l}} \tag{0.10}$$

where the aggregate price for non-traded goods is $P_{Nt} = [\omega(P_{Nt-1})^{1-\lambda} + (1-\omega)(P^o_{Nt})^{1-\lambda}]^{\frac{1}{1-\lambda}}$.

2.3 Monetary Policy Rules

The exchange rate regimes can be represented by a domestic interest rate targeting rule, which is given by

$$1 + i_{t+1} = \left(\frac{\pi_n}{\bar{\pi}_n}\right)^{\mu_{\pi_n}} \left(\frac{S_t}{\bar{S}}\right)^{\mu_S} (1 + \bar{\imath}). \tag{0.11}$$

where μ_{π_n} allows the monetary authority to control the inflation rate (π_n) in the non-traded good sector around a target rate of $\bar{\pi}_n$ and μ_S controls the degree to which the monetary authority attempts to control variations in the exchange rate around a target level of $\bar{S}$.

2.4 Equilibrium

In equilibrium, the non-traded good market clears, $Y_{Nt} = a\frac{P_t Z_t}{P_{Nt}}$, where Z_t is the total demand for aggregate goods and is given by $Z_t = C_t + I_t + \frac{\psi_D}{2}(D_{t+1} - \bar{D})^2$. Since $B_t = 0$ in equilibrium, from the aggregate budget constraint, the following balance of payments condition must be satisfied,

$$CA_t = S_t(D_t - D_{t+1}) = P_t Y_t - P_t Z_t - S_t i_t^* D_t$$

where CA_t is the current account in terms of domestic currency and $Y_t = \frac{P_{Nt}Y_{Nt}+P_{Xt}Y_{Xt}}{P_t}$ is the domestic output.

3. Current Account Dynamics

The model has only a small number of parameters that need be calibrated. The calibration of structural parameters for the model is described in Table 1.[1]

For the monetary policy regime, we focus on two cases: $\mu_{\pi_N} = 900$, $\mu_s = 0.01$ and $\mu_{\pi_N} = 0.01$, $\mu_s = 900$. In the first case, the monetary authority targets the inflation rate of non-traded goods (NPT rules) so that the exchange rate is flexible. In the second case, the nominal exchange rate is fixed at the target level, $\bar{S}$.

Consider a terms of trade shock, which is represented by a shock to $\frac{P_X^*}{P_F^*}$. Following Devereux, Lane, and Xu (2006), we assume that the shock is described as AR(1) processes with persistence 0.77 and variance $\sigma_e^2 = 0.013^2$. In the later analysis, we will vary the shock persistence and investigate how the current account responds. For a small open economy, a positive terms of trade

[1] The calibration of structural parameters in the model is standard, for simplicity, we just follow Shi (2011).

Table 1: Calibration Parameters

Parameter	value	Parameter	value	Parameter	value
σ	2	β	0.99	a	0.6
λ	11	$\bar{D}$	0	α_N	0.3
α_X	0.7	ψ_D	0.0007	ω	0.75
ψ	1	δ	0.025	η	2.5

shock is equivalent to a positive income shock or a productivity shock coming from the export sector. The standard prediction from an inter-temporal model of the current account is that a transitory terms of trade shock will lead to trade balance improvement, while a persistent one implies a deterioration in the trade balance. Will this result still hold in a two-sector small open economy model with non-traded goods?

To answer this question, consider first the current account dynamics with flexible prices. Set $\omega = 0$ so that all non-traded good prices adjust when shocks hit the economy. When the prices are flexible the exchange rate regime is neutral. Figure 1 depicts the responses of the current account to terms of trade shocks with different persistence. The current account dynamics in such a two-sector model with non-traded goods exhibits two interesting patterns. No matter whether the shock is transitory or persistent, the economy runs a current account surplus initially; Subsequently, there will be a sharp decline into current account deficit, following by a long period of flat recovery. Roughly speaking, the response of the current account to the terms of trade shock looks like L-shaped. A more persistent shocks only reduces the first response of the current account and makes the path of the dynamics flatter.

