The Effects of Foreign Shocks when U.S. Interest Rates are at Zero

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International Spillovers

Literature mostly converged on the view that even pronounced slowdowns abroad have only modest contractionary impact on the U.S. (Dynamic factor models often find a small role for global factor.)

Policy models such as FRB/Global and SIGMA deliver similar results.

Justiniano and Preston quantify the spillover effects of foreign shocks for a small-open economy model estimated on Canadian data and confirm these results.

International Spillovers (continued)

However, most studies are based on historical episodes in which monetary policy could adjust interest rates without restrictions to offset shocks.

Under the zero bound constraint on nominal interest rates, monetary policy will not be able to accommodate additional shocks temporarily once policy rates have reached zero (unless policymakers move to less conventional policies).

This situation was captured in spirit by the first open-economy models to emerge from the Keynesian paradigm in the post-war period. Large international spillovers of country-specific shocks stemmed from a flat LM curve, implying no reaction of monetary policy.

Related Open Economy Literature

McCallum (2000 and 2001), Svensson (2001) evaluate alternative policies in stylized, small open economy models.

Coenen and Wieland (2003) build a three country model to analyze alternative exit strategies from the ZLB for Japan. However the model is a mixture of optimization-based conditions and additional simplifying assumptions (not optimization-based) such as a term structure that departs from the expectation hypothesis for the transmission of interest rates.

Our focus is on spillovers, and our model is a simple optimization-based open economy macro model.

Model Overview

- DGE model with two countries; each produces a single final good by aggregating a continuum of domestically-produced intermediate goods.

- Nominal and Real Rigidities:

  - staggered wage and price contracts

  - habit persistence in consumption

  - investment adjustment costs

- Exports are priced in the currency of the buyer (local currency pricing).

Optimizing Households

- Maximize an intertemporal utility functional; the period utility function depends on a composite consumption good, leisure, and real balances.

- Accumulate capital by purchasing an investment good.

- Monopolistically competitive sellers of differentiated labor services.

- Private consumption, investment, and government consumption goods are a composite of the domestically-produced good and the imported good.

Firm Behavior

- There are three types of producers in each country: intermediate goods producers, producers of the aggregate domestic good, and distributors.

- Producers of the intermediate goods are monopolistically competitive and set prices in Calvo-style contracts. They rent capital and labor from households.

- Producers of the aggregate domestic good bundle the continuum of intermediate goods, and take prices as given in input and product markets.

- Distributors purchase both the domestically produced good and imported goods, and resell the final consumption, investment, and government goods.

Government Sector

- Transfers and govt spending determined exogenously.

- Govt spending does not affect HH utility or production function but requires real resources to produce.

- Finances its expenditures with lump-sum taxes, budget is balanced every period.

Monetary Policy

Monetary policy follows a Taylor-type rule and is constrained by the zero bound on nominal interest rates.

Define the notional rate as:

$$x_t = \gamma_x(x_{t-1} - \bar{r} - \bar{\pi}) + \bar{r} + \bar{\pi}_t + \gamma_\pi(\pi_t - \bar{\pi}) + \gamma_y(y_t - y_t^{pot}). \quad (1)$$

The effective rate is then given by:

$$i_t = \max(0, x_t). \quad (2)$$

Calibration

Home country is one third as large as foreign.

κ_w and κ_p consistent with 4 quarter contracts ; κ_x consistent with 2 quarter contracts .

Consumption elasticity $\sigma = 2$; habit persistence parameter $\varkappa = 0.8$.

Trade elasticity of substitution is 1.1.

Adjustment costs for investment set to match peak response of investment following a monetary innovation, $\phi_I = 3$, and elasticity of substitution between capital and labor in production function is 0.50.

Calibration (continued)

Baseline case for interest rate rule: $\gamma_i = 0.9$, $\gamma_\pi = 1.5$, $\gamma_y = 0.125$.

ω_A is set to 0.12, to be consistent with an import share of 12%.

Model Solution

Following the ZLB literature in optimization based models (for example, Eggertson and Woodford), we replace the original equilibrium conditions by a log-linear approximation except for the constraint on nominal interest rates.

