Tariffs and Cheapflation

Avik Chakrabarti [*]

Abstract

This paper identifies *cheapflation* as a distinct channel through which tariffs redistribute income. In a parsimonious setting of Heterogeneous Agent New Keynesian (HANK) model with international trade in vertically differentiated goods, we demonstrate that optimal tariff depends on consumption composition and monetary policy. When low-quality goods are disproportionately imported and consumed by high–marginal-propensity-to-consume households, tariffs shift real income toward wealthier households: monetary tightening amplifies this effect, lowering the optimal tariff.

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Keywords: Cheapflation, Tariff, Monetary Policy, HANK.

1. Introduction

Conventional models of strategic trade policy have typically viewed tariff as a tool for manipulating terms of trade or extracting rents from foreign firms. Such constructs abstract from a central feature of modern economies: households are heterogeneous. To fill this void, we develop a Heterogeneous Agent New Keynesian (HANK) model with trade in vertically differentiated goods and demonstrate that when low-quality goods are disproportionately imported and consumed by high–marginal-propensity-to-consume households, tariffs generate *cheapflation* (Sangani (2025, 2026)) — an endogenous inflation differential. This relative price channel redistributes real income toward asset holders and away from liquidity-constrained households, independently of wage or employment effects. Moreover, because tariffs operate as cost-push shocks, monetary policy amplifies these redistributive forces by tightening in response to tariff-induced inflation. Consequently, the optimal tariff deviates systematically when inequality concerns or monetary stabilization motives are sufficiently strong. We show how, once consumption composition and nominal rigidities are taken seriously, tariffs are intrinsically

transformed into redistributive macroeconomic shocks. Thus, by integrating strategic trade theory with heterogeneous-agent macroeconomics, this paper overturns the standard view of tariffs as pure terms-of-trade instruments and establishes that optimal trade policy depends fundamentally on the distribution of consumption across households and the conduct of monetary policy. The rest of our paper is organized as follows. In the next section, we place our work in the context of three distinct strands of the relevant literature on strategic trade policy, cheapflation, and HANK—a comprehensive review of which is beyond the scope of this paper. In section 3, we lay out a HANK model with trade in vertically differentiated goods and present our main results. We summarize our findings in the concluding section.

2. Context

2.1 Strategic Trade Policy

The foundation of modern optimal tariff analysis dates back to the seminal insights of Johnson (1953) who showed how large countries can improve welfare by imposing tariffs that exploit the foreign export supply elasticity. This terms-of-trade logic was further formalized in the trade policy literature and became a benchmark against which subsequent strategic motives were evaluated in the light of New Trade Theory since Krugman (1979). In the 1980s, Brander and Spencer introduced a new dimension by embedding trade policy within oligopolistic competition: their model demonstrated that governments could use tariffs and subsidies to shift rents from foreign to domestic firms when firms compete in quantity since Brander and Spencer (1984). The ensuing literature on strategic trade policy emphasized market structure and firm conduct, but it typically assumed a representative household and therefore abstracted from within-country distributional consequences. Subsequent extensions explored endogenous market entry and firm heterogeneity along the lines of “New” New Trade Theory since Melitz (2003). For example,

models of firm selection have consistently highlighted how trade liberalization reallocates resources across heterogeneous firms. However, even relatively richer versions of these models have maintained representative consumers, treating tariffs primarily as rent-shifting or reallocation tools rather than as instruments with intrinsic distributional effects. Recent studies have begun to relax the Representative Agent (RA) assumption in trade theory. For instance, Adão, et al. (2017) develop a nonparametric framework for evaluating counterfactual trade-policy changes without imposing restrictive functional-form assumptions on preferences and technology. Their approach highlights how changes in trade costs affect factor demand, factor prices, and welfare, providing a general framework for assessing heterogeneous effects of trade shocks. Adão et al. (2022) take this distributional perspective further by developing measures of individual exposure to imports and exports and estimating their incidence on earnings. They show that international trade can generate earnings inequality because individuals differ in their exposure to trade through both export and import channels. Adão et al. (2023) develop a revealed-preference approach that identifies the welfare weights implicitly placed on different groups by observed import tariffs. Applying their framework to the United States, they find that redistributive considerations account for a significant share of tariff variation and that the resulting transfers are driven primarily by differences across sectors of employment. More recently, Muñoz (2025) examine how trade policy interacts with heterogeneous labor markets, emphasizing wage and employment channels. Yet, the possibility that tariffs could generate differential pass-through and consequential inflation inequality has not been systematically analyzed. In this sense, our paper extends strategic trade theory by showing that vertical differentiation and heterogeneous import exposure endogenously generate relative price distortions that matter for distribution.

