Commodity Tax Principles, Firm Location, and Skilled-Wage Incidence

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Abstract

This paper studies the welfare and distributional effects of destination and origin-based commodity taxation in a two-country economy with monopolistic competition, mobile firms, and heterogeneous labor. Destination taxation affects consumer prices but leaves production location pinned down by factor supplies, whereas origin taxation changes the relative attractiveness of countries and therefore operates through firm relocation. I show that under cooperation the choice of tax principle is neutral: the two tax principles implement the same corrective subsidy against monopoly markups. Under non-cooperative taxation however, the two principles are different because origin taxation creates a production-location margin that affects skilled wages, capital income, consumer prices, and fiscal revenue. The numerical analysis decomposes welfare into these four channels and shows that firm attraction is neither necessary nor sufficient for welfare dominance. Origin taxation is more likely to dominate when the skilled-wage or fiscal-revenue channels are strong, but its within-country incidence depends on how the fiscal adjustment is assigned across skilled and unskilled workers.

Keywords: destination principle, origin principle, commodity taxation, monopolistic competition, firm mobility, labor heterogeneity.
JEL codes: F12, F15, H21, H25, H87, R12.

1 Introduction

How a country taxes the goods that cross its borders is among the oldest and most consequential questions in public finance. The dominant instrument worldwide is the value-added

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tax (VAT), and the central design choice is the principle under which it is levied: the destination principle taxes goods where they are consumed, while the origin principle taxes them where they are produced. The choice is not merely accounting. VAT is a central source of public revenue in modern tax systems and has long been at the core of the European debate over the design of indirect taxation (Ebrill et al., 2001; Keen et al., 1996). Hence, even small differences in the definition and enforcement of the VAT base can have large fiscal implications. The salience of these stakes is illustrated by the European Commission's 2024 VAT Gap report, which estimates that the EU VAT compliance gap—revenue legally due but uncollected—amounted to €89.3 billion in 2022, representing about 7% of theoretically expected VAT revenue (CASE and Oxford Economics, 2024; European Commission, 2024). The EU's VAT in the Digital Age reform further highlights the renewed importance of place-of-taxation rules, cross-border reporting, and enforcement in integrated markets (European Commission, 2025b,a). Against this background, the theoretical question remains central: should commodity taxation be designed so that it leaves production location neutral, or can it be used as an instrument that affects the spatial allocation of firms?

This paper studies that choice, and asks a question the prior literature has largely left aside: when a country switches between the destination and the origin principle, *who inside the country bears the burden*? The answer hinges on who ultimately absorbs the change—consumers through prices, workers through wages, or capital owners through returns—and on how those burdens are distributed within, not only across, countries. This within-country dimension also speaks to the European Union's cohesion objective. Article 174 of the Treaty on the Functioning of the European Union (European Union, 2008) commits the Union to reducing disparities between the levels of development of its regions. In the model developed below, the two tax principles differ precisely in their implications for the spatial allocation of production: a destination-based tax leaves firm location pinned down by factor supplies, whereas an origin-based tax changes the relative attractiveness of production locations. The choice of a principle may therefore affect not only national revenue and consumer prices, but also the geographic distribution of activity inside an integrated market and the incidence of that activity across factors.

To address this question, I study the welfare and distributional effects of destination and origin commodity taxation in a model where the economy is characterized by two-country with monopolistic competition, internationally mobile firms, and mobile capital. The single substantive departure from the standard framework is heterogeneous labor. Each differentiated variety is produced from skilled and unskilled labor under a Cobb–Douglas technology: skilled labor is internationally immobile and paid a flexible wage that adjusts to changes in firm profitability, while unskilled labor is paid the fixed numeraire wage.

Governments set commodity taxes to maximize the welfare of their residents and rebate the proceeds lump sum. This modification turns the destination-versus-origin question from one about production efficiency, tax bases, and capital rents into one about factor incidence. The governing object is the effective skilled-labor income share, $s = \alpha(\sigma - 1)/\sigma$, which measures how strongly firm revenue is transmitted to skilled wages. In the symmetric benchmark, the ranking of the two principles turns on this object; in asymmetric economies, it interacts with skilled-labor endowments, market size, and capital ownership.

Three results follow. First, under cooperation the choice of a tax principle is neutral. A supranational planner who internalizes all cross-border spillovers implements the same corrective subsidy against the monopoly markup, $t = -1/\sigma$, under both tax regimes. Under the aggregate welfare criterion used here, labor-market composition affects incidence but not the cooperative ranking between principles. Second, under non-cooperative taxation the two principles diverge, because origin taxation creates a production-location margin absent under destination taxation. Destination taxes leave firm location pinned down by factor supplies and operate only through demand and income effects, which keeps the destination game analytically tractable. Origin taxes alter the relative attractiveness of the two locations and therefore make commodity-tax policy an instrument of locational competition. Third, in the symmetric economy the welfare ranking is governed by a single threshold: origin taxation welfare-dominates destination taxation if and only if the effective skilled-labor income share,s, is greater than one-half, with the two principles coinciding exactly at $s = 1/2$. When the effective skilled-labor share is high, the skilled-wage gain from attracting firms under origin taxation outweighs the locational distortion; when it is low, the distortion dominates and destination taxation is preferred.

The numerical analysis then shows that, in asymmetric economies, this clean threshold is perturbed by differences in skilled-labor endowments, market size, and capital ownership. Decomposing the welfare gap into four channels—consumer prices, skilled wages, capital income, and fiscal revenue—reveals that firm attraction is neither necessary nor sufficient for welfare dominance. Origin taxation can disperse activity without raising home welfare, and can concentrate it while still raising welfare, because the ranking reflects the full balance of the four channels rather than firm location alone. Finally, the paper separates aggregate welfare dominance from worker-level incidence. Because skilled and unskilled workers differ in population size, how the fiscal adjustment is rebated matters: an equal split of the revenue change between the two groups is not the same as an equal per-capita transfer. Tracing the per-capita skilled–unskilled incidence gap as a function of the fiscal-assignment rule, I show that a tax principle can raise national welfare while lowering the skilled wage or shifting the fiscal gain toward one group, and that the same revenue change can reverse the sign of the incidence gap depending on the rebate rule. The choice of tax principle and the design of the fiscal rebate are therefore not separable: the welfare ranking determines the size of the surplus, but its distribution across workers is a distinct policy decision.

The remainder of the paper is organized as follows. Section 2 situates the paper in the literature. Section 3 sets out the two-country model and derives the equilibrium under each principle. Section 4 establishes the cooperative neutrality benchmark. Section 5 characterizes the non-cooperative equilibria and the symmetric dominance threshold. Section 6 presents the numerical analysis, the four-channel welfare decomposition, and the worker-incidence results. Section 7 concludes.

2 Related literature

This paper connects three strands of work: the theory of destination versus origin commodity taxation, the new-economic-geography literature on taxation and firm location, and the applied debate on cross-border shopping, e-commerce, and digital trade.

Destination versus origin under imperfect competition. The foundational question is when, and why, the two principles differ. Under perfect competition the classical benchmark holds that the two principles are equivalent under appropriate uniformity and border-adjustment conditions, while destination taxation avoids the production inefficiencies that origin taxation can introduce (Lockwood, 2001). Lockwood et al. (1994) establish that these equivalence conditions are fairly general. Once imperfect competition is admitted, the equivalence breaks down. Keen and Lahiri (1998) show that, with integrated markets and oligopolistic firms, moving from destination to origin taxation can raise welfare, overturning the perfect-competition presumption. The ranking however is sensitive to market structure, demand, integration, and the treatment of tax revenue. Hashimzade et al. (2005) analyze product differentiation under Bertrand competition and show that, with linear demand and consumer rebates, the origin principle dominates the destination principle; with nonlinear demand, the dominance result depends on the extent of economic integration. A related branch studies not the ranking of the two principles but the welfare effects of harmonizing indirect taxes. Lahiri and Raimondos-Møller (1998) show, in a model with public-good provision, that the desirability of indirect-tax harmonization depends on how additional revenue is used, so that harmonizing reforms need not be welfare-improving once government spending is accounted for. Keen et al. (2002) further show that, under imperfect competition, the welfare effects of tax harmonization depend on the tax principle and on the initial configuration of taxes; harmonization may be welfare-reducing in some cases. The broader lesson is that, once perfect competition is abandoned, neither principle is unconditionally preferred. The present paper takes up this lesson by identifying a sufficient statistic for the symmetric welfare ranking—the effective skilled-labor income share—and by showing how this statistic interacts with asymmetries in a monopolistic-competition economy with heterogeneous labor.

Haufler and Pflüger (2004) bring the destination-versus-origin debate into a monopolistic-competition setting with internationally mobile firms and capital, and characterize it through the fiscal externalities generated by national tax policy. In the destination principle, taxes are attached to consumer markets; the relocation and capital-rent externalities exactly offset, so the non-cooperative equilibrium is Pareto efficient. Whereas in the origin principle taxes are attached to production locations; unilateral tax changes directly alter the international allocation of firms and generate additional externalities on the foreign tax base and the foreign price level, pushing non-cooperative taxes above their efficient level.

The present paper retains this externality architecture but changes the factor through which it matters. In Haufler and Pflüger (2004), relocation reaches welfare through firm location and capital rents, because labor is a single homogeneous input. The burden of a tax-principle switch therefore cannot fall differentially across labor types. Here, because varieties are produced from skilled and unskilled labor, skilled labor is internationally immobile, and skilled wages adjust endogenously, the same relocation margin also moves the domestic wage structure. The origin-specific externality they identify is therefore no longer welfare-decisive on its own: whether it dominates depends on how strongly firm revenue is transmitted to skilled wages, which is exactly what the effective skilled-labor share s measures. My cooperative-neutrality result is, in this light, the planning-problem counterpart of their decentralized efficiency result. The novelty appears once taxation is decentralized *and* labor is heterogeneous.[1]

Taxation and firm location. A second strand makes location the central margin through which the choice of principle operates. In the tax-competition tradition initiated by Mintz and Tulkens (1986), origin-based taxes are set strategically because the tax base is mobile; the new-economic-geography literature then embeds this mobility in models where firm location itself is endogenous. The work closest to the spatial dimension of this paper is Behrens et al. (2009), who study commodity-tax competition and industry location under the two principles with mobile firms, trade frictions, and asymmetric country sizes. They find that, relative to destination taxation, the origin principle intensifies tax competition and erodes

[1] In Haufler and Pflüger (2004), the foreign-price-level externality operates partly through iceberg trade costs. The base model developed here is frictionless, so this externality runs through the CES price aggregator rather than through a trade-cost wedge.

revenue, yet delivers a more even spatial distribution of economic activity.

