Supply Shocks, Network Propagation, and Inflation Persistence

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Outline of the Presentation

Questions	Section
1a. How persistent is inflation?	Data + Model
1b. Are tariff effects mostly behind us?	Tariffs: 2025 vs 2026
2a. What drove post-pandemic inflation?	Lessons from 2021
2b. Which mechanisms make it persistent?	Networks

Bottom line: inflation can be **persistent without being permanent**.

Transitory cost shocks become **persistent through production networks** and staggered pass-through, not necessarily through a shift in trend inflation.

Why do supply shocks produce persistent inflation under global networks?

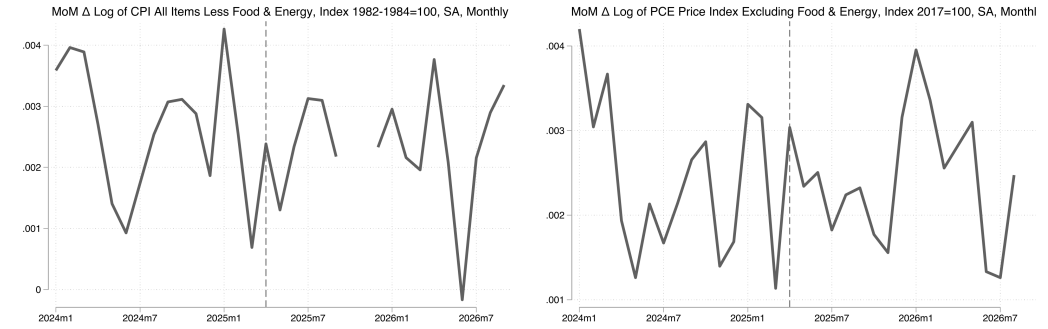
Three channels, in order of how much I will say about them:

1. **Input-output propagation** (production networks)
   - A tariff or energy shock is a tax on inputs under integrated supply chains
   - Real marginal cost distortions spread across sectors and countries and unwind slowly
   - Goods shock today $\Rightarrow$ services cost pressure tomorrow (transport, retail margins, business services)
2. **Nominal rigidities and staggered pass-through**
   - Inventories, contracts, exemptions delay the price response
   - Pass-through is spread over quarters; not concentrated on impact
3. **Expectations and demand**
   - Amplification is state-dependent: large when demand is high (2021), smaller when demand is slack (2025); important for AI-investment-boom (2026+)

Inflation-output trade-off worsens under a supply shock; monetary policy cannot remove a network cost distortion, only reallocate its burden.

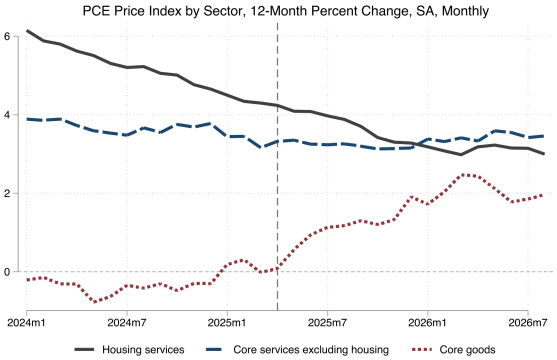
What does the data show?

Average monthly core inflation 0.25 % (3 % annualized) in 2026



Source: FRED, October 15, 2026. Monthly log change, as a fraction (0.003 = 0.3%). Core CPI through September 2026, core PCE through August 2026; no October 2025 CPI (government shutdown).

Three sectors, three different stories



- **Core goods:** from 0 to +2% after April 2025. Tariff pass-through, still rising in mid-2026.
- **Housing services:** from 6% to 3%. Rent disinflation is the only sector pulling down.
- **Services ex housing:** flat at 3.5%. The largest and stickiest piece: labor costs plus input costs propagated from goods.

Persistence issue is about services ex housing (and goods under additional global supply shocks).

Source: BEA, 12-month percent change of PCE price indexes; data through August 2026, retrieved October 15, 2026.

Are tariff effects behind us?

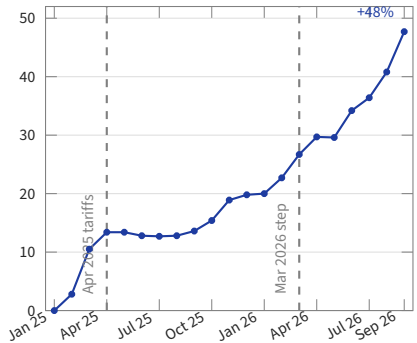
Scorecard: what I said here in September 2025, and what happened

September 2025	October 2026
Tariffs are a stagflationary impulse: demand + supply + uncertainty GLL: 0.2–0.5pp inflation, 0.5–1% output ↓	Core goods 0 → 2%; GDP about 0.4% below trend; dollar weaker Price level 0.3% above pre-2025 trend (model: 0.3%); output −0.4%
Implemented tariffs will show up once firms fill orders at tariffed prices Uncertainty is deflationary, weakens the dollar	Goods inflation rose through 2026 as inventories were replenished Dollar depreciated; the deflationary offset faded as tariffs were implemented
Small effects in 2025: less import exposure, smaller tariffs, price stickiness, exemptions, inventories, uncertainty	Inventories and uncertainty offsets have run their course; exemptions and lower tariff rates remain

The 2025 tariffs behaved as a slow-pass-through supply shock.
The 2026 tariffs are earlier in the same process.

