Fiscal Consolidation in an Open Economy*

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Abstract

This paper uses a New Keynesian small open economy model to examine how the effects of fiscal consolidation vary depending on whether monetary policy is constrained by currency union membership vs. the zero bound on interest rates.

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1. Introduction

Given heightened concerns about debt sustainability, many countries are implementing ambitious fiscal consolidation plans in which government spending reductions often play a major role. The usual presumption is that the effects of government spending cuts on output are smaller when a country conducts an independent monetary policy (IMP) than when constrained by membership in a currency union, reflecting that interest rate cuts and currency depreciation appear to significantly dampen the adverse impact on aggregate demand. While historical evidence from large-scale fiscal consolidations episodes supports this view (Alesina and Perotti, 1997), it is unclear whether an IMP retains its comparative advantage if constrained by the zero lower bound, especially in light of "closed economy" analysis showing how a liquidity trap can amplify the fiscal multiplier.[1]

This paper uses a New Keynesian DSGE model of a small open economy to examine conditions under which a persistent cut in government spending reduces output more under an IMP constrained by the zero lower bound than in a currency union (CU). Given that adjustment of the policy rate is precluded in both monetary regimes for at least some time, the output effects of fiscal contraction are larger than under an unconstrained IMP. But across the two constrained regimes, the relative magnitude of the output contraction turns out to be highly sensitive to structural features which determine how the real exchange rate and long-term real interest rate respond to fiscal consolidation. If inflation is fairly sensitive to the output gap (i.e., the Phillips Curve has substantial upward slope), output contracts more deeply under an IMP than a CU if policy rates are constrained from adjusting for a sustained period of roughly two years or more. Importantly, the anchoring of the nominal exchange rate in a CU turns out to be a blessing insofar as it avoids the large *appreciation* of the real exchange rate that would occur in a persistent liquidity trap, and implies a smaller rise (if any) in long-term real interest rates. By contrast, if the Phillips Curve is very flat, the real exchange rate depreciates even in a prolonged liquidity trap and long-term real interest rates fall, so that the output contraction under an IMP is smaller than under a CU; thus, the economy benefits from front-loaded depreciation, even if smaller than in the unconstrained case. We conclude by arguing that recent episodes of large-scale fiscal consolidations – including in countries facing each form of monetary constraint – should be highly informative in discriminating between these contrasting predictions of the theory.

[1] See papers by Eggertson (2010), Woodford (2011), and Christiano, Eichenbaum, and Rebelo (2011).

2. A New Keynesian Open Economy Model

Our benchmark model is very similar to the small open economy models of Clarida, Galí, and Gertler (2001), and Galí and Monacelli (2008). Under an independent monetary policy, the key equations are given by:

$$x_t = x_{t+1|t} - \hat{\sigma}^{open}(i_t - \pi_{t+1|t} - r_t^{pot}), \tag{1}$$

$$\pi_t = \beta\pi_{t+1|t} + \kappa_p x_t, \tag{2}$$

$$i_t = \max\left(-i, \gamma_\pi \pi_t + \gamma_x x_t\right), \tag{3}$$

$$y_t = \hat{\sigma}^{open}\tau_t + g_y g_t + (1 - g_{y)})(1-\omega)\nu_c \nu_t \tag{4}$$

$$y_t^{pot} = \frac{1}{\phi_{mc}\hat{\sigma}}[g_y g_t + (1-g_y)(1-\omega)\nu_c\nu_t] \tag{5}$$

$$\tau_t^{pot} = -\frac{1}{\hat{\sigma}^{open}}(1 - \frac{1}{\phi_{mc}\hat{\sigma}^{open}})\left[g_y g_t + (1-g_y)(1-\omega)\nu_c\nu_t\right] \tag{6}$$

$$r_t^{pot} = \tau_{t+1|t}^{pot} - \tau_t^{pot}, \tag{7}$$

$$p_t = p_{t-1} + \pi_t, \tag{8}$$

$$e_t = p_t + \tau_t, \tag{9}$$

where $\hat{\sigma}^{open}$, κ_p, and ϕ_{mc} are composite parameters defined as:

$$\hat{\sigma}^{open} = (1-g_y)[(1-\nu_c)(1-\omega)^2\sigma + \omega(2-\omega)\varepsilon_P] \tag{10}$$

$$\kappa_p = \kappa_{mc}\phi_{mc} \tag{11}$$

$$\phi_{mc} = \frac{\chi}{1-\alpha} + \frac{1}{\hat{\sigma}^{open}} + \frac{\alpha}{1-\alpha} \tag{12}$$