This paper keeps the location margin but reaches different conclusions about it, and adds a question that this strand does not ask. First, neither of the results emphasized by Behrens et al. (2009) is unconditional here. Whether origin taxation raises or lowers equilibrium taxes relative to destination taxation depends on the effective skilled-labor share: in the symmetric economy, the origin tax lies below the destination tax when this share exceeds one half and above it otherwise. Origin taxation therefore intensifies tax competition only in part of the parameter space. Likewise, origin taxation disperses activity in some asymmetries, such as unequal skilled-labor supplies, but concentrates it in others, such as market-size and capital-ownership asymmetries. A more even spatial distribution is therefore one possible outcome rather than a general property. Second, and distinct from this strand, the paper asks how tax-induced relocation translates into factor incidence *inside* each country. This matters because, as the numerical analysis shows, a movement of firms toward home is not the same as a welfare gain, and spatial dispersion is not the same as an incidence improvement for any particular group.

Cross-border shopping, e-commerce, and digital taxation. A third, more applied strand studies how consumer mobility and digital trade shape the destination/origin choice in practice. Agrawal and Fox (2017) and Agrawal and Fox (2021) argue that the destination principle is the appropriate place-of-taxation rule for cross-border consumption, and analyze European VAT reforms alongside U.S. enforcement options. Agrawal (2021) shows how the growth of online commerce can erode the ability to enforce destination-based taxation. Agrawal and Wildasin (2020) model a setting in which online purchases are taxed at destination and brick-and-mortar purchases at origin, with the extent of online activity determined endogenously. Aiura and Ogawa (2024) show that destination-based taxation can distort the consumer's channel choice between online and in-store purchasing, while origin-based taxation is neutral on that margin. This literature focuses primarily on the mobility of *consumers* and on the enforcement of the destination principle. The present paper is complementary: it holds enforcement aside and focuses instead on the mobility of *firms* and the incidence of relocation across domestic factors.

Contribution. Relative to the location-centered analysis of Behrens et al. (2009) and the externality-based analysis of Haufler and Pflüger (2004), the paper makes three contributions. First, it embeds labor heterogeneity into the destination-versus-origin comparison and shows that, in the symmetric economy, a single sufficient statistic—the effective skilled-labor income share—governs the welfare ranking, while asymmetries in skilled-labor endowments, market size, and capital ownership perturb that benchmark. Second, it provides a transparent four-channel decomposition that disentangles price, wage, capital-income, and revenue effects, and demonstrates that locational outcomes and welfare outcomes need not align. Third, it opens the distributional dimension by characterizing within-country incidence across skilled and unskilled workers under alternative fiscal-rebate rules.

3 The Model

We consider a version of the Dixit-Stiglitz-Krugman model of monopolistic competition (Dixit and Stiglitz, 1977; Krugman, 1979 and Krugman, 1980) where firms produce monopolistically goods that enter international trade using one unit of capital and a variable amount of labor. The economy is made up of two countries, home h and foreign f. We assume that the home and the foreign countries are populated by L and L^* individuals respectively. In addition, suppose that each country is populated by two types of individuals, skilled denoted by s and unskilled denoted by u. Let us further denote by ψ_i (resp. ψ_i^*) $i \in \{s, u\}$ the proportion of individuals of type i in the total population of the home country (resp. in the foreign country). Each individual owns one unit of labor and an amount of capital that differs from one type of individual to another while being the same for all individuals of the same type.

There are two goods: a homogeneous numeraire produced from unskilled labor under constant returns, and a differentiated good produced under monopolistic competition. Each firm produces one variety using skilled and unskilled labor and one unit of capital as a fixed cost. We develop the notation as the model is built; Table 1 collects it for reference.

3.1 Preferences and demand

A type-i consumer in the home country derives utility from a basket of differentiated varieties $D_{i,k}$ and the numeraire $E_{i,k}$, under tax principle $k \in \{d, o\}$. The numeraire enters linearly,

$$U_{i,k} = \mu_i \ln D_{i,k} + E_{i,k}, \qquad \mu_i > 0, \tag{1}$$

where the differentiated basket is the usual CES aggregate over home and foreign varieties,

$$D_{i,k} = \left[\int_{\Omega} D^h_{i,k}(v)^{(\sigma-1)/\sigma}\, dv + \int_{\Omega^*} D^f_{i,k}(v)^{(\sigma-1)/\sigma}\, dv \right]^{\sigma/(\sigma-1)}, \qquad \sigma > 1. \tag{2}$$

Here $D^h_{i,k}(v)$ is the home consumer's demand for a variety v produced at home, $D^f_{i,k}(v)$ the demand for a foreign-produced variety, and Ω (Ω^*) the set of home (foreign) varieties. One unit of the numeraire is produced using one unit of unskilled labor under perfect competition and is non-traded, this assumption normalizes both the price of the numeraire and the unskilled wage to one.[2]

Each differentiated good faces an ad valorem tax on the producer price. Let $\tau_{h,k}$ and $\tau_{f,k}$ denote the gross tax factors applied in the home market to varieties produced at home and abroad, respectively. Under the destination principle, $\tau_{h,d} = \tau_{f,d} = \tau$. Under the origin principle, $\tau_{h,o} = \tau$ and $\tau_{f,o} = \tau^*$. Therefore, the budget constraint of any consumer of type i in the domestic country is given by:

$$\int_{\Omega} \tau_{h,k} p_{h,k}(v) D^h_{i,k}(v)\, dv + \int_{\Omega^*} \tau_{f,k} p_{f,k}(v) D^f_{i,k}(v)\, dv + E_{i,k} = \omega_{i,k} + R_k K_i + B_{i,k}, \tag{3}$$

where K_i is the consumer's capital, R_k the (common) capital return, $B_{i,k}$ a lump-sum transfer, and $p_{h,k}$ ($p_{f,k}$) the producer price of a home- (foreign-) produced variety.[3] Defining the consumer price index

$$P^h_k = \left[\int_{\Omega} (\tau_{h,k} p_{h,k})^{1-\sigma} dv + \int_{\Omega^*} (\tau_{f,k} p_{f,k})^{1-\sigma} dv\right]^{1/(1-\sigma)}, \tag{4}$$

the budget constraint compresses to $P^h_k D_{i,k} + E_{i,k} = \omega_{i,k} + R_k K_i + B_{i,k}$, and utility maximization yields the variety demands

$$D^h_{i,k} = \mu_i \Big[\tau_{h,k} p_{h,k}\Big]^{-\sigma} (P^h_k)^{\sigma-1}, \qquad D^f_{i,k} = \mu_i \Big[\tau_{f,k} p_{f,k}\Big]^{-\sigma} (P^h_k)^{\sigma-1}, \tag{5}$$

with analogous expressions abroad. Substituting the optimal choices into (1) gives the indirect utility

$$V_{i,k} = \mu_i \ln\Big(\mu_i (P^h_k)^{-1}\Big) + \Big(\omega_{i,k} + R_k K_i + B_{i,k} - \mu_i\Big). \tag{6}$$

Because each consumer's demand scales with the taste weight μ_i, the relevant measure of a country's demand is the taste-weighted population. We therefore define *market size*

$$M = L \sum_i \psi_i \mu_i, \qquad M^* = L^* \sum_i \psi^*_i \mu^*_i, \tag{7}$$

so that M captures both population and the intensity of preference for the differentiated

[2]The numeraire is naturally interpreted as a non-tradable service (local services, real estate, construction) whose international exchange is prohibitively costly; this assumption is standard in tax-competition models that isolate the effects of policy on traded goods (see Grossman, 1980; Helpman and Krugman, 1985). For tradable-numeraire cases see Melitz (2003) and Costinot and Rodríguez-Clare (2014).

[3]In the foreign country the corresponding producer prices are denoted $p^*_{h,k}$ and $p^*_{f,k}$.

good. We will measure market-size asymmetry by the ratio

$$\lambda = \frac{M^*}{M}; \tag{8}$$

$\lambda > 1$ means the foreign country is the larger demand market, $\lambda < 1$ the reverse.

3.2 Production, the skilled wage, and the effective skill share

A home firm produces with a Cobb–Douglas technology in skilled and unskilled labor,

$$\sum_i \psi_i D^h_{i,k}(v) L + \sum_i \psi^*_i D^{h,*}_{i,k}(v) L^* = A\, \ell^{\alpha}_{s,k} \ell^{1-\alpha}_{u,k}, \tag{9}$$

with the foreign technology defined symmetrically, where $\ell_{s,k}, \ell_{u,k}$ are the firm's skilled and unskilled labor inputs and $A > 0$. Skilled workers are paid a flexible wage ω^h_k; unskilled workers are paid the numeraire wage, normalized to one. Each firm also rents one unit of capital–used as fixed costs– at the common return R_k, paid before operation. With free capital mobility the return is equalized across countries. The home firm's profit is

$$\pi_{h,k}(v) = p_{h,k}(v) \sum_i \psi_i D^h_{i,k}(v) L + p^*_{h,k}(v) \sum_i \psi^*_i D^{h,*}_{i,k}(v) L^* - \omega^h_k \ell_{s,k}(v) - \ell_{u,k}(v) - R_k. \tag{10}$$

Profit-maximizing prices satisfy the constant-markup rule, so the domestic and export prices coincide, $p_{h,k}(v) = p^*_{h,k}(v)$, and profit reduces to operating surplus net of the fixed cost,

$$\pi_{h,k}(v) = \frac{p_{h,k}(v) F_k(v)}{\sigma} - R_k. \tag{11}$$

Free entry drives operating surplus to the fixed cost. The markup revenue $(\sigma - 1)R_k$ available for variable factors is split between the two labor types according to the Cobb–Douglas shares,

$$\omega^h_k \ell_{s,k}(v) = \alpha(\sigma - 1)R_k, \qquad \ell_{u,k}(v) = (1 - \alpha)(\sigma - 1)R_k. \tag{12}$$

The skilled wage is flexible and absorbs changes in profitability, while unskilled employment scales with firm income at a fixed wage.

Equation (12) isolates the parameter that governs the whole analysis. Only the fraction $(\sigma - 1)/\sigma$ of revenue is paid to variable factors—the remainder is markup revenue covering the fixed cost—and of that, the share α accrues to skilled labor. The product,

$$s = \frac{\alpha(\sigma - 1)}{\sigma} \tag{13}$$

is the *effective skilled-labor income share*: the fraction of firm revenue ultimately transmitted to skilled wages. It is s, not the raw production share α, that scales the strength of the skilled-wage adjustment channel. We will see that, in the symmetric benchmark, the destination-versus-origin ranking turns on this single object; in asymmetric economies, it interacts with skilled- labor endowments, market size, and capital ownership.

