THE OPTIMAL MONETARY POLICY RESPONSE TO TARIFFS

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  - Tighten monetary policy to contain inflationary pressures, or...
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Jay Powell pushes back on calls for Federal Reserve rate cuts as soon as July

US central bank chair tells congressional committee economy remains ‘solid’ but tariffs could push up prices

Jay Powell has been under fire from the US president over the Federal Open Market Committee’s decision to keep interest rates on hold © Mark Schiefelbein/AP

Top Federal Reserve official calls for rate cuts as soon as July

Governor Chris Waller says US has yet to see an inflation ‘shock’ from Donald Trump’s tariffs

Christopher Waller joined the Fed’s policy-setting panel in 2020 after being nominated by Donald Trump during his first term as president © Bloomberg

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This paper:

- Optimal monetary policy response to tariffs is **expansionary**

Preview

- Open-economy New Keynesian model with home and importable goods
  - Macroeconomic effects depend on monetary policy

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flex-price allocation

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    $\neq$ terms-of-trade shock

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Output gap can be positive in response to tariff

≠ textbook cost-push shock

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- Extensions: ex/endogenous TOT, intermediates, temporary/permanent

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- Monetary authority: sets monetary policy optimally, taking as given tariffs $\{\tau_t\}$

Households

- Preferences

$$\sum_{t=0}^{\infty} \beta^t \left[U(c_t^h, c_t^f) - v(\ell_t) \right]$$

$$U(c_t^h, c_t^f) = \frac{\sigma}{\sigma - 1} \left[\omega (c_t^h)^{1-\frac{1}{\gamma}} + (1-\omega)(c_t^f)^{1-\frac{1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1} \frac{\sigma-1}{\sigma}}, \quad v(\ell_t) = \omega \frac{\ell_t^{1+\psi}}{1+\psi}$$

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- Budget constraint:

$$P_t^h c_t^h + P_t^f (1 + \tau_t) c_t^f + \frac{e_t b_{t+1}}{R^*} + \frac{B_{t+1}}{R_t} = e_t b_t + B_t + W_t \ell_t + T_t + D_t$$

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- Law of one price (before tariffs): $P_t^h = e_t P_t^{h*}$, $P_t^f = e_t P_t^{f*}$
- Terms-of-trade exogenous $p \equiv \frac{P_t^{f*}}{P_t^{h*}}$ $\Leftarrow$ Limit case w/ export elasticity $= \infty$

Firms

- Final good

$$Y_t = \left(\int_0^1 y_{jt}^{\frac{\varepsilon - 1}{\varepsilon}} \, dj \right)^{\frac{\varepsilon}{\varepsilon - 1}}$$

- Intermediate goods

$$y_{jt} = \ell_{jt}$$

  - Monopolistically competitive with Rotemberg price adjustment costs
  - Constant subsidy to correct markup distortion

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  - Dividends:

$$\frac{D_t}{P_t^h} = (1+s)\, y_t - \frac{W_t}{P_t^h} \ell_t - \Upsilon \frac{\varphi}{2} \pi_t^2 y_t, \quad \text{with } \Upsilon \in (0,1)$$

Fraction Υ of price adjustment costs are deadweight losses (rest is rebated)

$\pi_t \equiv P_t^h / P_{t-1}^h - 1$ is PPI inflation

Competitive Equilibrium

Given b_0, a government policy $\{\tau_t, s, T_t\}$, and monetary policy $\{R_t\}$, a competitive equilibrium is a set of allocations $\left\{b_{t+1}, c^f_{t+1}, c^h_{t+1}\right\}$ and prices $p, \left\{P^h_t, e_t, W_t\right\}$ such that

1. Households optimize + Firms optimize
2. Government budget constraint holds: $\tau_t p\, c^f_t = \frac{T_t}{P^h_t} + s\, y_t$
3. Labor markets clear $\ell_t = \int_0^1 \ell_{jt}\, dj$

Country budget constraint:

$$\underbrace{\left(1 - \Upsilon \frac{\varphi}{2} \pi^2\right) \ell_t - c^h_t}_{\text{exports}} - \underbrace{p c^f_t}_{\text{imports}} = \underbrace{\frac{b_{t+1}}{R^*} - b_t}_{\text{capital outflows}}$$

Competitive equilibrium

$$(1+\pi_t)\pi_t = \frac{\varepsilon}{\varphi}\left[\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} - 1\right] + \frac{1}{R^*}\frac{\ell_{t+1}}{\ell_t}(1+\pi_{t+1})\pi_{t+1}$$

$$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = p(1+\tau_t)$$

$$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$$

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- Tariffs: distort MRS $=p$ constraint
- Sticky prices: labor wedge & inflation costs

Two distortions

Competitive equilibrium $\tau = 0$

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Competitive equilibrium $\tau = 0$ (with $\pi_t = 0$)

$$0 = \frac{\varepsilon}{\varphi}\left[\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} - 1\right]$$

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Competitive equilibrium $\tau > 0$

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Proposition. Assume that $\beta R^* = 1, \tau_t = \tau$. Then, employment is given by

$$\ell_t(\tau) = \left[\frac{\Theta_\tau + \tau}{1+\tau}\left(\omega\Theta_\tau\right)^{\frac{\sigma-\gamma}{\gamma-1}}\right]^{\frac{1}{1+\sigma\psi}}, \qquad \Theta_\tau \equiv 1 + \left(\frac{1-\omega}{\omega}\right)^{\gamma}\left(p(1+\tau)\right)^{1-\gamma} > 1$$

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and

$$c_t^h(\tau) = \frac{1+\tau}{\Theta_\tau + \tau}\ell_t(\tau), \qquad c_t^f(\tau) = \frac{\Theta_\tau - 1}{p\left(\Theta_\tau + \tau\right)}\ell_t(\tau)$$

Are Tariffs Expansionary or Contracionary?

- Under look-through policy $\rightsquigarrow$ flex-price allocation

$$\frac{d\log \ell(\tau)}{d\tau} = -\overbrace{\frac{(\Theta_\tau - 1)}{(1+\sigma\psi)(1+\tau)(\Theta_\tau+\tau)\Theta_\tau}}^{>0}\left[\sigma\Theta_\tau + (\sigma-\gamma)\tau\right]$$

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- Three goods, two changes in relative prices:
  1. Substitution (c^f, ℓ)
     - Tariff reduces the real wage in terms of $c^f \Rightarrow$ substitution away from labor
  2. Substitution (c^f, c^h)
     - $\sigma > \gamma$ goods are Hicksian complements $\Rightarrow$ labor unambiguously falls
     - $\sigma < \gamma$ goods are Hicksian substitutes $\Rightarrow$ labor increases for large τ

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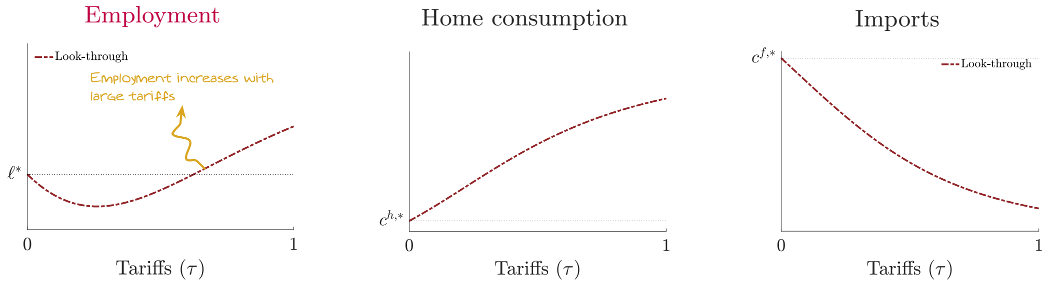
    - Consumption rebalancing towards c^h leads to $\downarrow u_h$, which implies in a flex-price eqm. a lower level of employment
  - For large τ, ambiguous.