All variables are measured as percent or percentage point deviations from their steady state level, and for simplicity, all foreign variables are set equal to their steady state values.[2]

As in Clarida et al, the first three equations represent the New Keynesian open economy IS curve, Phillips Curve, and monetary rule, respectively, that jointly determine the output gap ($x_t = y_t - y_t^{pot}$), price inflation (π_t), and the nominal policy rate (i_t), with the key difference that equation (3) requires the policy rate to remain above its lower bound ($-i$). Thus, the output gap x_t depends inversely on the deviation of the real interest rate ($i_t - \pi_{t+1|t}$) from its potential rate r_t^{pot}, with the sensitivity parameter $\hat{\sigma}^{open}$ varying positively with the household's intertemporal elasticity of substitution in consumption σ and trade price elasticity ε_P (the relative weight on the latter rises with trade openness ω). Given the Calvo-Yun contract structure, equation (2) indicates that the Phillips Curve slope κ_p varies directly with the product of parameters determining the sensitivity of inflation to marginal cost κ_{mc} and of marginal cost to the output gap ϕ_{mc} (the latter depends inversely on the Frisch elasticity of labor supply $\frac{1}{\chi}$, the parameter $\hat{\sigma}^{open}$, and the labor share in production $(1-\alpha)$). From equation (5), a contraction in government spending g_t (where g_y is the government spending share of steady state output) or negative taste shock ν_t (where ν_c is a scaling parameter) reduces potential output y_t^{pot}. Even so, both of these exogenous shocks, if negative, cause the the potential terms of trade τ_t^{pot} to depreciate (a rise in τ_t^{pot} in equation 6) because they depress the marginal utility of consumption (e.g., lower government spending boosts private consumption). If both shocks follow AR(1) processes, and hence have front-loaded effects, a reduction in government spending or negative taste shock reduces the potential real interest rate r_t^{pot}. Finally, equations (8) and (9) are identities for the price level (p_t) and the nominal exchange rate (e_t).

Given that the form of the equations determining output, inflation, and interest rates is identical to that in a closed economy – as emphasized by Clarida et al – results from extensive closed economy analysis are directly applicable for assessing the impact of government spending shocks in a liquidity trap.

We next consider how the model is modified for the CU case. A CU member takes the nominal exchange rate as fixed, so that the terms of trade τ_t is simply the gap between home and foreign price levels, i.e., $\tau_t = -(p_t - p_t^*) = -p_t$.[3] Moreover, the home economy is assumed to be small

[2] We use the notation $y_{t+j|t}$ to denote the conditional expectation of a variable y at period $t+j$ based on information available at t, i.e., $y_{t+j|t} = \mathrm{E}_t y_{t+j}$. The superscript 'pot' denotes the level of a variable that would prevail under completely flexible prices, e.g., y_t^{pot} is potential output.

[3] In this model, the terms of trade is equivalent to the real exchange rate using domestic price deflators; hence, we use the terms interchangeably.

enough that the policy rate is effectively exogenous. Given that equation (4) implies that the output gap is proportional to the terms of trade gap, i.e., $x_t = \hat{\sigma}^{open}(\tau_t - \tau_t^{pot})$, the price setting equation (2) may be expressed as a second order difference equation in the terms of trade:

$$\tau_t - \tau_{t-1} = \beta(\tau_{t+1|t} - \tau_t) + \kappa_p \hat{\sigma}^{open}(\tau_t - \tau_t^{pot}), \tag{13}$$

which has the solution:

$$\tau_t = \lambda \tau_{t-1} + \kappa_p \hat{\sigma}^{open} \frac{\lambda}{1 - \beta\rho\lambda} \tau_t^{pot}, \tag{14}$$