Combining (12) with the free-entry condition and the constant markup, the pre-tax producer prices are proportional to marginal cost with a common markup,

$$p_{h,k} = p^*_{h,k} = \frac{\sigma}{\sigma-1}\frac{(\omega^h_k)^\alpha}{A\,\alpha^\alpha(1-\alpha)^{1-\alpha}}, \qquad p_{f,k} = p^*_{f,k} = \frac{\sigma}{\sigma-1}\frac{(\omega^f_k)^\alpha}{A\,\alpha^\alpha(1-\alpha)^{1-\alpha}}. \tag{14}$$

No tax term appears: ad valorem taxes do not alter the markup rule directly and affect producer prices only through general-equilibrium adjustments in wages and demand. For later use, write the common producer-price constant as $C = \frac{\sigma}{\sigma-1}[A\,\alpha^\alpha(1-\alpha)^{1-\alpha}]^{-1}$, so that $p_{h,k} = C\,(\omega^h_k)^\alpha$ and $p_{f,k} = C\,(\omega^f_k)^\alpha$.

3.3 Market clearing and firm location

Three equilibrium conditions close the factor side of the model. First, skilled labor is internationally immobile, so each country's skilled supply equals the skilled labor employed by the firms located there:

$$\psi_s L = N^h_k \ell_{s,k}, \qquad \psi^*_s L^* = N^f_k \ell^*_{s,k}, \tag{15}$$

where N^h_k (N^f_k) is the mass of firms at home (abroad). It is natural to summarize the international distribution of skilled labor directly. Define aggregate skilled supplies and their shares,

$$S = L\psi_s, \quad S^* = L^*\psi^*_s, \qquad q = \frac{S}{S+S^*}, \quad \chi = \frac{S^*}{S+S^*} = 1-q. \tag{16}$$

Thus q is the home share of the world skilled-labor base; a country may be skill-abundant either through population or through a high skilled fraction. Second, capital is mobile, and each firm uses one unit, so the world capital stock pins down the total mass of firms:

$$N^h_k + N^f_k = \bar{K}. \tag{17}$$

Capital ownership, however, need not coincide with firm location. Let

$$\kappa = \frac{K^h}{\bar{K}} \tag{18}$$

denote the share of world capital owned by home residents; a tax change alters the worldwide return R_k, but only the fraction κ accrues at home. Third, free entry equalizes revenue and fixed cost,

$$p_{f,k}A(\ell^*_{s,k})^{\alpha}(\ell^*_{u,k})^{1-\alpha} = p_{h,k}A(\ell_{s,k})^{\alpha}(\ell_{u,k})^{1-\alpha} = \sigma R_k. \tag{19}$$

The notation introduced so far is the full set of structural parameters used below: the skill intensity α and elasticity σ (through s), the skilled-labor distribution (q, χ), the market-size ratio λ, and the capital-ownership share κ. Throughout the paper, country superscripts identify the country, h for home and f for foreign, while the subscript $k \in \{d, o\}$ identifies the tax principle. Thus, for any country-specific object X, X^h_k and X^f_k denote its home and foreign values under principle k. The capital return R_k has no country superscript because capital is perfectly mobile and its return is common across countries. Table 1 summarizes the notation.

Table 1: Summary of notation

Symbol	Meaning
σ	elasticity of substitution across varieties
α	skilled-labor share in production
$s = \alpha(\sigma-1)/\sigma$	effective skilled-labor income share
M, M^*	taste-weighted market size, home/foreign
$\lambda = M^*/M$	relative market size
S, S^*	aggregate skilled-labor supply, home/foreign
q, $\chi = 1-q$	home/foreign share of world skilled labor
$\bar{K}$, K^h	world capital, home-owned capital
$\kappa = K^h/\bar{K}$	home ownership share of world capital
N^h_k, N^f_k	mass of firms located home/foreign
$\tau = 1+t,\ \tau^* = 1+t^*$	gross tax factors
T^h_k, T^f_k	tax bases, home/foreign
P^h_k, P^f_k, ω^h_k, ω^f_k, R_k, G^h_k, G^f_k	price index, skilled wage, capital return, tax revenue

3.4 Government and aggregate welfare

Each government sets its commodity tax to maximize the welfare of its residents and rebates the proceeds lump sum. Under the destination principle taxes fall on goods consumed domestically (home-made and imported); under the origin principle they fall on goods produced domestically (sold at home or exported). Home tax revenue is therefore

$$G_d^h = t\ \underbrace{L\sum_i \psi_i\Big(N_d^h p_{h,d} D_{i,d}^h + N_d^f p_{f,d} D_{i,d}^f\Big)}_{T_d^h} \quad \text{(destination)}, \tag{20}$$

$$G_o^h = t\ \underbrace{N_o^h\Big[L\sum_i \psi_i p_{h,o} D_{i,o}^h + L^*\sum_i \psi_i^* p_{h,o}^* D_{i,o}^{h,*}\Big]}_{T_o^h} \quad \text{(origin)},$$

with foreign counterparts G_d^f, G_o^f defined symmetrically. We write $G_k^h = (\tau - 1)T_k^h$, where T_k^h is the domestic tax base under principle k.

We now derive the welfare criterion used throughout, rather than positing it. Aggregating the indirect utilities (6) over both labor types yields a compact expression in four objects.

Lemma 1 (Aggregate welfare)**.** *Under quasi-linear preferences (1), lump-sum rebating of tax revenue, and a fixed unskilled transfer, aggregate domestic welfare under principle $k \in \{d, o\}$ is, up to a constant independent of taxes,*

$$W_k^h = -M \ln P_k^h + S\,\omega_k^h + K^h R_k + G_k^h. \tag{21}$$

Its foreign counterpart is given by:

$$W_k^f = -M^* \ln P_k^f + S^* \omega_k^f + K^f R_k + G_k^f. \tag{22}$$

Proof. Summing (6) over types with population weights $L\psi_i$,

$$W_k^h = L\sum_i \psi_i\Big[\mu_i \ln(\mu_i (P_k^h)^{-1}) + \omega_{i,k} + R_k K_i + B_{i,k} - \mu_i\Big].$$

Collect four blocks. *(i) Consumer surplus:* the price terms sum to $-(L\sum_i \psi_i\mu_i)\ln P_k^h = -M\ln P_k^h$ by (7), while $L\sum_i \psi_i(\mu_i \ln \mu_i - \mu_i)$ is a tax-independent constant $\mathcal{C}_0$. *(ii) Labor income:* only skilled workers earn the flexible wage (the unskilled wage equals the numeraire and is absorbed into $\mathcal{C}_0$), so $L\sum_i \psi_i \omega_{i,k} = S\omega_k^h$ by (16). *(iii) Capital income:* home residents own $K^h = L\sum_i \psi_i K_i$, earning $R_k K^h$. *(iv) Transfers:* budget balance gives $L\sum_i \psi_i B_{i,k} = G_k^h$. Adding (i)–(iv) and discarding $\mathcal{C}_0$ yields (21). $\square$

Lemma 1 makes explicit the four objects through which taxation reaches welfare: the consumer price index P_k^h, the skilled wage ω_k^h, the capital return R_k, and revenue G_k^h. Quasi-linearity is what delivers the additively separable form: income effects on the differentiated good are absent, so consumer welfare enters only through $-M\ln P_k^h$. The constant $\mathcal{C}_0$ is common to both principles and therefore cancels in any comparison $W_o^h - W_d^h$—a property the numerical section relies on.

3.5 Equilibrium under each principle

We can now solve for the equilibrium objects in (21) under each principle. The derivations combine the labor-cost split (12), market clearing (15)–(19), the producer prices (14), and the demand system (5).

Destination principle. Goods are taxed where consumed, so home- and foreign-made goods sold in the same market bear the same tax: $t_{h,d} = t_{f,d} = t$ at home and t^* abroad. A consumption tax creates no production-location wedge, so firm location is fixed by skilled-labor and capital clearing alone:

$$N_d^h = \bar{K}q, \quad N_d^f = \bar{K}\chi, \quad \text{and} \quad (P_d^h)^{1-\sigma} = N_d^h\,(\tau p_{h,d})^{1-\sigma} + N_d^f\,(\tau p_{f,d})^{1-\sigma} \tag{23}$$

If q is small, the home country has few firms and cannot attract more firms by cutting its destination tax. A destination subsidy only lowers the consumer price at home and expands domestic consumption, but it does not change the production location. Since the fiscal cost of the subsidy is borne domestically, yet part of the demand expansion leaks to foreign producers; hence the government has less incentive to subsidize under destination taxation.

The capital return, the (common) skilled wage, and the tax bases are

$$R_d = \frac{1}{\sigma\bar{K}}\left(\frac{M}{\tau} + \frac{M^*}{\tau^*}\right), \quad \omega_d^h = \omega_d^f = \frac{s}{S+S^*}\left(\frac{M}{\tau} + \frac{M^*}{\tau^*}\right), \quad T_d^h = \frac{M}{\tau}, \quad T_d^f = \frac{M^*}{\tau^*}. \tag{24}$$

The size of the home consumption base sharpens the same point. When λ is low, M is large relative to M^*: home has a large domestic consumption base. A destination tax cut or subsidy would be very costly because it applies to the whole domestic consumer market.

Origin principle. Goods are taxed where produced, so the domestic tax bears directly on firms located at home and the relative attractiveness of the two locations responds to the tax differential. Define the relocation index

$$B = \frac{S^*}{S}\left(\frac{\tau^*}{\tau}\right)^{-1/s}, \tag{25}$$

which is the equilibrium ratio of foreign to home firm masses. The firm masses, capital return, skilled wages, and tax bases are:

$$
\begin{aligned}
N_o^h &= \frac{\bar{K}}{1+B}, & N_o^f &= \frac{\bar{K}B}{1+B},\\
\omega_o^h &= \frac{s(M+M^*)}{S}\frac{1}{\tau+B\tau^*}, & \omega_o^f &= \frac{s(M+M^*)}{S^*}\frac{B}{\tau+B\tau^*},\\
T_o^h &= \frac{M+M^*}{\tau+B\tau^*}, & T_o^f &= \frac{B(M+M^*)}{\tau+B\tau^*}\\
(P_o^h)^{1-\sigma} &= N_o^h(\tau p_{h,o})^{1-\sigma}\left[1+\frac{N_o^f}{N_o^h}\left(\frac{\tau^* p_{f,o}}{\tau p_{h,o}}\right)^{1-\sigma}\right], & R_o &= \frac{M+M^*}{\sigma\bar{K}}\frac{1+B}{\tau+B\tau^*}
\end{aligned}
\tag{26}
$$

When q is small, $\frac{S}{S^*}$ is small, so initially most firms are abroad. A lower home origin tax or equivalently a stronger production subsidy, reduces B, attracts firms toward home, and raises the domestic skilled wage.

When λ is low, Home is the larger consumer market. A lower home origin tax can attract firms and shift production income, skilled wages, and part of the taxable base toward Home. The incentive is therefore not a home-market-effect mechanism, but a production-tax-base and factor-income mechanism.

Under origin taxation, the home country becomes more attractive when the domestic origin tax is low relative to the foreign tax. Thus origin taxation makes commodity-tax policy an instrument of production-location competition. The exponent $-1/s$ in (25) is where the effective skill share enters firm location: a smaller s makes relocation more sensitive to a given tax gap.