Illustration: Hicksian Substitutes

$\sigma = 1/2,\ \gamma = 4$



Ramsey Optimal Monetary Policy

$$\max_{\pi_t, b_{t+1}, \ell_t, c_t^f, c_t^h} \sum_{t=0}^{\infty} \beta^t \Big[u(c_t^h, c_t^f) - v(\ell_t) \Big],$$

$$\text{s.t.} \quad c_t^h + p\, c_t^f + \frac{b_{t+1}}{R^*} = b_t + \ell_t \left(1 - \Upsilon \frac{\varphi}{2} \pi_t^2\right),$$

$$\frac{u_f(c_t^h c_t^f)}{u_h(c_t^h c_t^f)} = p\,(1 + \tau_t),$$

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Sticky prices induce costs only from output gap (will relax later)

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Fiscal Externality

Households "indirect utility" as a function of c^f

$$\mathbf{W}(c^f;\tau) \equiv u\Big(\mathbf{L}(c^f) + \mathbf{T}(c^f) - p(1+\tau)c^f, c^f\Big) - v\Big(\mathbf{L}(c^f)\Big)$$

employment $\frac{\Theta_\tau+\tau}{\Theta_\tau-1}pc^f$

revenue $p\tau c^f$

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- Optimality

$$\underbrace{-\frac{\partial \mathbf{L}}{\partial c^f}}_{<0}\overbrace{\left[1-\frac{v'(\ell)}{u_h(c^h,c^f)}\right]}^{\text{labor wedge must be negative}} = \underbrace{\frac{\partial \mathbf{T}}{\partial c^f}}_{\text{fiscal externality}>0}$$

Fiscal Externality

Households "indirect utility" as a function of c^f

$$\mathbf{W}(c^f;\tau) \equiv u\Big(\underbrace{\mathbf{L}(c^f)}_{\text{employment } \frac{\Theta_\tau+\tau}{\Theta_\tau-1} p c^f} + \underbrace{\mathbf{T}(c^f)}_{\text{revenue } p\tau c^f} - p(1+\tau)c^f, c^f\Big) - v\Big(\mathbf{L}(c^f)\Big)$$

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- Households do not internalize that $\uparrow c^f$ raises tariff revenue and agg. income
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employment $\frac{\Theta_\tau+\tau}{\Theta_\tau-1}pc^f$ revenue $p\tau c^f$

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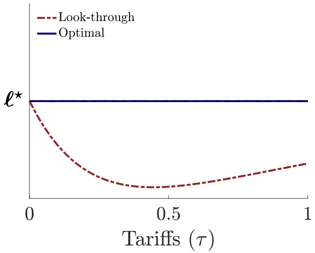
- Households do not internalize that $\uparrow c^f$ raises tariff revenue and agg. income
  - Optimal policy tries to mitigate externality by stimulating employment
- Without fiscal rebate: flex-price allocation is efficient $\Rightarrow$ zero labor wedge and $\pi_t = 0$

When Are Tariffs Cost-Push Shocks?

Illustration with $\gamma = 4$

(b) $\sigma = 1$

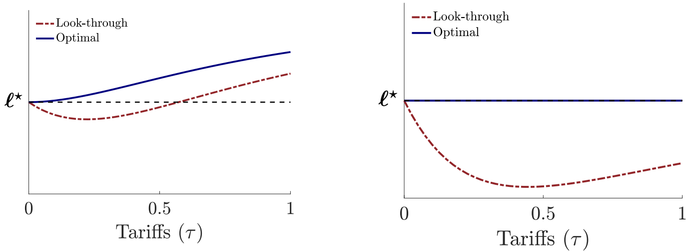


- keeps employment at the efficient level — it falls under look-through

When Are Tariffs Cost-Push Shocks?

Illustration with $\gamma = 4$

(a) $\sigma = 0.5$ (b) $\sigma = 1$



- employment increases (positive output gap) in response to tariffs

$\neq$ textbook cost-push shock

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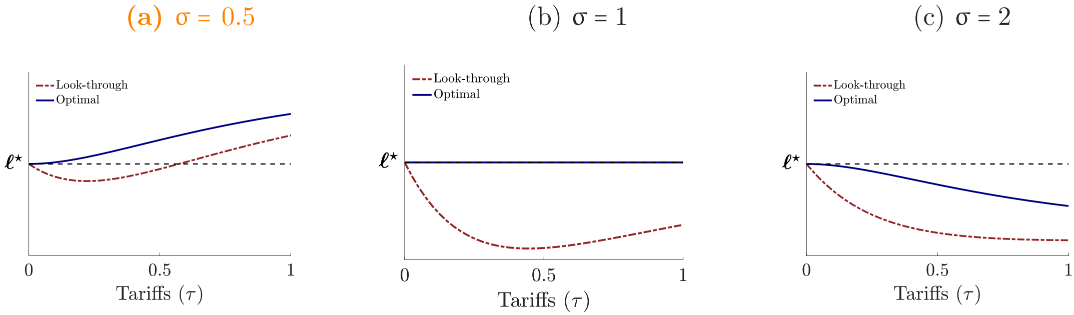

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Quantitative Analysis

Standard NK assumption: price adjustment costs are not rebated, $\Upsilon = 1$

- With $\Upsilon = 0$, optimal policy generates a permanent output boom and inflation
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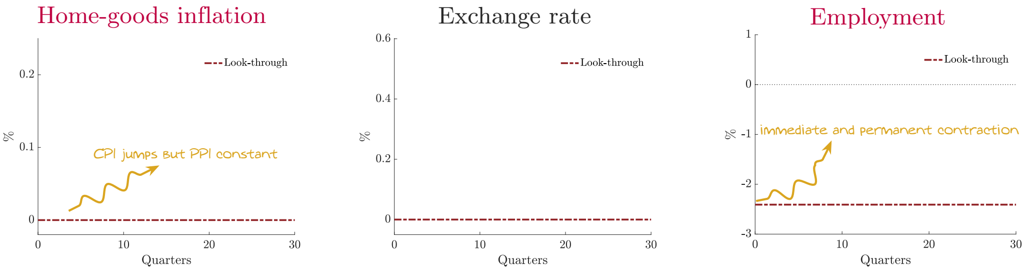
- With $\Upsilon = 0$, optimal policy generates a permanent output boom and inflation
- With $\Upsilon > 0$, optimal policy remains expansionary:
  - Starting from $\pi = 0$, costs of stimulating are second order, but there are first-order gains from mitigating fiscal externality
  - Stimulus only in the short-run $\Leftarrow$ inflation in the long-run is too costly

Calibration

Parameter	Description	Value
β	Discount factor	0.99
γ	Elasticity between h and f	4
σ	Intertemporal elasticity	0.5
ψ	Inverse Frisch elasticity	1
ε	Elasticity of substitution (varieties)	6
φ	Price-adjustment cost	$3,272$

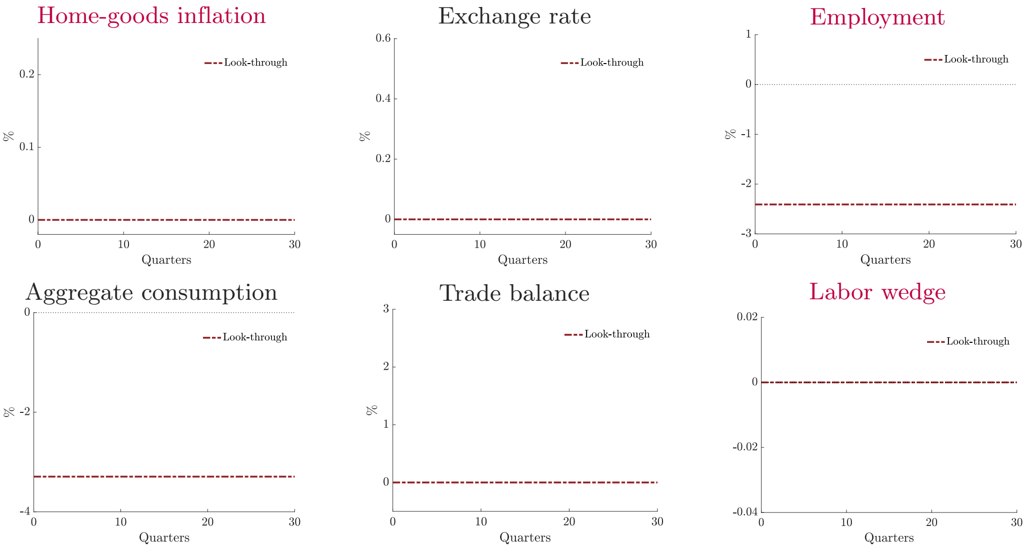
- Target: slope of PC=0.0055 (Hazell et al.) & ratio of imports to tradable GDP
- Baseline tariff: $\tau_t = 15\%$
- Non-linear impulse response

Permanent Tariff: Look-through



Inflation is annualized. Consumption, employment and the exchange rate are expressed in percentage deviation from the pre-tariff allocation. Trade balance are expressed as a fraction of GDP.