2.2 Cheapflation

A growing empirical literature underscores that inflation is not a single aggregate statistic experienced uniformly across households. For illustration, Chen et al. (2024) document that lower-income households often face higher effective inflation. Such differences, triggering cheapflation, are important for understanding real living standards and welfare, particularly in periods of volatile price movements. Building on the observation that firms often transfer the burden of hikes in upstream cost to consumers, a phenomenon coined as "pass-through in levels" by Sangani (2026), Sangani (2025) identified cheapflation as a distinct source of fluctuations in inflation inequality within narrow product categories triggered by input cost shocks: "When the cost of upstream inputs rises, varieties within a product category tend to have similar absolute price increases. … Since low-income households tend to buy lower-priced varieties, the inflation rates they face are disproportionately sensitive to upstream costs." In comparison, theoretical work on inflation heterogeneity has tended to focus on exogenous price shocks or demand shifts. For instance, Auclert (2019) develops a framework for understanding the distributional effects of inflation and monetary policy in heterogeneous-agent models. What has been largely absent from this literature is a policy-driven source of inflation heterogeneity. In our paper, the term cheapflation refers to the relative inflation of low-quality goods induced by tariffs. Recently Cavallo et al. (2025) have provided compelling evidence of differential price responses to tariffs: "Between October 2024 and September 2025, prices in the cheapest quartile rose by about 5 percent, compared with 2.5 percent in the most expensive quartile. This is further evidence of cheapflation …". Although prior research on consumption inequality recognized the role of expenditure composition, none have linked trade policy directly to this channel. Our paper bridges this gap by formalizing how asymmetric foreign exposure in a vertically differentiated industry affect prices in ways that

disproportionately burden households with high expenditure shares on low-quality imports, generating inflation inequality as a direct consequence of tariff policy.

2.3 HANK

The HANK literature has transformed how macroeconomists think about monetary and fiscal policy by explicitly modeling heterogeneity in assets, income, marginal propensities to consume, and interest rate exposure (since Kaplan et al. 2018). HANK has become a leading framework, while remaining firmly rooted in the New Keynesian (NK) tradition, especially for understanding why and how heterogeneity reshapes the aggregate effects of policy interventions. By integrating micro-level household heterogeneity into the standard NK macroeconomic framework, HANK models allow room for households to differ in wealth, income risk, liquidity, and marginal propensities to consume (MPCs) within environments subject to incomplete markets and borrowing constraints. By allowing analysis of policy transmission through distributional and income channels, this class of models demonstrates that aggregate policy shocks materially affect welfare and transmission. For example, monetary tightening can reduce the consumption of highly interest-sensitive, liquidity-constrained households more than that of wealthier savers. Despite this progress, trade shocks in HANK models have mostly been treated as exogenous cost or productivity disturbances (e.g. Gornemann et al. 2016). They have not been integrated with strategic trade instruments whose design can be welfare optimized. Moreover, the interaction between trade policy, relative price distortions across quality tiers, and monetary stabilization has not been explored. Our paper bridges this gap by embedding a strategic tariff shock within a HANK environment. In doing so, we show that tariffs influence inflation through pass-through and trigger monetary responses via the Taylor rule, which then have heterogeneous effects on households depending on their interest-rate sensitivity and consumption composition: this creates

an additional redistributive channel that lies outside the scope of both standard trade and standard HANK analyses.