4 Cooperative Benchmark

A supranational planner chooses both taxes to maximize world welfare $\Omega_k = W_k^h + W_k^f$, and therefore internalizes all cross-border spillovers. This identifies the tax vector that eliminates the monopoly-pricing distortion once international externalities are internalized. W_k is given by Lemma 1. Differentiating with respect to the domestic tax, the marginal effect decomposes into the four channels of Lemma 1,

$$
\frac{\partial W_k^h}{\partial \tau} = -M\,\frac{1}{P_k^h}\frac{\partial P_k^h}{\partial \tau} + S\,\frac{\partial \omega_k^h}{\partial \tau} + K^h\frac{\partial R_k}{\partial \tau} + \frac{\partial G_k^h}{\partial \tau}. \tag{27}
$$

The first term is the consumer-price effect, the second and third the labor- and capital-income effects, and the last the revenue effect.

The equilibrium derivatives needed to evaluate (27) under each principle are collected in

Appendix A. Applying them gives the central neutrality result.

Proposition 1 (Cooperative tax)**.** *Under both the destination and origin principles, the cooperative tax factors are*

$$\tau^C = (\tau^*)^C = \frac{\sigma - 1}{\sigma}, \qquad \textit{equivalently} \qquad t^C = (t^*)^C = -\frac{1}{\sigma}.$$

Proof. See Appendix B □

Proposition 1 implies a gross tax factor below one, $\tau^C = (\sigma - 1)/\sigma < 1$, or equivalently a negative net tax rate $t^C = -1/\sigma$. This should not be interpreted as a prediction that observed VAT rates should be negative. It is the unconstrained corrective benchmark of a model in which commodity taxation is the only instrument used to offset the monopolistic markup and tax revenue is rebated lump sum. Since a monopolistically competitive firm charges a price above marginal cost, the planner would like to reduce the consumer price of differentiated goods. With lump-sum taxation available in the background, the commodity-tax instrument therefore acts as a corrective subsidy.

5 Non-Cooperative Taxation

The cooperative benchmark characterizes the tax vector that maximizes aggregate world welfare. Its role is therefore normative: it identifies the allocation that would be chosen by a supranational planner who internalizes all cross-border spillovers. This does not imply, however, that asymmetric countries will voluntarily implement the cooperative allocation. When countries differ in market size, skilled-labor endowments, or capital ownership, cooperation may raise world welfare while redistributing surplus across countries. In the absence of compensating transfers, a country that loses from the cooperative allocation has no reason to accept it.

This observation motivates the non-cooperative analysis. We now suppose that each government chooses its own commodity tax to maximize national welfare (21), taking the foreign tax as given. The relevant equilibrium is therefore a Nash equilibrium in taxes. This setting captures the political constraint that each government internalizes the welfare of its own residents, but not the welfare effects imposed on the other country.

The purpose of this section is to derive the decentralized tax conditions under both principles and to isolate the mechanisms through which national tax choices generate international fiscal externalities.

5.1 Decentralized taxes

Proposition 2 (Destination best responses)**.** *Under the destination principle, the domestic and the foreign taxes at the Nash equilibrium are given by:*

$$\tau_d^N = \frac{A_h\,(1+r^*)}{1+r^*\,(1-\alpha)}, \quad \textit{and} \quad \tau_d^{N,*} = \frac{A_f\,(1+r^*)}{1+r^*-\alpha}, \tag{28}$$

with

$$r^* = \frac{-(1-\alpha)(\lambda A_h - A_f) + \sqrt{(1-\alpha)^2(\lambda A_h - A_f)^2 + 4\lambda A_h A_f}}{2\lambda A_h},$$

where

$$A_h = 1 - sq - \frac{\kappa}{\sigma} \quad \textit{and} \quad A_f = 1 - s\chi - \frac{1-\kappa}{\sigma}.$$

Proof. See Appendix C. □

Proposition 2 provides a useful closed-form benchmark for the non-cooperative destination game. Under the destination principle, taxes are levied where goods are consumed, so a unilateral tax change affects the domestic price index, the common skilled wage, the common capital return, and domestic revenue, but it does not directly alter the international allocation of firms: $N_d^h = \bar{K}q$ and $N_d^f = \bar{K}\chi$. The strategic interaction therefore operates through demand and income effects rather than through a production-location margin. The terms

$$A_h = 1 - sq - \frac{\kappa}{\sigma}, \qquad A_f = 1 - s\chi - \frac{1-\kappa}{\sigma}$$

summarize the non-price marginal welfare cost of taxation for the home and foreign governments. They decrease when the local skilled-wage or capital-income channel is more important, because a higher tax depresses the tax base and the common factor returns. The relative-tax term r^* captures the strategic dependence between the two destination taxes. Thus the proposition shows that, even with asymmetric countries, the destination game remains analytically tractable because taxes do not move firms across countries.

Proposition 3 (Origin-principle Nash conditions)**.** *A Nash equilibrium in the origin principle is a vector of taxes $(\tau_o^N, (\tau_o^*)^N)$ that satisfy:*

$$\begin{cases} F_o^h(\tau,\tau^*) &= 0 \\ F_o^f(\tau,\tau^*) &= 0 \end{cases} \tag{29}$$

The domestic first-order condition is

$$F_o^h(\tau,\tau^*) \equiv -M\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} + \frac{M+M^*}{\tau+B\tau^*}\left[\frac{\partial A_o^h}{\partial \tau} - \frac{A_o^h}{\tau+B\tau^*}\left(1+\tau^*\frac{\partial B}{\partial \tau}\right)\right] = 0,$$

and the foreign first-order condition is

$$F_o^f(\tau,\tau^*) \equiv -M^* \frac{1}{P_o^f}\frac{\partial P_o^f}{\partial \tau^*} + \frac{M+M^*}{\tau + B\tau^*}\left[\frac{\partial A_o^f}{\partial \tau^*} - \frac{A_o^f}{\tau + B\tau^*}\left(B + \tau^* \frac{\partial B}{\partial \tau^*}\right)\right] = 0.$$

The income-revenue terms are

$$A_o^h \equiv s + \frac{\kappa}{\sigma}(1+B) + (\tau - 1),$$

and

$$A_o^f \equiv sB + \frac{1-\kappa}{\sigma}(1+B) + B(\tau^* - 1).$$

Their derivatives are

$$\frac{\partial A_o^h}{\partial \tau} = 1 + \frac{\kappa}{\sigma}\frac{\partial B}{\partial \tau}, \quad \textit{and} \quad \frac{\partial A_o^f}{\partial \tau^*} = B + \frac{\partial B}{\partial \tau^*}\left[s + \frac{1-\kappa}{\sigma} + (\tau^* - 1)\right].$$

Proof. See Appendix D □

Proposition 3 highlights the distinctive difficulty of the origin principle. Under origin taxation, a unilateral tax change modifies not only the domestic price index, skilled wages, capital income, and fiscal revenue, but also the relative attractiveness of the two production locations. This additional margin is summarized by

$$B = \frac{S^*}{S}\left(\frac{\tau^*}{\tau}\right)^{-1/s},$$

which determines the equilibrium ratio of foreign to home firms. Because B depends on the relative tax wedge, each government's tax affects the location of firms, the domestic and foreign skilled wages, the capital return, and the size of both tax bases. This explains why the origin equilibrium is characterized by the implicit system

$$F_o^h(\tau,\tau^*) = 0, \qquad F_o^f(\tau,\tau^*) = 0,$$

rather than by a transparent closed-form expression. The objects A_o^h and A_o^f collect the income and revenue gains from the firms located in each country, while the derivatives of B capture the fiscal externality created by tax-induced relocation. Proposition 3 therefore identifies the central mechanism of the paper: under origin taxation, commodity-tax competition becomes competition over the location of production.

Proposition 4 (Symmetric dominance threshold)**.** *Let τ_d denote the symmetric destination Nash tax obtained in Proposition 2, and let τ_o denote the symmetric origin Nash tax obtained* *in Proposition 3. Then*

$$\operatorname{sign}\left(W_o^h - W_d^h\right) = \operatorname{sign}\left(s - \frac{1}{2}\right).$$

At $s = 1/2$, both principles yield the same welfare, $W_o^h = W_d^h$.

By symmetry, the same ranking applies to the foreign country.

Proof. See Appendix E □

Proposition 4 isolates the role of the skilled-wage channel in the cleanest possible environment. At a common tax, destination and origin taxation generate the same allocation in the symmetric economy. The difference between the two principles comes from the tax incentives faced by governments. Under origin taxation, a lower domestic tax attracts firms and raises the domestic skilled wage. The strength of this channel is governed by s, the effective skilled-labor income share. When $s > 1/2$ the skilled-wage gain from the origin-based location margin is strong enough to make origin taxation welfare-dominant. When $s < 1/2$, the location distortion dominates, and destination taxation yields higher welfare. In asymmetric economies, this sharp threshold is perturbed by differences in skilled-labor endowments, market size, and capital ownership.

6 Numerical analysis

The numerical analysis is organized around the welfare channels identified in Lemma 1, rather than around individual parameters. The purpose of the numerical analysis is to complement the theoretical results and to illustrate how the structural asymmetries of the economy shape three outcomes: the welfare ranking between the origin and destination principles, the spatial allocation of firms across countries, and the distribution of gains and losses between skilled and unskilled workers. The comparative-static parameters used below—the effective skill share s, the skilled-labor allocation q, the market-size ratio λ, and the capital-ownership share κ—are useful because each shifts the strength of one or more of these channels.

Under the destination principle, the Nash equilibrium is computed from the closed-form best responses in Proposition 2. Under the origin principle, the equilibrium is obtained by solving the two first-order conditions in Proposition 3. For every reported origin equilibrium, the code verifies that the first-order residual is numerically negligible, that each government's own second-order condition is satisfied, and that the interior solution is unique over a multi-start grid. We normalize the domestic market size to $M = 1$, so $M^* = \lambda$, set $S + S^* = 1$, normalize the world capital stock to $\bar{K} = 1$, and set $\sigma = 4$ throughout.

The benchmark symmetric economy is

$$\alpha = 2/3, \qquad q = 0.50, \qquad \lambda = 1.0, \qquad \kappa = 0.50.$$

Table 2: Symmetric benchmark equilibrium ($\alpha = 2/3$, $\sigma = 4$, $q = \frac{1}{2}$, $\lambda = 1$, $\kappa = \frac{1}{2}$, so $s = \frac{1}{2}$).

	Destination	Origin	Difference
Panel A. Taxes and allocation			
Home gross tax factor, τ_k^h	0.9375	0.9375	0.0000
Foreign gross tax factor, τ_k^f	0.9375	0.9375	0.0000
Home firm mass, N_k^h	0.5000	0.5000	0.0000
Home skilled wage, ω_k^h	1.0667	1.0667	0.0000
Capital return, R_k	0.5333	0.5333	0.0000
Home fiscal revenue, G_k^h	−0.0667	−0.0667	0.0000
Panel B. Welfare			
Home welfare, W_k^h	0.75485	0.75485	0.00000
Foreign welfare, W_k^f	0.75485	0.75485	0.00000

Notes: At the symmetric benchmark $s = \frac{1}{2}$, so the two principles coincide: every equilibrium object is identical and $\Delta W^h = W_o^h - W_d^h = 0$ to machine precision. The benchmark is the knife-edge of Proposition 4.