Permanent Tariff: Look-through vs. Optimal Policy



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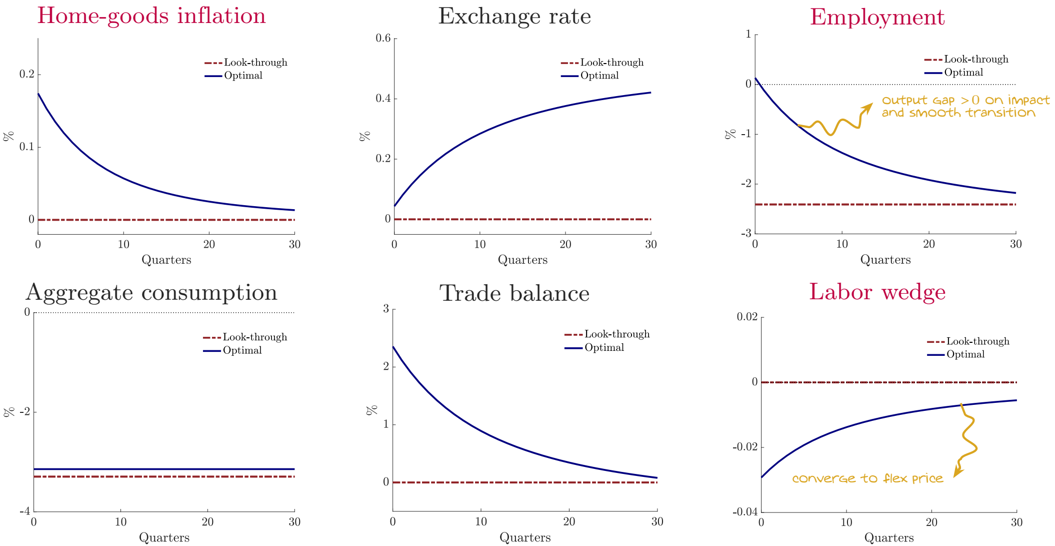

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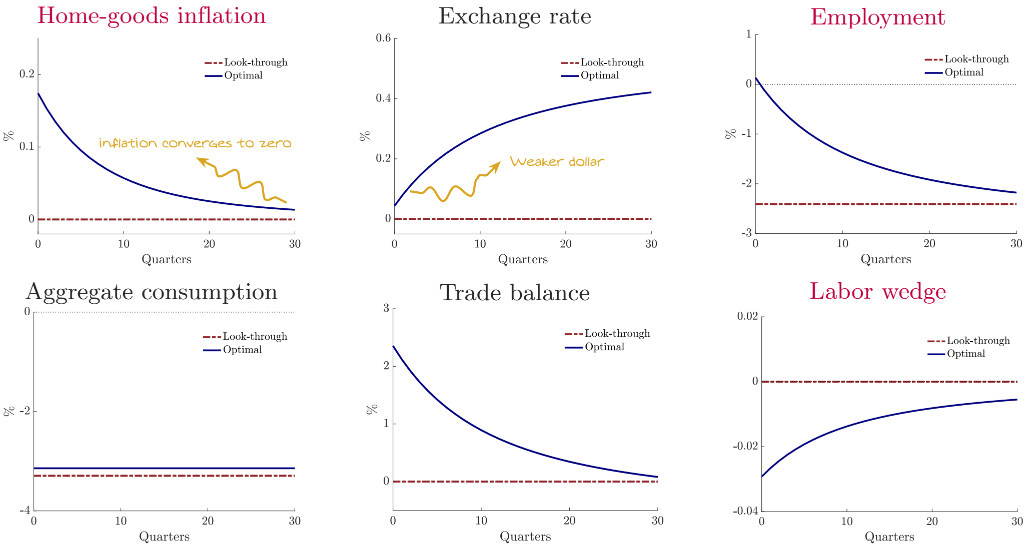

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Additional Results

- Permanent shocks vs transitory ⏩ Details
- Anticipated shocks: ⏩ Details
  - Respond today, but less strongly
  - Trade deficit on impact
- PPI vs. CPI Targeting ⏩ Details

In the Paper

- Main extensions Next
  i) Endogenous Terms-of-Trade
  ii) Intermediate inputs
  iii) Distorted steady state

Endogenous Terms-of-Trade

- Continuum of open economies where c^f is a CES composite of goods produced abroad

$$c_{it} = \left[\omega\left(c_{it}^h\right)^{1-\frac{1}{\gamma}} + (1-\omega)\left(c_{it}^f\right)^{1-\frac{1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}},$$

$$c_{it}^f = \left(\int_0^1 \left(c_{it}^k\right)^{1-\frac{1}{\theta}} dk\right)^{\frac{\theta}{\theta-1}}$$

- Export demand for home good

$$p_t = A(y_t - c_t^h)^{\frac{1}{\theta}} \qquad \Leftarrow \text{Baseline } \theta = \infty$$

- Optimal tariff is positive $\tau^* = \frac{1}{\theta-1}$ with $\theta > 1$

Endogenous Terms-of-Trade

Analytical results: no deadweight loss from price adjustment $\Upsilon = 0$

Proposition. Assume that $\beta R^{\star} = 1$, $\Upsilon = 0$, $\tau_t = \tau^{\star} + \Delta\tau$. Then, the labor wedge ($\wp$) under the optimal policy is given by

$$\wp_t = -\left[1 + \frac{\theta - 1 + \gamma}{\theta} \frac{c^h}{pc^f}\right]^{-1} \frac{\Delta\tau}{1 + \tau^{\star}}$$

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- Starting from this efficient tariff, the optimal monetary policy is expansionary in response to a tariff increase implies [$\wp < 0$ if and only if $\Delta\tau > 0$]

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- Generally, the optimal monetary policy is *more* expansionary in response to an increase in tariff [$\wp'(\tau) < 0$]

