The Macroeconomic Effects of Trade Tariffs: Revisiting the Lerner Symmetry Result

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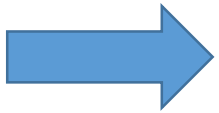
Motivation

- Recent policy proposals have stimulated a debate on border adjustment of corporate income taxes (BAT), see e.g. Auerbach et al (2017)
- Under some conditions **BAT = *Import tariff + export subsidy***
- Debate strongly influenced by an old trade theory result (Lerner 1936):

Import tariff + export subsidy (equal rate) 

- The exchange rate appreciates (at same rate)
- No effect on real allocations and other prices

(Lerner Symmetry Theorem)

- How general is the result?
- What deviations are <u>quantitatively</u> relevant?

What we do

- We use a TANK model to analyze and **quantify deviations from Lerner symmetry** for the following factors:
  - Anticipation effects
  - Gradual exchange rate adjustment (and currency pegs)
  - Asymmetric pricing mechanisms (ERPT~=TPT)
  - Structure of international asset markets and risk sharing (**CM vs. IM**)
- Work with an empirically relevant open-economy model and since trade policy is taking a prominent stage we also use it to study **Trade Wars**
  - Present results for alternative assumptions on exchange rate determination (**CM vs. IM**)
  - Evaluate how adverse effects depend on how other countries **retaliates**

Existing Literature

Old Trade literature:

No uncertainty/static: Lerner (1936) - two goods environment; McKinnon (1966), Meade (1977), Grossman (1980) - multiple goods.

Razin and Svensson (1983) - permanent vs. transitory (symmetry breaks down).

Uncertainty and the role of asset markets: Stockman and Dellas (1986) and Barari Lapan (1993) - symmetry breaks down but no quantitative assessment.

More recent contributions:

Quantitative work with DSGE models: Erceg et al (2017), Barbiero et al (2017).

Theory: Costinot and Werning (2017)

Outline of Presentation

- Model (with focus on import and export tariffs)
- The Lerner symmetry result
- Transient deviations from Lerner
- Permanent deviations from Lerner
- Macroeconomic effects of a Trade War
- Conclusions

Model – basic features

- Two country medium-scale quantitative DSGE model calibrated to the US
- Trade: Home bias in consumption and investment → RER not constant
- Sticky domestic prices and wages
- LCP: sticky import prices (low ERPT to import prices)
- In addition, model features real rigidities and Keynesian accelerator mechanisms to enhance its empirical relevance
  - Keynesian accelerator mechanisms: endogenous capital, financial accelerator, liquidity constrained households (TANK)
  - Real rigidities: consumption habit, investment adj. costs, and import and export adj. costs

Model – basic features

- Three Main Assumptions (caveat):
  - (A1) Trade is balanced in steady state: no revenue effects
    IF relaxed: TB~=0 still not relevant if Ricardian equivalence holds (Costinot & Werning, 2017)
  - (A2) Foreign asset/liabilities in terms of foreign-currency bonds: no valuation effects from exchange rate movements.
    IF relaxed: permanent but small deviation from Lerner (Barbiero et al., 2017)
  - (A3) Trade policy has uniform application
    Counter-example in Barbiero et al. (2017)

Model – introduction of tariffs and subsidies

USD per foreign currency: up USD depreciation

Foreign export prices in foreign units

Deviations from LOP

$$\delta_t = -p_{M,t} + s_t + p^*_{X,t} + \tau_{M,t} - \tau^*_{X,t},$$

Home country

$$\Delta\delta_t = -\pi_{M,t} + \Delta s_t + \pi^*_{X,t} + \Delta\tau_{M,t} - \Delta\tau^*_{X,t}.$$

Foreign country

$$\Delta\delta^*_t = -\pi^*_{M,t} - \Delta s_t + \pi_{X,t} + \Delta\tau^*_{M,t} - \Delta\tau_{X,t}.$$

Import Phillips curve
(Local Currency Pricing)

$$\pi_{M,t} = \frac{\beta}{1+\iota_M}\mathrm{E}_t\pi_{M,t+1} + \frac{\iota_M}{1+\iota_M}\pi_{M,t-1} + \kappa_M\left(mc^*_t + \delta_t\right)$$

Foreign marginal costs

Model – introduction of tariffs and subsidies II

Deviations from LOP

$$\delta_t = -p_{M,t} + s_t + p^*_{X,t} + \tau_{M,t} - \tau^*_{X,t},$$

Import tariff

Home country

$$\Delta\delta_t = -\pi_{M,t} + \Delta s_t + \pi^*_{X,t} + \Delta\tau_{M,t} - \Delta\tau^*_{X,t}.$$

Export subs.

Foreign country

$$\Delta\delta^*_t = -\pi^*_{M,t} - \Delta s_t + \pi_{X,t} + \Delta\tau^*_{M,t} - \Delta\tau_{X,t}.$$

Import Phillips curve (LCP)

$$\pi_{M,t} = \frac{\beta}{1+\iota_M}\mathrm{E}_t\pi_{M,t+1} + \frac{\iota_M}{1+\iota_M}\pi_{M,t-1} + \kappa_M\left(mc^*_t + \delta_t\right)$$

(PCP): Phillips curve in export prices Px

The Lerner Symmetry Result

- Under (A1)-(A3), if ERPT=TPT, Lerner symmetry holds exactly independently of:
  - Nominal rigidities (sticky import/export prices, sticky wages, LCP, PCP, or DCP)
  - Capital or financial accelerator mechanisms
  - Real rigidities (investment, import/export adjustment costs, habit, liquidity constraint agents)
  - Monetary policy rule (except reacting to exchange rate)
  - Country size
- Intuition:
  - Assume import tariff and export subsidy move by the same rate
  - Full exchange rate adjustment then offsets both the import tariff and export subsidy's distortions (i.e., the T.o.T. is unchanged)
  - (A1)-(A2) (TB =0, B=0): No fiscal implications/valuation effects

Lerner Theorem: Mechanics

Assume: deviations from LOP =0

Price stickiness irrelevant

Assume the USD fully adjusts

$$\Delta\tau_{M,t} = -\Delta s_t$$

$$\Delta\tau_{X,t} = -\Delta s_t$$

Is this an Equilibrium?

Exchange rate adjustment mechanism (UIP consistent with IM)

$$\Delta E_t s_{t+1} = i_t - i_t^*$$

Current account (IM)

$$\Delta B_{F,t+1}\mathcal{E}_t - \Delta B^{\star}_{H,t+1} = B_{F,t}\mathcal{E}_t i_t^{\star} - B^{\star}_{H,t-1} i_t + NX_t$$

Lerner Theorem: Mechanics

Assume: deviations from LOP =0

Price stickiness irrelevant

Assume the USD fully adjusts

$$\Delta\tau_{M,t} = -\Delta s_t$$

$$\Delta\tau_{X,t} = -\Delta s_t$$

Is this an Equilibrium?