Table 3: Level of the four domestic welfare channels at the symmetric benchmark under the destination principle.

Channel	Level
Consumer-surplus channel, $-M^h \ln P_d^h$	0.02151
Skilled-wage channel, $S^h \omega_d^h$	0.53333
Capital-income channel, $K^h R_d$	0.26667
Fiscal-revenue channel, G_d^h	−0.06667
Total domestic welfare, W_d^h	0.75485

Notes: The table reports levels, not origin–destination differences. At the symmetric benchmark $\alpha = 2/3$, $\sigma = 4$, $q = \frac{1}{2}$, $\lambda = 1$, and $\kappa = \frac{1}{2}$, so $s = \frac{1}{2}$ and the origin and destination principles coincide. Reporting one principle is therefore sufficient.

6.1 Impact of the different asymmetries

We now use the numerical model to clarify how the choice between destination and origin taxation affects welfare, firm location, and spatial concentration. The exercise is organized around the symmetric benchmark

$$\alpha = \frac{2}{3}, \qquad \sigma = 4, \qquad q = \frac{1}{2}, \qquad \lambda = 1, \qquad \kappa = \frac{1}{2},$$

for which

$$s = \frac{\alpha(\sigma - 1)}{\sigma} = \frac{1}{2}.$$

At this benchmark the two countries are identical, the origin and destination principles coincide, and the welfare gap

$$\Delta W^h \equiv W_o^h - W_d^h$$

is equal to zero (see Table 2). Each comparative static varies one primitive at a time, keeping the others fixed at the benchmark. Figure 1 reports four complementary objects: Panel (a) plots the home welfare gap, Panel (b) separates the firm-location response from the skilled-wage response, Panel (c) reports the spatial-concentration gap, and Panel (d) decomposes the welfare gap into the four channels of Lemma 1: consumer prices, skilled wages, capital income, and fiscal revenue. Table 4 summarizes these mechanisms in representative configuration.

The first lesson is that spatial relocation is not a mechanical consequence of every parameter change. When the experiment varies either α or σ, the countries remain symmetric because $q = 1/2$, $\lambda = 1$, and $\kappa = 1/2$. Hence the origin equilibrium has $\tau_o^h = \tau_o^f$, the relocation index satisfies $B = 1$, and firm masses remain equal across countries:

$$N_o^h = N_o^f = \frac{\bar{K}}{2}.$$

Therefore, Panels (b) and (c) show no spatial reallocation in the α- and σ-experiments. The welfare ranking nevertheless changes because α and σ change the effective skilled-labor income share

$$s = \frac{\alpha(\sigma - 1)}{\sigma}.$$

When $s < 1/2$, the skilled-wage channel is too weak to compensate for the distortions created by origin taxation, and destination taxation dominates. When $s > 1/2$, the skilled-wage channel becomes sufficiently strong, and origin taxation dominates. Thus, in the symmetric economy, the ranking changes because the incidence of firm revenue changes, not because firms move across space.

The second lesson is that spatial effects appear only once the countries differ in skilled-labor supply, market size, or capital ownership. Under destination taxation, a domestic tax applies equally to home and foreign varieties consumed in the same market. It affects consumer prices, revenues, and factor incomes, but it does not change the relative profitability of producing at home rather than abroad. Firm location is therefore pinned down by factor supplies:

$$N_d^h = \bar{K}q, \qquad N_d^f = \bar{K}(1-q).$$

By contrast, under origin taxation, the tax is attached to the location of production. A lower home origin tax makes home production more attractive in both markets, whereas a higher home origin tax makes foreign production more attractive. Origin taxation therefore turns the commodity tax into a location instrument. This is why the origin principle can move firms even when total world capital is fixed.

To interpret Panel (c), define the signed firm-location imbalance

$$\Xi_k = N_k^h - N_k^f, \qquad k \in \{d, o\},$$

and the spatial concentration index

$$\Gamma_k = |\Xi_k|.$$

The difference

$$\Gamma_o - \Gamma_d$$

measures whether switching from destination to origin taxation makes production more or less spatially concentrated. A positive value means that origin taxation concentrates activity relative to destination taxation; a negative value means that origin taxation disperses activity. This distinction is important because a movement of firms toward Home is not the same thing as spatial concentration. If destination taxation already places most firms in Foreign, then a movement toward Home can reduce spatial concentration. Conversely, if destination taxation begins from a symmetric allocation, any movement toward either country increases concentration.

This logic explains the skilled-labor asymmetry panel. When q is low, Home has a small share of the world skilled-labor base. Under destination taxation, few firms are located at Home because location is pinned down by q. Under origin taxation, the tax game partially offsets this initial disadvantage: firms move toward Home, so $\Delta\Xi = \Xi_o - \Xi_d > 0$. Yet this movement reduces rather than increases concentration because the initial destination allocation is strongly tilted toward Foreign. In that case, origin taxation disperses activity. When q is high, the opposite occurs. Destination taxation initially places many firms at Home; origin taxation moves some firms away from Home, again reducing spatial concentration. Thus, in the q-experiment, origin taxation tends to act as a dispersion force: it weakens the initial concentration created by unequal skilled-labor supplies.

The market-size experiment operates through a different mechanism. When $\lambda = M^f/M^h$ differs from one, the two countries do not have the same demand base. Under destination taxation, this market-size asymmetry affects tax bases and revenues but not the location of production. Under origin taxation, however, a country can influence the location of firms serving the larger market. If the foreign market is small, Home is relatively attractive and origin taxation moves firms toward Home. If the foreign market is large, Foreign becomes the stronger demand center and origin taxation moves firms away from Home. Since the benchmark has $q = 1/2$, destination taxation starts from an equal firm distribution. Any movement away from equality therefore raises $\Gamma_o - \Gamma_d$. This is why the market-size panel can display spatial concentration even though the direction of relocation changes with λ. The economic interpretation is that origin taxation gives governments a fiscal instrument that interacts with the home-market effect: when one market is large, production tends to become more tied to the location from which that market can be taxed or served most profitably.

Capital ownership generates a third type of spatial mechanism. The parameter κ does not directly change the technological location of skilled labor, but it changes the government's valuation of the capital-return channel. When Home owns little capital, it places less weight on the gains from raising the common capital return and may choose an origin tax that weakens domestic attractiveness. Firms then move toward Foreign. When Home owns a large share of capital, it internalizes more of the capital-income effect and has a stronger incentive to preserve domestic profitability and attract firms. Origin taxation then moves firms toward Home. Since the destination allocation is symmetric in the κ-experiment, either movement creates spatial concentration. The policy implication is that capital ownership affects not only who receives the return on mobile capital, but also the strategic tax incentives that determine where firms locate.

Panel (d) shows why firm relocation and welfare dominance are not equivalent. The welfare gap is

$$\Delta W^h = \Delta W^{P,h} + \Delta W^{\omega,h} + \Delta W^{R,h} + \Delta W^{G,h}.$$

A country may attract firms under origin taxation, but still lose if the gain in skilled wages is offset by a higher price index, lower fiscal revenue, or a smaller capital-income effect. Conversely, a country may lose firms but still prefer origin taxation if the fiscal-revenue or capital-return channel is sufficiently strong. This is the central message of the figure: spatial relocation is the mechanism that distinguishes origin taxation from destination taxation, but welfare depends on the full incidence of that relocation.

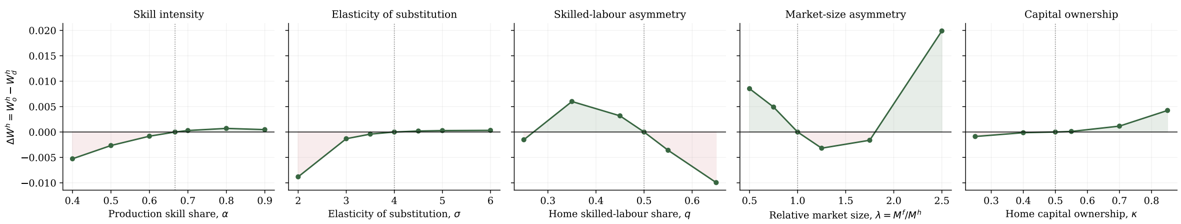
The policy implications are immediate. Destination taxation is spatially neutral in the sense that it insulates production location from commodity-tax competition. This is attractive when policymakers want to avoid tax-induced relocation and preserve the allocation implied by factor supplies. Origin taxation is different. It gives governments a tool that can attract or repel firms and can therefore either reduce or amplify spatial concentration. This makes origin taxation potentially useful for cohesion or regional-development objectives, but also risky. A policy that succeeds in attracting firms may still reduce welfare if it erodes fiscal revenue or worsens consumer prices. Conversely, a policy that disperses production may not be welfare improving if the dispersion comes at the cost of lower skilled wages or lower revenue.

Thus Figure 1 should not be read as saying that one principle always dominates the other, or that firm attraction is always desirable. It shows instead that the choice of tax principle changes the margin on which governments compete. Destination taxation mainly reallocates purchasing power through prices and revenues. Origin taxation additionally reallocates production across space. Whether that relocation is beneficial depends on the relative strength of the price-index, skilled-wage, capital-income, and fiscal-revenue channels.

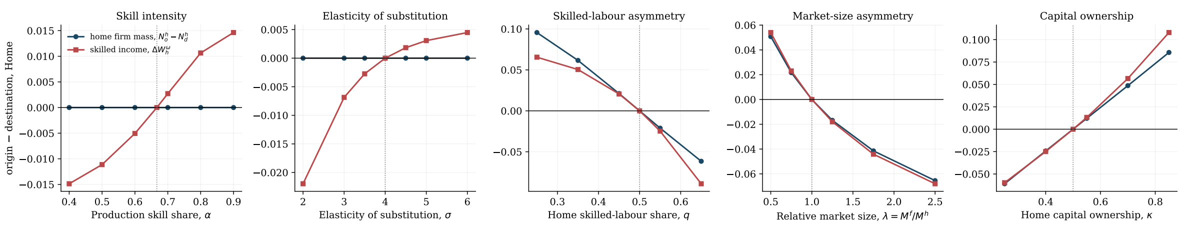
Table 4: Mechanism summary: spatial relocation and welfare channels.