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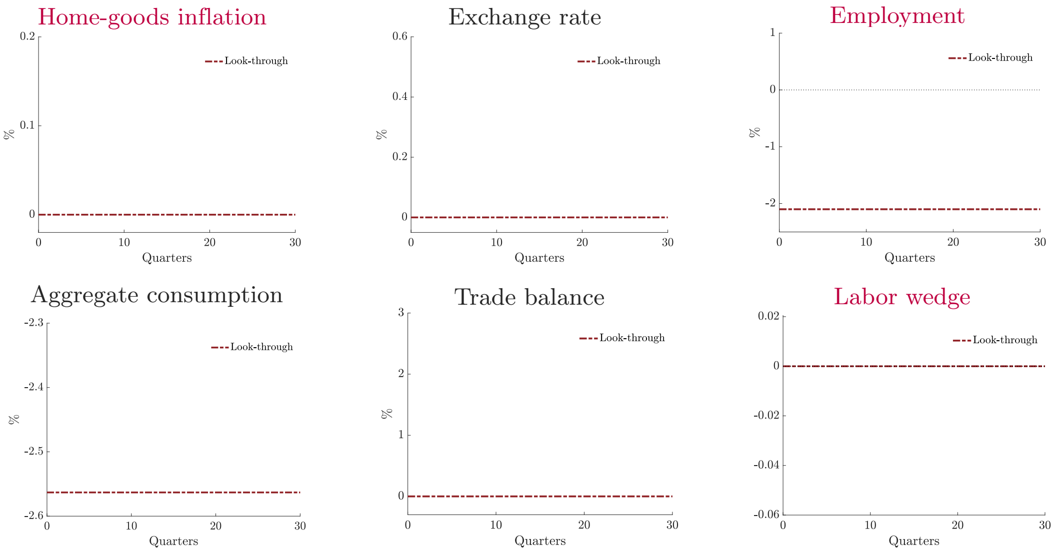
Quantitative results: $\Upsilon = 1$, $\theta = 10$ (Head and Ries, 2001)

Endogenous Terms-of-Trade



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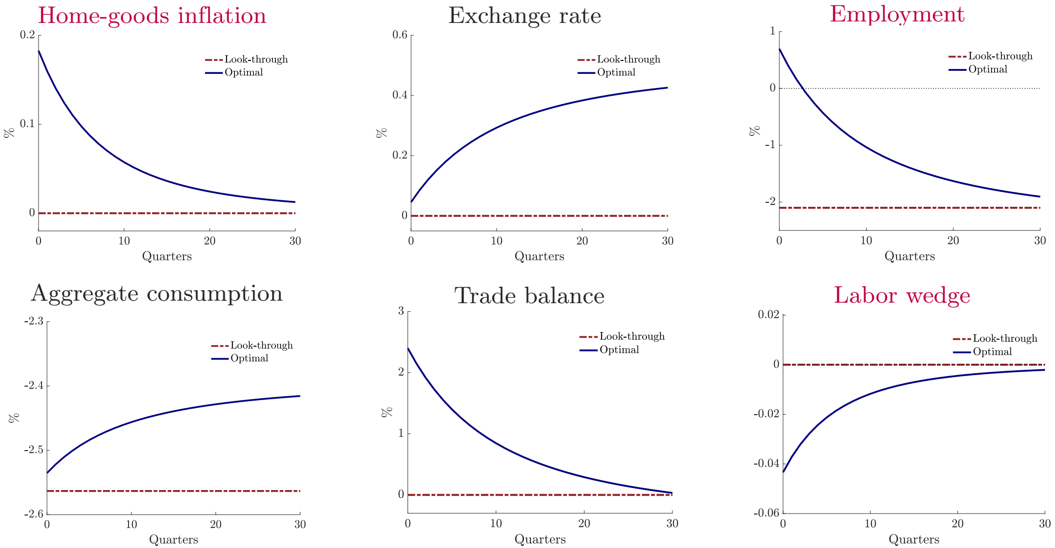


As in the baseline, optimal policy implies positive output gap and inflation

Tariffs on Imported Inputs

- Production of domestic varieties $y_{jt} = (\ell_{jt})^{1-\nu}(x_{jt})^{\nu}$
- NK Phillips curve:

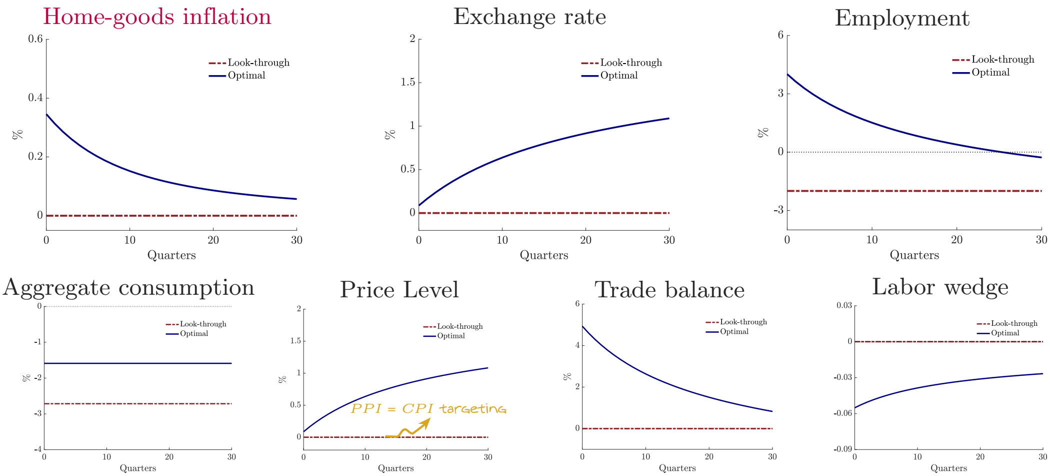
$$(1+\pi_t)\pi_t = \frac{\varepsilon}{\varphi}\left[mc_t - 1\right] + \frac{1}{R}\frac{y_{t+1}}{y_t}(1+\pi_{t+1})\pi_{t+1},$$

$$mc_t = \left[\frac{W_t}{(1-\nu)P_t^h}\right]^{1-\nu}\left[\frac{p(1+\tau_t^x)}{\nu}\right]^{\nu}$$

- Same as baseline: firms perceive cost of imported inputs to be larger than social one

  $\Rightarrow$ Optimal policy is stimulative

Tariff on Inputs Only



Calibrate ν, ω to match (i) share of intermediate inputs in total imports; (ii) imports-to-tradable GDP

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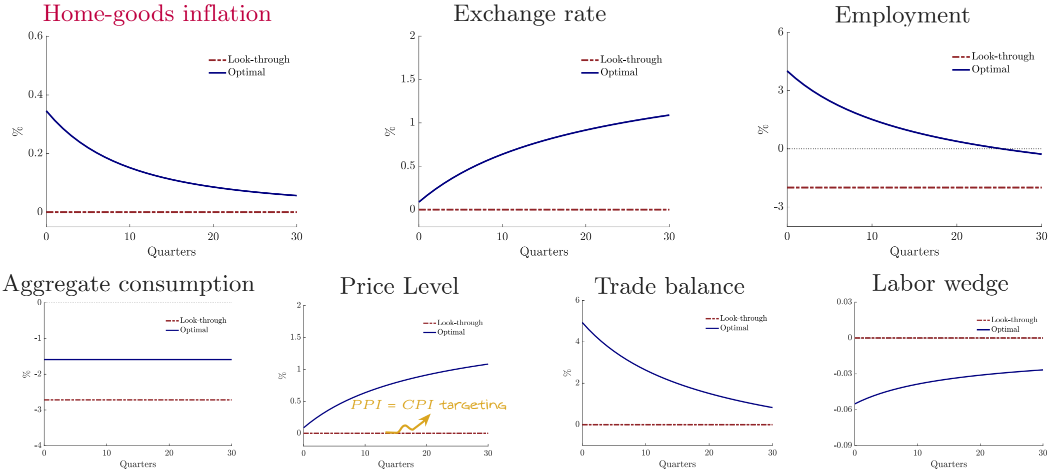

Calibrate ν, ω to match (i) share of intermediate inputs in total imports; (ii) imports-to-tradable GDP

- Tariffs on inputs and consumption ▸▸ results

Welfare

	Optimal Policy	Tariff loss Optimal pol.	Tariff loss look-through
Baseline	**0.01**	**0.99**	**1.00**
Anticipated tariffs	0.008	0.96	0.97
Endogenous TOT	0.007	0.68	0.69

Note: Welfare corresponds to permanent consumption equivalence (%).

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Baseline	0.01	0.99	1.00
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Endogenous TOT	0.007	0.68	0.69
Model w/ imported inputs			
Tariffs on c and x	**0.32**	**1.61**	**1.91**
Tariffs on c	0.01	1.00	1.01
Tariffs on x	0.22	0.59	0.80

Note: Welfare corresponds to permanent consumption equivalence (%).