Exchange rate adjustment mechanism (UIP – consistent with IM)

$$\Delta E_t s_{t+1} = i_t - i_t^*$$

The long-term "equilibrium" exchange rate adjusts, no need for nominal or real interest rates to move!

→ **It is an equilibrium**

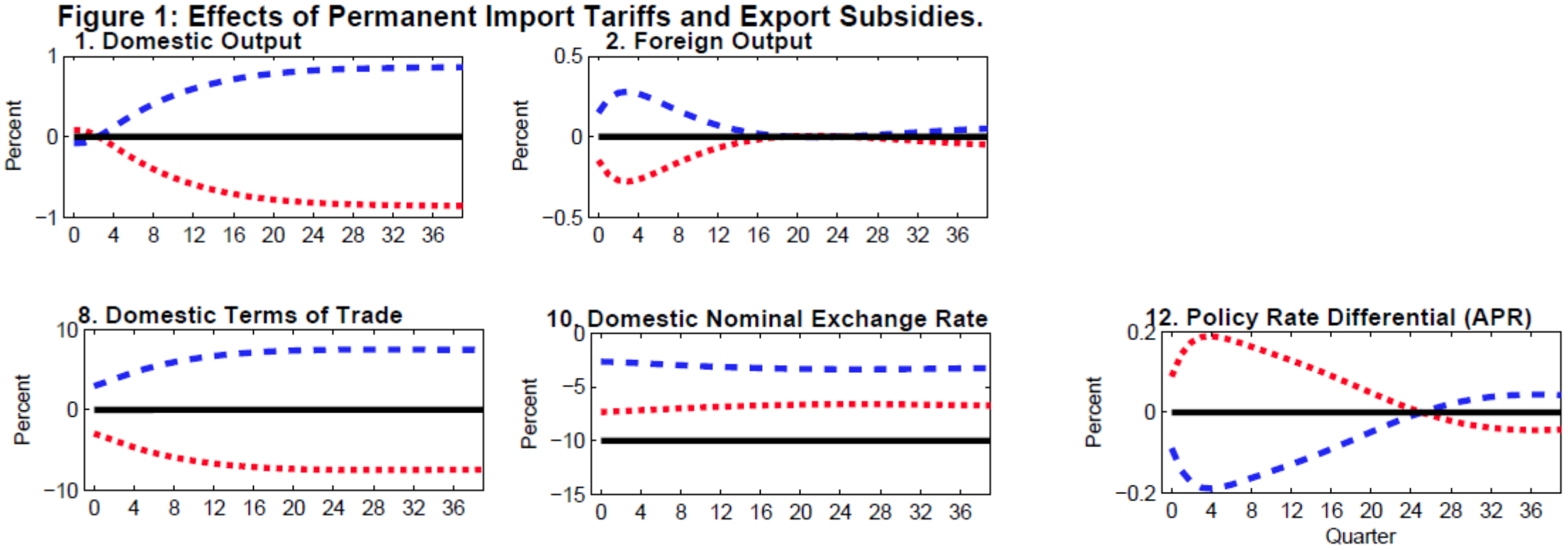
$$s_t = -\sum_{j=0}^{\infty} \mathrm{E}_t(i_{t+j} - i^*_{t+j}) + \breve{s} = \breve{s}.$$

Long-term (equilibrium) exchange rate

With heterogeneous beliefs on long-run exchange => coordination problem

$$\breve{s} = \lim_{j->\infty} \mathrm{E}_t s_{t+j}.$$

Effects of tariff and subsidy: Lerner symmetry



Permanent and unanticipated 10p.p. import tariff and export subsidy shock
LCP both countries (ERPT=TPT)

Transient deviations from Lerner: Asymmetric pass through

- Lerner symmetry temporarily breaks down under pre-tax pricing (and sticky prices): ERPT ~= TPT
- LCP: low exchange rate pass-through on import prices (in both countries)
  - Pre-import tariff and pre-export subsidy pricing: both tariff and subsidy are like a sales tax (both full pass-through);
  - Pre-import tariff pricing: tariff is like a sales tax (full pass-through);

Intuition: Asymmetric pass-through breaks the exchange rate offset on import prices

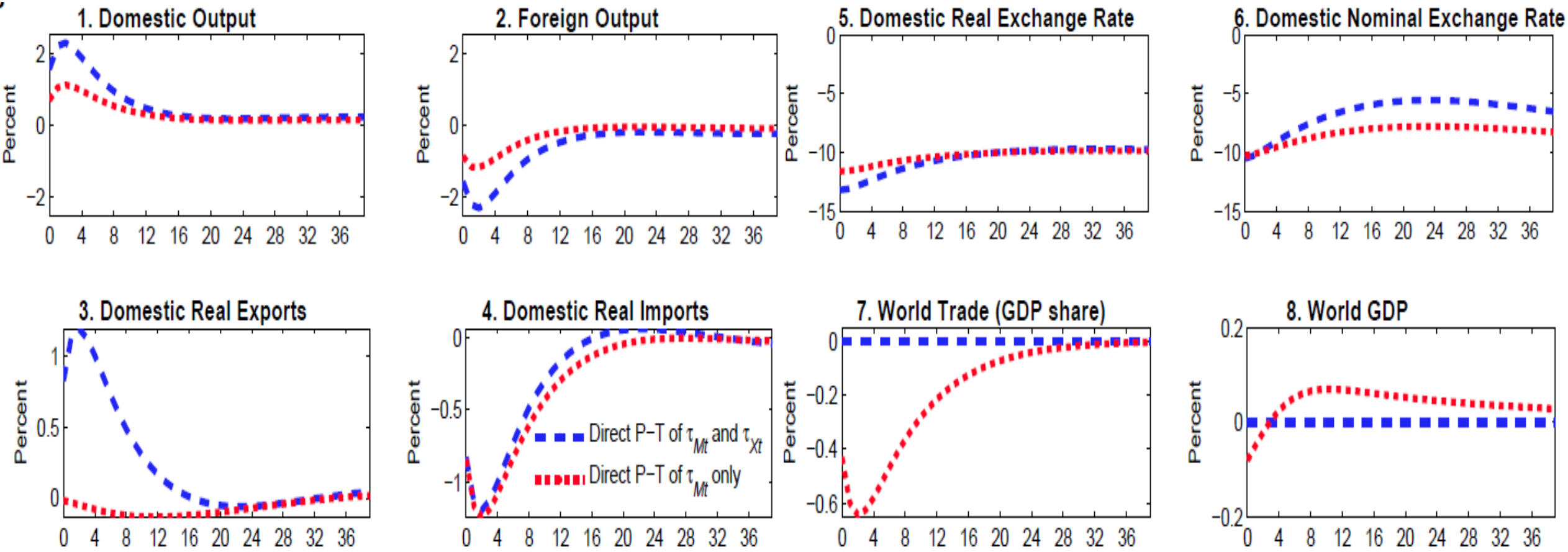
$$\Delta\delta_t = -\pi_{M,t} + \Delta s_t + \pi^*_{X,t} + \cancel{\Delta\tau_{M,t} - \Delta\tau^*_{X,t}}.$$