Propagation in action: rebar, January 2025 to September 2026

PPI: structural metal and rebar, % change since Jan 2025



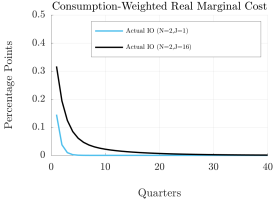
- **Rebar is a hard-to-substitute input with strong complementarity to other inputs.**
- **First leg, 2025:** PPI **+13%** by mid-2025 after the March-April tariffs; retail price +35% as inventories were replenished at post-tariff prices.
- **Second leg, 2026:** the index kept climbing, accelerated after the March 2026; +48% since January 2025.
- This is the staggered pass-through channel: **one-time tariffs, a multi-quarter price response**, and spillover into services (construction).

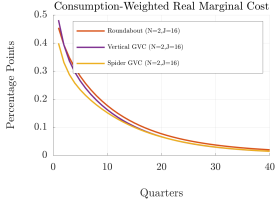
Source: BLS Producer Price Index, fabricated structural metal bar joists and concrete reinforcing bars (FRED WPU1074051), through September 2026; retail price from the September 2025 EAP presentation.

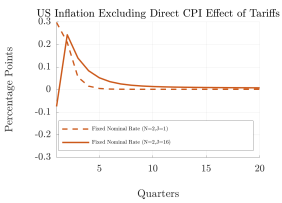
Amplification and propagation: what networks add

Networks: policy cannot undo the sectoral cost distortion

- **With networks** (I-O linkages): real marginal cost distortions persist, multiple sectors create propagation, and the distortions unwind slowly.
- **Without input-output links**: a one-time price jump on impact, then reversal.
- **Normative implication.** *N* policy rates (plus $N - 1$ exchange rates) cannot span *NJ* sectoral cost distortions: a passive rule puts the burden on output, an active rule shifts it to the exchange rate.







Left and middle: CPI-weighted real marginal cost, 10% U.S. tariff on RoW, passive policy, one sector vs. granular networks. Right: U.S. inflation excluding the direct CPI effect of tariffs. Source: Kalemli-Özcan, Soylu, Yildirim (2025).

2021 vs 2025-2026

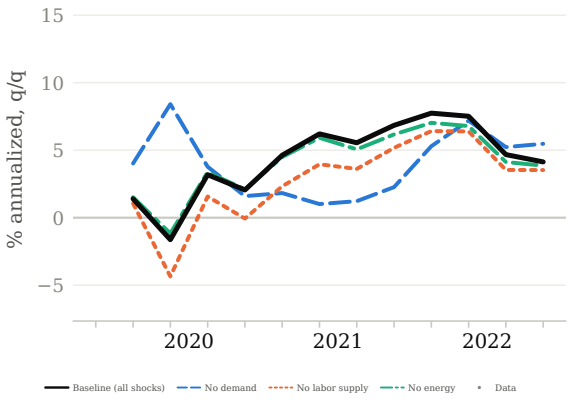
This is a cost-wedge shock, not a bottleneck shock: GSCPI now vs. 2021

NY Fed Global Supply Chain Pressure Index:

Near zero in 2025–26 (1.2 current) vs. +4 standard deviations in 2020-2021 (peak: 4.4).

- 2021: supply chains were **rationed**. Quantities could not respond, so demand pressure translated into prices nonlinearly.
- 2025–26: supply chains are open; the shock is a **tax wedge** on inputs. No rationing, so the response is roughly linear in the tariff and spread out over time.
- Same propagation channel, different amplification: persistent, but not explosive.

Lessons from 2021: high demand on top of constrained supply



- **No demand**: inflation is cut by more than half in 2021.
- **No labor supply shock**: sizeable contribution, concentrated in services.
- **No energy**: does not matter much.

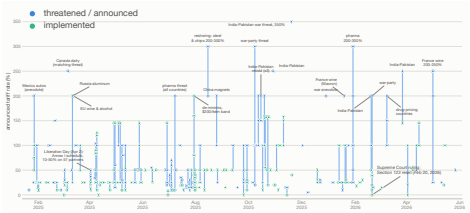
Lesson: amplification came from demand interacting with sectoral production constraints.