The case with distorted steady state

- Baseline model: labor subsidy s is set to offset markup distortion

The case with distorted steady state

- Suppose we start at $s = 0$ and use tariff revenue to subsidize labor $P_t^f \tau_t c_t^f = s_t W_t \ell_t$
  - Unambiguous increase in employment
  - Output gap remains positive but rise in inflation is mitigated ▸ results

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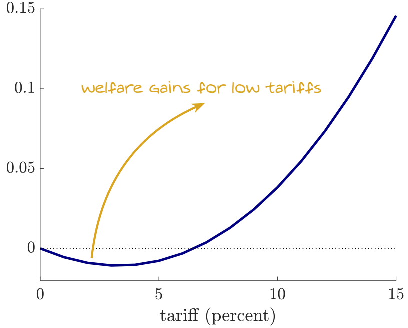
Welfare loss from tariffs



Note: All parameters are set to their baseline values.

Conclusions

- How should a monetary authority should respond to import tariffs?
- Optimal policy is to overheat economy: to offset fiscal externality, need monetary stimulus, letting inflation rise above and beyond the direct effects from tariffs

Conclusions

- How should a monetary authority should respond to import tariffs?
- Optimal policy is to overheat economy: to offset fiscal externality, need monetary stimulus, letting inflation rise above and beyond the direct effects from tariffs
- Ongoing/future work:
  - Discretion vs. commitment, richer supply chains, uncertainty, spillovers

Extra Slides

Efficient Allocation

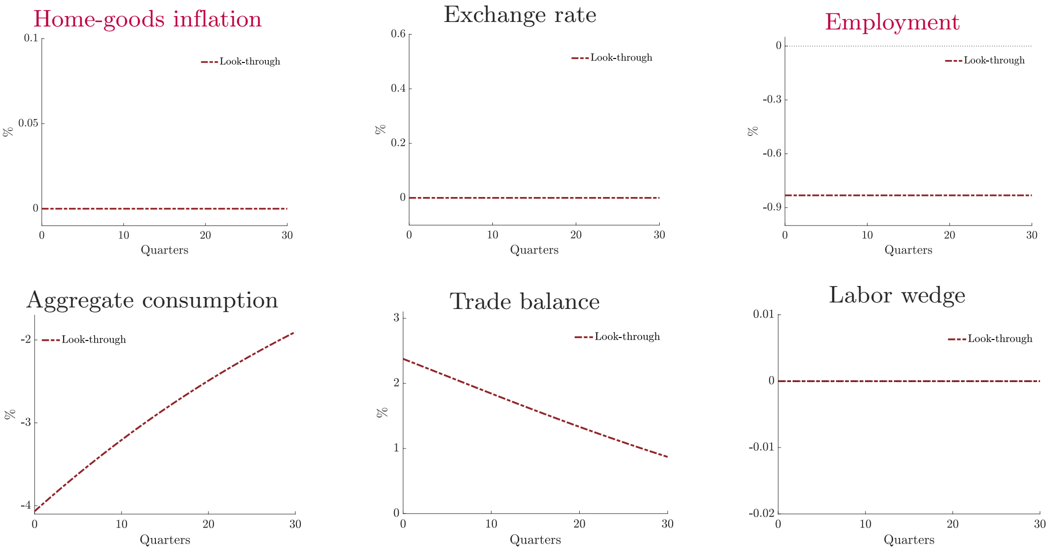
$$\max_{\left\{b_{t+1}, c_t^f, c_t^h, \ell_t\right\}} \sum_{t=0}^{\infty} \beta^t \left[u(c_t^h, c_t^f) - v(\ell_t)\right],$$