Low pass-through

$$\pi_{M,t} = \frac{\beta}{1+\iota_M}\mathrm{E}_t\pi_{M,t+1} + \frac{\iota_M}{1+\iota_M}\pi_{M,t-1} + \kappa_M\left(mc^*_t + \delta_t\right)$$

$$\widetilde{\pi}_{M,t} = \pi_{M,t} + \Delta\tau_{M,t}$$ full pass-through

Transient deviations from Lerner:
Asymmetric pass through



Transient deviations from Lerner: Other Mechanisms

- Lerner symmetry also temporarily breaks down under
  - *Slow nominal exchange rate adjustment*
    - The nominal exchange rate moves (appreciates) "too slowly"
  - *Anticipation* of the change in trade policy
    - The exchange rate moves (appreciates) too early
  - *Currency pegs* (no adjustment of NER), worst case - all RER adjustment has to go through via relative prices
    - Substantial negative impact on world GDP

Why these mechanisms cause transient deviations from Lerner

Anticipation

$$\Delta\delta_t \downarrow = -\pi_{M,t} \downarrow + \Delta s_t \downarrow + \pi^*_{X,t} \uparrow$$

$$\Delta s_t \approx \Delta \breve{s}_t = \mathrm{E}_t \Delta \tau_{M,t+j}$$

Exchange rate moves in anticipation

Slow exchange rate adjustment

UIP adj parameter

$$s_t = \gamma s_{t-1} + (1-\gamma) E_t s_{t+1} - (i_t - i^*_t)$$

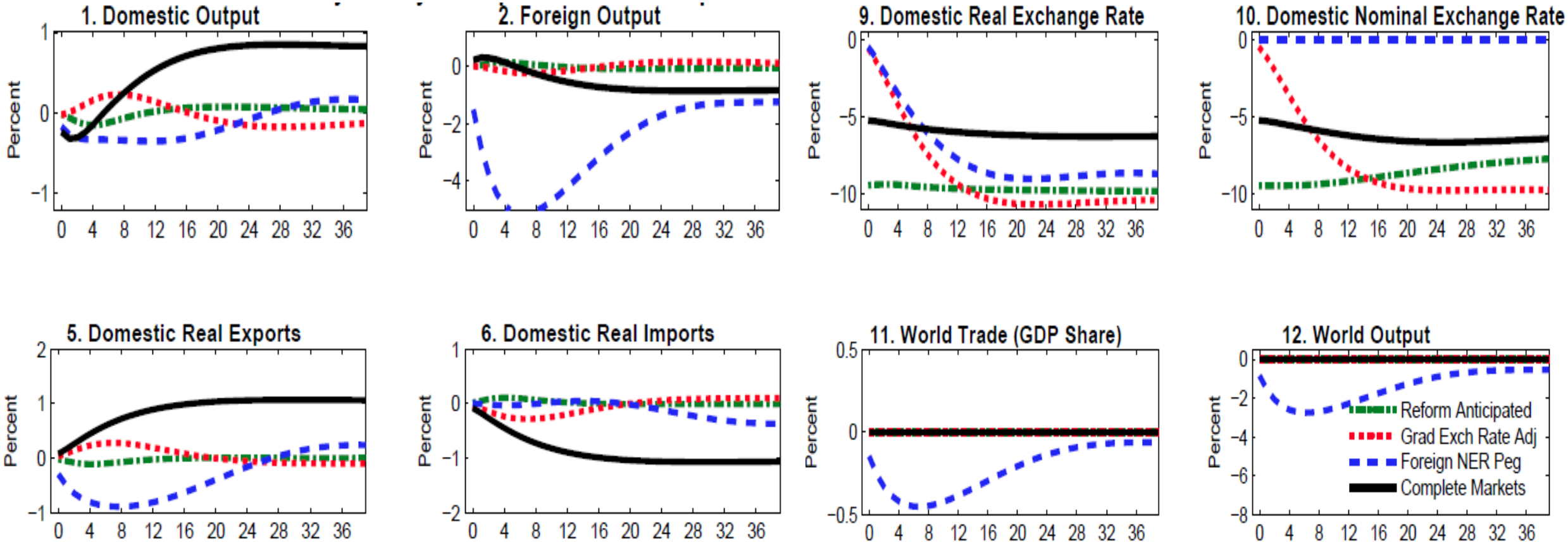
$$\Delta\delta_t \uparrow = -\pi_{M,t} + \Delta s_t \downarrow + \pi^*_{X,t} + \Delta\tau_{M,t} \uparrow\uparrow$$

$$s_t = \frac{s_{t-1}}{\phi(\gamma)} - \frac{1}{\gamma\phi(\gamma)}\left[\sum_{j=0}^{\infty} \mathrm{E}_t(i_{t+j} - i^*_{t+j}) + \breve{s}\right]$$

$$\lim_{\gamma->0} \gamma\phi(\gamma) = 1$$

Same mechanics but past level slows down the adjustment

Quantifying deviations from Lerner: Anticipation, Grad exch. rate adj., For NER peg



Permanent deviations from Lerner: Complete markets

- Complete international asset markets (CM)
- The first welfare theorem does not hold for BAT
  - CM do not guarantee efficiency
- CM insure a wealth effect but do not fix price distortions
- World GDP and trade unaffected (the pie does not change)
- Lower welfare at home (lower consumption) but higher GDP and TB
- Nominal rigidities: short-run drop in output
- Exchange rate adjustment only 60% of the shock

Permanent deviations from Lerner: Mechanics under CM

Complete Asset Markets $S_t P^*_{C,t}/P_{C,t} = Q_t = \Lambda^*_{C,t}/\Lambda_{C,t},$ Home bias, tariffs, … → RER not constant

under log-utility $P^*_{C,t} C^*_t S_t = P_{C,t} C_t$

Dollar-expenditures equated across countries
RER moves → values not volumes insured

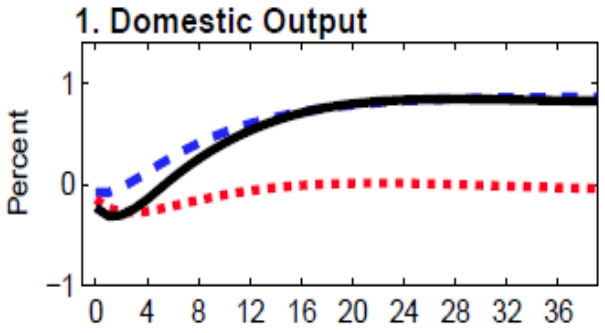
Real "UIP condition"