That interaction is absent in 2026, which is why **the same network channel delivers smaller, slower and persistent inflation.**

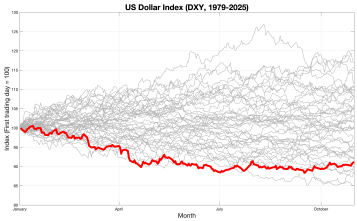
Source: di Giovanni, Kalemli-Özcan, Silva, Yildirim (2022, 2023).

Risks

Tariff uncertainty, the dollar, and import prices



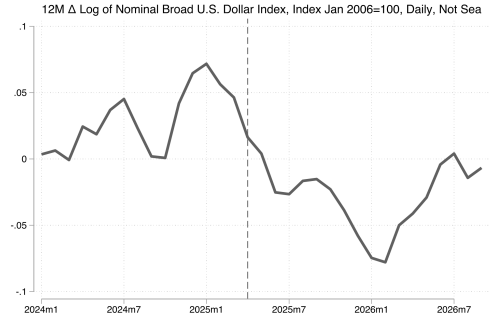
TiRADE: every communicated tariff *rate* (speeches, social media, official communications). Source: GLL.

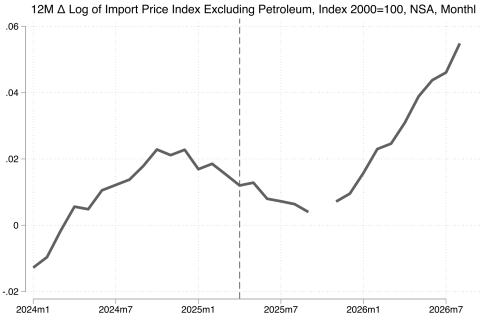


Gray: DXY within one calendar year, first trading day = 100; **red: 2025**. Source: Kalemli-Özcan and Soylu (2026).

- 434 tariff rate statements since January 2025; 71% never became statutory.
- Higher uncertainty depreciates the dollar; A risk channel, not a dollar-funding channel.
- **Matters for inflation**: uncertainty → weaker dollar → higher import prices → goods inflation.

Dollar Weakness 7.5%, Import Prices ex oil up 5.5%, Yields up 5%





- **Medium-term risk:** tighter financial conditions w/5% LT yields, rising import prices, staglationary mix.

Source: FRED, October 15, 2026. 12-month log change; import prices ex petroleum through August 2026, broad dollar index through September 2026.

Takeaways

Data

- Core inflation about 3% annualized in 2026.
  Goods rising since April 2025; housing falling; services ex housing persistent at 3.5%.

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Persistence

- 2025 tariffs: mostly in the price level (0.3%, data and model).
  2026 tariffs: not behind us; about 0.1pp still to come through mid-2028 and beyond with the Fed looking through, more of it in services.
- Energy shock: a one-off level effect (0.5% by 2026Q3); still going through the network.
- AI: a demand and energy-price shock near term; a disinflationary sector productivity shock much later.

Takeaways

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- Core inflation about 3% annualized in 2026.
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Drivers, amplification, propagation, policy

- Supply shocks in global networks: input-output propagation and staggered pass-through make transitory cost shocks persistent. Persistent is not permanent.
- Amplification is state-dependent: larger under high demand (2021).
- Risks: Moving forward a combination of policy uncertainty, dollar weakness and high AI-demand make look-through policy costly.

https://www.globallinkages.org/

Global Linkages Lab at Brown University

Model code, TiRADE, and other databases are downloadable at GLL

Thank you!

Appendix: GLL model background

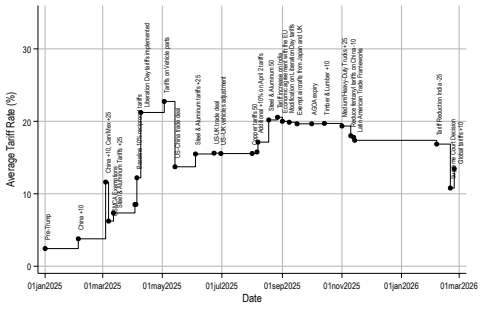
The GLL model in one slide

- **Global New Keynesian economy** with N countries and J sectors, nested CES production (labor and intermediates; inputs across sectors and countries) and consumption; Rotemberg pricing with a PCP/DCP/PTM mix; retailers; segmented asset markets with a UIP wedge.
- **Calibrated** to the OECD inter-country input-output tables; sector price rigidities from Nakamura-Steinsson; Armington elasticity 1.5; U.S. Fed "looks through" ($\rho_m^{US} = 1$), others Clarida-Galí-Gertler.
- **Shocks:** country-sector tariffs from the WTO-IMF Tariff Tracker as implemented; reversed tariff threats (expectations channel); UIP premium shocks to match the dollar; export wedges for energy.
- **Reduces to five vector equations** (NKIS, UIP, CPI, NKPC, BoP), which give an analytical decomposition of inflation into direct effects, network propagation, and wealth transfer.
- **Validation:** 2018 tariffs (price level +0.12% vs. 0.1 to 0.2% in Barbiero-Stein; real GDP −0.05% vs. a real income loss of 0.04% of GDP in Fajgelbaum et al.; the dollar appreciates 1.1% against the yuan, as it did around the announcements).