$$\text{s.t } c_t^h + p c_t^f + \frac{b_{t+1}}{R^*} = b_t + \ell_t.$$

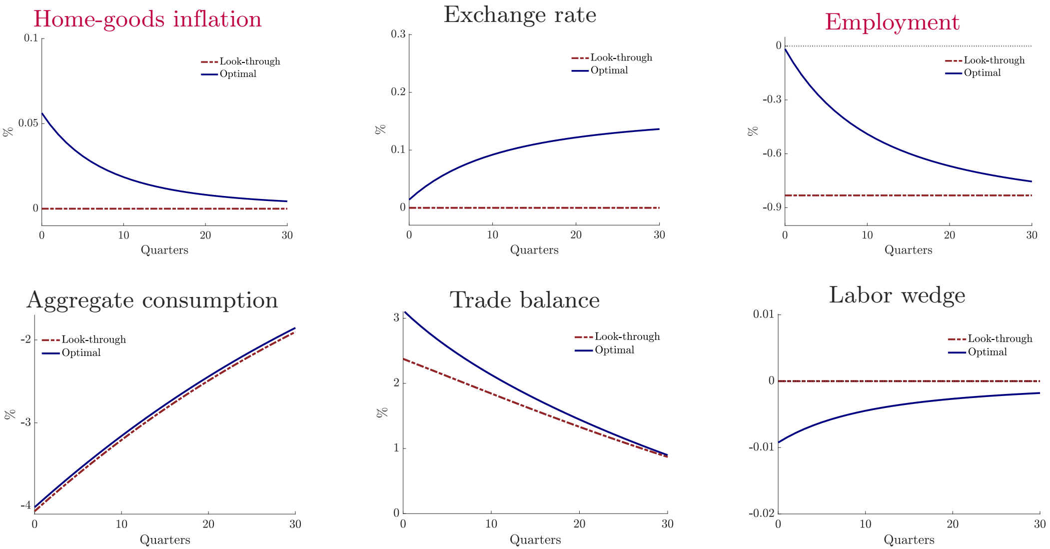
back

Temporary Tariff $\tau_t = 0.97 \cdot \tau_{t-1}$

▸ back

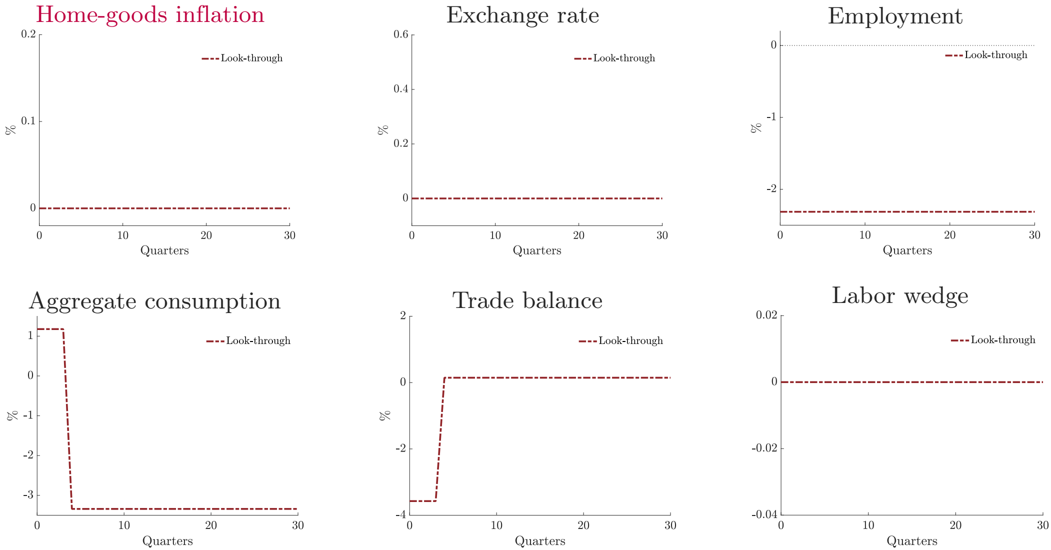


Temporary Tariff $\tau_t = 0.97 \cdot \tau_{t-1}$ ‣ back



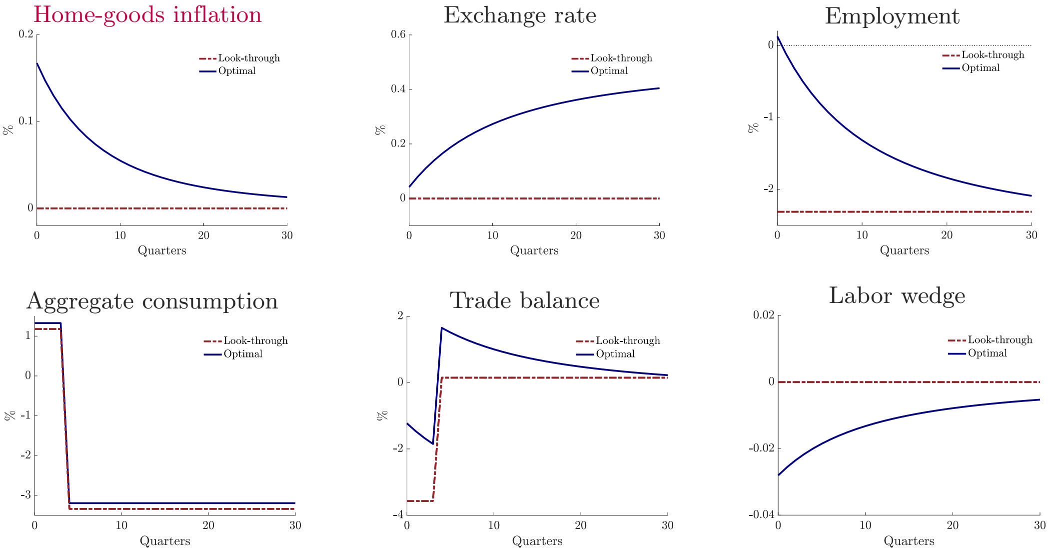
As in the case of a permanent tariff, optimal MP stimulates the economy