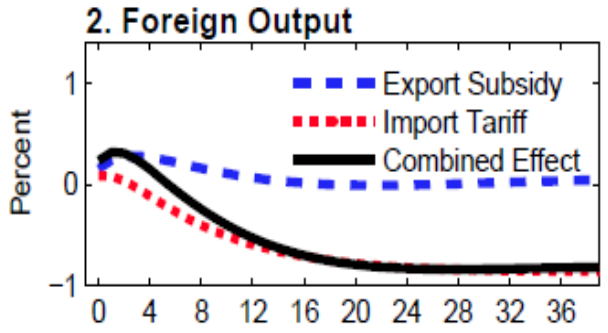
$$\Delta q_t = \Delta \lambda^*_{C,t} - \Delta \lambda_{C,t}.$$

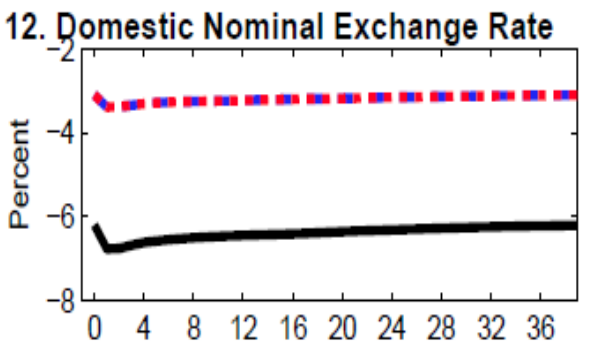
$$\Delta q_t = r^*_{t-1} - r_{t-1} + \xi_t$$

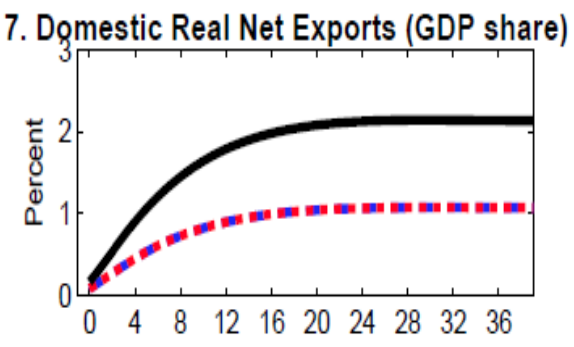
real rate differential "surprise"

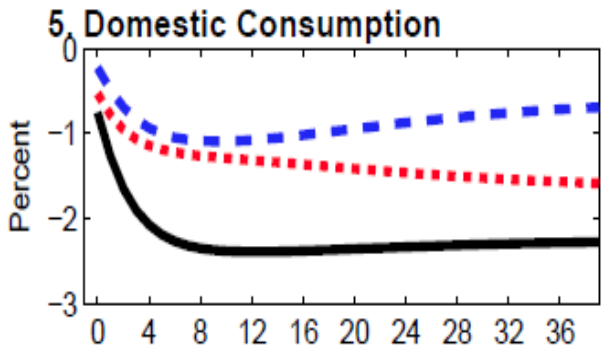
Permanent deviations from Lerner: Quantifying effects of CM