When a non-traded good sector is introduced, the response of the current account depends on inter-temporal substitution of consumption across time periods and atemporal substitution between home non-traded goods and foreign goods. In response to a positive shock to the terms of trade, inter-temporal substitution will encourage the households to consume more, while the substitution between non-traded goods and foreign goods will encourage them to consume more foreign goods. Note that the substitution effect is due to a real exchange rate appreciation. In the face of a positive terms of trade shock, the traded good sector expands while the non-traded good sector shrinks. When the shock is transitory, the industrial changes are large. As a result, investment declines sharply as well, which leads to the initial trade surplus. Once the shock has proved persistent, however, the industrial adjustment is more gradual and less volatile. This is because the firms expect that the positive terms of trade will persist longer. From the households, the persistent terms of trade shock will have a larger and persistent income effect on consumption, which also offsets the substitution effect of real exchange rate appreciation on non-traded goods. Due to the substitution effect, the non-traded sector still shrinks. This leads to a decline in investment, which helps to improve the trade balance at first. This makes the magnitude of the initial response of the current account is smaller than that in response to a transitory shock.

When nominal rigidities are considered ($\omega > 0$), then the exchange rate regime matters for the economy's response. As shown by Devereux, Lane and Xu (2006), an NPT rule can fully replicate the flexible price equilibrium. So the current account response under flexible exchange rates would be exactly the same as that under flexible prices. This can be seen in Figure 3 and 4. As shown in Figure 2, however, if the economy is under a fixed exchange rate regime, the current account responds differently. When the shock is transitory, the initial response is similar to that with flexible prices or flexible exchange rates, but the magnitude is smaller. When the shock becomes persistent, however, the response of the current account looks like a hump-shaped. A persistent shock leads a deterioration in the current account in initial period, but the current account balance then rises continuously to a peak and then declines gradually. Figure 2 shows that the decline in the current account in the first period is caused by the sharp increase in investment. When the exchange rate is fixed, the real exchange rate is simply determined by non-traded good prices. Due to price stickiness, the non-traded goods prices increase gradually, which leads to a small appreciation in the real exchange rate. This implies a small substitution effect between non-traded goods and imported goods. The non-traded good sector therefore expands instead as the demand for non-traded goods increases. The industrial change in the beginning thus differs from that under flexible exchange rates. This causes the rise in investment and the deterioration of the current account.

The analysis demonstrates that, the different predictions from a two-sector model with non-traded goods are simply due to the effect of real exchange rate. If the effect is small or limited, the result is close to that predicted by one-sector models. This can be demonstrated by varying ω. Figure 5 shows that the first response of the current account to a persistent shock under fixed exchange rates is to move into deficit from surplus when ω increases. This because the bigger the ω, the smaller the real exchange rate effect. As a result, the current account responds to the shock as predicted by one-sector models.

It should be noted that the perverse behavior of current account in models with non-traded goods has been discussed in the literature. For example, Driskill (2001) shows that, in an endowment economy with non-traded goods, the current account behavior is perverse if and only if the cross-partial of instantaneous utility function is positive. However, this criterion can not be simply applied to models with production. This is because the current account depends on both consumption and production. In our model, we use a standard constant elasticity utility function where the inter-temporal elasticity of substitution is smaller than the intra-temporal elasticity of substitution. The cross-partial of instantaneous utility function is negative. With this kind of utility function, our results show that there still exist perverse current account dynamics in response to terms of trade shock, depending on price stickiness and exchange rate regime.[2]

4. Conclusion

This paper reexamines the response of the current account to terms of trade shocks in a two-sector small open economy model with non-traded goods. We find that, due to the presence of a real exchange rate effect in two sector model, a persistent shock to the terms of trade may not lead to the deterioration in the current account, which is the prediction of one-sector inter-temporal models of the current account. We also show that, the choice of exchange rate is important for the current account dynamics when sticky prices are taken into consideration.

References

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[2] The investigation of the existence of a general criterion for perverse current account behavior in models with production will be interesting. However, we feel that this issue is important and deserves careful study in a separate paper.

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Figure 1: Impluse response to Terms of Trade Shock under Flexible Prices