Anticipation Effects ▸ back



Anticipation Effects

▸ back

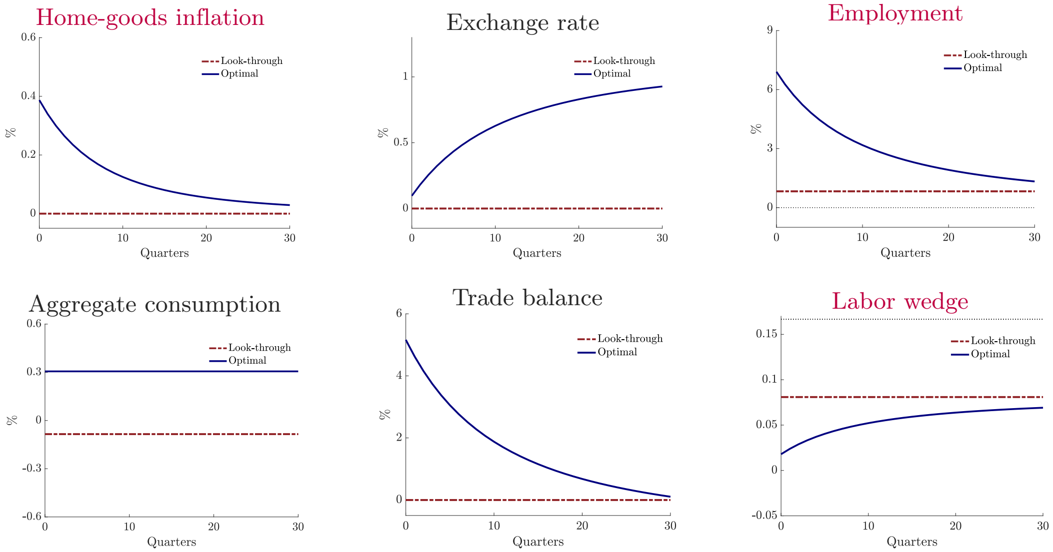


Distorted Steady State: Tariff Revenue to Subsidize Wage Bill

Employment rises under look-through

back

Distorted Steady State: Tariff Revenue to Subsidize Wage Bill

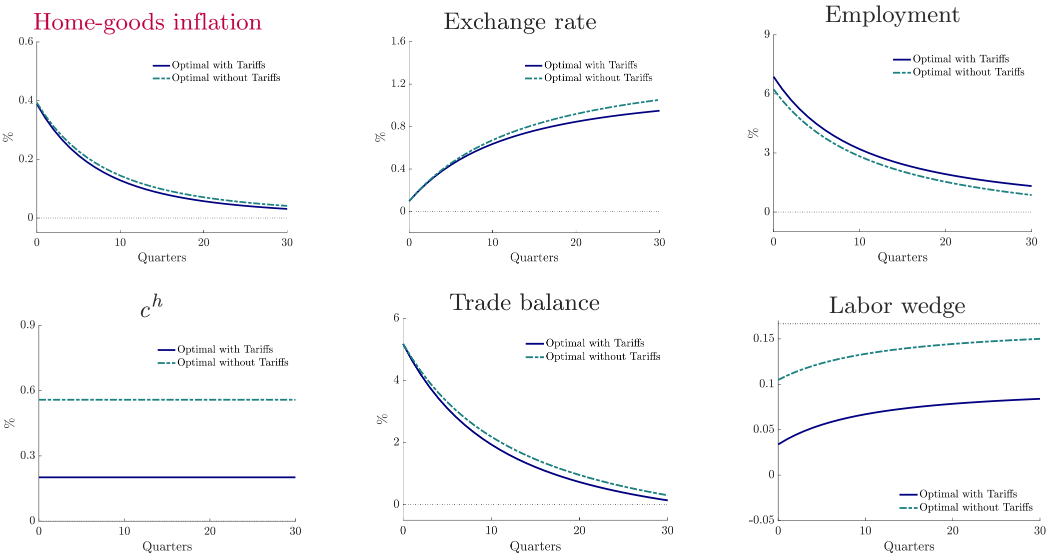


Effect of tariff and labor subsidy cancel out approx. on inflation

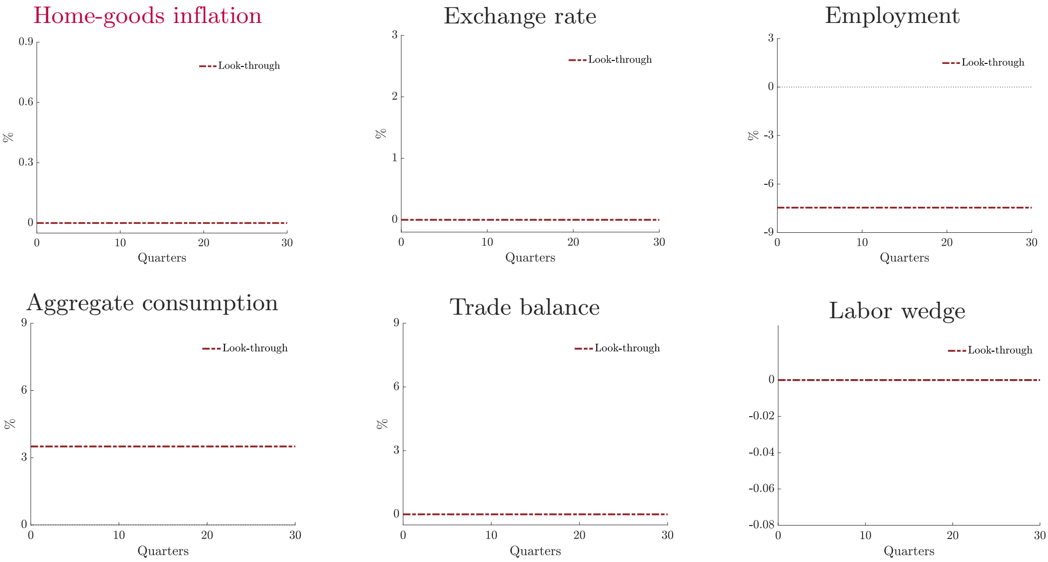
back

The Case with Distorted Steady State

back



Tariffs on Inputs and Consumption



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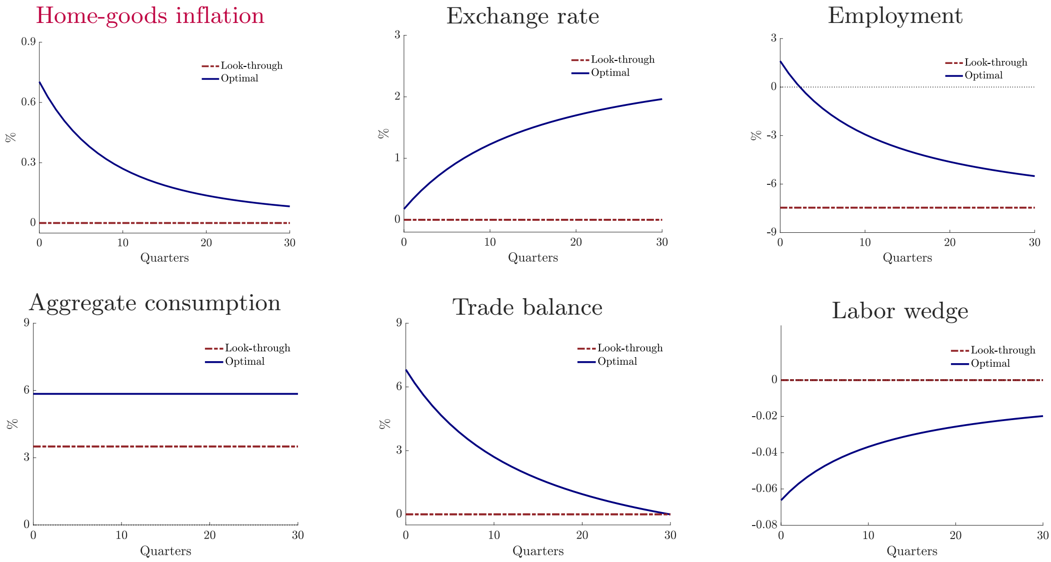
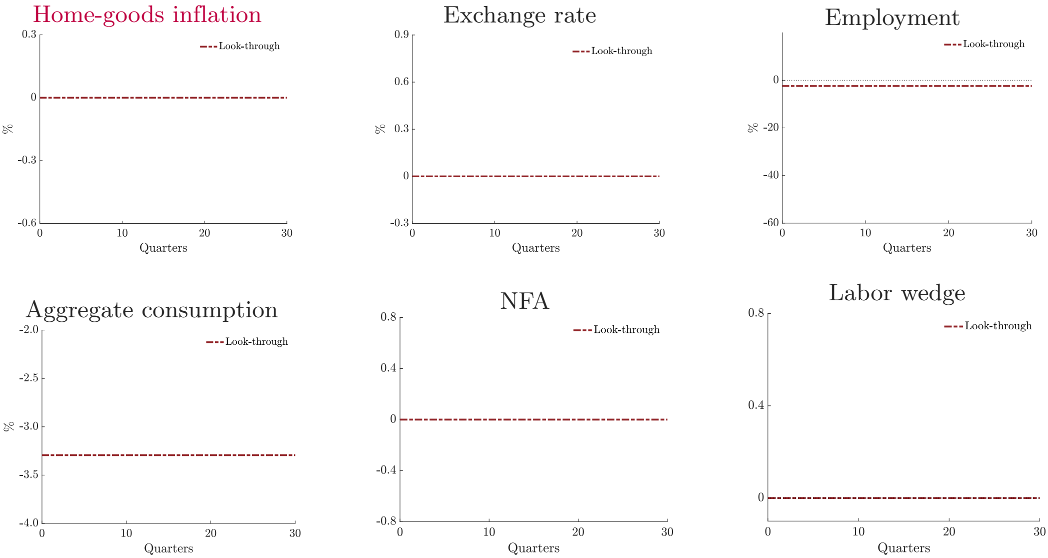
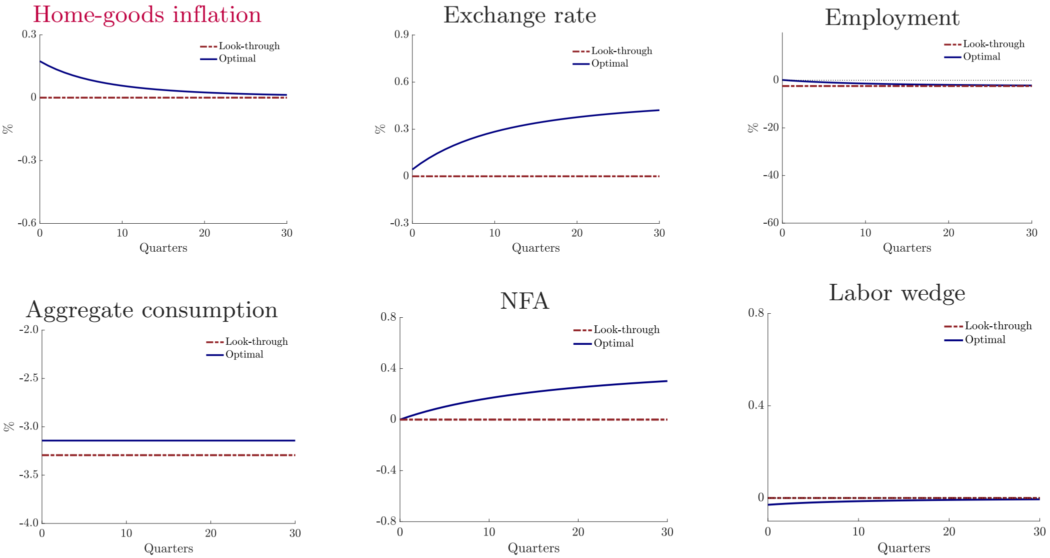