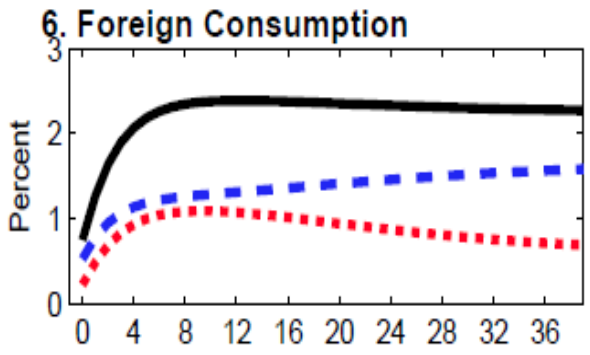


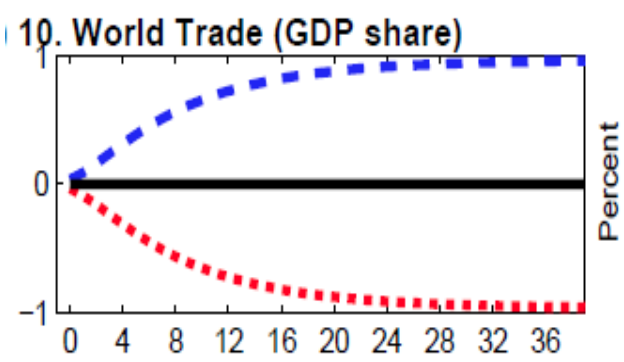


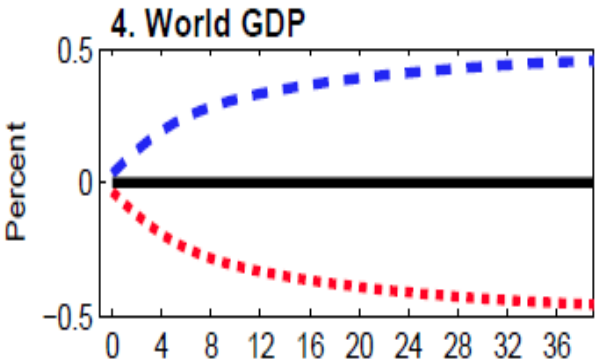






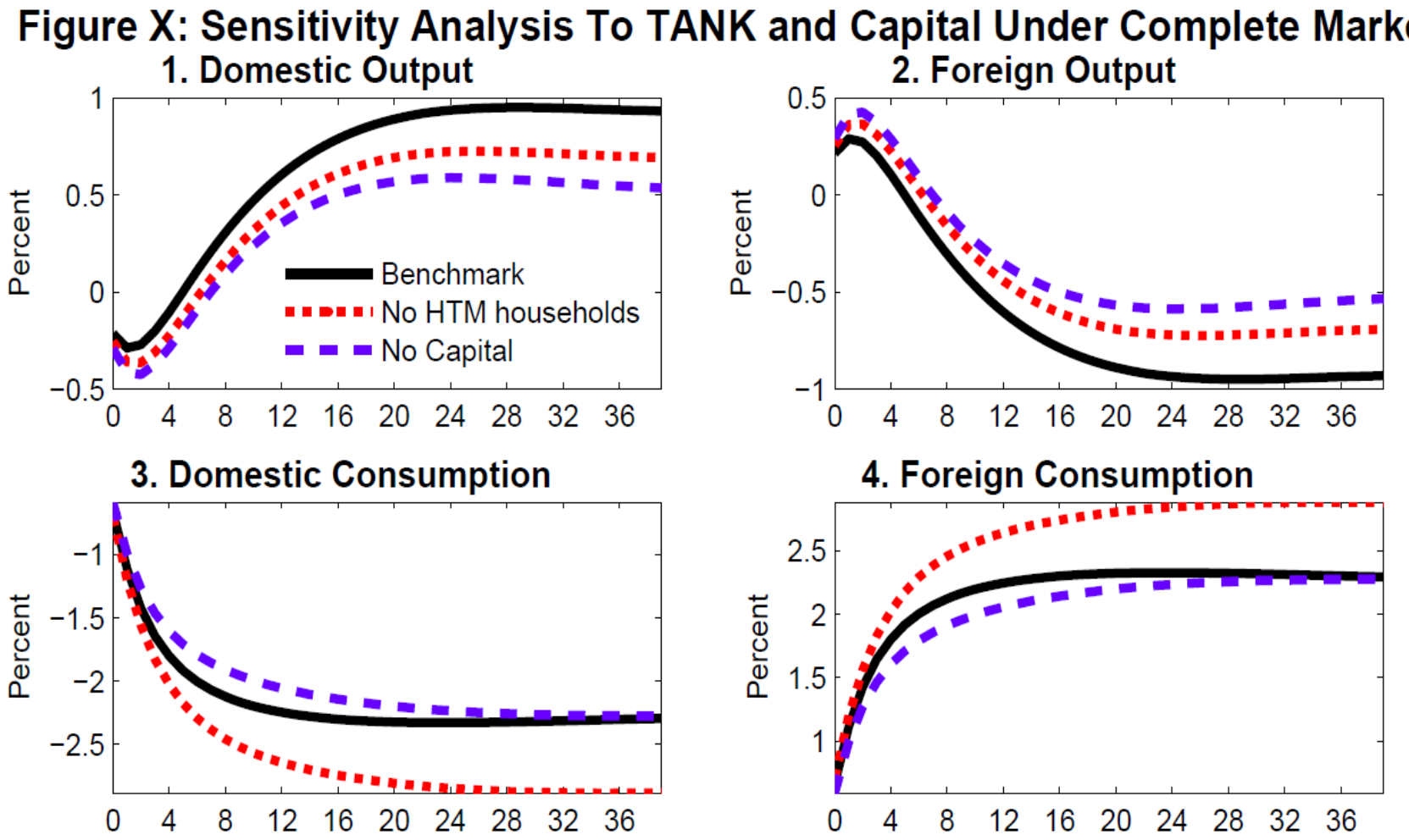






LCP, ERPT = TPT, Permanent and unanticipated 10 p.p. import tariff and export subsidy shock

Permanent deviations from Lerner: Sensitivity (CM)



LCP, ERPT = TPT

Trade Wars

- Simulate the effects of Trade Wars in Home and Foreign economies under two alternative assumptions about retaliation
- First case, "Asymmetric" retaliation: Foreign economy imposes a 20 percent tariff in foreign country
  - IM: foreign suffers the most
  - CM: symmetric effects
- Second case, "Fully symmetric" retaliation: BAT in Foreign country as well
  - No effects at all (Lerner symmetry in IM case and cancelling of effects in CM case)

Trade Wars: Asymmetric retaliation

Deviations from LOP

$$\delta_t = -p_{M,t} + s_t + p^*_{X,t} + \tau_{M,t} - \tau^*_{X,t},$$

Home country

$$\Delta\delta_t = -\pi_{M,t} + \Delta s_t + \pi^*_{X,t} + \Delta\tau_{M,t} - \Delta\tau^*_{X,t}.$$

Foreign country

$$\Delta\delta^*_t = -\pi^*_{M,t} - \Delta s_t + \pi_{X,t} + \Delta\tau^*_{M,t} - \Delta\tau_{X,t}.$$

Experiment is to simulate $\Delta\tau_{X,t} = \Delta\tau_{M,t} = 10, \Delta\tau^*_{M,t} = 2\Delta\tau_{M,t}$, and $\Delta\tau^*_{X,t}$=0

Trade Wars: Fully symmetric retaliation

Deviations from LOP

$$\delta_t = -p_{M,t} + s_t + p^*_{X,t} + \tau_{M,t} - \tau^*_{X,t},$$

Home country

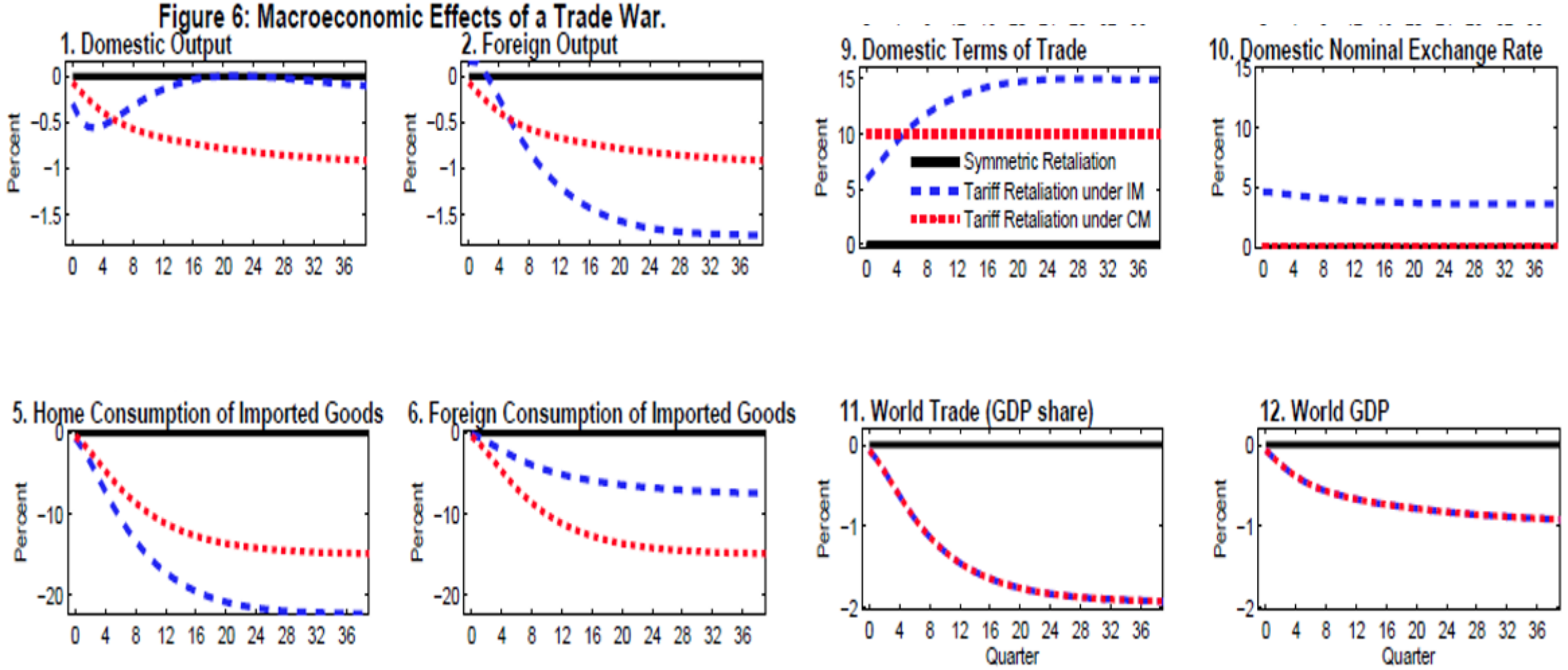
$$\Delta\delta_t = -\pi_{M,t} + \Delta s_t + \pi^*_{X,t} + \Delta\tau_{M,t} - \Delta\tau^*_{X,t}.$$