The persistence parameter $\lambda = 0.5(a - \sqrt{a^2 - 4/\beta}\ )$, where $a = (\frac{1}{\beta})(1 + \beta + \kappa_p \hat{\sigma}^{open})$, lies between 0 and unity, and ρ is the persistence of the shock processes (assumed to be the same for the taste shock and government spending). Equation (14) has two important implications. First, because $\lambda > 0$, a contraction in government spending – which raises τ_t^{pot} by equation (6) – moves τ_t in the same direction, implying a depreciation. Together with equation (4), this implies that the government spending multiplier m_t is strictly less than unity, i.e., $m_t = \frac{1}{g_y}\frac{dy_t}{dg_t} = 1 + \frac{1}{g_y}\frac{d\tau_t}{d\tau_t^{pot}}\frac{d\tau_t^{pot}}{dg_t} < 1$ (recalling that $\frac{d\tau_t^{pot}}{dg_t} < 0$). Second, as $\kappa_p \hat{\sigma}^{open}$ becomes very small, λ rises toward unity and the coefficient on τ_t^{pot} shrinks, implying very gradual adjustment of the terms of trade to τ_t^{pot} (and hence to a change in government spending); conversely, the terms of trade adjustment is much more rapid if $\kappa_p \hat{\sigma}^{open}$ is larger. In economic terms, the terms of trade adjusts more quickly if the Phillips Curve has a relatively high slope (high κ_p), or if aggregate demand is relatively sensitivity to the terms of trade (high $\hat{\sigma}^{open}$).

2.1. Simulation Results

The left panel of Figure 1 shows the effects of a 1 percent of baseline GDP cut in government spending under a calibration in which the Phillips Curve slope *relating inflation to marginal cost* $\kappa_{mc} =$ .025. This calibration is towards the higher side of empirical estimates, while the right panel shows a calibration which sets $\kappa_{mc} =$ .007, towards the very low end of empirical estimates. If factors were completely mobile, these calibrations would imply mean price contract durations of about 7 and 12 quarters, respectively, but – as emphasized by an extensive literature (e.g., Altig et al., 2010) – the reduced form slopes could be regarded as consistent with much shorter contract durations under reasonable assumptions about strategic complementarities. As seen in the upper panels, the potential terms of trade τ_t^{pot} depreciates (rises) initially, and then dies out slowly at the rate $\rho = 0.95$. This fall in the relative price of domestically-produced goods reflects that the government spending cut boosts home consumption relative to foreign consumption. Moreover, the positive wealth effect reduces potential output y_t^{pot} (lower panels). A country with an IMP – *if unconstrained by the zero lower bound* – could achieve this flexible price allocation simply through a monetary rule (3) that responded very aggressively to inflation. Under such a rule, the terms of trade τ_t would track τ_t^{pot} exactly, and given that inflation remained unchanged from baseline, both the real and nominal interest rate would decline in line with r_t^{pot} (reflecting that consumption would be expected to fall after its initial rise). Thus, output would track y_t^{pot} irrespective of the degree of price stickiness. With the price level constant, the jump in the real exchange rate would be achieved through nominal exchange rate depreciation.

Because the nominal exchange rate is fixed in a CU, the government spending cut initially boosts τ_t^{pot} much more than the actual terms of trade τ_t (upper panels). The negative terms of trade gap $\tau_t - \tau_t^{pot}$ – which may be regarded as an "overvalued" terms of trade – causes output to fall persistently below potential. The negative output gap causes inflation to fall persistently – implying a progressive depreciation of the terms of trade – and the progressive narrowing of the terms of trade gap eventually moves output towards potential. As noted previously, the adjustment process proceeds more quickly with shorter-lived price contracts, which explains why the output contraction in the left panel is smaller and less persistent than in the right panel. In addition, factors that raise the sensitivity $\hat{\sigma}^{open}$ of demand to the terms of trade – such as a higher elasticity of demand for traded goods – would also speed-up the adjustment. Importantly, although the terms of trade adjust sluggishly in line with the price level, it does at least move in the "right direction" for narrowing the output gap. Moreover, as highlighted by Corsetti et al. (2011), the ex ante long-term real interest rate actually falls in response to a temporary fall in government spending: although inflation declines in the near-term, the terms of trade (and hence price level) must eventually revert to steady state, implying some rise in long-run expected inflation.[4]