3. Model

3.1 Sellers

Consider an industry with N upstream firms producing two differentiated varieties: "cheap" (V_1) at marginal cost c and "expensive" (V_2) at a marginal cost $c + k, k > 0$. Each upstream firm i would

$$\underset{\{q_{i1}, q_{i2}\}}{\text{Maximize:}}\ \pi_i = (w_1 - c)q_{i1} + (w_2 - c - k)q_{i2} - F$$

where F is the fixed cost of entry, w_i is the wholesale price of V_i.

Market inverse demand functions boil down to

$$P_1 = \frac{a - s}{b} - \frac{1}{b}Q_1$$

$$P_2 = \frac{a}{b} - \frac{1}{b}Q_2$$

where $Q_1 = \sum q_{i1};\ Q_2 = \sum q_{i2};$ and $s > 0$ is a fixed cost of adjustment differential due to quality (e.g. cheap variety requires extra "effort," search cost, conversion cost, perceived hassle, etc., equivalent to lower utility by s). Since downstream retailers are perfectly competitive, retail prices are set to $p_1 = w_1, p_2 = w_2$.

3.2 Buyers

A typical consumer has linear preference with a fixed quality/utility differential $s > 0$:

$$q_1 = a - b(p_1 + s)$$

and

$$q_2 = a - bp_2$$

3.3 Market

For symmetric upstream costs and fixed *N*,

$$w_1 = \frac{Nc + \frac{a-s}{b}}{N+1}$$

$$w_2 = \frac{N(c+k) + a/b}{N+1}$$

A uniform cost shock Δc leads to identical pass-through:

$$\Delta p_1 = \Delta p_2 = \frac{N}{N+1}\Delta c$$

3.4 Entry

With free entry, upstream profits shrink to zero:

$$\pi_i = (w_1 - c)q_1 + (w_2 - c - k)q_2 - F = 0$$

3.5 Tariff

Consider two countries, home (*h*) and foreign (*f*), with possible asymmetric upstream costs $c_h \neq c_f$. Home imposes a tariff $\tau_h$on foreign firms selling in its market. Wholesale prices at home are

$$w_1^h = \frac{N_h c_h + N_f(c_f + \tau_h) + \frac{a-s}{b}}{N_h + N_f + 1}$$

$$w_2^h = \frac{N_h(c_h + k) + N_f(c_f + k + \tau_h) + a/b}{N_h + N_f + 1}$$

Home welfare is defined as

$$W_h = CS_h + \Pi_h + TR_h$$

where CS_h= consumer surplus; Π_h= domestic firm profits; and TR_h= tariff revenue. The first order conditions (FOCs) of welfare maximization can be expressed as

$$\frac{N_f}{D} + \frac{N_h N_f}{D^2} + \frac{N_f}{D} - \tau_h \frac{N_f^2}{D^2} = 0$$

where $D = N_h + N_f + 1$, yielding an optimal tariff:

$$\tau_h^* = \frac{N_h}{N_f}$$

Lemma I. A uniform upstream cost shock or tariff leads to identical changes in the retail prices of both varieties.

Proof: $\frac{\partial p_1^h}{\partial \tau_h} = \frac{\partial p_2^h}{\partial \tau_h} = \frac{N_f}{N_h + N_f + 1}$

Intuitively, linear residual demand and Cournot markups guarantee symmetric responses; downstream competition passes wholesale changes fully to consumers.

Lemma II. Free entry upstream lowers the optimal strategic tariff relative to fixed entry.

Proof: Zero-profit condition pins upstream rents to zero.

$$\tau^{EE} = \frac{1}{2}\tau^{FE}$$

Intuitively, only terms-of-trade extraction motive prevails once entry dissipates rents.