Foreign country

$$\Delta\delta^*_t = -\pi^*_{M,t} - \Delta s_t + \pi_{X,t} + \Delta\tau^*_{M,t} - \Delta\tau_{X,t}.$$

Experiment is to simulate $\Delta\tau^*_{M,t} = \Delta\tau_{M,t} = 10$ and $\Delta\tau^*_{X,t} = \Delta\tau_{X,t} = 10$

The effects of Trade Wars in model

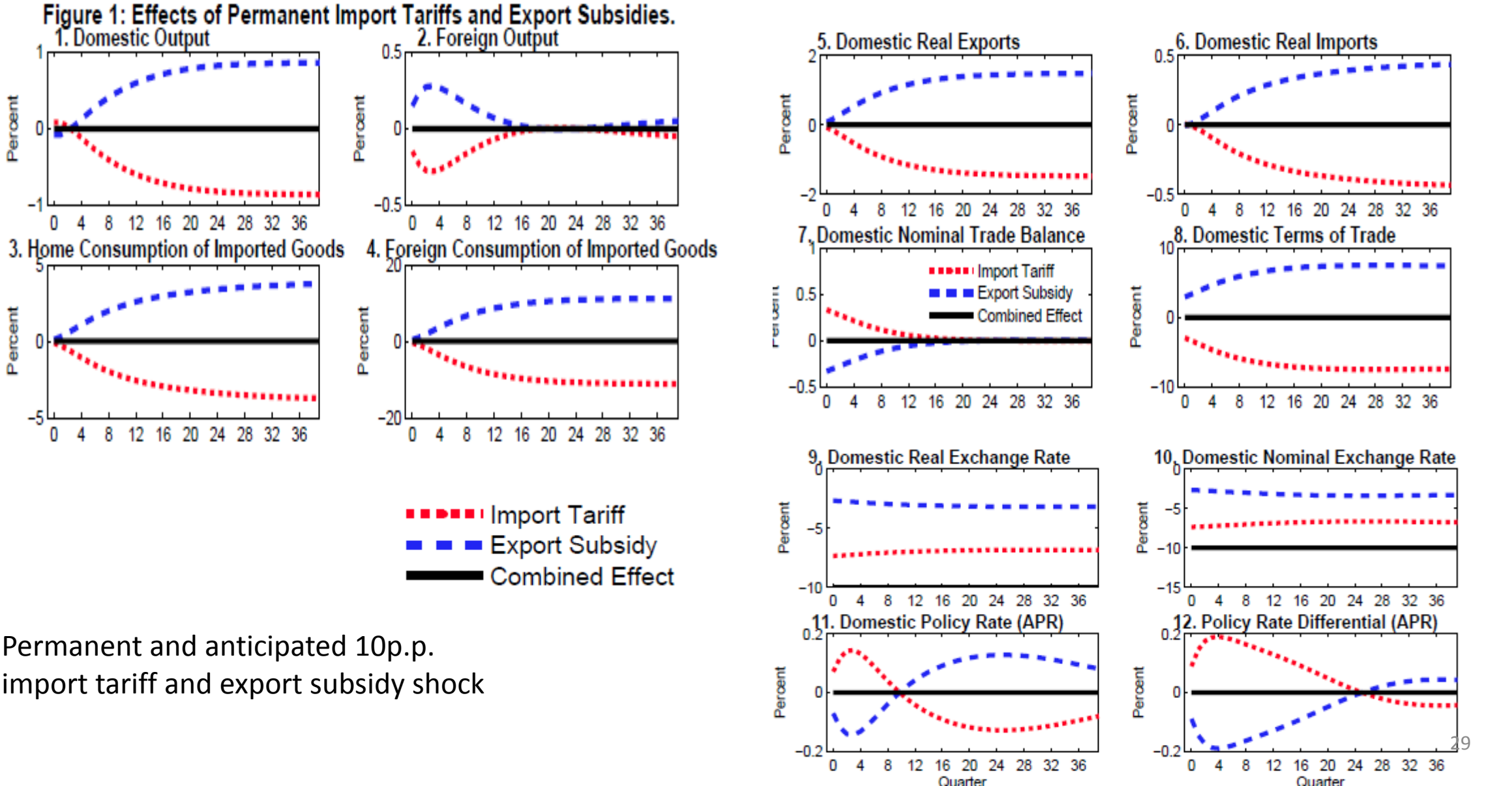


Conclusions

1) Modest transient deviations from Lerner symmetry when trade reforms are anticipated or exchange rate adjustment is gradual
   - Global trade and output NOT affected
2) More substantial near-term deviations from Lerner under asymmetric pricing assumptions and NER pegs
   - NER pegs: Global trade and output potentially strongly adversely affected
3) Long-term effects may be substantial under complete markets
   - Fall in domestic consumption but increase in domestic output
   - Global trade and output NOT affected (redistribution among H and F only)
   - Capital and HTM amplify effects
4) Macroeconomic costs of Trade Wars can be substantial under both IM and CM
   - But also benign outcome possible: Adverse impact on H and F countries can be offset by fully symmetric retaliation (at zero budget cost)