While greater price flexibility cushions the impact of a government spending cut in a CU, more price flexibility – or more generally, a more upward sloping Phillips Curve slope – can greatly deepen the contraction that occurs under an IMP subject to the zero bound constraint, and imply an output multiplier much larger than in a CU. In this vein, Figure 1 shows the effects of the government spending contraction under an IMP against the backdrop of initial conditions which imply an ten quarter liquidity trap (i.e., a negative taste shock that is scaled to induce a liquidity

[4] With a permanent fall in spending, the rise in long-term real interest rates would be very small.

trap lasting ten quarters in the absence of the fiscal shock). As the government spending shock reduces r_t^{pot} while the policy rate remains fixed, the output gap would contract even if expected inflation remained constant. However, the output contraction is reinforced by a persistent decline in inflation that is particularly large when price adjustment is relatively rapid (the left panel). Thus, the peak output decline is 1.5 under the IMP, compared with 0.8 in a CU. Importantly, the large output decline under the IMP reflects two factors. First, long-term ex ante real interest rates rise substantially, in contrast to the decline that occurs in a CU. Second, the rise in the real interest rate under an IMP implies a "perverse" initial appreciation of the terms of trade (as seen in the upper left panel). Thus, although the CU precludes the nominal exchange rate from adjusting, the lack of adjustment serves to better cushion output than the appreciation that occurs under an IMP.

Under more sluggish price adjustment, the multiplier is only about 0.6 under an IMP, smaller than the multiplier of 0.9 in a CU. With inflation much less responsive, long-term real interest rates fall under an IMP, and this allows a front-loaded depreciation of the terms of trade to cushion the impact on output. Overall, our results underscore that the same conditions which tend to mitigate the effects of fiscal consolidation in a CU – namely, an upward-sloping Phillips Curve – tend to exacerbate the effects under an IMP constrained by the zero lower bound; and conversely, a flatter Phillips Curve tends to make an IMP look relatively more attractive, since the real exchange rate can immediately adjust to lessen the bite on aggregate demand.

While the results in Figure 1 consider the specific case of a ten quarter liquidity trap, it is natural to ask how long a liquidity trap is required for fiscal consolidation to produce a more contractionary effect under an IMP than a CU. To address this question, Figure 2 plots the output response to 1 percent of GDP contraction under different assumptions about the duration of the liquidity trap faced under an IMP (with the longer-lived traps generated by progressively largely adverse taste shocks). As in Figure 1, the left panel adopts the calibration in which price adjustment is relatively faster, while the right panel assumes that price adjustment is slower. In the former case, the output contraction becomes much more pronounced as the liquidity trap lengthens – increasing in a convex fashion – with the multiplier in the case of a eight quarter liquidity trap exceeding the multiplier under a CU of 0.8 (the dashed line). With a three year liquidity trap, the spending multiplier is nearly 3, as a sharp rise in long-term real interest rates (caused by lower expected inflation) causes a large improvement in the terms of trade (lower panel) In this environment, the anchoring of the long-run price level provided by a CU is clearly very beneficial in insulating the economy from the potential pressures that can arise in a liquidity trap. By contrast, with long-lived 12 quarter price contracts, the liquidity trap must last 12 quarters for the multiplier under an IMP to exceed that under a CU; for liquidity traps of less than two years, the front-loaded depreciation of the terms of trade (lower right panel) significantly mitigates the effects of the spending cut on output. As the slope of the Phillips Curve becomes flatter, the liquidity trap duration required to produces a larger output downturn than in a CU becomes progressively longer.