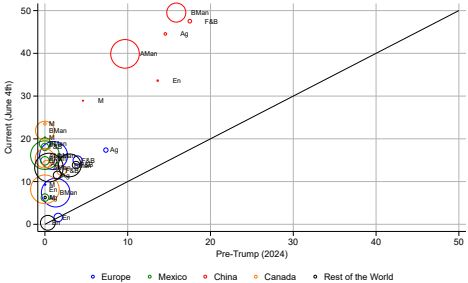
Kalemli-Özcan, Soylu, Yildirim (2025); code and data at `https://www.globallinkages.org/`.

2025–2026 tariffs rose unevenly across country-sectors

(a) Effective U.S. tariff rate



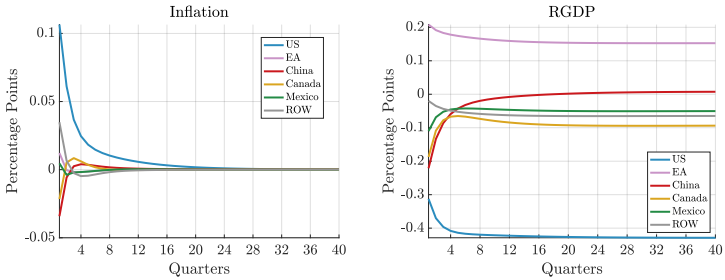
(b) Country-sector rates: pre-2025 vs. Now



Dispersion across country-sectors is what makes the network channel matter: uniform tariffs would propagate very differently from tariffs concentrated in **metals, autos, and critical inputs.**

Source: WTO-IMF Tariff Tracker; bubble size = import share.

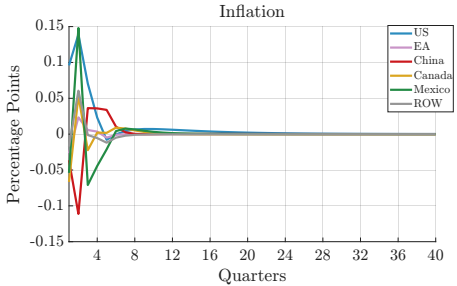
2025 tariffs: model 0.3 % vs. data 0.3 % on the price level



- **Data.** Dec 2024–Aug 2026 (7 quarters): headline CPI up 5.2% cumulative. Pre-2025 trend of 2.9% annualized gives 4.9%. Excess: 0.3%.
- **Model.** GLL model with implemented tariffs: price level 0.3% higher after 7 quarters; GDP −0.4%; euro area gains via trade diversion, contraction elsewhere.
- The inflation effect of the 2025 tariffs is largely in the level by now. What remains comes from the slow unwinding of input-cost distortions.

Source: Kalemli-Özcan, Soylu, Yildirim (2025).

2026 tariffs: Not behind us. Persistent inflation, up to 8-10 quarters

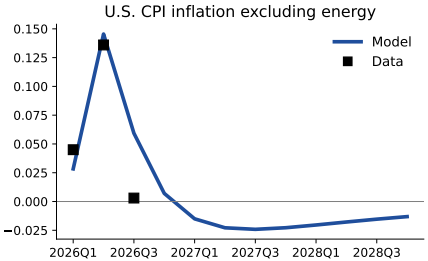


Inflation: successive tariffs overlaid quarter by quarter (MIT shocks); UIP premium shocks match the dollar.

- **2025 tariffs:** mostly behind us (0.3% excess, in the data and in the model).
- **2026 tariffs:** not behind us. Cumulative 0.1pp of inflation still to come through mid-2028 and beyond, conditional on the Fed looking through.
- **Composition shifts:** goods pass-through fades first (4-5 quarters); input-cost propagation into services comes later and lasts longer (quarters 3-7).
- Services persistence is **inherited** from goods through input-output linkages, so it will not fade just because goods inflation fades.

Source: Kalemli-Özcan, Soylu, Yildirim (2025).

2026 energy shock: inflation with and without energy, model vs. data



- **Exercise.** Export-tariff wedge on cross-border energy sales, set quarter by quarter so the U.S. consumer energy price matches the CPI for energy. Blue: model; squares: data.
- **Headline:** a one-off level effect of about 0.5% by 2026Q3, *not* a permanently higher inflation rate.
- **Ex energy:** the network channel. Energy is an input everywhere, so core prices rise with a one-quarter lag and unwind slowly; this is the part that is still in the pipeline.
- Uncertainty on energy shock persistence: match Brent spot/futures path (0.83 per quarter).

