Random Tariff Wars and Business Uncertainty

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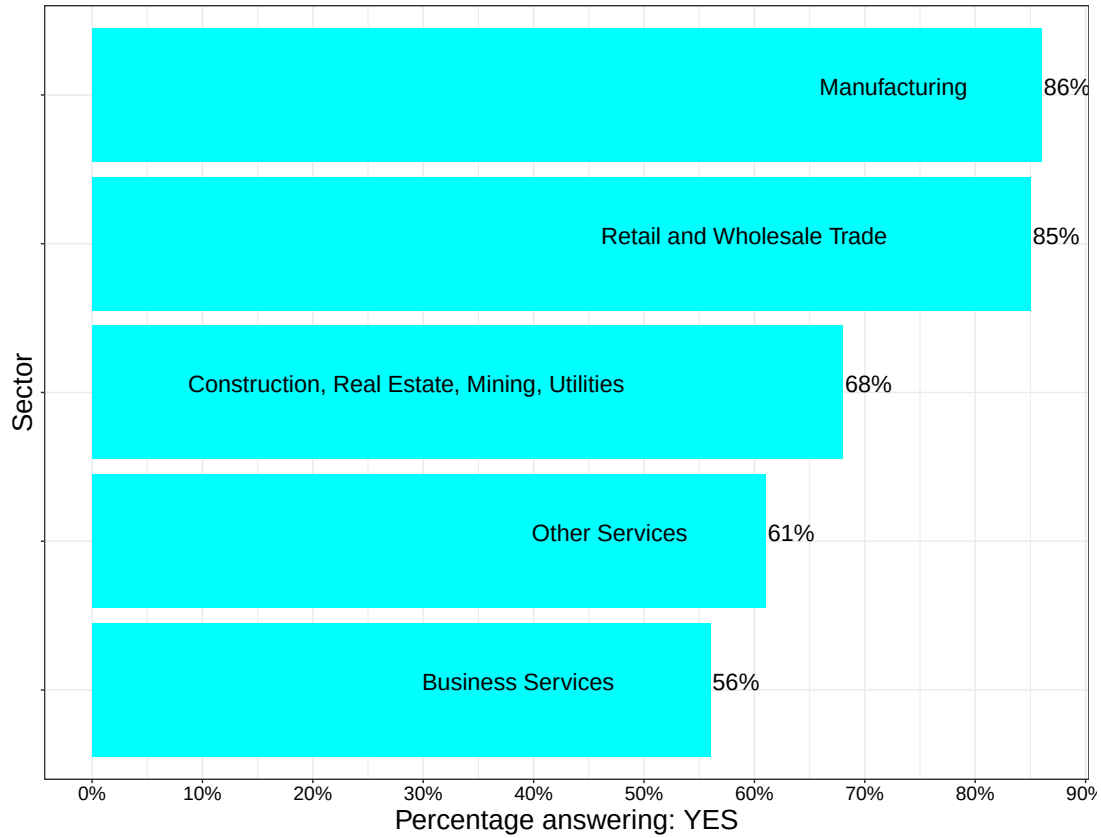
Brown bag seminar, January 13, 2026

Observations and research motivation

- 2025 was perhaps the most volatile year with respect to the imposition of import tariffs and immediate retaliations by other countries.
- Import tariff rates (and retaliatory rates) were changed (and keep changing) frequently (examples to follow).
- Surveys of business leaders during 2025 reveal great concern about tariff uncertainty.
- See, Barrero et al. Atlanta Macroblog July 2025 and Andrade et al. Boston Fed WP 2025-12.

Atlanta Fed's Survey of Business Uncertainty

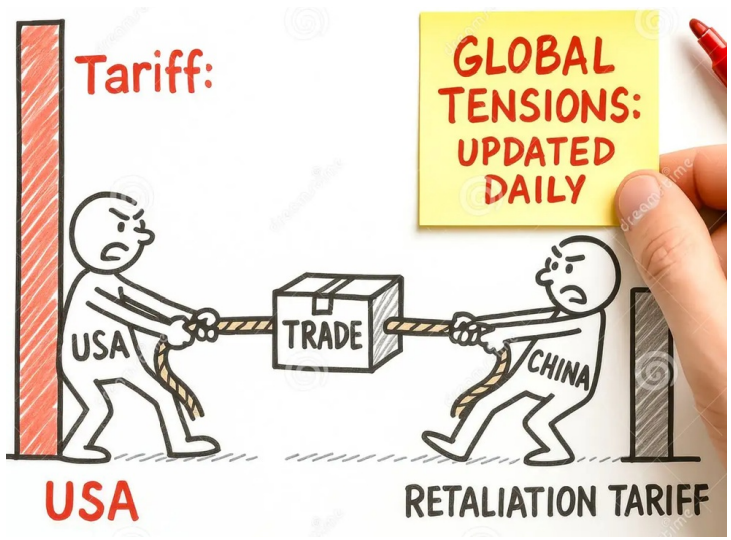


Business executives were asked the following question: "Is your firm currently facing any uncertainty related to tariffs or trade policy?" Across the more than 900 responses, 7 of 10 executives answered "yes" to this question. Not surprisingly, over 85-percents of the manufacturing, retail, and wholesale trade sectors expressed concerns about tariff uncertainty.

U.S.–China 2025 import tariff wars

Announcements (not necessarily actual)

Month	U.S.	China
2025/2	Imposes 10%	15%–25%
2025/3–4	Increased to 145%	125% (not all items)
May 12	(Geneva talks): Dropped to 30%	10%
2025/10	Additional 100% (130% effective)	Additional 100%
2025/11	(APEC summit): 47.5% (average)	31.9% (average)
2025/12	Tariffs on "legacy" chips postponed AI-chips export bans relaxed	Resumes exports of rare-earth minerals (25/6)



U.S.–Canada 2025 import tariff wars

Announcements (not necessarily actual)

Month	U.S.	Canada
2025/2	Announced 25%	10% (energy & $30b)
2025/3	25% (10% energy & minerals)	25%
2025/8	35% (most goods)	Expanded range of products

Note: Hard to follow the exact range of products covered by each tariff announcement and implementation.