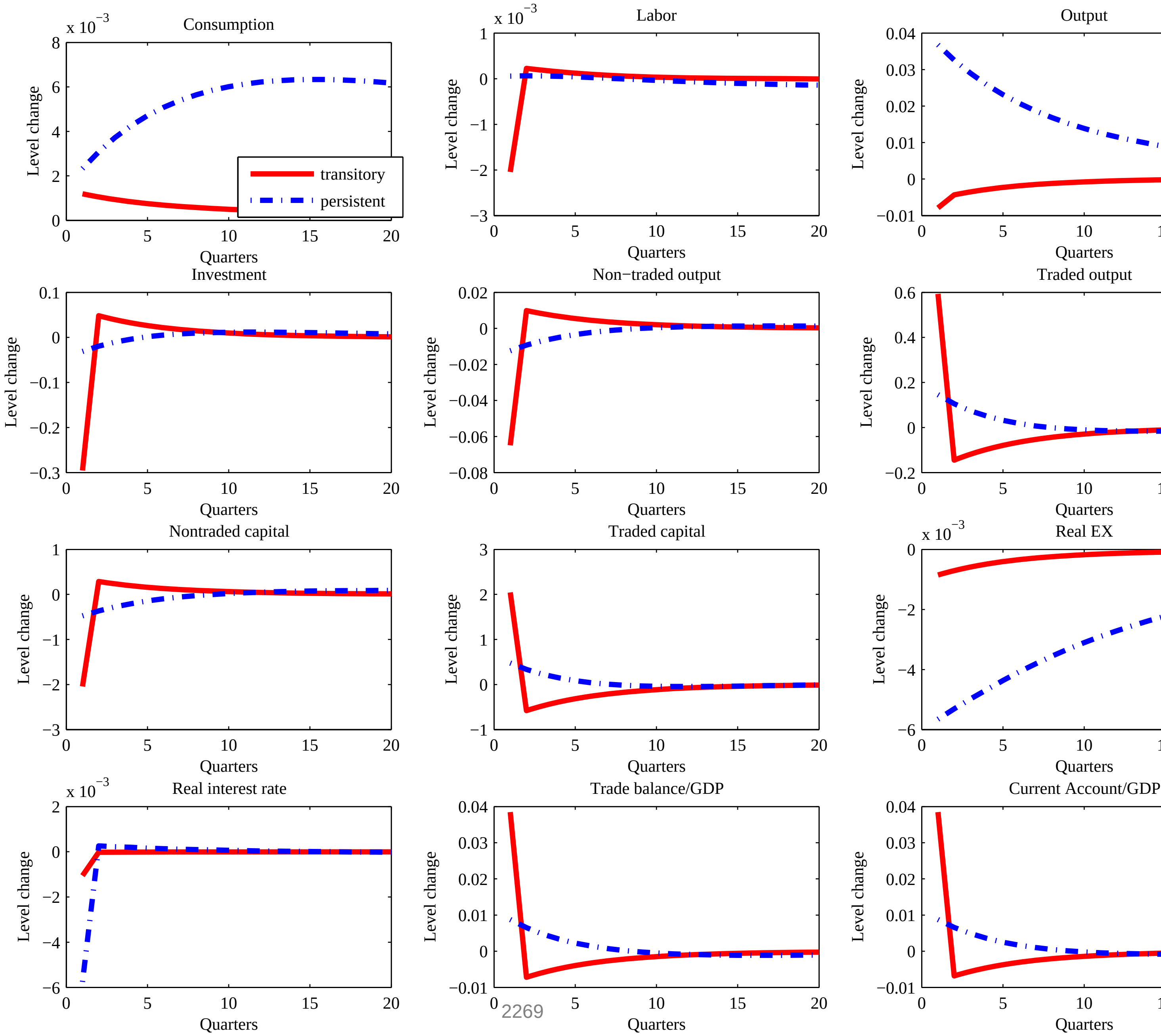