Source: Kalemli-Özcan, Soylu, Yildirim (2025). U.S. policy rate held fixed; CPI from FRED.

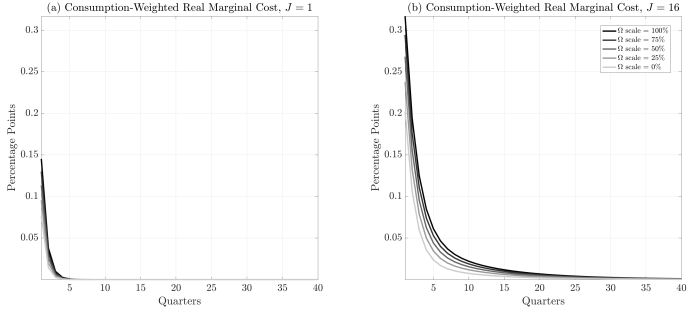
2026 energy shock across regions: U.S. inflation +0.4pp in Q2

2026Q2 response	US	Euro area	China	Oil producers	Rest of world
Inflation (pp)	0.44	0.33	0.38	−0.12	0.34
Real GDP (%)	−0.07	−0.20	0.44	−3.01	−0.92
Consumption (%)	−0.27	−1.15	−0.62	0.44	−0.36

- Energy propagates through the same input-output channel as tariffs: it is an input everywhere, so every region outside the oil producers sees inflation, including those with no direct exposure.
- The U.S. loses less output than the euro area or the rest of the world; oil producers lose output through the export wedge.

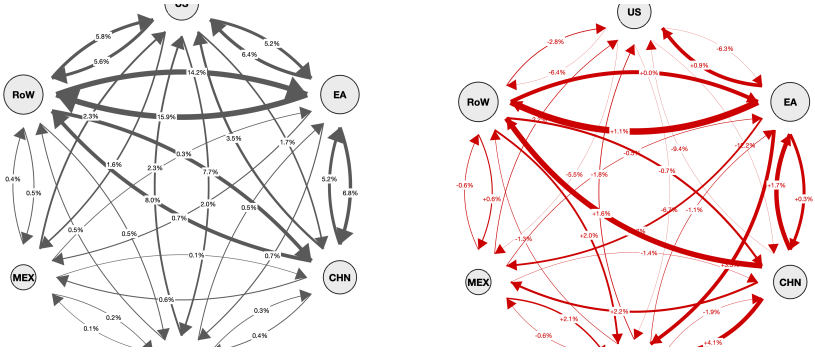
Source: Kalemli-Özcan, Soylu, Yildirim (2025). U.S. policy rate held fixed; CPI from FRED. Persistence of the shock 0.83 per quarter, from Brent spot and futures prices, 2026.

Granularity creates the channel, I-O intensity amplifies it



- $J = 1 \rightarrow J = 16$ sectors: raises both the level and the persistence of the cost distortion.
- Conditional on $J = 16$: a denser I-O matrix $\boldsymbol{\Omega}$ raises peak and tail. At $J = 1$, scaling $\boldsymbol{\Omega}$ only moves the impact; the tail is flat.

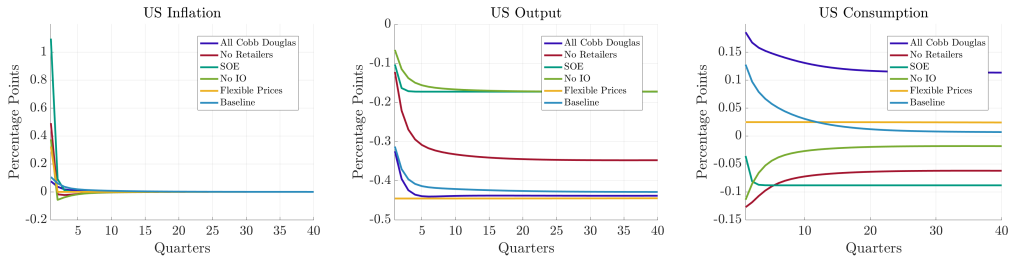
Tariffs rewire the network, so propagation is not static



Model-based trade and production network before 2025 and after the 2025–26 tariffs (12 quarters out). Trade diverts toward the euro area and Mexico; the U.S.–China link thins. The input-cost distortion travels along the new links, which is why its unwinding is slow.

Source: Global Linkages Lab, VoxEU 2026.