Mechanism	Case	$\Xi_o = N_o^h - N_o^f$	$\Delta\Xi$	$\Gamma_o - \Gamma_d$	ΔW^P	ΔW^ω	ΔW^R	ΔW^G	Driver	Prefers
Benchmark	Home	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	*tie*	*tie*
	Foreign	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	*tie*	*tie*
Skill intensity	low α	0.0000	0.0000	0.0000	−0.0276	−0.0149	−0.0124	0.0496	Price	Destination
	high α	0.0000	0.0000	0.0000	0.0034	0.0106	0.0044	−0.0177	Wage	Origin
Elasticity	low σ	0.0000	0.0000	0.0000	−0.0048	−0.0069	−0.0051	0.0154	Wage	Destination
	high σ	0.0000	0.0000	0.0000	0.0026	0.0045	0.0013	−0.0081	Wage	Origin
Skilled labor	low q	−0.3088	0.1912	−0.1912	0.1007	0.0655	−0.0284	−0.1393	Revenue	Destination
	high q	0.1768	−0.1232	−0.1232	−0.0921	−0.0891	−0.0097	0.1808	Price	Destination
Market size	small foreign	0.1015	0.1015	0.1015	0.0921	0.0540	0.0068	−0.1444	Price	Origin
	large foreign	−0.1309	−0.1309	0.1309	−0.1883	−0.0680	0.0267	0.2495	Revenue	Origin
Capital	low κ	−0.1218	−0.1218	0.1218	0.0706	−0.0597	0.0016	−0.0134	Wage	Destination
	high κ	0.1714	0.1714	0.1714	−0.0866	0.1079	0.0111	−0.0282	Wage	Origin

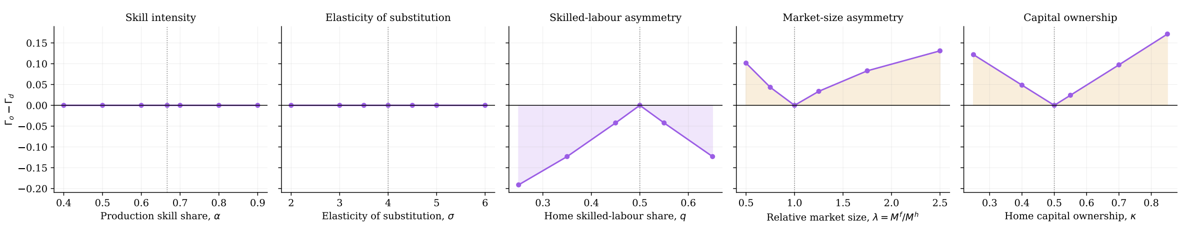
Notes: $\Xi_k \equiv N_k^h - N_k^f$ is the signed firm-location imbalance under principle k; $\Delta\Xi \equiv \Xi_o - \Xi_d$ is the change in location imbalance caused by switching from destination to origin; and $\Gamma_o - \Gamma_d$, with $\Gamma_k = |\Xi_k|$, is the change in spatial concentration (negative: origin disperses). "Driver" is the largest channel sharing the sign of ΔW. The first two rows give the symmetric benchmark, where all channels are zero. The cases show that relocation and welfare need not move together: firm attraction is neither necessary nor sufficient for welfare dominance.



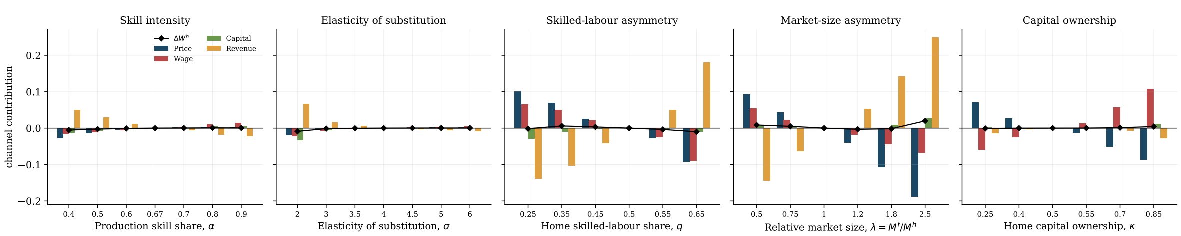
(a) Welfare comparative statics



(b) Firm-location and skilled-wage channels



(c) Firm spatial concentration



(d) Channel contribution to welfare

Figure 1: Comparative static, mechanism, spatial concentration and channel's contribution. Panel (a) reports the home welfare gap $\Delta W_h = W_o - W_d$. Panel (b) reports the firm-location gap $N_o - N_d$ and the skilled-income effect $S(\omega_o - \omega_d)$. Panel (c) reports the spatial concentration gap $\Gamma_o - \Gamma_d$, where negative values indicate that origin taxation disperses activity relative to destination taxation and positive values indicate that it concentrates activity. Panel (d) reports the contribution to welfare of the four channels identified in (21)

6.2 Who receives or finances the fiscal adjustment?

The previous subsection ranks the destination and origin principles in terms of aggregate domestic welfare. This ranking is sufficient for identifying which principle is preferred by a government maximizing national welfare. It is not, however, sufficient for identifying who gains inside the country. The reason is that the aggregate welfare gap combines four components: consumer prices, skilled wages, capital income, and fiscal revenue. Among these components, the fiscal-revenue change is a transfer aggregate. Its contribution to national welfare is independent of how the proceeds are allocated across residents, but its incidence across worker groups is not.

This subsection therefore performs an ex post incidence exercise. The equilibrium taxes and allocations are kept fixed. I do not assume that governments choose taxes to redistribute between skilled and unskilled workers. Instead, I ask how the welfare change from switching from destination to origin taxation would be distributed across workers under alternative fiscal-assignment rules. This distinction is important because the model already contains heterogeneous labor: skilled workers receive a flexible wage positively correlated to firm location and profitability, whereas unskilled workers earn the fixed numeraire wage. As a result, the wage component of the tax-principle switch is borne only by skilled workers, while the fiscal component can be assigned to skilled and unskilled workers in different ways.

Let $\Delta W_h^G = G_o - G_d$ denote the change in domestic fiscal revenue when the country moves from destination to origin taxation. If domestic population is L and skilled labor supply is S, the unskilled population is $L - S$.

As previously mentioned, let $\psi_s \equiv \frac{S}{L} \in (0,1)$ denote the skilled share of the domestic population, and let $\theta \in [0,1]$ denote the share of the revenue change rebated to skilled workers, with the remaining $1-\theta$ going to the unskilled. This split is a policy choice: from the legislator's perspective, a unit of revenue may be worth more in the hands of one group than the other. Normalizing $L = 1$, the skilled population is therefore ψ_s and the unskilled population is $1 - \psi_s$. The per-capita incidence of switching from destination to origin taxation for skilled workers is

$$\delta_S(\theta, \psi_s) = (\omega_o - \omega_d) + \frac{\theta \, \Delta W_h^G}{\psi_s}.$$

The first term is the skilled-wage effect; the second is the per-capita fiscal assignment to skilled workers. Since the unskilled wage is fixed by the numeraire, the per-capita incidence for unskilled workers is

$$\delta_U(\theta, \psi_s) = \frac{(1-\theta)\Delta W_h^G}{1-\psi_s}.$$

The per-capita skilled–unskilled incidence gap is therefore

$$\delta_{S-U}(\theta,\psi_s) \equiv \delta_S(\theta,\psi_s) - \delta_U(\theta,\psi_s) = (\omega_o - \omega_d) + \left[\frac{\theta}{\psi_s} - \frac{1-\theta}{1-\psi_s}\right]\Delta W_h^G.$$

This expression separates two different assumptions. The value $\theta = 1/2$ corresponds to an equal split of the fiscal adjustment between the skilled and unskilled groups. Equal per-capita redistribution instead corresponds to

$$\theta = \psi_s.$$

Table 5 and Figure 2 move from aggregate welfare to within-country incidence. The object of interest is no longer only whether the origin principle raises domestic welfare relative to the destination principle, but whether the destination-to-origin switch benefits skilled workers more than unskilled workers. Since the unskilled wage is normalized to one, the direct wage effect of the switch is entirely captured by the change in the skilled wage, $\omega_o^h - \omega_d^h$. The fiscal component then depends on how the revenue change $\Delta W^{G,h} = G_o^h - G_d^h$ is allocated across the two groups.

In table 5, I set the skilled population share at $\psi_s = 0.30$ and assume that skilled workers receive the fraction $\theta = 0.50$ of the fiscal-revenue change; the fiscal adjustment is therefore equally divided across the two labor groups of the economy. When $\Delta W^{G,h} > 0$, assigning half of the fiscal gain to skilled workers gives them more than their population-proportional share. Conversely, when $\Delta W^{G,h} < 0$, the same rule makes skilled workers bear a disproportionate share of the fiscal loss.

Several patterns follow. Along the skill-intensity and elasticity margins, the aggregate welfare ranking changes as the economy crosses the threshold $s = 1/2$, but the incidence ranking mostly favors skilled workers under the assumed fiscal rule. For low values of α or σ, origin taxation lowers the skilled wage, yet the positive fiscal-revenue change more than compensates skilled workers under $\theta = 0.50$. For high values of α or σ, the skilled-wage channel itself becomes positive, so skilled workers gain more even though the fiscal-revenue channel turns negative.

The skilled-labor asymmetry experiment shows that incidence and aggregate welfare are distinct. When $q < 1/2$, origin taxation increases the skilled wage by attracting production toward the skill-scarce home economy. Skilled workers therefore gain more even in cases where aggregate welfare does not necessarily increase. When $q > 1/2$, the wage effect turns negative because origin taxation moves activity away from the skill-abundant home country, but the fiscal-revenue gain can still be large enough to make the per-capita skilled–unskilled gap positive.

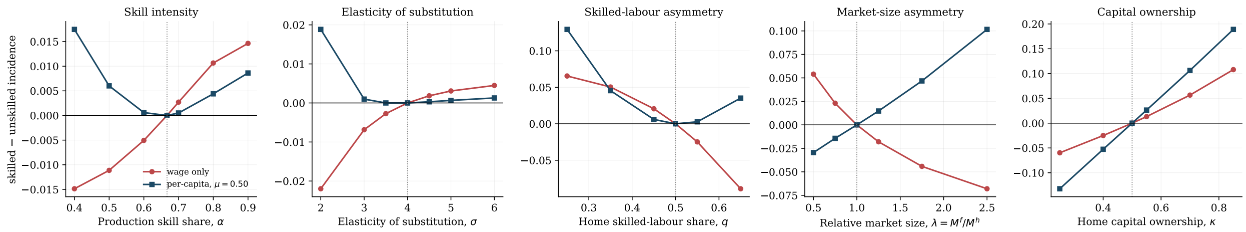


Figure 2: Worker incidence of switching from destination to origin taxation. The figure compares the wage-only skilled-income component with the per-capita skilled–unskilled incidence gap after fiscal redistribution. The wage-only series reports the skilled-wage channel, while the per-capita series reports $\delta_{S-U}(\theta, \psi_s)$ under the benchmark fiscal rule $\theta = 0.50$ and skilled population share $\psi_s = 0.30$. Positive values indicate that skilled workers gain more (or lose less), than unskilled workers; negative values indicate that unskilled workers gain more. Each panel varies one structural parameter around the symmetric benchmark.