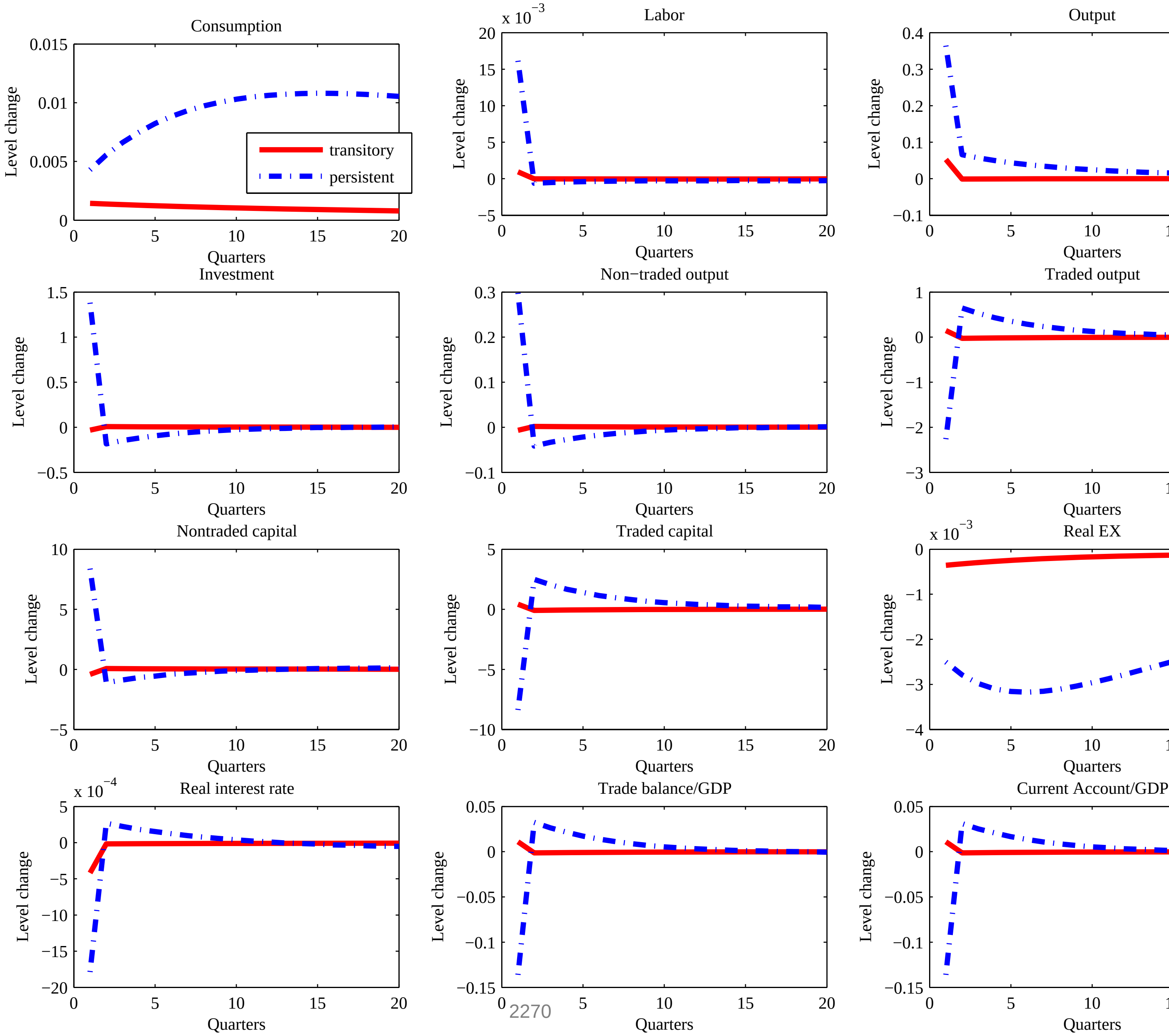