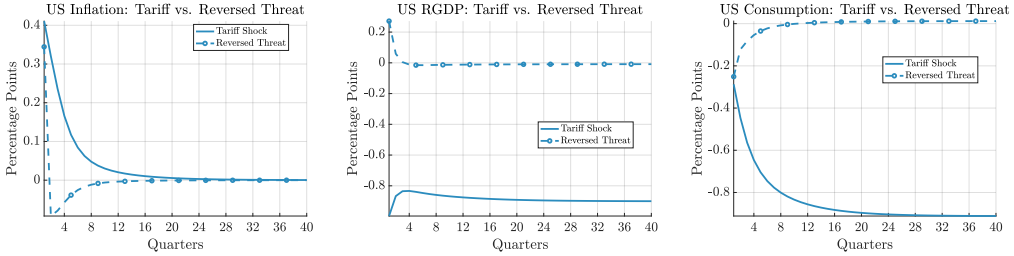
Model counterfactuals: no I-O linkages overstates on-impact inflation, misses persistence



Cases. Baseline; all Cobb-Douglas; no retailers; SOE; no I-O; flexible prices.

- Without retailers (SOE, no retailers): full tariff pass-through to consumer prices on impact.
- Models without I-O linkages miss the slow-moving cross-country propagation.

Reversed tariff threats: the expectations channel alone



Experiment. Tariffs announced for next period with expected retaliation, then withdrawn ("fake news" IRFs, Auclert-Bardóczy-Rognlie-Straub).

U.S. on impact. Inflation +0.34pp, consumption −0.25%, real GDP +0.27%, NEER +2.66%; 4–12 quarters to return to steady state. Credible announcements alone generate sizable, persistent macro effects.

5-Equation Global New Keynesian Representation

NKIS+TR: $\sigma(\mathbb{E}_t\hat{\boldsymbol{C}}_{t+1} - \hat{\boldsymbol{C}}_t) = \boldsymbol{\Phi\Gamma}\pi_t^P - \mathbb{E}_t\pi_{t+1}^C$

UIP+TR: $\mathbb{E}_t\hat{\mathcal{E}}_{t+1} - \hat{\mathcal{E}}_t = \tilde{\boldsymbol{\Phi}}\boldsymbol{\Gamma}\pi_t^P$

CPI: $\hat{\boldsymbol{P}}_t^C = \boldsymbol{\Gamma}\,\hat{\boldsymbol{P}}_t^P + \boldsymbol{L}_{\mathcal{E}}^C\hat{\mathcal{E}}_t + \boldsymbol{L}_{\tau}^C\hat{\tau}_t$

NKPC: $\hat{\boldsymbol{P}}_t^P = \boldsymbol{\Psi}_{\bigwedge}\left[\hat{\boldsymbol{P}}_{t-1}^P + \boldsymbol{\Lambda}\left(\boldsymbol{\alpha}(\hat{\boldsymbol{P}}_t^C + \sigma\hat{\boldsymbol{C}}_t) + \boldsymbol{L}_{\mathcal{E}}^P\hat{\mathcal{E}}_t + \boldsymbol{L}_{\tau}^P\hat{\tau}_t\right) + \beta\mathbb{E}_t\hat{\boldsymbol{P}}_{t+1}^P\right]$

BoP: $\beta\hat{V}_t = \hat{V}_{t-1} + \Xi_2\hat{\boldsymbol{C}}_t + \Xi_3\hat{\boldsymbol{P}}_t^P + \Xi_4\hat{\mathcal{E}}_t + \Xi_5\hat{\tau}_t$

+ inflation definition

Analytical Solution: Decomposing the Impact

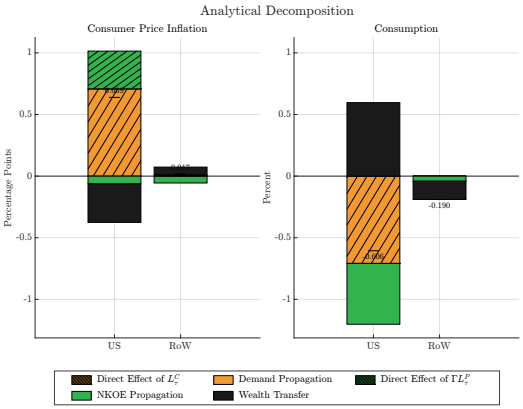
Theoretical Example: U.S. vs. RoW, 10% Tariff

Based on the analytical solution:

$$\frac{\partial \pi_t^C}{\partial \hat{\tau}_t} = \underbrace{\Gamma L_\tau^P}_{\text{Direct supply}} + \underbrace{L_\tau^C}_{\text{Direct demand}} + \underbrace{\left[(I + \mathcal{Z})\Gamma\left((1-\rho)\Lambda\mathcal{K}(\rho, \Psi^{\text{NKOE}})^{-1}\right) + \mathcal{Z}\sigma R_\tau - \Gamma\right] L_\tau^P}_{\text{NKOE propagation}}$$