The only nonlinear equation in the model is given by

$$i_t = \max(0, x_t). \tag{3}$$

We only consider perfect-foresight experiments, i.e., the shocks surprise agents in the first period, but thereafter agents expect that no more shocks will hit the system.

Model Solution: Newton-Raphson-Type Method

Employ an algorithm first proposed by Laffargue (1990) and extended by Boucekkine (1995) and Juillard (1996), which itself builds on work by Fair and Taylor (1983).

Stack all equations through time, which is equivalent to collapsing the Type I and II iterations in the Fair-Taylor algorithm into one step.

The size of the first-derivative to implement a Newton-type recursion is kept manageable by exploiting the sparsity implied by the stacked system.

The initial guess for the Newton-type recursion, is taken to be the responses implied by the linear model as recommended by Anderson (1999).

Initial Baseline Path: Construction

The home country experiences a large and persistent preference shock that leads to a sustained contraction of consumption in the home country.

The expected number of periods at the zero bound is 8 quarters.

We then consider the marginal effects of additional shocks that originate in either the home or the foreign country.

These shocks may, or may not vary the expected duration of the zero-lower-bound regime.

Figure 1: Severe Domestic Recession Scenario (Initial Baseline Path)

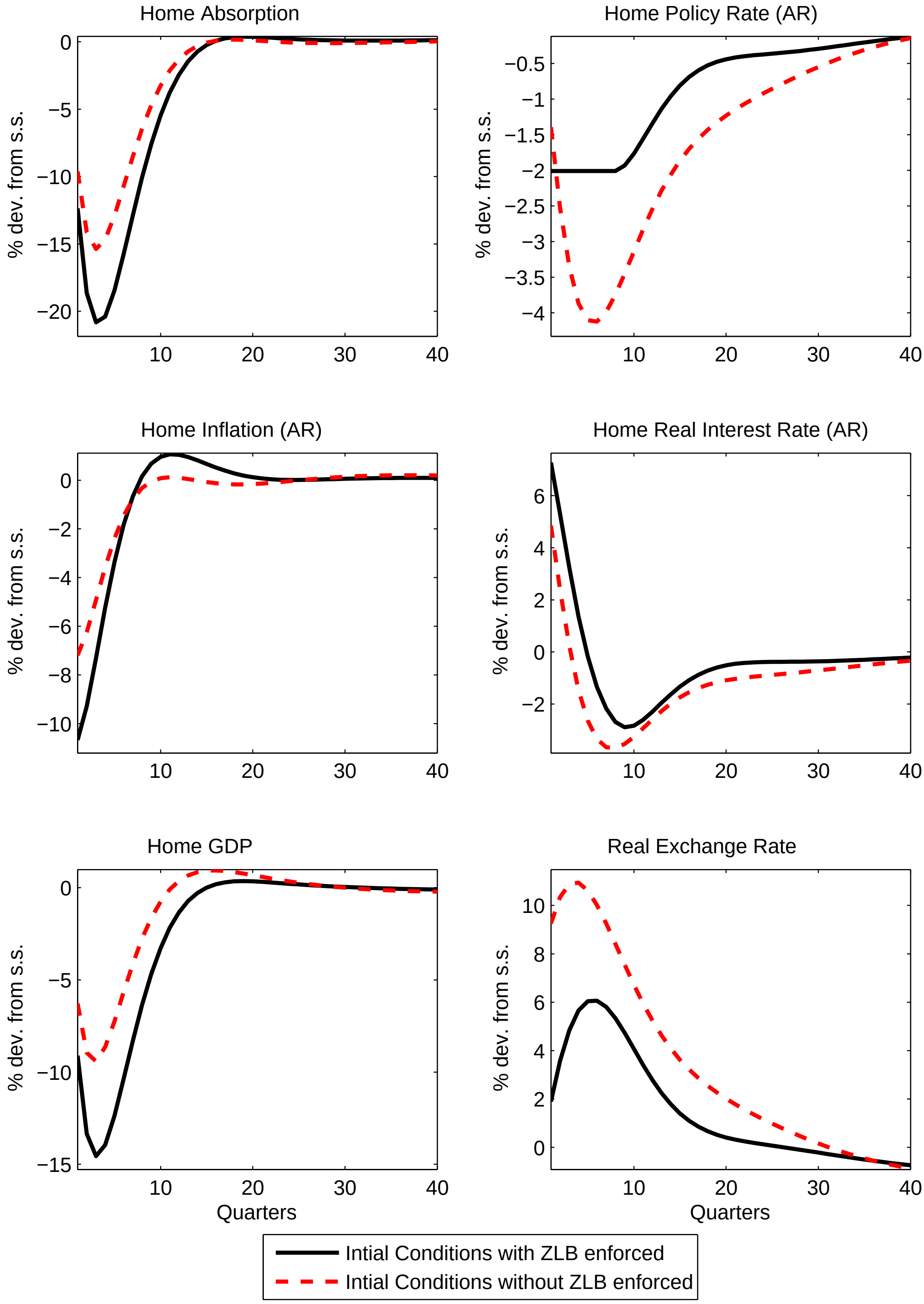
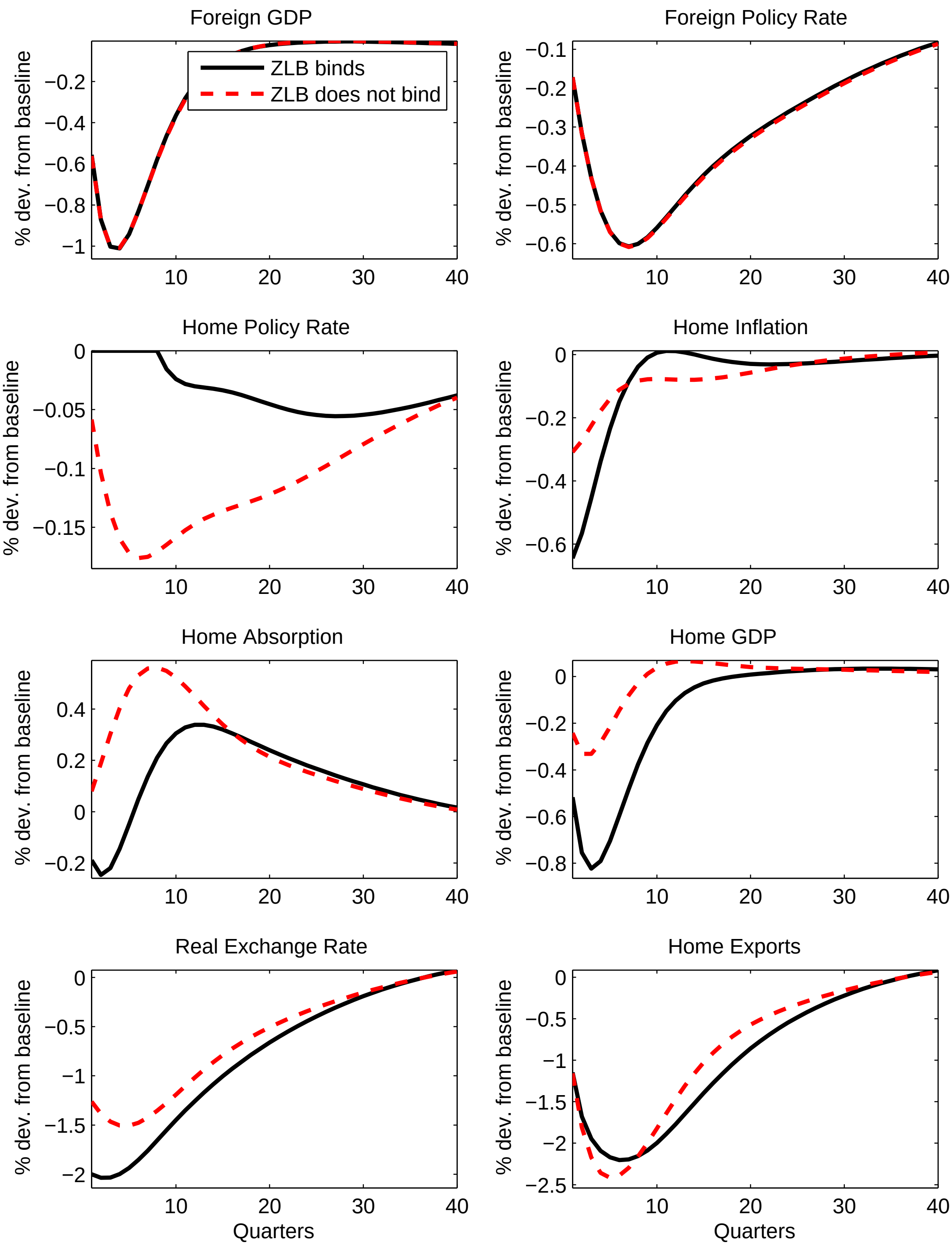