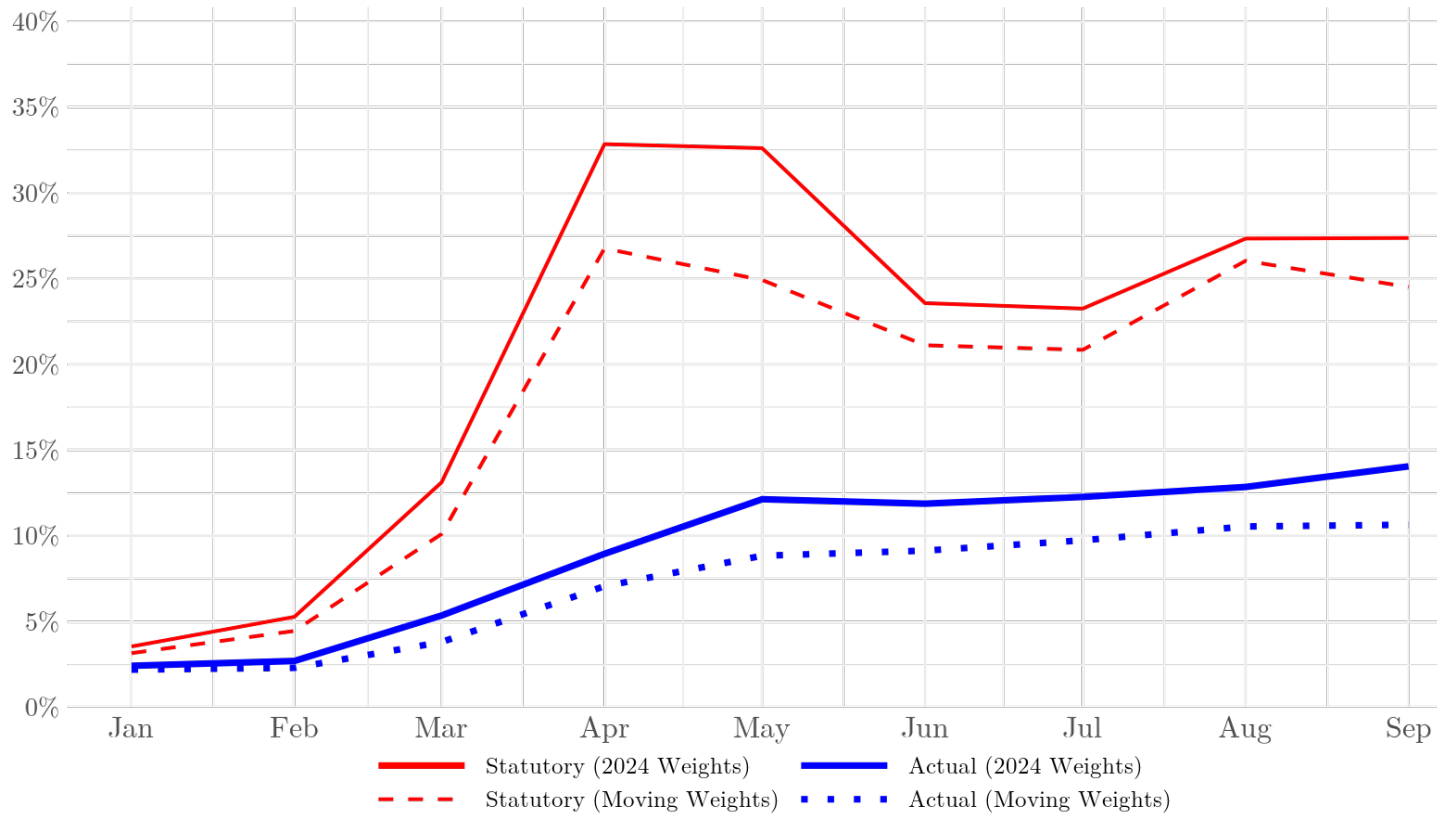
Historical note I: The first recorded tariff war (with reciprocal tariffs) was the Anglo-Dutch War (1651–1654) triggered by England.

Historical note II: Tariff existed long before that: Ancient Greece on some city-states (5^{th} century BC). Roman Republic on provinces (2^{nd}–1^{st} BC).

Sources of tariff war uncertainty

1. Tariff is used to trigger trade negotiations (for bargaining purposes).
2. Lobbying! Tariff rates are frequently changing under industry pressures.
3. Tariffs are used as (non-economic) political threats on other countries.
4. Unanticipated retaliatory tariffs.
5. Uncertainty regarding (see next slide): (i) which products are included/excluded; (ii) shipment gaps, (iii) implementation gaps.
6. Uncertainty regarding a future Supreme Court decision about executive branch authority.
7. Uncertainty regarding *trade diversion* and *trade creation* in a multicountry world (Jacob Viner, 1950). E.g. China diverts some of its agriculture imports from the U.S. to South America.

Statutory versus actual tariffs



Source: Gopinath-Neiman, NBER WP 2026

This may indicate high variability of actual tariffs across product groups.

The research question

Is it possible to construct a *simple* model to show that firms might earn *lower expected profits* under uncertain tariff wars than under a permanent tariff war?

And...without assuming any risk aversion!

The model:

1. Two countries.
2. Two differentiated products.
3. Bidirectional trade.
4. Risk-neutral producers/sellers and consumers.
5. Exogenous uncertain tariff war in reciprocal tariffs.