Our analysis has focused on a simple model that abstracts from an array of empirically-relevant nominal and real frictions. Even so, our key points continue to hold in more realistic open economy settings. Figure 3 shows responses to a 1 percent of GDP fiscal contraction in a larger-scale open economy model used in Erceg and Lindé (2011) that embeds nominal wage and price rigidities, endogenous capital accumulation, rule-of-thumb consumers, and incomplete exchange rate passthrough in the short-run. The left panel with "faster price adjustment" adopts a calibration of the price and wage contract duration parameters that is broadly representative of the estimates of the slopes of price and wage Phillips Curves based on data prior to the financial crisis, and specifically, adopts the estimate of Altig et al. (2010) of $\kappa_{mc} = 0.014$. The right panel shows estimates under an alternative calibration that imposes an extremely flat price (and wage) Phillips Curve of $\kappa_{mc} = 0.002$.[5] The unconstrained IMP follows a Taylor rule, while the constrained policy is derived under the assumption that the liquidity trap lasts ten quarters.

Under the calibration with relatively faster price adjustment, output declines over 2 percent after 4 quarters under the constrained IMP, compared with only about 0.7 percent in a CU. The larger output decline in the former case reflects a larger fall in inflation (middle left panel) – which pushes up long-term real interest rates – and a sizeable real appreciation of the exchange rate. Thus, the fiscal shock is amplified by a sharp contraction in private domestic demand and real net exports. In a CU, the real exchange rate depreciates slightly even in the near-term, and the long-term real interest rate is about constant. By contrast, under very slow price adjustment – the right panel – the effects of fiscal consolidation on output are modestly smaller under a constrained IMP than CU. The smaller output decline under an IMP reflects both a front-loaded exchange rate depreciation and fall in long-term real interest rates (since inflation barely moves, and policy rates fall after two years). For a short-lived liquidity trap, the advantages of an IMP are even larger.

[5] Under "faster price adjustment," the contract duration parameters for prices and wages are $\xi_p = 0.86$ and $\xi_w = 0.82$, respectively, while $\xi_p = 0.95$ and $\xi_w = 0.90$ under "slower price adjustment." The model and calibration of other parameters are described in Erceg and Lindé (2011).

3. Implications and Open Questions

Conditional on some key structural parameters, including those highlighted above, our modeling framework has clear implications to help gauge whether the output effects of fiscal consolidation in an economy such as the United Kingdom – where policy rates are constrained by their ZLB – are likely to be larger than in a CU member such as Portugal or Belgium. But given that even the qualitative answer hinges on factors that determine the responsiveness of inflation, which view does the evidence favor?

There is a substantial amount of econometric evidence estimating the sensitivity of price inflation to marginal cost, and of wage inflation to the wage markup; as noted, the calibration in the left panel of Figure 3 seems squarely in line with such evidence. On this basis, fiscal consolidation would have a significantly deeper contractionary impact on an open economy provided that monetary policy were constrained for a period exceeding two years; and the seeming strictures of a CU would in fact ameliorate the output contraction. Moreover, the relative impact under an IMP would appear even more dire in the case of a longer-lived trap, or if price and wage-sensitivity were somewhat higher.

However, the resilience of inflation during the recent global recession suggests the possibility that the responsiveness of inflation may be considerably lower than implied by most existing econometric evidence. As seen in the left panel of Figure 3, the 1 percent of GDP fiscal contraction reduces inflation sharply by around 2 percentage points. Moreover, under the same calibration of price adjustment, a fall in output of say 6-8 percent or more below its pre-crisis trend path – as was experienced by the United States and Europe during the recent recession – would imply a fall in both inflation and one-year ahead expected inflation of more than 4 percentage points below the central bank's perceived inflation target if mainly driven by aggregate demand shocks. This implied decline is much larger than actually occurred in either the United States, where core inflation and market expectations of core inflation have remained well above 1 percent, or in major economies in Europe.

It is quite conceivable that inflation behavior during the past few years can be rationalized as consistent with econometric evidence based on pre-crisis observations. For example, financial shocks and other shocks may have adversely impacted the supply side of the economy enough to accomodate observed inflation behavior within the range of existing econometric evidence. However, future analysis may well point to a somewhat lower degree of inflation responsiveness. If so, outside of a very prolonged liquidity trap, our analysis would indicate that an economy with an IMP may be somewhat better poised to absorb the effects of fiscal consolidation than a CU, with real exchange rate and interest movements tending to cushion rather than amplify the impact.