Lemma III. With asymmetric costs $c_h \neq c_f$, foreign firms exit the home market if

$$\tau_h^R = w_1^{h-only} - c_f = \frac{N_h c_h + (a - s)/b}{N_h + 1} - c_f$$

Proof: See appendix.

Note: Pass-through symmetry ensures an analogous result for V_2.

Intuitively, free entry pins price to zero-profit equilibrium and tariff must offset foreign cost advantage.

2.4 Static HANK

Let us define

$$\Xi \equiv \frac{\partial p_1}{\partial \tau} - \frac{\partial p_2}{\partial \tau} = \frac{N_f^1}{D_1} - \frac{N_f^2}{D_2}$$

where $D_1 = (N_h^1 + 1)$; $D_2 = (N_h^2 + 1)$; and tariff pass-through under asymmetric foreign exposure is measured by

$$\frac{\partial p_1}{\partial \tau} = \frac{N_f^1}{D_1}, \frac{\partial p_2}{\partial \tau} = \frac{N_f^2}{D_2}$$

To fix ideas, partition asset holders in two groups indexed by j: poor ($j = L$) with share λ and rich ($j = H$) with share $(1 - \lambda)$, the MPC being relatively high for the former, and the cheap-good expenditure shares be

$$\omega_L > \omega_H$$

Then, the indirect utility for a typical household from group j can be expressed as

$$V_j = Y_j - \omega_j p_1 - (1 - \omega_j) p_2$$

Marginal welfare effect of tariff for group j is

$$\frac{dV_j}{d\tau} = -\omega_j \frac{\partial p_1}{\partial \tau} - (1 - \omega_j) \frac{\partial p_2}{\partial \tau} + \frac{\partial Y_j}{\partial \tau}$$

A weighted utilitarian welfare can be defined as

$$W = \lambda V_L + (1 - \lambda) V_H - \gamma (V_H - V_L) \tag{1}$$

where the last term penalizes inequality when policymaker has inequality aversion $\gamma > 0$.

From (1),

$$\frac{dW}{d\tau} = (\lambda + \gamma) \frac{dV_L}{d\tau} + (1 - \lambda - \gamma) \frac{dV_H}{d\tau} \tag{2}$$

Substituting price derivatives in (2),

$$\frac{dW}{d\tau} = -A \frac{\partial p_1}{\partial \tau} - B \frac{\partial p_2}{\partial \tau} + \frac{d\mathrm{Y}}{d\tau}$$

where $A = (\lambda + \gamma)\omega_L + (1 - \lambda - \gamma)\omega_H$ and $B = (\lambda + \gamma)(1 - \omega_L) + (1 - \lambda - \gamma)(1 - \omega_H)$.

The RA optimal tariff is

$$\tau^{RA} = \tau_h^* = \frac{N_h}{N_f}$$

Then,

$$-A\frac{\partial p_1}{\partial \tau} - B\frac{\partial p_2}{\partial \tau} = -(A + B)\frac{\partial p_2}{\partial \tau} - A\Xi = -\frac{\partial p_2}{\partial \tau} - A\Xi$$

where cheapflation enters welfare through the last term. Since $\omega_L > \omega_H$, inequality aversion raises weight on cheapflation.

The optimal tariff must satisfy the FOC for welfare maximization:

$$\frac{dW}{d\tau} = 0$$

which can be decomposed into

$$\frac{dW^{RA}}{d\tau} - A\Xi = 0$$

Hence,

$$\tau^* = \frac{N_h}{N_f} - A\Xi$$

Proposition I. Cheapflation transforms tariffs from a terms-of-trade tool into a mechanism of regressive distortion.