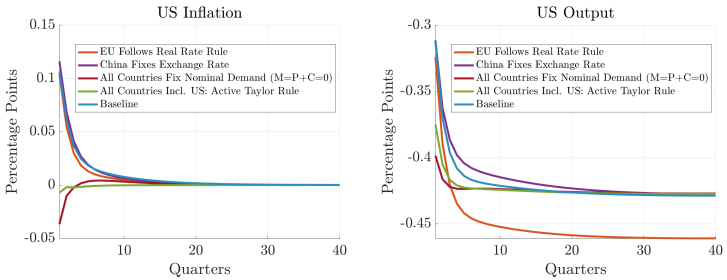
$$+ \underbrace{[(1-\sigma)\mathcal{Z}]L_\tau^C}_{\text{Demand propagation}} + \underbrace{[\Gamma p_w + \mathcal{Z}(\sigma c_w + \Gamma p_w) + L_\mathcal{C}^C m] w_\tau}_{\text{Wealth transfer}}$$

$$\frac{\partial \hat{\mathbf{C}}_t}{\partial \hat{\tau}_t} = \underbrace{R_\tau L_\tau^P}_{\text{NKOE propagation}} - \underbrace{L_\tau^C}_{\text{Direct demand}} + \underbrace{c_w w_\tau}_{\text{Wealth transfer}} .$$



How should monetary policy respond to supply shocks?

Policy rules in the network model



- An active Taylor rule/a nominal-demand target lowers U.S. inflation at an output cost.
- Other countries' rules shift the burden between U.S. inflation and output; persistence itself is structural (networks) and does not depend on any country's rule.

A state-dependent rule of thumb

	2021–22	2025–26
Demand	High: fiscal transfers, reopening	Slack: unemployment 4.2%, prime-age flat
Supply shock	Bottlenecks, quantities rationed	Cost wedge: tariffs, energy, labor supply
Amplification	Nonlinear: demand $\times$ constraints	Roughly linear: network propagation
Persistence	Demand meeting constraints	Input-output unwinding, services lag
Policy	Lean against demand	Look through the *first-round* level effect, not persistence

1. **Look through** the first-round price-level effect of tariffs and energy: it is a tax, policy cannot undo it, and demand is not the amplifier this time.
2. **Do not look through** the second round persistence in services ex housing; this will not go away on its own as it is inherited from goods, and it lasts quarters.
3. **Watch expectations and the dollar.** The 2025–26 combination of policy uncertainty and dollar weakness is the channel through which a look-through policy could be costly.

AI and labor supply

AI and inflation through the same lens

Near term (2026–27): a demand shock, not a supply shock

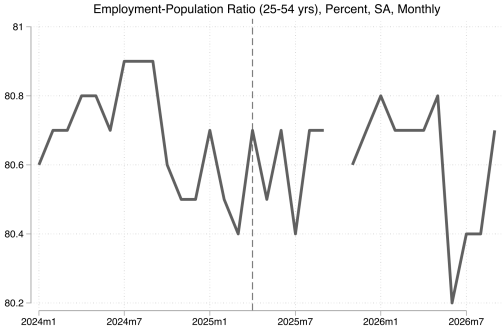
- AI capex is investment demand concentrated in a few sectors (semiconductors, data centers, construction, power generation).
- Data-center electricity demand raises energy input prices; this feeds the energy channel above and is inflationary at the margin.
- Offsetting disinflation from productivity is not yet visible in sector price data.

Longer term: a sector-specific positive productivity shock

- The mirror image of the tariff analysis: a cost *reduction* in AI-exposed services, propagated through input-output linkages.
- Aggregate disinflation depends on how central the exposed sectors are as inputs (professional and business services are central; housing is not).
- Trade channel: National security tariffs (export controls on chips/semiconductors) make AI a global network shock.

Bottom line: AI is a longer-run disinflationary force, not a reason to look through 2026–27 tariff pass-through.

Labor supply: the 2021 lesson applied to 2026

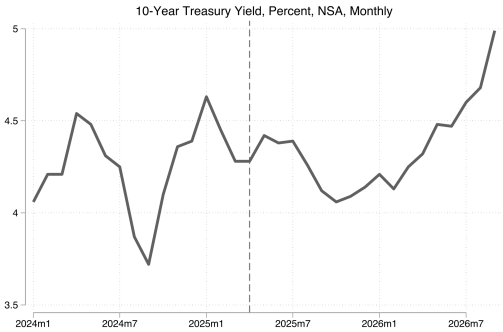


Source: FRED, October 15, 2026.

- The 2021 decomposition attributes a sizeable part of services inflation to the **labor supply** shock.
- Prime-age employment-population ratio is flat; unemployment is low (4.2).
- Immigration restrictions in 2025–26 are a labor supply shock concentrated in non-housing services (construction, hospitality, care).
- A second reason, beyond input-cost propagation, to expect services ex housing inflation to stay near 3.5%.