CPI Targeting Rule

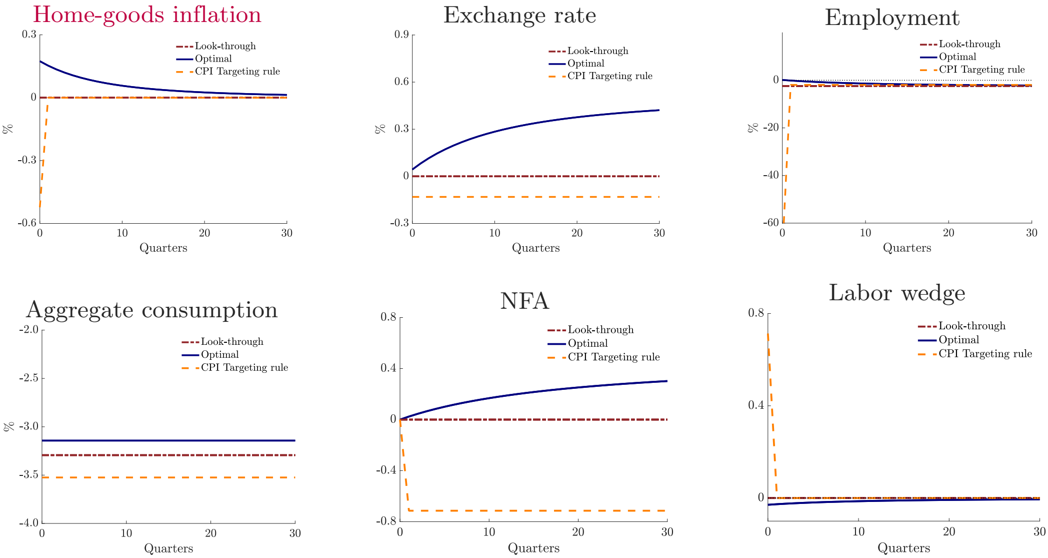
Permanent Tariff ▸ Back



Permanent Tariff ▸▸ Back

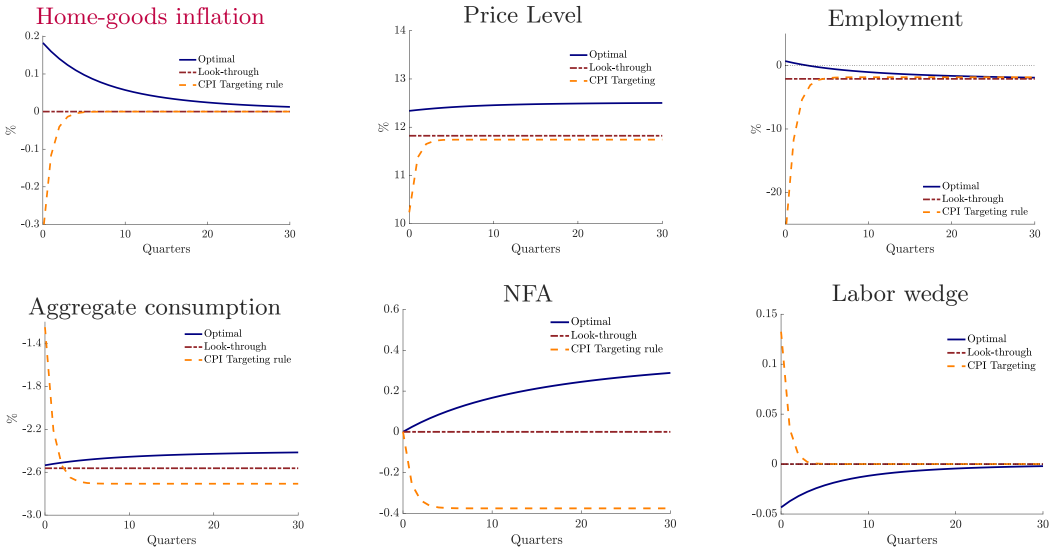


Permanent Tariff ▸▸ Back



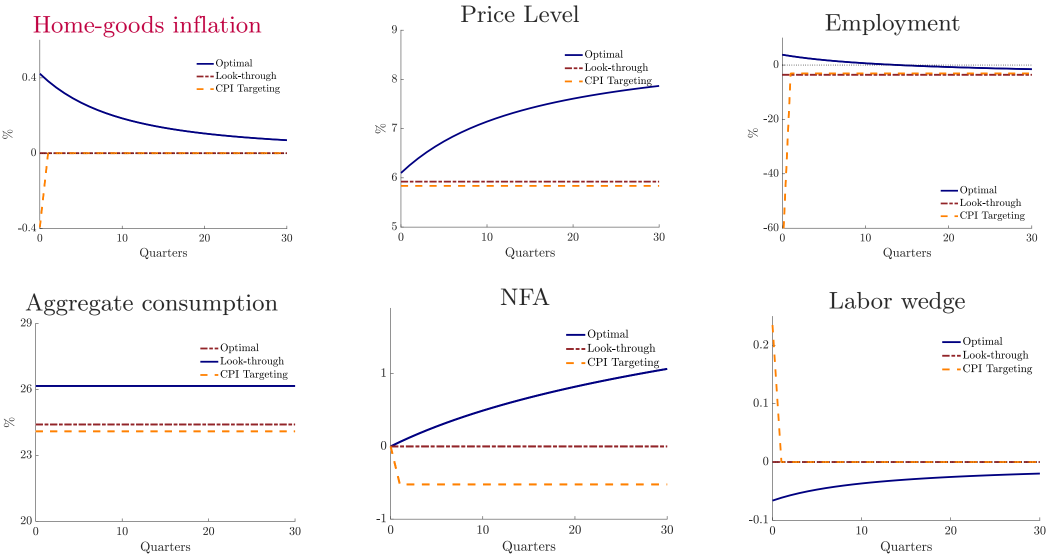
Endogenous Terms of Trade

Back



Model with Imported Inputs

Back



CPI vs PPI targeting ⏩ Back

- Consider now CPI targeting where the policy rate follows ⏩ impulse responses

$$R_t = \bar{R}_t \left(\frac{\mathcal{P}_t^c}{\mathcal{P}_{t-1}^c} \right)^{\phi_\pi} \quad \text{with} \quad \bar{R}_t \equiv R^* \frac{e_{t+1}}{\bar{e}_t} \quad \text{and} \quad \phi_\pi > 0$$

- $\phi_\pi = 0$ corresponds to "look-through policy" or PPI targeting (our benchmark)

CPI vs PPI targeting ⏩ Back

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- $\phi_\pi = 0$ corresponds to "look-through policy" or PPI targeting (our benchmark)

	Gains Optimal Policy			Losses from Tariffs		
	$\phi_\pi = 0$	$\phi_\pi = 1.5$	$\phi_\pi = 5$	$\phi_\pi = 0$	$\phi_\pi = 1.5$	$\phi_\pi = 5$
Baseline	**0.01**	**0.26**	**2.73**	**1.00**	**1.25**	**3.77**
Anticipated tariffs	0.008	0.26	0.67	0.97	1.22	1.64
Endogenous TOT	0.006	0.04	0.10	0.69	0.72	0.78
Model w/ imported inputs						
Tariffs on c and x	**0.32**	**0.61**	**0.85**	**1.91**	**2.21**	**2.48**
Tariffs on c	0.01	0.29	1.00	1.01	1.30	2.02
Tariffs on x	0.22	0.22	0.22	0.80	0.80	0.80

Tariff without Rebate

Competitive equilibrium

$$(1+\pi_t)\pi_t = \frac{\varepsilon}{\varphi}\left[\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} - 1\right] + \frac{1}{R^*}\frac{\ell_{t+1}}{\ell_t}(1+\pi_{t+1})\pi_{t+1}$$

$$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = p(1+\tau)$$

$$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$$

$$\left(1 - \Upsilon\frac{\varphi}{2}\pi_t{}^2\right)\ell_t - c_t^h - p(1+\tau)c_t^f = \frac{b_{t+1}}{R^*} - b_t$$

Efficient allocation

$$\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} = 1$$

$$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = p$$

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$$\ell_t - c_t^h - p\,c_t^f = \frac{b_{t+1}}{R^*} - b_t$$

Tariff without Rebate

Same eqm. conditions as with TOT shock $\rightarrow \widehat{p} \equiv p(1+\tau)$

Competitive equilibrium

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$$\ell_t - c_t^h - p\, c_t^f = \frac{b_{t+1}}{R^*} - b_t$$

Tariff without Rebate

Flex-price allocation ($\pi_t = 0$) coincides with efficient with different TOT

Competitive equilibrium	Efficient allocation
$0 = \frac{\varepsilon}{\varphi}\left[\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} - 1\right]$	$\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} = 1$
$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = \widehat{p}$	$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = p$
$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$	$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$
$\ell_t - c_t^h - \widehat{p} c_t^f = \frac{b_{t+1}}{R^*} - b_t$	$\ell_t - c_t^h - p c_t^f = \frac{b_{t+1}}{R^*} - b_t$

Tariff without Rebate

With a genuine rise in cost, optimal to let imports fall and set $\pi_t = 0$.

Competitive equilibrium	Efficient allocation
$0 = \frac{\varepsilon}{\varphi}\left[\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} - 1\right]$	$\frac{v'(\ell_t)}{u_h(c_t^h, c_t^f)} = 1$
$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = \widehat{p}$	$\frac{u_f(c_t^h, c_t^f)}{u_h(c_t^h, c_t^f)} = p$
$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$	$u_h(c_t^h, c_t^f) = \beta R^* u_h(c_{t+1}^h, c_{t+1}^f)$
$\ell_t - c_t^h - \quad \widehat{p}\, c_t^f = \frac{b_{t+1}}{R^*} - b_t$	$\ell_t - c_t^h - p\, c_t^f = \frac{b_{t+1}}{R^*} - b_t$