Related literature

Industrial organization:

1. Earlier (1970s-80s): analyzed output decisions of a single risk-averse firm facing uncertain demand or cost.
2. 1990s+: Duopoly models (some with risk-averse firms). Does uncertainty intensify or weaken competition?
3. Also, do firms have profit incentives to share information about uncertain cost and uncertain demand?

International trade:

1. Pomery (1984) surveys the early 1970s–1980s about optimal trade policy under uncertainty.
2. Uncertainty in export markets (embargos) and national defense arguments for protection.
3. Recent: Theoretical literature on effects on entry into markets.
4. Empirical literature on losses from changes in tariff policies.
5. Theoretical model on sources of uncertain trade policies (e.g. election outcomes).

This paper deviates from the above literature in that the source of uncertainty is the trade policy itself (random eruption of tariff wars).

Consumer demand

- Two countries ($k = H, F$, Home, Foreign).
- Two differentiated products (X and Y).
- Product X is produced in H. Product Y is produced in F.
- p_k^X and p_k^Y are (endogenous) prices in country $k = H, F$.
- x_k and y_k are (endogenous) consumption levels in country $k = H, F$.
- Inverse demand functions in country $k = H, F$:

$$p_k^X = \alpha - \beta x_k - \gamma y_k \quad \text{and} \quad p_k^Y = \alpha - \gamma x_k - \beta y_k$$

where $\alpha > 0$, $\beta > 0$ and $\beta^2 > \gamma^2$, hence

- "own effect" (on price) is stronger than the "cross effect," and
- $(\beta^2 \to \gamma^2) \Rightarrow$ highly substitutable products.
- $(\gamma^2 \to 0) \Rightarrow$ highly differentiated products.

Note 1: Quantity competition is needed for capturing shipping commitments (as opposed to price competition, see other paper). Hence,
Note 2: Segmented markets (no arbitrage across countries).

Random reciprocal import tariffs

- Specific tariffs for now (later extended to ad-valorem tariffs).
- t_H^Y = tariff on import of Y from country F into H.
  t_F^X = tariff on import of X from country H into F.
- Import tariffs take two values: $t_H^Y, t_F^X \in \{0, T\}$, $(T > 0)$.
- Immediate (tit-for-tat) retaliation: $t_H^Y = T \Rightarrow t_F^X = T$ and $t_H^Y = 0 \Rightarrow t_F^X = 0$, hence
- $t_H^Y = t_F^X = T$ is called a *tariff war* whereas
  $t_H^Y = t_F^X = 0$ is called *free trade*.
- Randomness: Country H (hence, country F) imposes an import tariff with probability λ, $(\lambda \in [0, 1])$.

Production, shipping, and sales

- X is produced only in H. Y is produced only in F.
- Unit production cost $c \geq 0$ (shipping cost inclusive).
- Key assumption: Production and shipping to the domestic and export markets must be made in advance. That is, before firms observe whether countries decide to engage in a reciprocal tariff war.

Firm X (located in H) chooses production and sales levels to solve:

$$\max_{x_H, x_F} \mathrm{E}\pi^X = \mathrm{E}\pi_H^X + \mathrm{E}\pi_F^X$$

$$= \underbrace{(p_H^X - c)x_H}_{\text{domestic sales profit}} + \underbrace{\lambda(p_F^X - c - T)x_F}_{\text{export profit (under tariff)}} + \underbrace{(1-\lambda)(p_F^X - c)x_F}_{\text{export profit (no tariff)}}.$$

Firm Y (located in F) chooses production and sales levels to solve:

$$\max_{y_F, y_H} \mathrm{E}\pi^Y = \mathrm{E}\pi_F^Y + \mathrm{E}\pi_H^Y$$

$$= \underbrace{(p_F^Y - c)y_F}_{\text{domestic sales profit}} + \underbrace{\lambda(p_H^Y - c - T)y_H}_{\text{export profit (under tariff)}} + \underbrace{(1-\lambda)(p_H^Y - c)y_H}_{\text{export profit (no tariff)}}.$$

Effects of uncertainty (λ) on sales and prices

Recall that $\lambda \in [0, 1]$ measures the probability of an import tariff war.

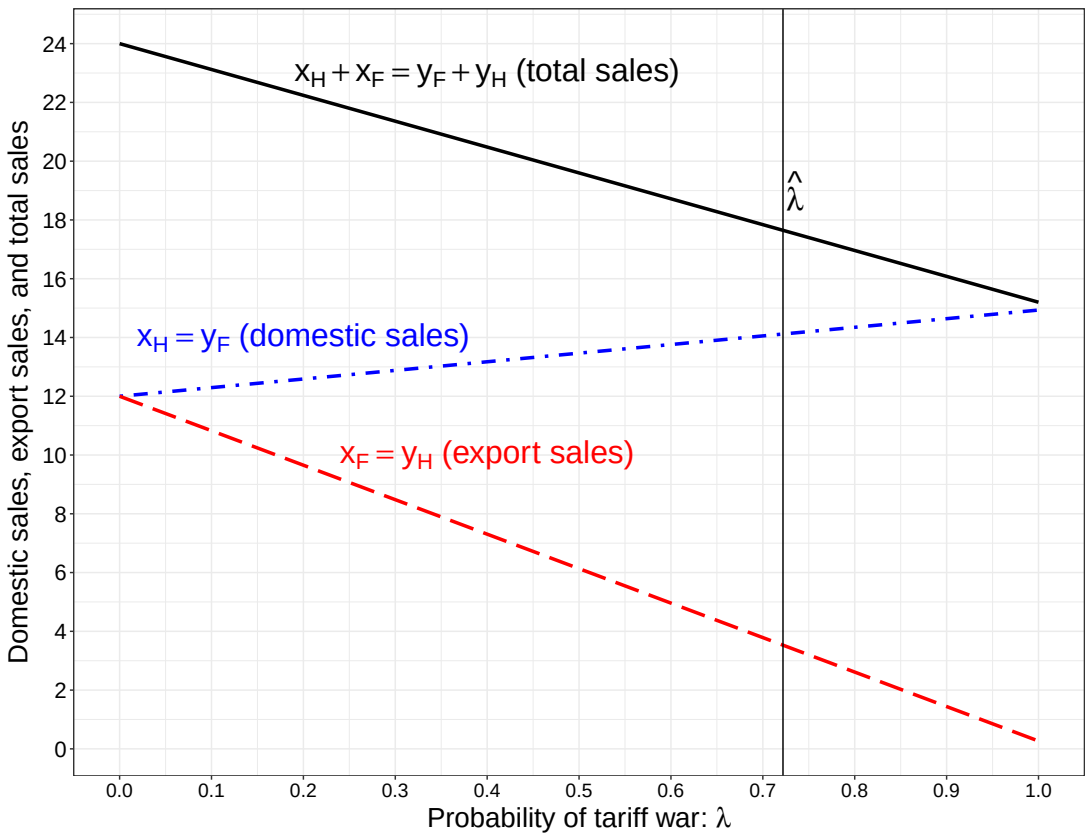
An increase in λ:

(a) reduces export levels: $x_F \downarrow$ and $y_H \downarrow$;

(b) increases domestic sales: $x_H \uparrow$ and $y_F \uparrow$;

(c) reduces global production and sales: $(x_H + x_F) \downarrow$ and $(y_F + y_H) \downarrow$;

(d) increases all prices: $p_H^X \uparrow$, $p_F^X \uparrow$, $p_F^Y \uparrow$, $p_H^Y \uparrow$.



Note: Exports fall faster than the increase in domestic sales! Why is that? Because import prices rise faster than domestic prices. This also explains why global sales decline.

Source of firms' uncertainty

Firms ship their products to the domestic and export markets before they know whether tariffs will be implements. Sellers' (random) export prices are:

$$s_F^X = s_H^Y = \begin{cases} p_F^X = p_H^Y & \text{free trade (prob. } 1-\lambda), \\ p_F^X - T = p_H^Y - T & \text{tariff war (prob. } \lambda). \end{cases}$$

Therefore, equilibrium expected profits from domestic and export sales are:

$$\text{Domestic profit:} \quad \mathrm{E}\pi_H^X = \mathrm{E}\pi_F^Y = \frac{\beta\left[(\alpha-c)(2\beta-\gamma)+\gamma\lambda T\right]^2}{(4\beta^2-\gamma^2)^2}$$

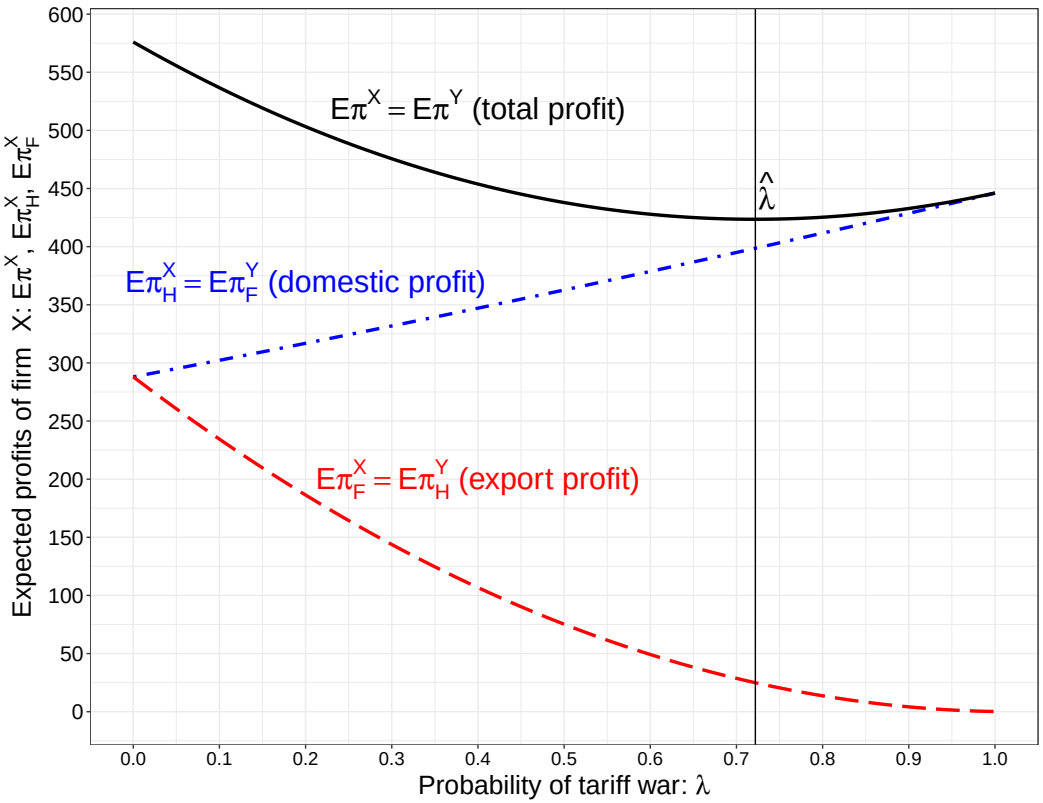
$$\text{Exports profit:} \quad \mathrm{E}\pi_H^Y = \mathrm{E}\pi_F^X = \frac{\beta\left[(\alpha-c)(2\beta-\gamma)-2\beta\lambda T\right]^2}{(4\beta^2-\gamma^2)^2}.$$

Therefore, as λ increases, domestic profits rise by a factor of γT (squared). In contrast, export profits fall by a factor of $-2\beta T$ (squared).