Proof: If the policymaker internalizes inflation inequality due to cheapflation, the optimal tariff is

$$\tau^* = \frac{N_h}{N_f} - [\omega_H + (\lambda + \gamma)(\omega_L - \omega_H)]\left(\frac{N_f^1}{D_1} - \frac{N_f^2}{D_2}\right)$$

In the absence of cheapflation ($\Xi = 0$),

$$\tau^* = \frac{N_h}{N_f}$$

In the face of cheapflation ($\Xi > 0$),

$$\tau^* < \frac{N_h}{N_f}$$

With Greater inequality aversion (i.e higher γ),

$$\frac{\partial \tau^*}{\partial \gamma} = -(\omega_L - \omega_H)\Xi < 0$$

Further, if cheap goods are disproportionately imported, higher N_f^1 implies larger Ξ and lower τ^*.

Intuitively, with heterogeneity, poor households consume more cheap goods, cheap goods inflate more, real income losses are concentrated among high-MPC agents, and inequality rises. The planner internalizes that distributional loss from cheapflation exceeds gains from tariff: hence, the optimal tariff is lower relative to the RA benchmark. In effect, cheapflation transforms tariffs from a terms-of-trade tool into a mechanism of regressive distortion: the stronger the foreign exposure of low-quality goods and the stronger inequality aversion, the smaller the optimal tariff.

2.5 Dynamic HANK

Let aggregate inflation (π_t) satisfy a standard New Keynesian Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa mc_t$$

Marginal cost (mc_t) depends on wholesale prices

$$mc_t = \omega p_{1t} + (1-\omega) p_{2t}$$

A tariff shock affects inflation through pass-through

$$\frac{\partial \pi_t}{\partial \tau_t} = \kappa \left[\omega \frac{\partial p_1}{\partial \tau} + (1-\omega) \frac{\partial p_2}{\partial \tau} \right]$$

Nominal interest rate (i_t) follows the Taylor rule:

$$i_t = r^* + \phi_\pi \pi_t$$

Where, by definition, real interest rate (r_t) is

$$r_t = i_t - E_t \pi_{t+1}$$

Under rational expectations and small shocks

$$\frac{\partial r_t}{\partial \tau_t} = \phi_\pi \frac{\partial \pi_t}{\partial \tau_t}$$

i.e. tariffs trigger monetary tightening proportional to ϕ_π.

For household type $j \in \{L, H\}$,

$$c_{j,t}^{-1} = \beta(1 + r_t) E_t c_{j,t+1}^{-1}$$

which can be linearized to

$$\frac{\partial c_{j,t}}{\partial r_t} = -\sigma_j c_j$$

where $\sigma_L > \sigma_H$ as poor households are more interest-sensitive. Therefore, monetary tightening has unequal effects.

Let

$$W = -\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2}\pi_t^2 + \frac{\lambda_y}{2} y_t^2 + \gamma\left(V_{H,t} - V_{L,t}\right) \right] \quad (3)$$

Using pass-through,

$$\frac{\partial \pi_t}{\partial \tau_t} = \kappa \left[\omega \frac{N_f^1}{D_1} + (1 - \omega) \frac{N_f^2}{D_2} \right] \Leftrightarrow \frac{\partial \pi_t}{\partial \tau_t} = \kappa \Psi$$

where

$$\Psi = \omega \frac{N_f^1}{D_1} + (1 - \omega) \frac{N_f^2}{D_2}$$

The effect of tariff on real rate is

$$\frac{\partial r_t}{\partial \tau_t} = \phi_\pi \kappa \Psi$$

The response of consumption inequality to tariff is

$$\frac{\partial (c_L - c_H)}{\partial \tau} = -[\sigma_L - \sigma_H] \phi_\pi \kappa \Psi$$

Therefore, since $\sigma_L > \sigma_H$, monetary tightening widens inequality.

From (3),

$$\frac{dW}{d\tau} = \left(\frac{N_h}{N_f} - \tau\right) - A\Xi - \Omega\phi_\pi\kappa\Psi = 0 \quad (4)$$

where $\Omega = \gamma(\sigma_L - \sigma_H)$.