Extra slides

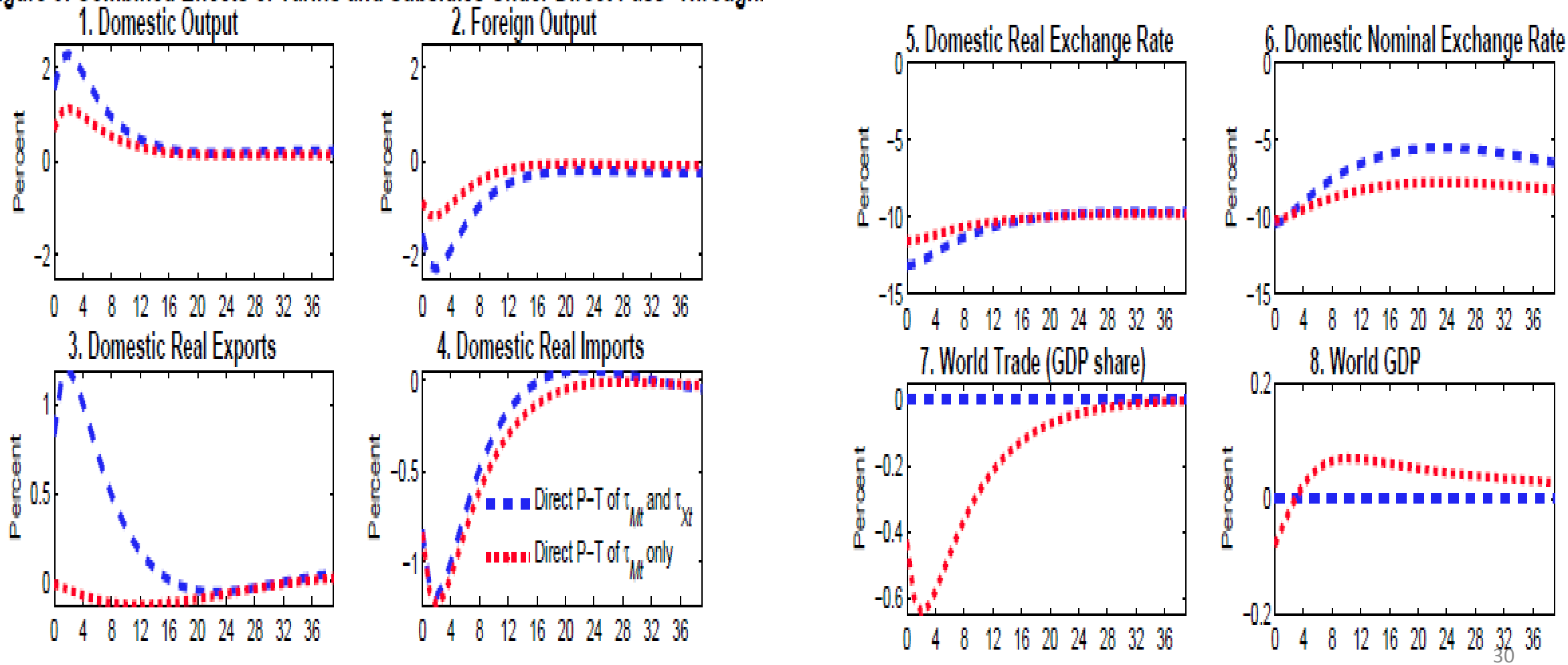
Effects of tariff and subsidy: Lerner symmetry



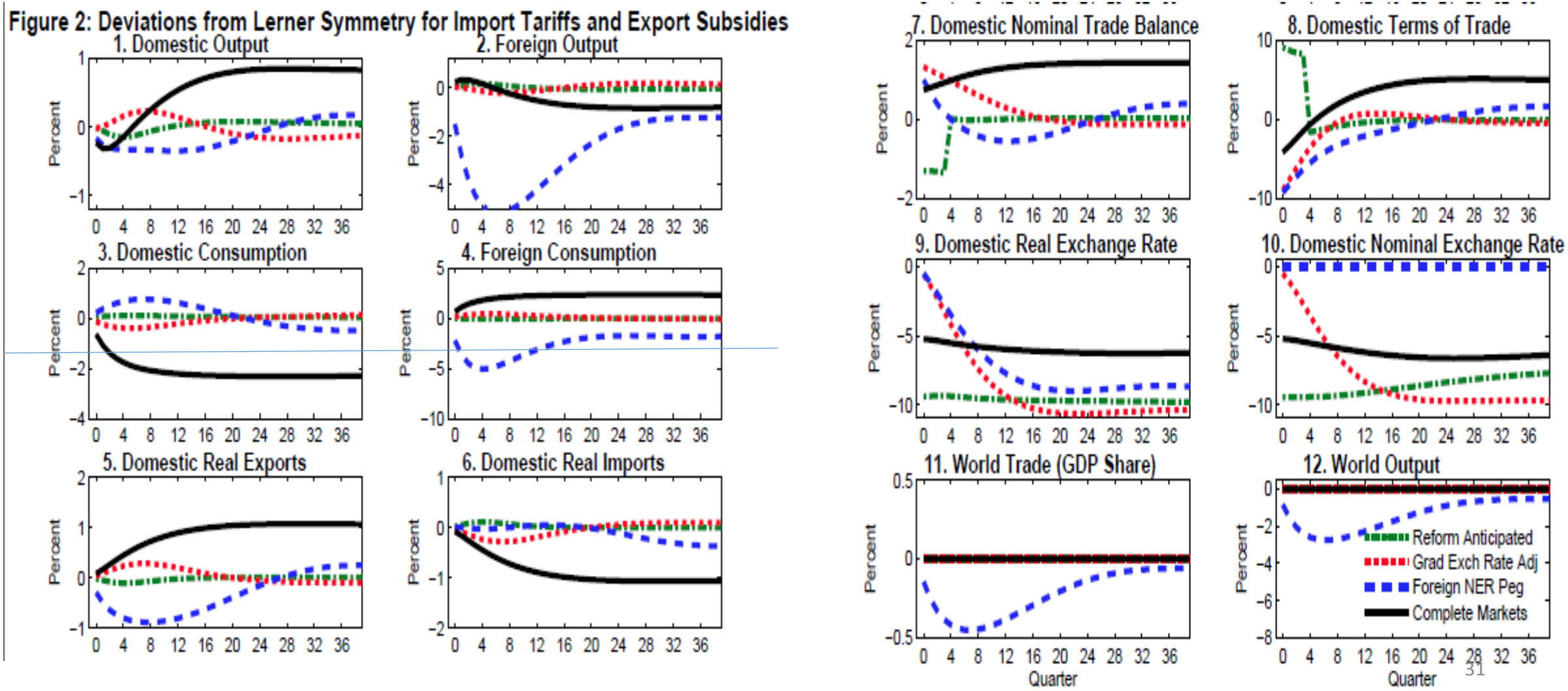
Permanent and anticipated 10p.p.
import tariff and export subsidy shock