Market-size asymmetry provides the clearest example of the interaction between wage and fiscal incidence. When the foreign market is small, origin taxation raises the domestic skilled wage but reduces fiscal revenue sufficiently that unskilled workers gain more per capita. When the foreign market is large, the skilled wage falls relative to destination, but fiscal revenue rises strongly enough to reverse the incidence ranking in favor of skilled workers. Thus, the group that benefits most from a tax-principle switch need not be the group favored by the wage channel alone.

Capital ownership works differently. When κ is low, origin taxation reduces the skilled wage and produces a negative or weak fiscal effect, so unskilled workers gain more. When κ is high, the skilled-wage channel becomes strongly positive and dominates the incidence comparison. Hence, capital ownership affects not only aggregate welfare through the capital-income channel, but also the worker-incidence ranking through its effect on equilibrium wages and fiscal revenue.

Figure 2 visualizes these mechanisms. The distance between the wage-only series and the per-capita incidence series measures the role of the fiscal assignment. Where the two series are close, the incidence ranking is mainly driven by the skilled-wage response. Where they differ sharply, the fiscal-revenue channel is central. The figure therefore reinforces the main message of Table 5: aggregate welfare dominance, firm relocation, and worker incidence are separate objects. A tax principle can raise domestic welfare while benefiting unskilled workers more than skilled workers, or can lower the skilled wage while still favoring skilled workers once the fiscal rebate is taken into account.

Table 5: Worker incidence of the destination-to-origin switch ($\psi_s = 0.30$, $\theta = 0.50$).

Case	$\omega_o^h - \omega_d^h$	$\Delta W^{\omega,h}$	$\Delta W^{G,h}$	$\delta_{S\text{-}U}$	ΔW^h	Incidence
Skill intensity						
$\alpha = 0.40$	-0.0297	-0.0149	0.0496	0.0175	-0.0053	Skilled gain more
$\alpha = 0.50$	-0.0223	-0.0111	0.0297	0.0060	-0.0027	Skilled gain more
$\alpha = 0.60$	-0.0101	-0.0051	0.0112	0.0006	-0.0008	Skilled gain more
$\alpha = 0.67$	0.0000	0.0000	0.0000	0.0000	0.0000	Neutral
$\alpha = 0.70$	0.0054	0.0027	-0.0052	0.0005	0.0003	Skilled gain more
$\alpha = 0.80$	0.0213	0.0106	-0.0177	0.0044	0.0007	Skilled gain more
$\alpha = 0.90$	0.0293	0.0146	-0.0217	0.0086	0.0005	Skilled gain more
Elasticity of substitution						
$\sigma = 2.00$	-0.0440	-0.0220	0.0659	0.0188	-0.0088	Skilled gain more
$\sigma = 3.00$	-0.0137	-0.0069	0.0154	0.0010	-0.0013	Skilled gain more
$\sigma = 3.50$	-0.0055	-0.0027	0.0057	0.0000	-0.0004	Neutral
$\sigma = 4.00$	0.0000	0.0000	0.0000	0.0000	0.0000	Neutral
$\sigma = 4.50$	0.0037	0.0018	-0.0035	0.0003	0.0002	Skilled gain more
$\sigma = 5.00$	0.0061	0.0031	-0.0058	0.0007	0.0003	Skilled gain more
$\sigma = 6.00$	0.0090	0.0045	-0.0081	0.0013	0.0003	Skilled gain more
Skilled-labor asymmetry						
$q = 0.25$	0.2620	0.0655	-0.1393	0.1294	-0.0015	Skilled gain more
$q = 0.35$	0.1441	0.0504	-0.1036	0.0454	0.0060	Skilled gain more
$q = 0.45$	0.0458	0.0206	-0.0418	0.0060	0.0032	Skilled gain more
$q = 0.50$	0.0000	0.0000	0.0000	0.0000	0.0000	Neutral
$q = 0.55$	-0.0451	-0.0248	0.0502	0.0027	-0.0036	Skilled gain more
$q = 0.65$	-0.1370	-0.0891	0.1808	0.0352	-0.0100	Skilled gain more
Market-size asymmetry						
$\lambda = 0.50$	0.1080	0.0540	-0.1444	-0.0295	0.0085	Unskilled gain more
$\lambda = 0.75$	0.0461	0.0230	-0.0634	-0.0143	0.0049	Unskilled gain more
$\lambda = 1.00$	0.0000	0.0000	0.0000	0.0000	0.0000	Neutral
$\lambda = 1.25$	-0.0360	-0.0180	0.0533	0.0147	-0.0032	Skilled gain more
$\lambda = 1.75$	-0.0883	-0.0442	0.1418	0.0468	-0.0016	Skilled gain more
$\lambda = 2.50$	-0.1360	-0.0680	0.2495	0.1016	0.0199	Skilled gain more
Capital ownership						
$\kappa = 0.25$	-0.1195	-0.0597	-0.0134	-0.1322	-0.0009	Unskilled gain more
$\kappa = 0.40$	-0.0499	-0.0250	-0.0029	-0.0526	-0.0001	Unskilled gain more
$\kappa = 0.50$	0.0000	0.0000	0.0000	0.0000	0.0000	Neutral
$\kappa = 0.55$	0.0264	0.0132	0.0000	0.0264	0.0001	Skilled gain more
$\kappa = 0.70$	0.1132	0.0566	-0.0072	0.1063	0.0012	Skilled gain more
$\kappa = 0.85$	0.2158	0.1079	-0.0282	0.1890	0.0042	Skilled gain more

Notes: $\psi_s = S/L$ is the skilled population share; μ is the share of the revenue change $\Delta W^{G,h}$ rebated to skilled workers. The unskilled wage is the numeraire and is invariant across principles. The per-capita skilled–unskilled gap is $\delta_{S\text{-}U} = (\omega_o^h - \omega_d^h) + \theta \Delta W^{G,h}/\psi_s - (1-\theta)\Delta W^{G,h}/(1-\psi_s)$. Equal per-capita redistribution corresponds to $\theta = \psi_s$, not $\theta = \frac{1}{2}$.

7 Conclusion

This paper studies how the choice between destination and origin commodity taxation affects welfare, firm location, and within-country incidence in an integrated economy with monopolistic competition, mobile firms and capital, and heterogeneous labor. The main message is that a tax principle is not only a technical rule for assigning fiscal authority. It also determines whether commodity taxation affects the location of production and, through that channel, how gains and losses are distributed across consumers, skilled workers, unskilled workers, and capital owners.

The cooperative benchmark delivers a clear neutrality result. When a supranational planner internalizes all cross-border spillovers, both destination and origin taxation implement the same corrective subsidy against the monopolistic markup. In that case, the institutional distinction between the two principles is irrelevant because the planner can correct the markup distortion and redistribute any gains or losses through lump-sum transfers.

This equality between those two principles changes once tax policy is decentralized. Under the destination principle, taxes affect consumer prices, revenue, and factor income, but they do not directly change where firms locate. Under the origin principle, however, a unilateral tax change modifies the relative attractiveness of production locations. Commodity taxation then becomes an instrument of locational competition.

The analytical comparison highlights the role of the effective skilled-labor income share. In the symmetric economy, origin taxation dominates destination taxation if and only if this share is above one half. When the skilled-wage channel is strong, the gains from attracting firms and raising skilled wages can outweigh the location distortion. When it is weak, destination taxation is preferred.

In asymmetric economies, this simple threshold is modified by differences in skilled-labor endowments, market size, and capital ownership. The numerical decomposition shows that firm attraction is neither necessary nor sufficient for welfare dominance. Origin taxation may attract firms without raising welfare, or it may raise welfare despite reducing the domestic firm mass. The final ranking depends on the combined effects on consumer prices, skilled wages, capital income, and fiscal revenue.

These findings have several policy implications. First, VAT principles should not be evaluated only in terms of administrative simplicity or revenue collection. If the tax principle affects firm location, it can also affect the spatial distribution of production and the allocation of income across factors. This matters especially in integrated markets, where governments care not only about national revenue, but also about where economic activity takes place.

Second, policies that use origin-based taxation to attract firms may have ambiguous welfare effects. Attracting production can raise skilled wages, but it can also worsen consumer prices, reduce fiscal revenue, or redistribute gains toward capital owners. A tax rule that succeeds as a location instrument does not necessarily succeed as a welfare instrument.

Third, aggregate welfare and worker incidence are distinct policy objects. A tax principle can raise national welfare while lowering the skilled wage, or it can benefit skilled workers only because the fiscal adjustment is assigned to them disproportionately. The design of the fiscal rebate is therefore inseparable from the choice of tax principle.

The analysis is deliberately stylized. It abstracts from enforcement costs, tax evasion, firm heterogeneity, and explicit government revenue requirements. These are important directions for future research. Nevertheless, the paper identifies a mechanism that should remain relevant in richer environments: the destination principle insulates production location from commodity-tax competition, whereas the origin principle links taxation to firm mobility and factor incidence. The policy implication is therefore not that one principle always dominates the other. Rather, the appropriate tax principle depends on the strength of the skilled-wage channel, the spatial distribution of productive capacity, the ownership of capital, and the fiscal rule used to redistribute tax revenue.

Appendix A Equilibrium derivatives

This appendix collects the derivatives of the equilibrium objects with respect to the domestic tax τ, holding τ^* fixed, and the foreign tax τ^* holding τ fixed. There are useful for the different proofs below.