Solving (4),

$$\tau^* = \frac{N_h}{N_f} - A\Xi - \gamma[\sigma_L - \sigma_H]\phi_\pi\kappa\Psi$$

where the first term captures any role that terms-of-trade plays while the second and third terms isolate the distinct effects of cheapflation and monetary amplification, respectively.

Consequently, aggressive central banks would reduce optimal tariffs:

$$\frac{\partial\tau^*}{\partial\phi_\pi} < 0$$

and the optimal tariff would be lower in the face of greater price rigidity (κ), greater heterogeneity ($[\sigma_L - \sigma_H]$), and/or when cheap goods are heavily imported (i.e. higher Ξ and Ψ). Our final proposition follows.

Proposition II. Monetary policy transforms tariffs into a macro-redistributive shock.

Proof: When tariffs generate inflation and the central bank stabilizes inflation via the Taylor rule, the optimal tariff satisfies

$$\tau^* < \frac{N_h}{N_f} - A\Xi$$

Monetary stabilization introduces an additional welfare cost proportional to

$$\gamma(\sigma_L - \sigma_H)\phi_\pi\kappa\Psi$$

Thus, monetary policy transforms tariffs into a macro-redistributive shock: the stronger the central bank's inflation response and the greater household heterogeneity, the smaller the optimal tariff. Intuitively, in the benchmark uniform upstream cost shocks or tariffs are passed through

symmetrically to both varieties, so tariffs operate purely as a terms-of-trade instrument and the optimal tariff reflects the ability to extract foreign rents; with free entry, however, profits are competed away and the strategic motive weakens because there are no rents left to shift. Once we introduce heterogeneity across goods in foreign exposure, tariffs generate regressive real income losses that the planner internalizes to the extent that cheap varieties experience larger tariff pass-through relative to expensive goods (cheapflation) thereby reducing the optimal tariff below the RA benchmark with the reduction increasing in inequality aversion and in the import intensity of cheap goods. Tariffs also raise inflation, prompting monetary tightening via the Taylor rule in the dynamic New Keynesian extension; since poorer households are more interest-sensitive, higher real rates further depress their consumption relative to richer households, amplifying inequality. Consequently, monetary policy transforms tariffs from a pure trade instrument into a macro-redistributive shock, adding an additional welfare cost proportional to heterogeneity, and central bank aggressiveness, and further lowering the optimal tariff relative to the standard terms-of-trade level.

4. Conclusion

This paper builds on and connects several strands of research that have largely evolved separately. First, in the optimal tariff and strategic trade literature, the canonical large-country benchmark implies that tariffs exploit foreign export supply elasticities, while imperfectly competitive models show how governments can shift rents from foreign to domestic firms. These frameworks, however, typically rely on representative agents and abstract from distributional consequences operating through consumption baskets. Second, the HANK literature demonstrates that monetary and fiscal policies have powerful redistributive effects because households differ in assets, marginal propensities to consume, and interest rate exposure. Yet, this literature treats trade

shocks largely as exogenous cost disturbances rather than policy instruments chosen in equilibrium. Third, the trade-and-inequality literature emphasizes wage and employment channels—most prominently through firm heterogeneity and reallocation effects—but pays comparatively little attention to inflation heterogeneity arising from differences in consumption composition. By introducing vertically differentiated goods into a HANK environment with strategic trade, we identify a distinct and previously unexplored mechanism: tariffs alter relative prices across quality segments, generating inflation inequality through cheapflation that interacts with monetary stabilization and reshapes optimal policy. In doing so, our paper unifies strategic trade theory and heterogeneous-agent macroeconomics and shows that optimal tariffs depend not only on foreign market power but also on the distribution of consumption across households and the conduct of monetary policy. In sum, our paper delves into the macroeconomic and distributional effects of tariffs, especially their role in creating inflation inequality and redistributing income. Specifically, we build on the insight that tariffs can generate cheapflation where higher inflation of lower-priced goods disproportionately benefit wealthier households, thereby exacerbating income inequality. Strategic trade policy and monetary policy thus interact, complicating the optimal design of tariffs with distributional consequences that go beyond simple price changes and affecting households differently based on their consumption baskets and wealth. The implication is immediate: tariffs can trigger inflation inequality through cheapflation which redistributes income toward wealthier households and, amplified by monetary policy, lowers the optimal tariff.