Effect of uncertainty (λ) on firms' expected profit

There exists a (randomly-imposed) tariff rate $\widehat{T}$, such that for any tariff rate $T > \widehat{T}$, there exists a tariff war probability $\widehat{\lambda}$ under which firms earn lower profit under random tariff wars than under a permanent tariff war.

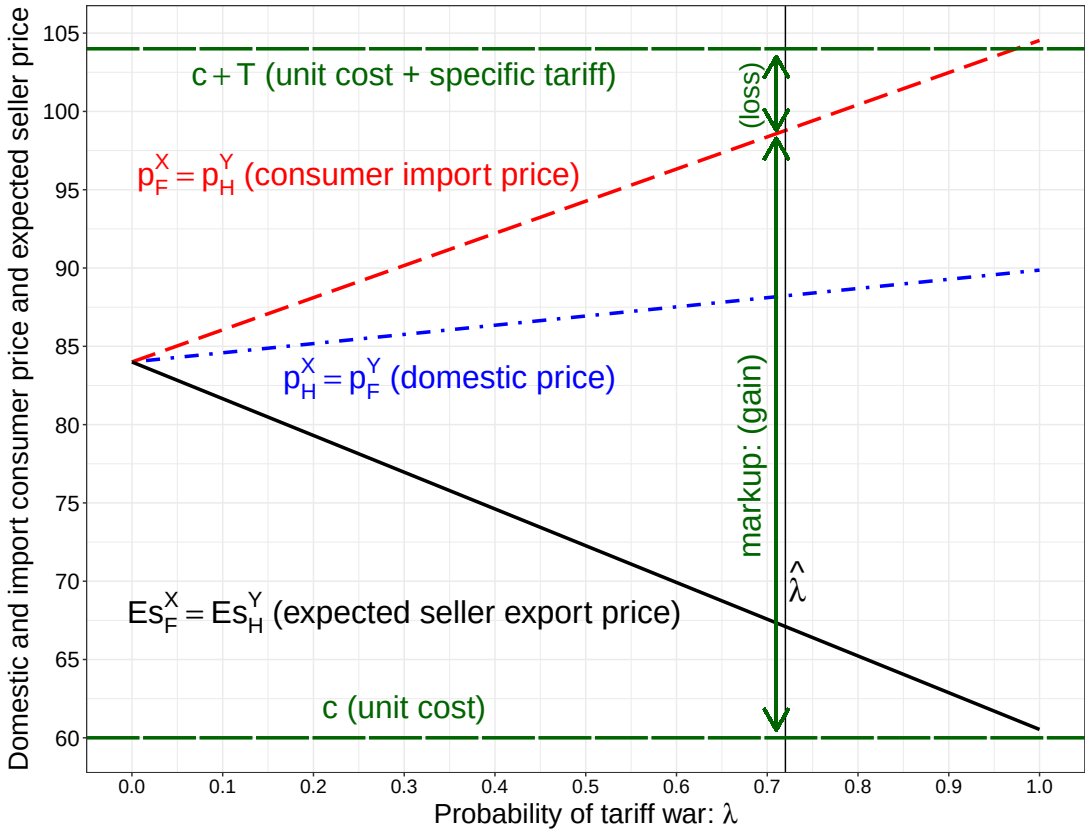
$$\mathrm{E}\pi^X|_{\widehat{\lambda}} < \mathrm{E}\pi^X|_{\lambda=1} \quad \text{and} \quad \mathrm{E}\pi^Y|_{\widehat{\lambda}} < \mathrm{E}\pi^Y|_{\lambda=1}.$$



Note: Profits from exports become negligible for war probabilities $\lambda > \widehat{\lambda}$. Therefore, higher λs enhance domestic profit more than they reduce exports profit. $\frac{\partial \mathrm{E}\pi_H^X(\widehat{\lambda})}{\partial \lambda} = \frac{\partial \mathrm{E}\pi_F^Y(\widehat{\lambda})}{\partial \lambda} = -\frac{\partial \mathrm{E}\pi_F^X(\widehat{\lambda})}{\partial \lambda} = -\frac{\partial \mathrm{E}\pi_H^Y(\widehat{\lambda})}{\partial \lambda}$. And $\frac{\partial^2 \mathrm{E}\pi_H^X}{\partial \lambda^2} = \frac{\partial^2 \mathrm{E}\pi_F^Y}{\partial \lambda^2} < \frac{\partial^2 \mathrm{E}\pi_F^X}{\partial \lambda^2} = \frac{\partial^2 \mathrm{E}\pi_H^Y}{\partial \lambda^2}$ More "convex."

More intuition: Price markups

Looking at prices and unit (tariff-inclusive) costs:



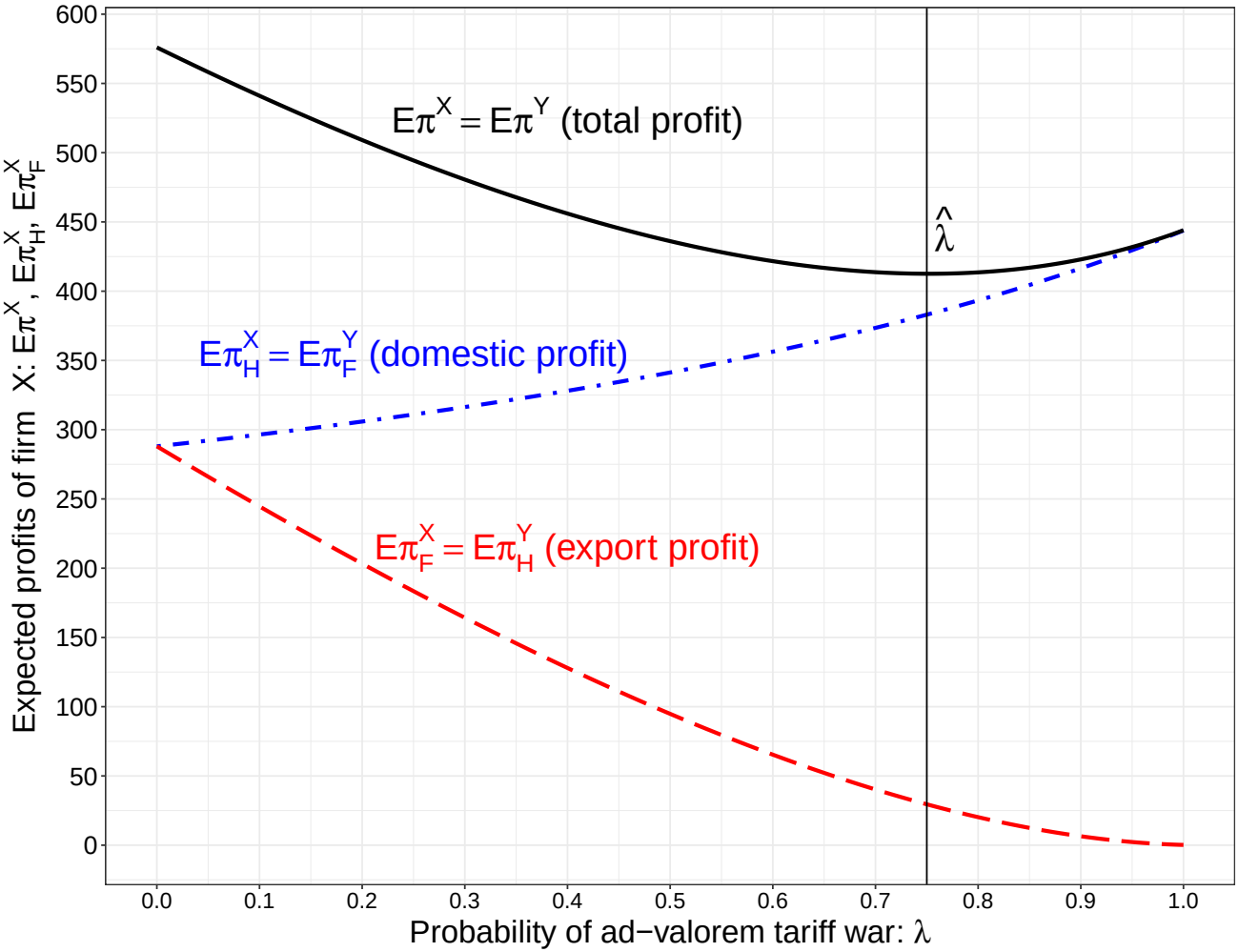
For $\lambda > \widehat{\lambda}$, the rise in domestic price multiplied large sales dominates the fall in (tariff-ridden) export prices multiplied by diminishing sales.

Random ad-valorem (percentage) tariffs

Replace the specific (random) tariff T with t_H^Y, $t_F^X \in \{0, \tau\}$ where $0 < \tau < 1$ is a fraction of the exports price.

$$\begin{aligned}
\max_{x_H, x_F} \mathrm{E}\pi^X &= \mathrm{E}\pi_H^X + \mathrm{E}\pi_F^X \\
&= \underbrace{(p_H^X - c)x_H}_{\text{domestic sales profit}} + \underbrace{\lambda\left[(1-\tau)p_F^X - c\right]x_F}_{\text{export profit (under tariff)}} + \underbrace{(1-\lambda)(p_F^X - c)x_F}_{\text{export profit (no tariff)}}, \\
\max_{y_F, y_H} \mathrm{E}\pi^Y &= \mathrm{E}\pi_F^Y + \mathrm{E}\pi_H^Y \\
&= \underbrace{(p_F^Y - c)y_F}_{\text{domestic sales profit}} + \underbrace{\lambda\left[(1-\tau)p_H^Y - c\right]y_H}_{\text{export profit (under tariff)}} + \underbrace{(1-\lambda)(p_H^Y - c)y_H}_{\text{export profit (no tariff)}}.
\end{aligned}$$

Random ad-valorem tariffs

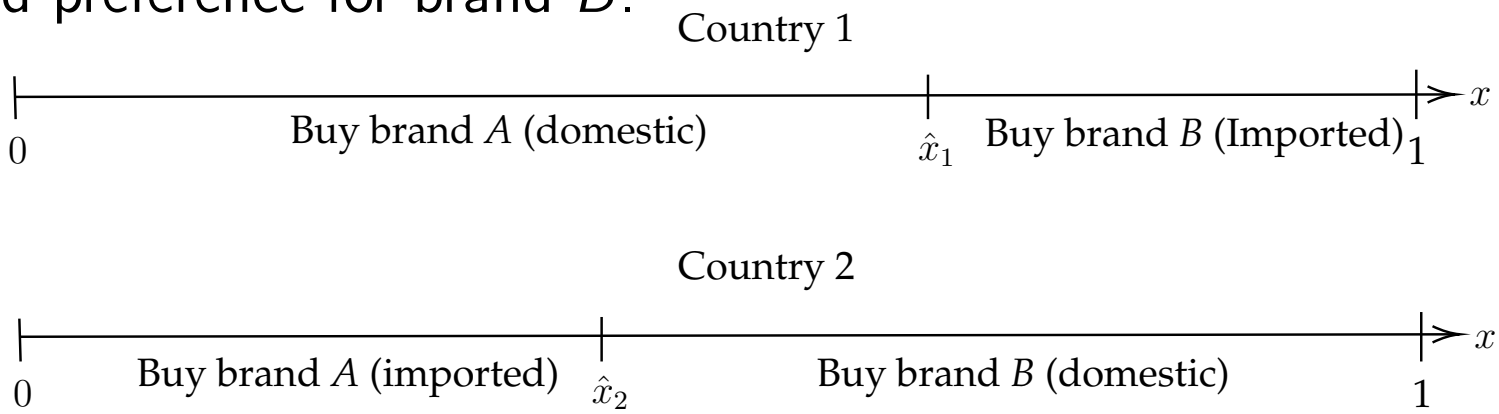


The results continue to hold under ad-valorem import tariffs.