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Figure 1: Persistent Contraction in Government Spending

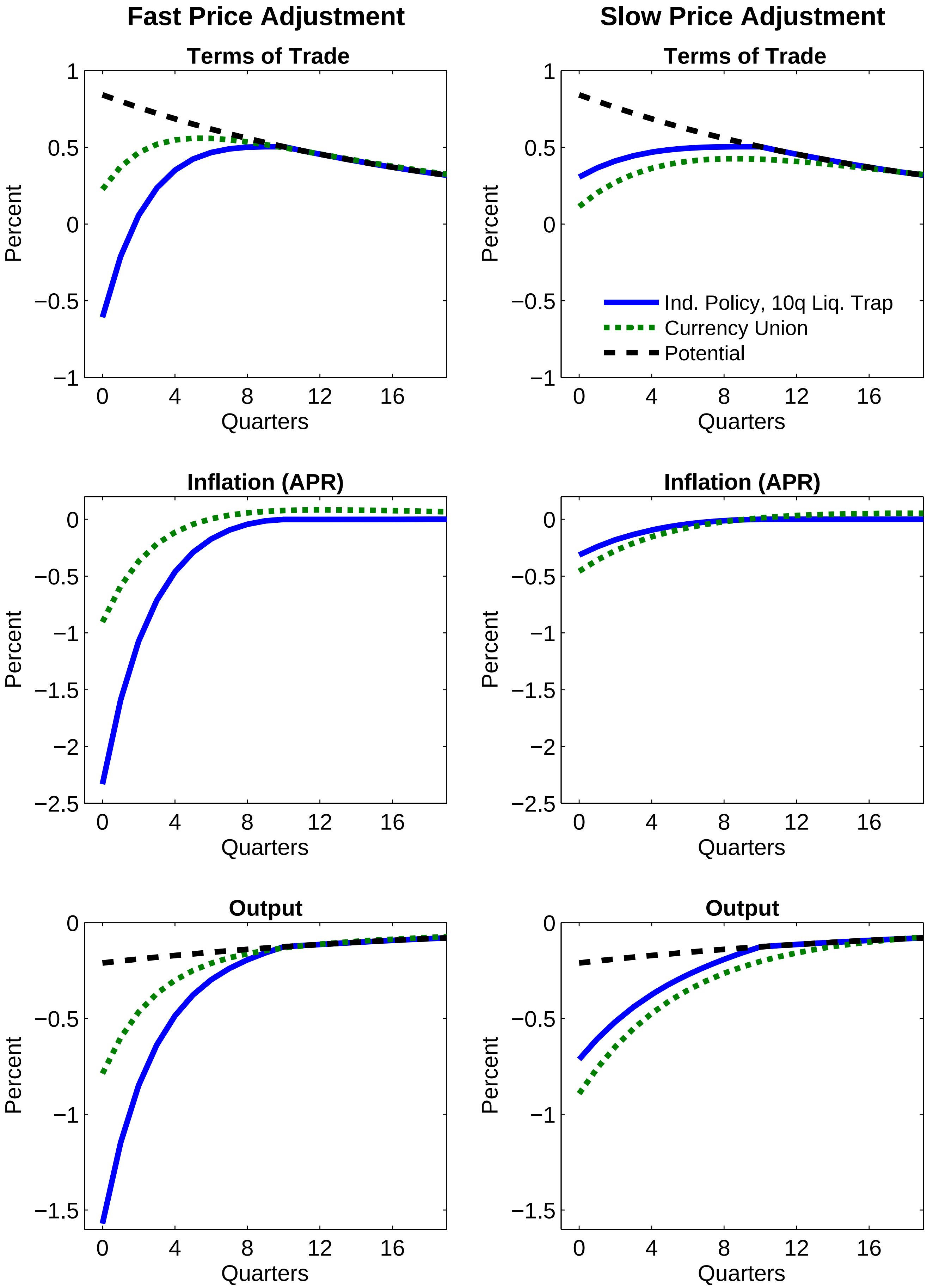

Figure 2: Impact Output Response to Immediate Government Spending Cut With Independent Monetary Policy and in a Currency Union