Figure 2: Impluse response to Terms of Trade Shock under Fixed Exchange Rates



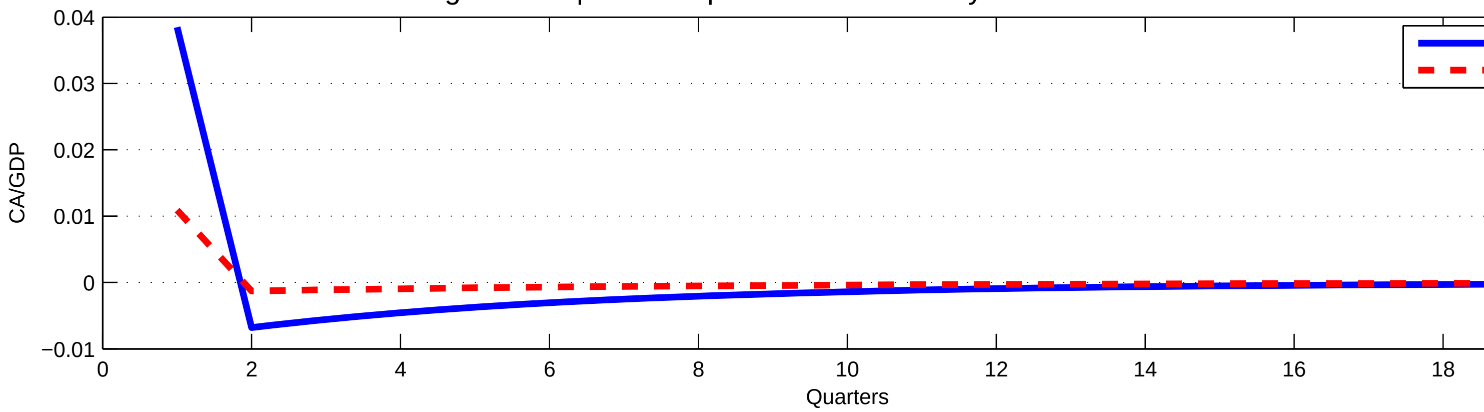


Figure 3: Impulse Response to a Transitory Terms of Trade Shock

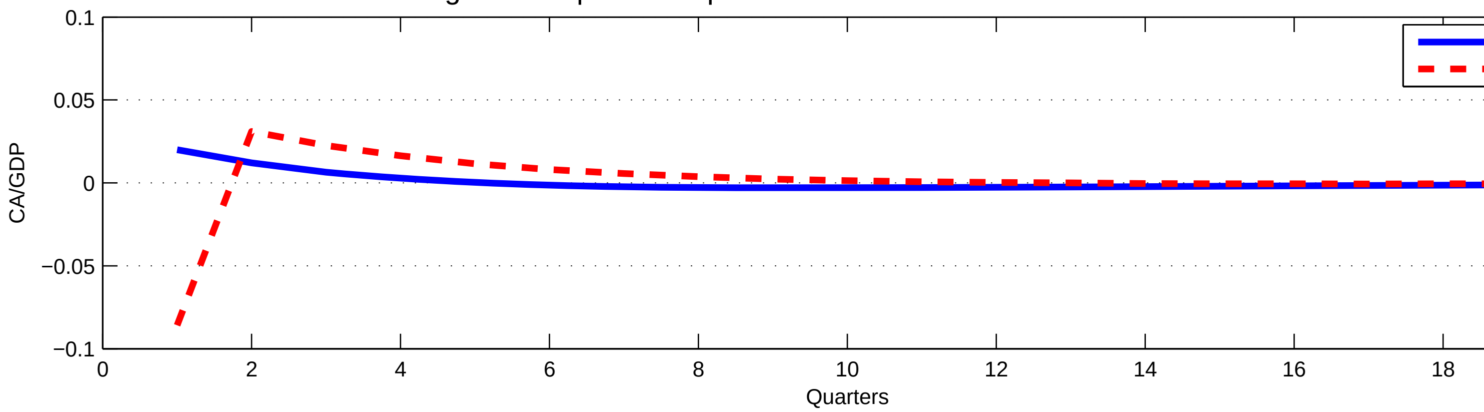


Figure 4: Impulse Response to a Persistent Terms of Trade Shock

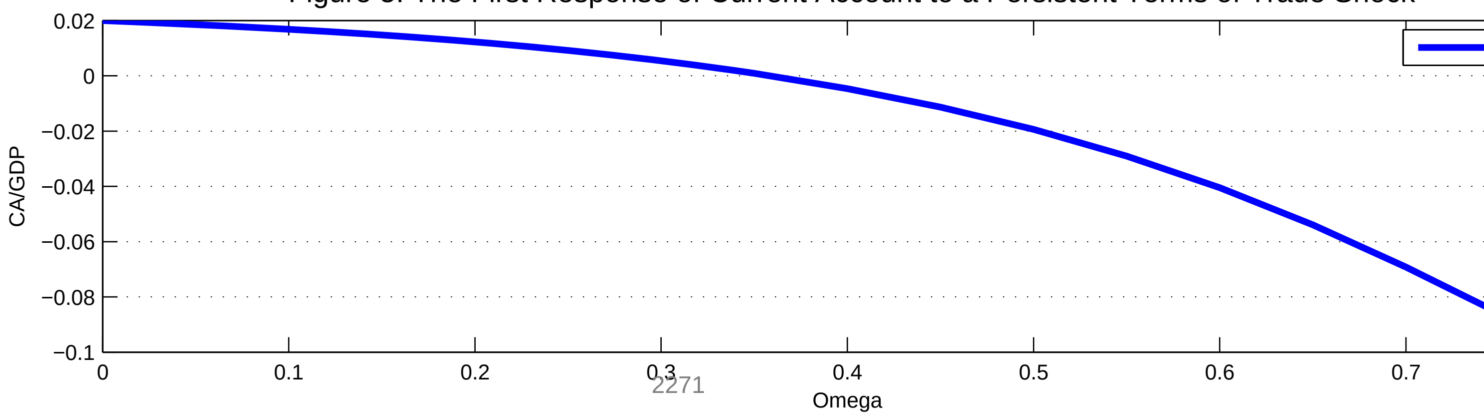


Figure 5: The First Response of Current Account to a Persistent Terms of Trade Shock