Do Firms Gain from Reciprocal Tariffs?

An alternative model: Price competition

In each country, consumers are uniformly distributed on $[0, 1]$ according to increased preference for brand B.



The utility of a consumer indexed by $x \in [0, 1]$ in country 1 is

$$U_1(x) = \begin{cases} I_1 + V^A - p^A - \delta x & \text{if buys brand } A \text{ (domestic)} \\ I_1 + V^B - p^B(1 + t_1) - \delta(1 - x) & \text{if buys brand } B \text{ (imported).} \end{cases}$$

The utility of a consumer indexed by $x \in [0, 1]$ in country 2 is

$$U_2(x) = \begin{cases} I_2 + V^A - p^A(1 + t_2) - \delta x & \text{if buys brand } A \text{ (imported)} \\ I_2 + V^B - p^B - \delta(1 - x) & \text{if buys brand } B \text{ (domestic).} \end{cases}$$

Do Firms Gain from Reciprocal Tariffs?

- Two countries (1 and 2). Two differentiated products (A and B).
- Product A is produced only in country 1. Product B only in country 2.
- Country 1 imposes an ad-valorem tariff t_1 on brand B (imported).
  Country 2 imposes an ad-valorem tariff t_2 on brand A (imported).
- Consumer prices of A: p^A in country 1 and $p^A(1+t_2)$ in country 2.
  Consumer prices of B: p^B in country 2 and $p^B(1+t_1)$ in country 1.
- N_1 consumers in country 1; N_2 in country 2.
  Define $\Delta N \equiv N_1 - N_2$.
- I_1 and I_2 consumer income in country 1 and 2.
- V^A (V^B) basic consumer value of brand A (brand B).
  Define and assume: $\Delta V \equiv V_A - V_B \geq 0$ (Consumer place higher (or equal) value of brand A).
- $\delta > 0$ degree of product differentiation.
- Analyze both: Unsegmented markets ($p_1^A = p_2^A$, $p_2^B = p_1^B$) and segmented markets ($p_1^A \neq p_2^A$, $p_2^B \neq p_1^B$).

Given tariffs, firms choose world uniform price

$$\max_{p^A} \pi^A(t_1, t_2) = \overbrace{(p^A - c^A)}^{\text{per-unit profit}}$$

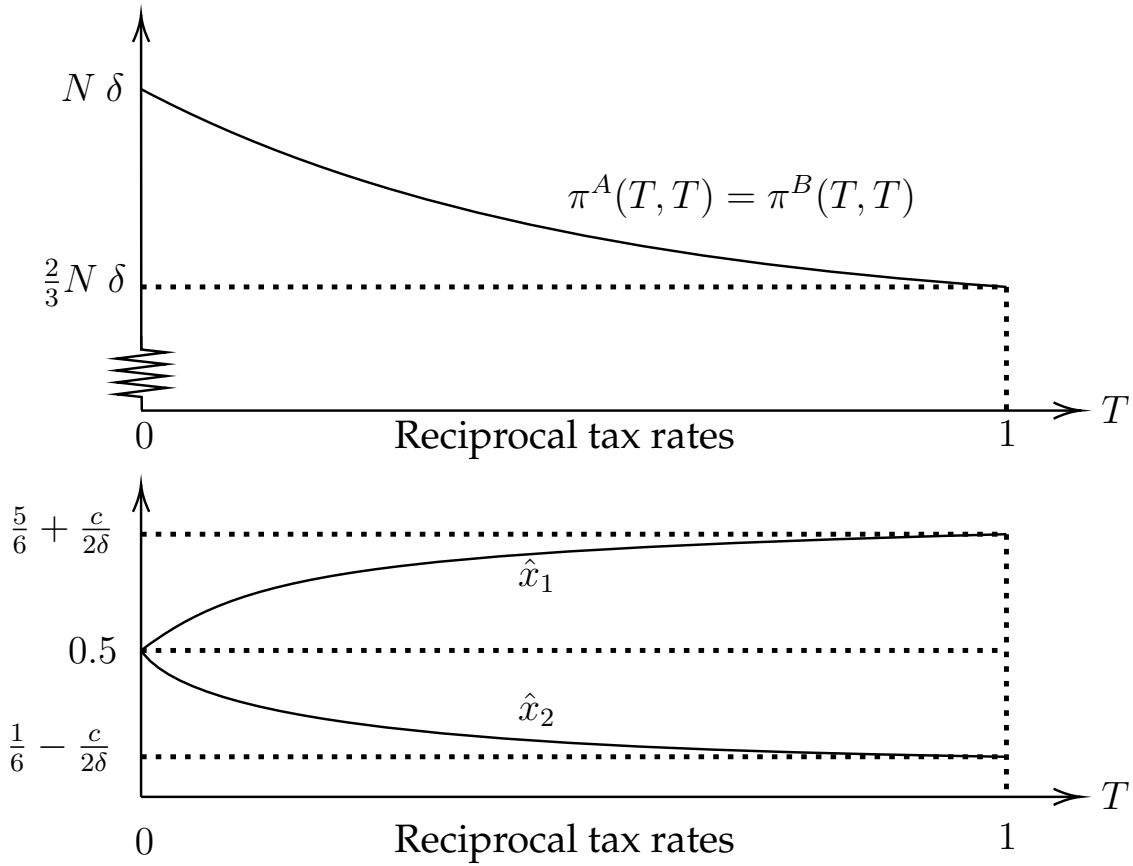
$$\times \left[\overbrace{N_1 \left(\frac{1}{2} + \frac{p^B(1+t_1) - p^A + \Delta V}{2\delta} \right)}^{q_1^A = N_1 \widehat{x}_1 \text{ domestic sales}} + \overbrace{N_2 \left(\frac{1}{2} + \frac{p^B - p^A(1+t_2) + \Delta V}{2\delta} \right)}^{q_2^A = N_2 \widehat{x}_2 \text{ exports}} \right]$$