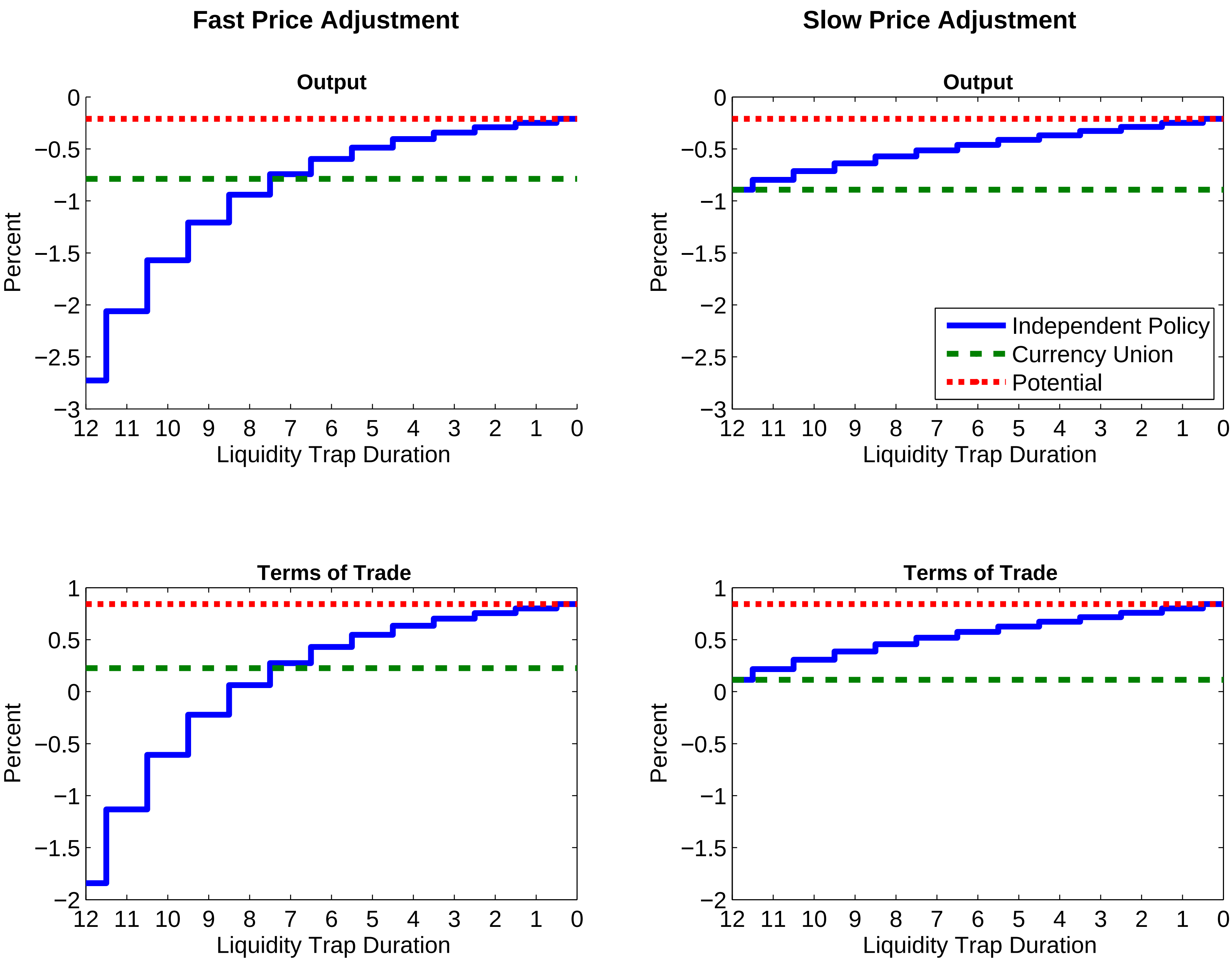

Figure 3: Persistent Government Spending Cut in Large Model