Appendix: data and events

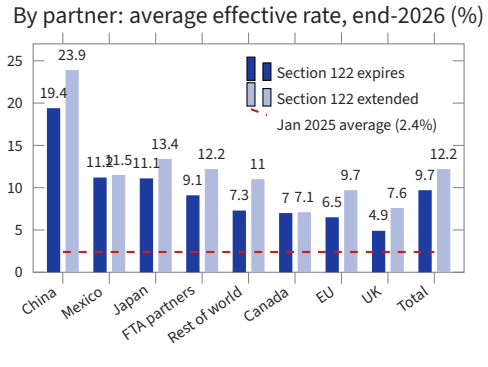
Long rates at 5 %: housing and the policy trade-off

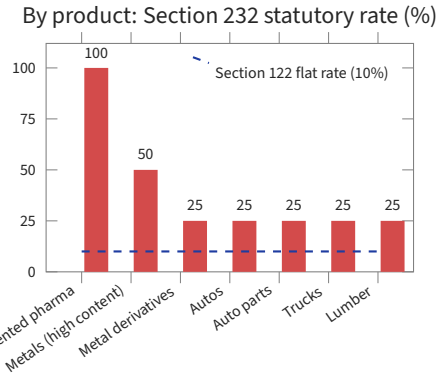


Source: FRED, 10-year Treasury yield through September 2026.

- 10-year yield at 5%.
- Housing: higher mortgage rates help housing services disinflation.
- Medium-term risk: Tighter financial conditions with higher import-price pass-through, a stagflationary mix.

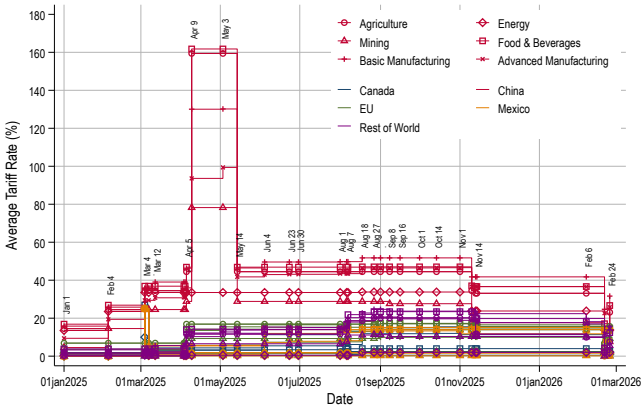
Tariff heterogeneity at end-2026: by partner and by product





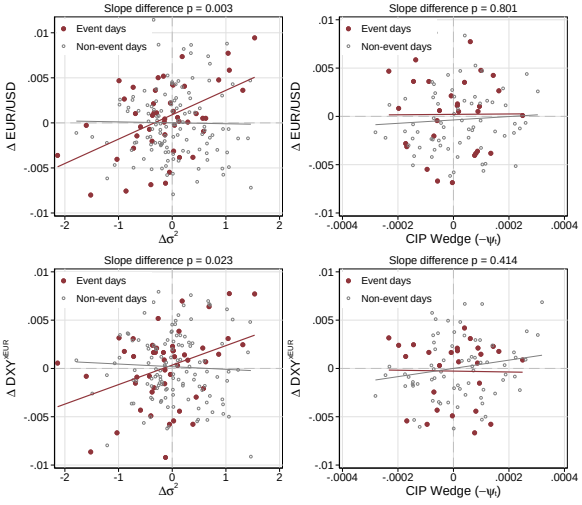
Left: pre-substitution average effective tariff rate at end-2026 under the two Section 122 scenarios; FTA partners = countries with a comprehensive free trade agreement with the U.S. Right: statutory Section 232 rates as of April 8, 2026; metal derivatives range 15–25%, lumber 10–25%, pharmaceutical tariff effective September 29, 2026. Realized customs duties (Penn Wharton, June 2026): steel and aluminum 40.9%, autos 13.2%, overall 7.1%. Source: The Budget Lab, *State of U.S. Tariffs*, April 8, 2026, Table 2; Penn Wharton Budget Model.

Country-sector tariff rates over time



Source: WTO-IMF Tariff Tracker.

The dollar and tariff uncertainty on announcement days



Source: Kalemli-Özcan, Soylu, Yildirim (2026).

- Left panels: on tariff announcement days the slope of the dollar on policy uncertainty is significantly steeper than on other days (p = 0.003 for EUR/USD, 0.023 for DXY).
- Right panels: no difference in the slope on the CIP wedge (p = 0.80, 0.41). The move is not a dollar-funding squeeze.
- A 1-sd announcement-window jump in tariff uncertainty: dollar −0.24%, equities −0.67%, interest differential flat.