$$\max_{p^B} \pi^B(t_1, t_2) = \overbrace{(p^B - c^B)}^{\text{per-unit profit}}$$

$$\times \left[\underbrace{N_1 \left(\frac{1}{2} - \frac{p^B(1+t_1) - p^A + \Delta V}{2\delta} \right)}_{q_1^B = N_1(1-\widehat{x}_1) \text{ exports}} + \underbrace{N_2 \left(\frac{1}{2} - \frac{p^B - p^A(1+t_2) + \Delta V}{2\delta} \right)}_{q_2^B = N_2(1-\widehat{x}_2) \text{ domestic sales}} \right]$$

Trade policy and equilibrium under symmetry

- The countries are said to be engaged in **free trade** if $t_1 = t_2 = 0$.
- The countries are said to impose **reciprocal tariffs** if they set the same import tariff rates so that $t_1 = t_2 = T$ where $0 < T < 1$.



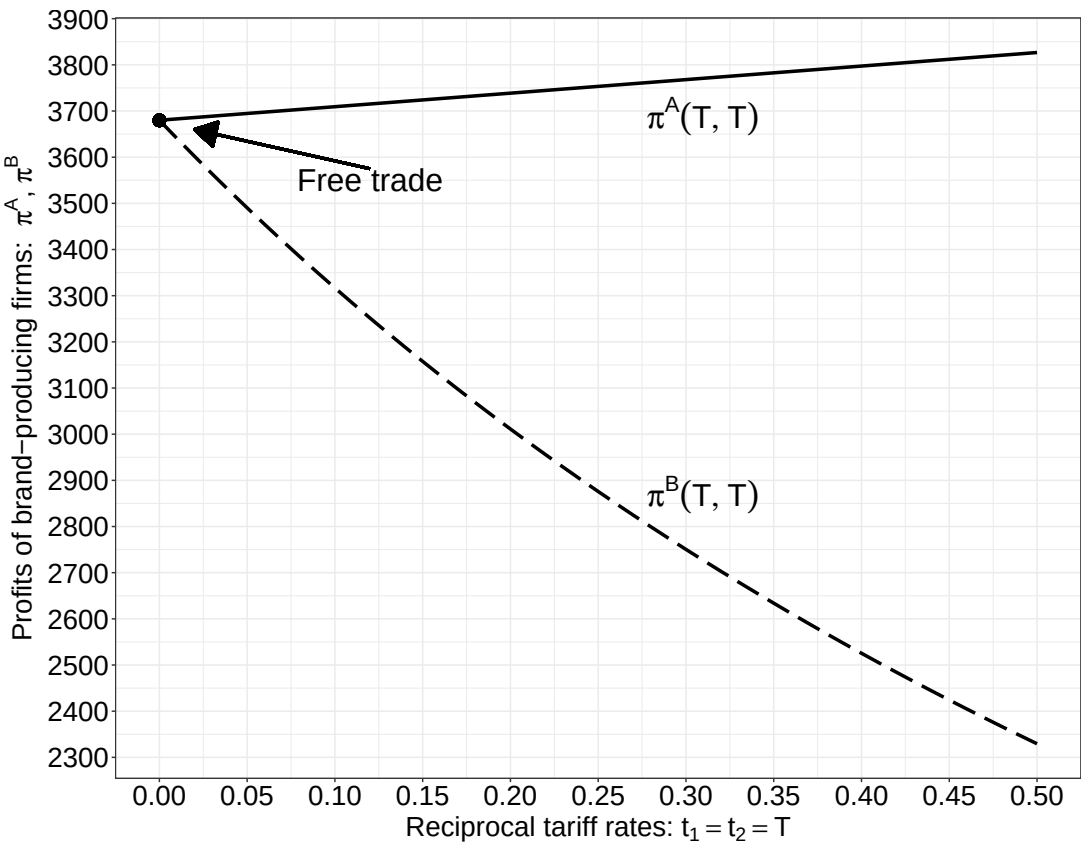
Conclusion: Under complete symmetry, firms lose from reciprocal tariffs.

Unequal market size

Suppose country 1 is larger than country 2 ($N_1 > N_2$).

$$\pi^A(T,T) = \frac{[Tc(N_1 - N_2) + 3\delta(N_1 + N_2)]^2}{18\delta(TN_2 + N_1 + N_2)}$$

$$\pi^B(T,T) = \frac{[Tc(N_1 - N_2) - 3\delta(N_1 + N_2)]^2}{18\delta(TN_1 + N_1 + N_2)}.$$



Subsidizing firms with tariff revenues

$$\pi_g^A(T,T) = \overbrace{Tp^B(T,T)N\left[1-\widehat{x}_1(T,T)\right]}^{\text{import tariff revenue (country 1)}} + \pi^A(T,T)$$

$$\pi_g^B(T,T) = \underbrace{Tp^A(T,T)N\widehat{x}_2(T,T)}_{\text{import tariff revenue (country 2)}} + \pi^B(T,T).$$