Transient deviations from Lerner:
Asymmetric pass through

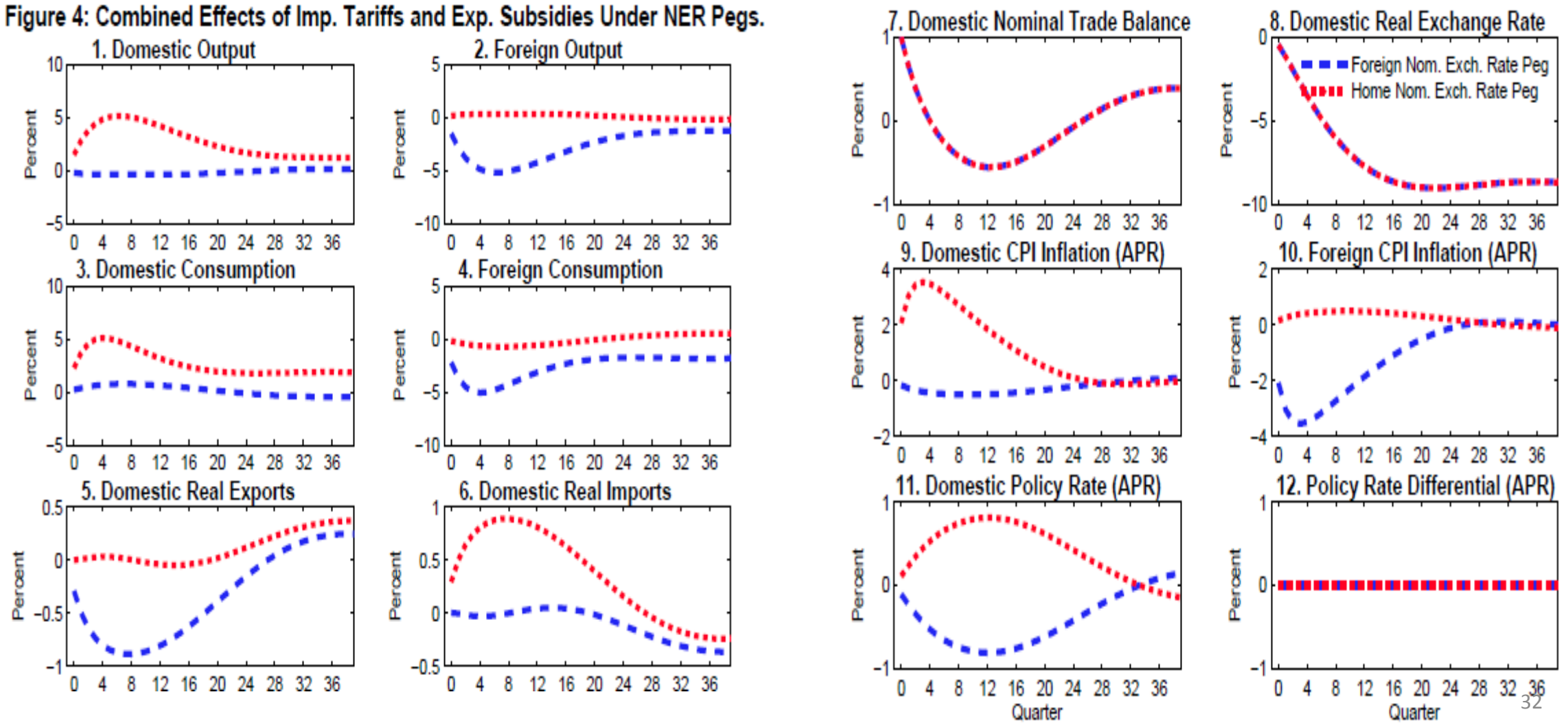
Figure 5: Combined Effects of Tariffs and Subsidies Under Direct Pass-Through.



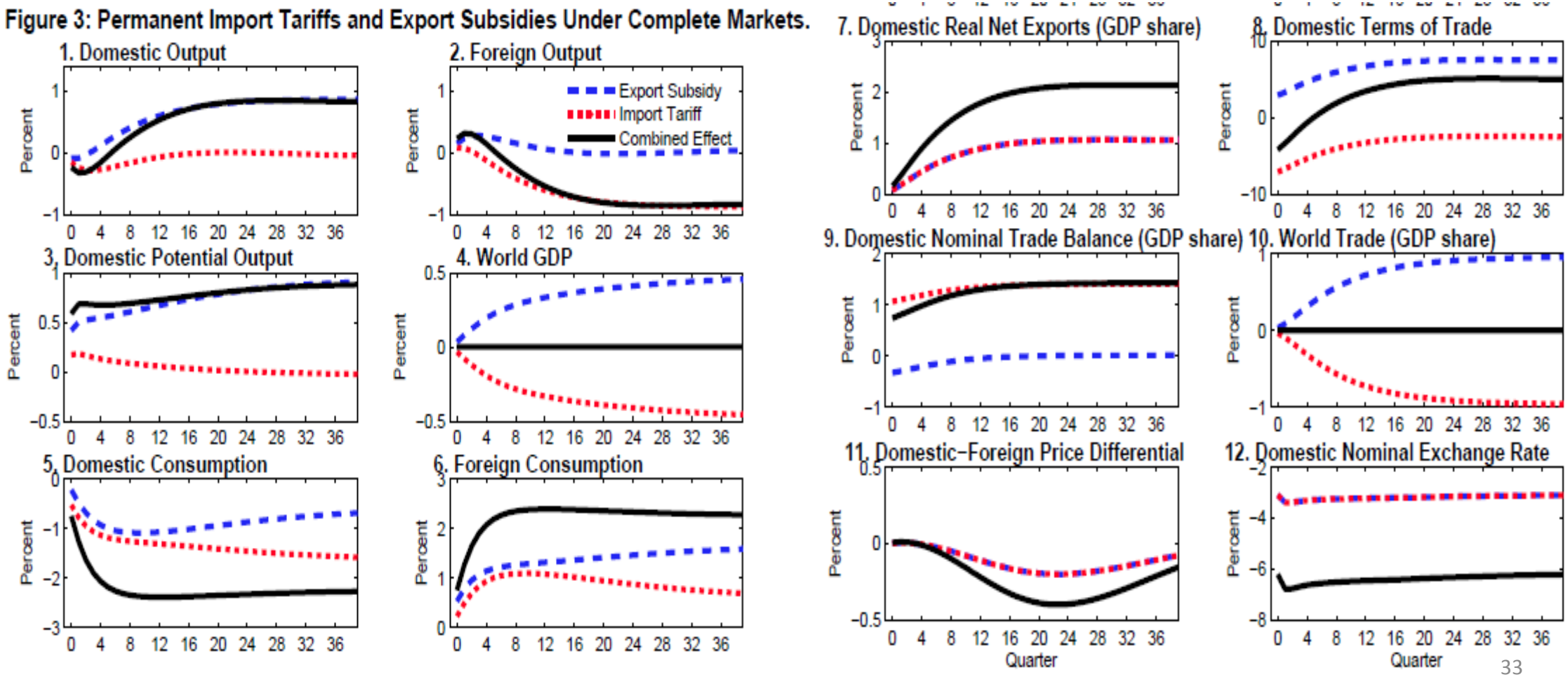
Quantifying deviations from Lerner: Anticipation, Grad exch. rate adj., For NER peg



Transient deviations from Lerner:
Digging Deeper into Currency Pegs



Permanent deviations from Lerner: Quantifying effects of CM



The effects of Trade Wars in model