Figure 2: Effects of Foreign Consumption Shock against Backdrop of Domestic Recession



Model Solution: Exploiting Piecewise Linearity

Following Jung, Teranishi, and Watanabe (2005), Eggertson and Woodford (2003), one can exploit the piecewise linearity of the model.

All model equations are linear while monetary policy is unconstrained and all model equations are linear while monetary policy is constrained, albeit the model equations differ across cases.

However, the duration of the second regime is nonlinear and depends on the underlying shocks.

Model Solution (continued)

Advantages of the Newton-Raphson approach:

- easy to apply, as one does not have to distinguish between cases (zero bound binds immediately or only over time, the number of countries that are at the zero bound including different durations),

- can be applied to a perfect-foresight exercise also in the fully non-linear model.

Model Solution (continued)

Advantages of the “Piecewise-Linear” approach:

- computationally faster if model is not too large and does not require too many case distinctions,

- provides insights that lead to theorems.

Some Features of the Model

Let ε_1 be an arbitrary shock vector that hits the economy in period 1.

$T(\varepsilon_1)$ is the resulting duration at the zero bound.

$\left\{s_t^{(\varepsilon_1, T(\varepsilon_1))}\right\}_{t=1}^{\infty}$ denotes the path of the endogenous variables s_t in this case.

For simplicity, assume that ε_1 is large enough to bring interest rates to zero immediately.

Some Features of the Model (continued)

Linearity at the zero bound:

Consider ε_1 and $\varepsilon_1 + \mu_1$, $\mu_1 \neq 0$.

If $T(\varepsilon_1) = T(\varepsilon_1 + \mu_1) = T^*$,

then $\left\{ s_t^{(\varepsilon_1 + \mu_1, T^*)} \right\}_{t=1}^{\infty} - \left\{ s_t^{(\varepsilon_1, T^*)} \right\}_{t=1}^{\infty} = \left\{ s_t^{(\mu_1, T^*)} \right\}_{t=1}^{\infty}$.

Some Features of the Model (continued)

Assume a shock ε_1 that implies the zero lower bound binds $T(\varepsilon_1) = T^*$ periods.

Two immediate corollaries are:

- Limited relevance of initial shock ε_1: for given T^*, the marginal effect of an additional shock μ_1 does not depend on the initial shock ε_1.

- Symmetry of shocks: the marginal effects of a positive and its corresponding negative shock are symmetric if the duration at the zero bound remains at T^*.

Some Features of the Model (continued)

If an additional shock changes T^*, its effects are nonlinear.

Numerical simulations show that the effects of a marginal shock are more pronounced the longer the economy is stuck at the zero bound (we are working on a general proof).