Appendix

A.1 Upstream Compeition

Each manufacturer i (upstream) would

$$\underset{\{q_{i1},q_{i2}\}}{\text{Maximize:}}\ \pi_i = (w_1 - c)q_{i1} + (w_2 - c - k)q_{i2}$$

Firm i's FOCs for each variety is

$$\frac{\partial \pi_i}{\partial q_{i1}}: w_1 - c - \frac{1}{b}q_{i1} - \frac{1}{b}\sum_{j \neq i} q_{j1} = 0$$

which yields

$$(N+1)q_1^* = \frac{a - s - bc}{b} \Rightarrow q_1^* = \frac{a - s - bc}{b(N+1)}$$

Therefore, total output and wholesale prices are

$$Q_1 = \frac{a - s - bc}{b} \cdot \frac{N}{N+1}$$

$$w_1 = \frac{a - s}{b} - \frac{Q_1}{b} = \frac{Nc + (a - s)/b}{N+1}$$

$$w_2 = \frac{N(c + k) + a/b}{N+1}$$

A.2 Pass-Through of Upstream Cost Shock

Consider an exogenous shock where c rises by Δc.

Then,

$$w_1 + \Delta w_1 = \frac{N(c + \Delta c) + (a - s)/b}{N+1} = w_1 + \frac{N}{N+1}\Delta c$$

and

$$\Delta w_2 = \frac{N}{N+1}\Delta c$$

Since retail and wholesale prices are equal,

$$\Delta p_1 = \Delta w_1 = \Delta p_2 = \Delta w_2$$

Therefore,

$$\Delta p_1 = \Delta p_2 = \frac{N}{N+1}\Delta \mathrm{c}$$

A.3 Strategic Tariff with Free Entry

A.3.1 Free Entry

Profit of upstream manufacturer i:

$$\pi_i = (w_1 - c)q_1 + (w_2 - c - k)q_2 - F$$

Due to symmetry,

$$q_1 = \frac{a - s - bc}{b(N+1)}, q_2 = \frac{a - b(c+k)}{b(N+1)}$$

$$w_1 - c = \frac{a - s - bc}{b(N+1)}, w_2 - c - k = \frac{a - b(c+k)}{b(N+1)}$$

Hence,

$$\pi_i = b(w_1 - c)^2 + b(w_2 - c - k)^2 - F$$

Zero-profit condition ensures

$$b(w_1 - c)^2 + b(w_2 - c - k)^2 = F$$

A.3.2 Optimal Tariff with Fixed Entry

For symmetric countries with fixed N, the optimal Nash tariff satisfies

$$\tau^{FE} = \frac{A - c}{N(2N+1)}$$

where $A = \left(\frac{a-s}{b}\right)$.

A.3.3 Optimal Tariff with Endogenous Entry

Under free entry, upstream profits are zero for both home and foreign firms. The home government's welfare reduces to:

$$W_h = CS + \tau_h N_f q_f$$

Solving yields

$$\tau^{EE} = \frac{1}{2}\tau^{FE} = \frac{A - c}{2N(2N + 1)}$$

Note: FOC includes the entry effect $\frac{\partial N_f}{\partial \tau_h} < 0$.

A.3.4 Relocation

With cost asymmetry $c_h < c_f$, foreign firms exit the home market when:

$$w_1^{h-only} - (c_f + \tau_h^R) = 0$$

Home-only price is

$$w_1^{h-only} = \frac{N_h c_h + (a - s)/b}{N_h + 1}$$

Hence, the threshold tariff for relocation is

$$\tau_h^R = w_1^{h-only} - c_f$$

An analogous threshold applies to both varieties, due to pass-through symmetry.

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