Figure 4: Positive vs Negative shocks

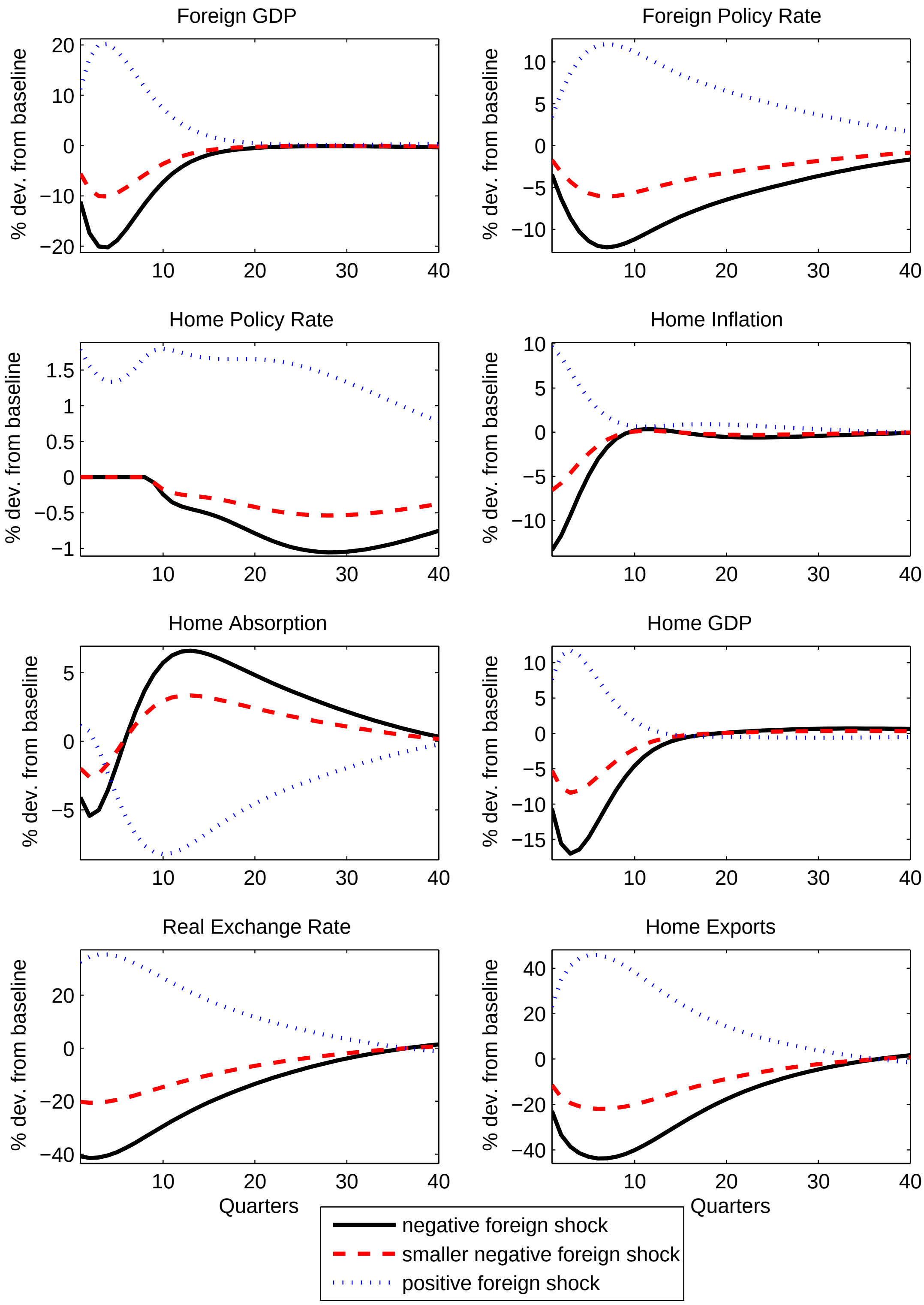
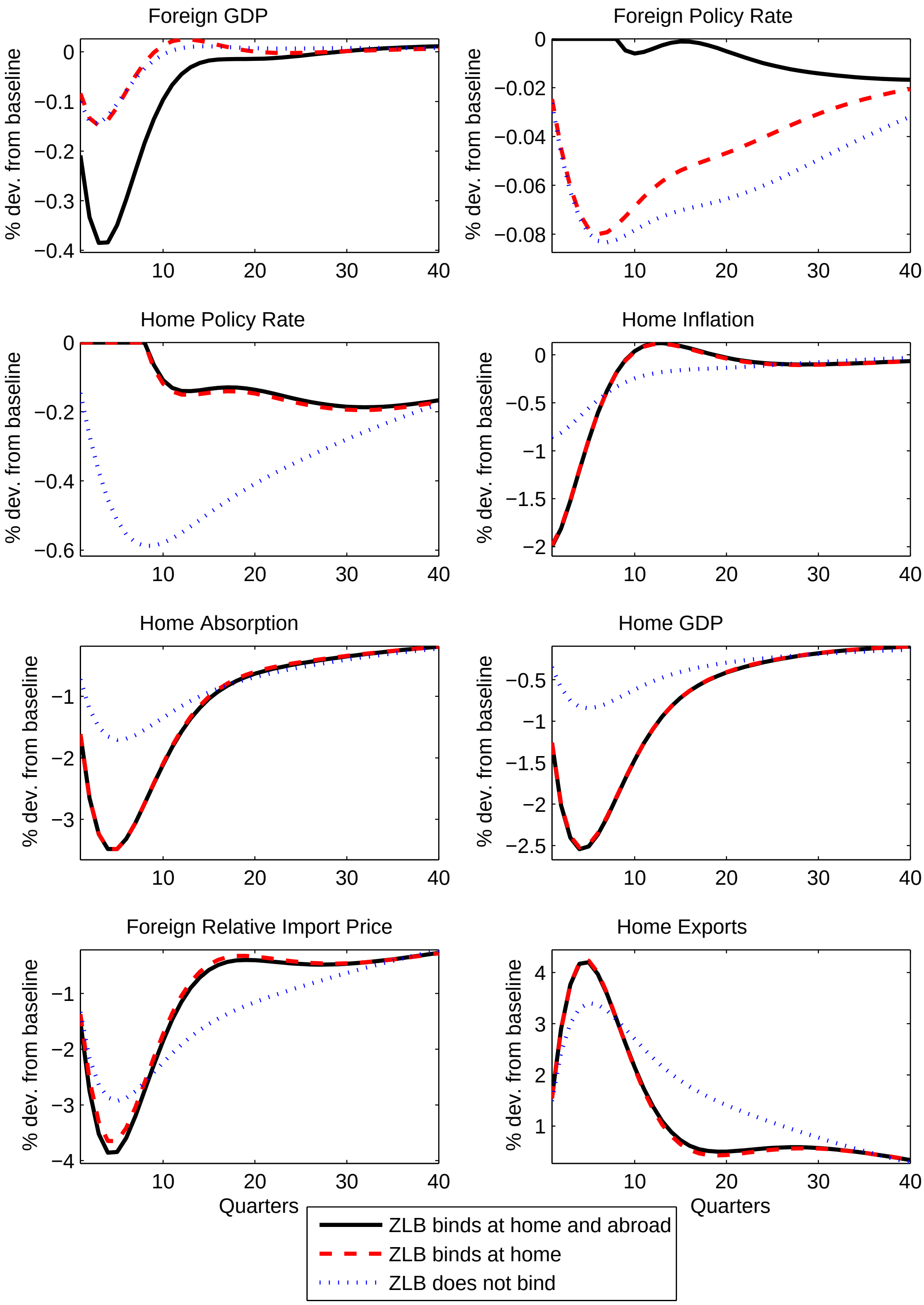
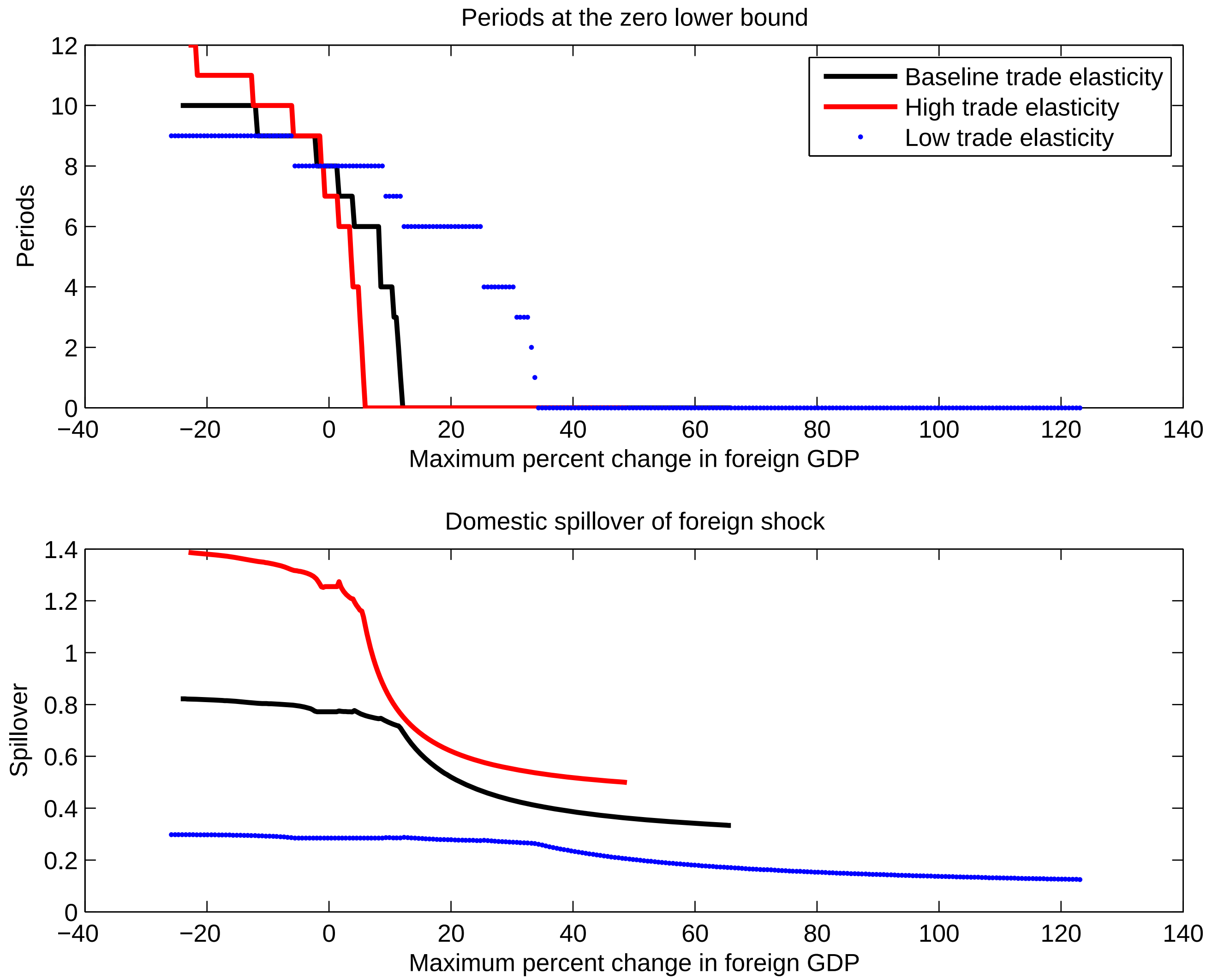
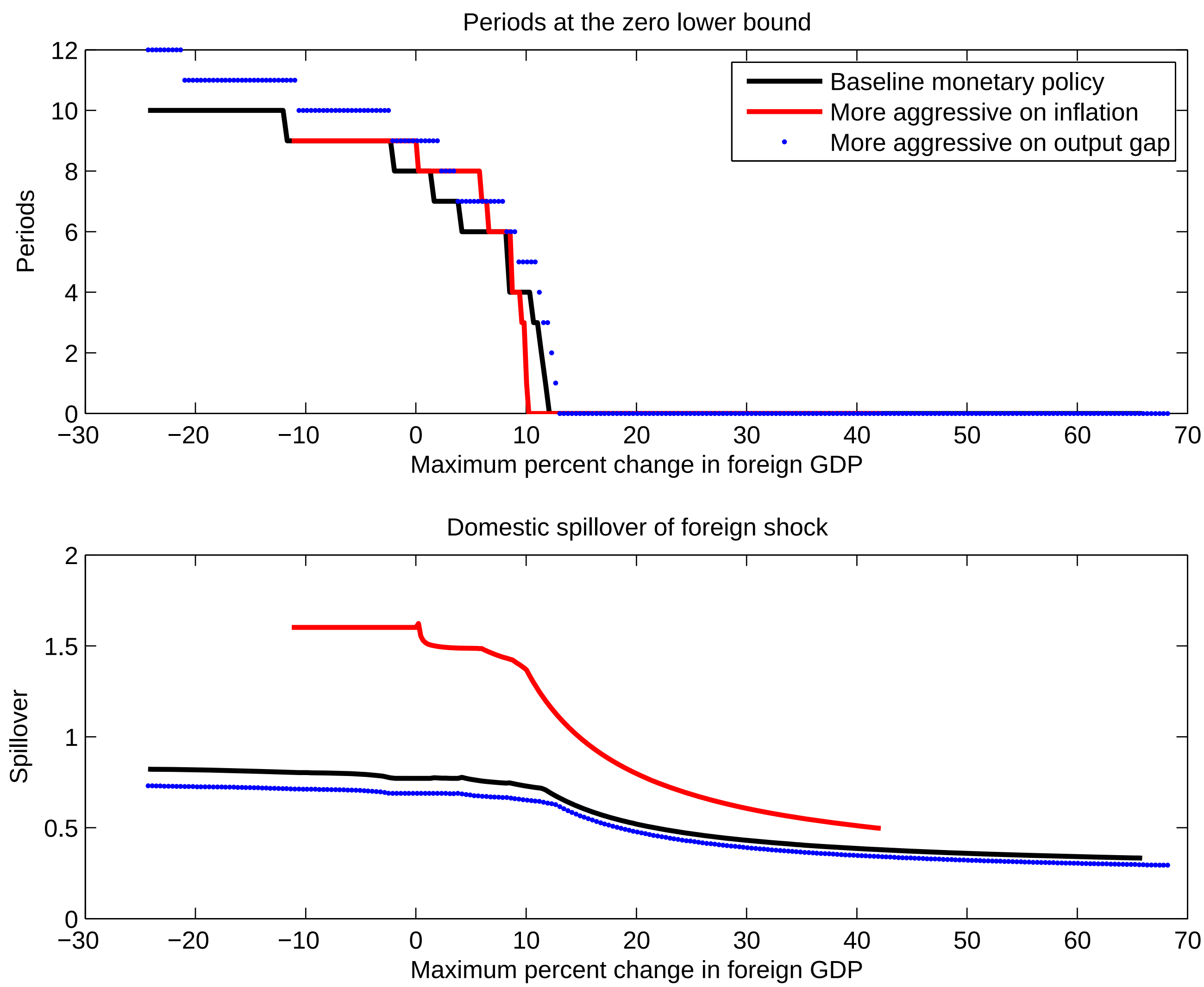


Figure 5: Zero Lower Bound Binds at Home and Abroad





Periods at the zero lower bound
Periods
Maximum percent change in foreign GDP
Baseline trade elasticity
High trade elasticity
Low trade elasticity
Domestic spillover of foreign shock
Spillover
Maximum percent change in foreign GDP



Periods at the zero lower bound
Periods
Maximum percent change in foreign GDP
Baseline monetary policy
More aggressive on inflation
More aggressive on output gap
Domestic spillover of foreign shock
Spillover
Maximum percent change in foreign GDP

Conclusion

Away from the ZLB foreign disturbances seem to have limited spillover effects onto the U.S. economy as monetary policy effectively stabilizes the domestic economy.

At the ZLB the spillover effects of foreign shocks have the potential of being greatly amplified if monetary policy is not able to take alternative measures to stimulate the domestic economy.

We interpret the results in this paper as bracketing the spillover effects of foreign disturbances when monetary is fully understood to be inactive at the ZLB.