Destination principle. From the destination block (24),

$$\frac{1}{P_d^h}\frac{\partial P_d^h}{\partial \tau} = \frac{1}{\tau} + \alpha\frac{1}{\omega_d^h}\frac{\partial \omega_d^h}{\partial \tau}, \qquad \frac{1}{P_d^f}\frac{\partial P_d^f}{\partial \tau} = \alpha\frac{1}{\omega_d^h}\frac{\partial \omega_d^h}{\partial \tau},$$

$$\frac{\partial R_d}{\partial \tau} = -\frac{M}{\sigma\bar{K}\tau^2}, \qquad \frac{\partial \omega_d^h}{\partial \tau} = -\frac{s}{S+S^*}\frac{M}{\tau^2}, \qquad \frac{\partial G_d^h}{\partial \tau} = \frac{M}{\tau^2}, \qquad \frac{\partial G_d^f}{\partial \tau} = 0.$$

The same derivatives in the foreign country give:

$$\frac{1}{P_d^f}\frac{\partial P_d^f}{\partial \tau^*} = \frac{1}{\tau^*} + \alpha\frac{1}{\omega_d^f}\frac{\partial \omega_d^f}{\partial \tau^*}; \quad \frac{\partial \omega_d^f}{\partial \tau^*} = -\frac{s}{S+S^*}\frac{M^*}{(\tau^*)^2}; \quad \frac{1}{\omega_d^f}\frac{\partial \omega_d^f}{\partial \tau^*} = -\frac{M^*}{(\tau^*)^2 X_d},$$

where

$$X_d = \frac{M}{\tau} + \frac{M^*}{\tau^*}$$

$$\frac{\partial R_d}{\partial \tau^*} = -\frac{M^*}{\sigma\bar{K}(\tau^*)^2}; \quad \frac{\partial G_d^f}{\partial \tau^*} = \frac{M^*}{(\tau^*)^2}$$

Origin principle. From the origin block, the derivative of (25) and (26) gives: ,

$$\frac{\partial N_o^h}{\partial \tau} = -\frac{BN_o^h}{s\tau(1+B)}, \qquad \frac{\partial N_o^f}{\partial \tau} = \frac{BN_o^h}{s\tau(1+B)},$$

$$\frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau} = -\frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}, \qquad \frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau} = \frac{1}{s\tau} - \frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*},$$

$$\frac{\partial R_o}{\partial \tau} = \frac{R_o}{(1+B)(\tau+B\tau^*)}\Big[(\tau-\tau^*)\tfrac{\partial B}{\partial \tau} - (1+B)\Big],$$

$$\frac{1}{T_o^h}\frac{\partial T_o^h}{\partial \tau} = -\frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}, \qquad \frac{\partial G_o^h}{\partial \tau} = T_o^h\Big[1-(\tau-1)\tfrac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}\Big].$$

$$\begin{aligned}(1-\sigma)\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} &= \frac{1}{N_o^h}\frac{\partial N_o^h}{\partial \tau} + \frac{1-\sigma}{\tau} + \alpha(1-\sigma)\frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau} \\ &+ \frac{Z}{1+Z}\left[\frac{1}{B}\frac{\partial B}{\partial \tau} - \frac{1-\sigma}{\tau} + \alpha(1-\sigma)\left(\frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau} - \frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau}\right)\right],\end{aligned}$$

that is

$$\begin{aligned}(1-\sigma)\,\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} &= -\frac{B}{s\tau(1+B)}+\frac{1-\sigma}{\tau}-\alpha(1-\sigma)\frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}\\ &+\frac{Z}{1+Z}\left[\frac{1}{B}\frac{B}{s\tau}-\frac{1-\sigma}{\tau}+\alpha(1-\sigma)\left(\frac{1}{s\tau}-\frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}+\frac{1+\frac{B\tau^*}{s\tau}}{\tau+B\tau^*}\right)\right],\end{aligned}$$

where $Z=B(\tau^*/\tau)^{1-\sigma}(\omega_o^f/\omega_o^h)^{\alpha(1-\sigma)}$, and $\frac{\partial B}{\partial \tau}=\frac{B}{s\tau}$.

Now the derivatives of the main origin-principle equilibrium variables with respect to the foreign origin tax τ^*, holding the domestic origin tax τ fixed. Define

$$Y\equiv M+M^*,\qquad D=\tau+B\tau^*.$$

Then

$$\frac{\partial B}{\partial \tau^*}=-\frac{B}{s\tau^*}.$$

Moreover,

$$D_{\tau^*}\equiv\frac{\partial D}{\partial \tau^*}=B+\tau^*\frac{\partial B}{\partial \tau^*}=B\left(1-\frac{1}{s}\right).$$

$$\frac{\partial N_o^h}{\partial \tau^*}=-\frac{N_o^h}{1+B}\frac{\partial B}{\partial \tau^*}=\frac{BN_o^h}{s\tau^*(1+B)}.$$

Similarly,

$$\frac{\partial N_o^f}{\partial \tau^*}=\frac{N_o^h}{1+B}\frac{\partial B}{\partial \tau^*}=-\frac{BN_o^h}{s\tau^*(1+B)}.$$

Equivalently,

$$\frac{1}{N_o^h}\frac{\partial N_o^h}{\partial \tau^*}=\frac{B}{s\tau^*(1+B)},\qquad \frac{1}{N_o^f}\frac{\partial N_o^f}{\partial \tau^*}=-\frac{1}{s\tau^*(1+B)}.$$

$$\frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau^*}=-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}\quad\text{and}\quad \frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau^*}=-\frac{1}{s\tau^*}-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}.$$

$$\frac{1}{R_o}\frac{\partial R_o}{\partial \tau^*}=-\frac{B}{s\tau^*(1+B)}-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}.$$

$$\frac{1}{T_o^h}\frac{\partial T_o^h}{\partial \tau^*}=-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}\quad\text{and}\quad \frac{1}{T_o^f}\frac{\partial T_o^f}{\partial \tau^*}=-\frac{1}{s\tau^*}-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}.$$

$$\frac{\partial G_o^h}{\partial \tau^*} = -(\tau-1)T_o^h \frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}; \quad \frac{\partial G_o^f}{\partial \tau^*} = T_o^f \left[1+(\tau^*-1)\left(-\frac{1}{s\tau^*}-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}\right)\right].$$

Using the expression of the domestic price index P_o^h, let us define the following expenditure shares

$$\theta_h = \frac{N_o^h(\tau p_{h,o})^{1-\sigma}}{(P_o^h)^{1-\sigma}}, \qquad \theta_f = \frac{N_o^f(\tau^* p_{f,o})^{1-\sigma}}{(P_o^h)^{1-\sigma}},$$

so that

$$\theta_h + \theta_f = 1.$$

Then

$$\frac{\partial \ln P_o^h}{\partial \tau^*} = \theta_h\left[\alpha\frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau^*}\right] + \theta_f\left[\frac{1}{\tau^*}+\alpha\frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau^*}\right] + \frac{1}{1-\sigma}\left[\theta_h\frac{1}{N_o^h}\frac{\partial N_o^h}{\partial \tau^*}+\theta_f\frac{1}{N_o^f}\frac{\partial N_o^f}{\partial \tau^*}\right].$$

Substituting the derivatives above gives the full expression:

$$\frac{\partial \ln P_o^h}{\partial \tau^*} = -\alpha\theta_h\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*} + \theta_f\left[\frac{1}{\tau^*}+\alpha\left(-\frac{1}{s\tau^*}-\frac{B\left(1-\frac{1}{s}\right)}{\tau+B\tau^*}\right)\right]$$

$$+\frac{1}{1-\sigma}\left[\theta_h\frac{B}{s\tau^*(1+B)}-\theta_f\frac{1}{s\tau^*(1+B)}\right].$$

Appendix B Proof of Proposition 1

Proof. Destination principle. Using Lemma 1 and the foreign analogue, the cooperative objective is, up to tax-independent constants,

$$\Omega_d = -M\ln P_d^h - M^*\ln P_d^f + sX_d + \frac{X_d}{\sigma} + (\tau-1)\frac{M}{\tau} + (\tau^*-1)\frac{M^*}{\tau^*}, \qquad X_d \equiv \frac{M}{\tau}+\frac{M^*}{\tau^*}.$$

Differentiating with respect to τ and using the destination derivatives of Appendix A,

$$\frac{\partial \Omega_d}{\partial \tau} = -\frac{M}{\tau} - (M+M^*)\frac{\alpha}{\omega_d^h}\frac{\partial \omega_d^h}{\partial \tau} - \left(s+\frac{1}{\sigma}-1\right)\frac{M}{\tau^2}.$$

Substituting $\partial\omega_d^h/\partial\tau$ and ω_d^h from (24) gives

$$\frac{\partial \Omega_d}{\partial \tau} = -\frac{M}{\tau} + \frac{\alpha(M+M^*)M}{\tau^2 X_d} - \left(s+\frac{1}{\sigma}-1\right)\frac{M}{\tau^2}.$$

At a common tax vector $\tau = \tau^*$ one has $X_d = (M + M^*)/\tau$, so the middle term equals $\alpha M/\tau^2$, and

$$\left.\frac{\partial \Omega_d}{\partial \tau}\right|_{\tau=\tau^*} = -(1-\alpha)\frac{M}{\tau^2} \cdot \tau - \left(s + \frac{1}{\sigma} - 1\right)\frac{M}{\tau^2} = -\frac{M}{\tau^2}\left[(1-\alpha)\tau + s + \frac{1}{\sigma} - 1\right].$$

Setting this to zero and using $s + 1/\sigma - 1 = -(\sigma-1)(1-\alpha)/\sigma$,

$$(1-\alpha)\tau = 1 - s - \frac{1}{\sigma} = \frac{(1-\alpha)(\sigma-1)}{\sigma} \implies \tau = \frac{\sigma-1}{\sigma}.$$

The foreign first-order condition is symmetric, giving $\tau^* = (\sigma-1)/\sigma$.

Origin principle. The cooperative objective is

$$\Omega_o = -M \ln P_o^h - M^* \ln P_o^f + S\omega_o^h + S^*\omega_o^f + \bar{K}R_o + G_o^h + G_o^f.$$

Evaluate the derivative at $\tau = \tau^*$, where $B = S^*/S$, $1/(1+B) = q$, $B/(1+B) = \chi$, and $P_o^h = P_o^f$. Using Appendix Appendix A, the relevant elasticities are

$$\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} = \frac{q(1-\alpha)}{\tau}, \quad \frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau} = -\frac{1}{\tau}\left(q + \frac{\chi}{s}\right), \quad \frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau} = \frac{q}{\tau}\left(\frac{1}{s} - 1\right), \quad \frac{1}{R_o}\frac{\partial R_o}{\partial \tau} = -\frac{q}{\tau}.$$

With $S\omega_o^h = sq(M+M^*)/\tau$, $S^*\omega_o^f = s\chi(M+M^*)/\tau$, $\bar{K}R_o = (M+M^*)/(\sigma\tau)$, the skilled-income derivatives sum to

$$\frac{\partial(S\omega_o^h + S^*\omega_o^f)}{\partial \tau} = -\frac{q(M+M^*)}{\tau^2}(sq+\chi) + \frac{q\chi(M+M^*)}{\tau^2}(1-s) = -\frac{sq(M+M^*)}{\tau^2},$$

the capital term is $-q(M+M^*)/(\sigma\tau^2)$, and the revenue terms are

$$\frac{\partial G_o^h}{\partial \tau} = q\frac{M+M^*}{\tau}\left[1 - \frac{\tau-1}{\tau}\left(q + \frac{\chi}{s}\right)\right], \quad \frac{\partial G_o^f}{\partial \tau} = \frac{(\tau-1)q\chi(M+M^*)}{\tau^2}\left(\frac{1}{s} - 1\right).$$

Substituting and dividing by $q(M+M^*)$,

$$0 = -\frac{1-\alpha}{\tau} - \frac{s}{\tau^2} - \frac{1}{\sigma\tau^2} + \frac{1}{\tau} - \frac{\tau-1}{\tau^2}\left(q + \frac{\chi}{s}\right) + \frac{\tau-1}{\tau^2}\chi\left(\frac{1}{s} - 1\right).$$

Since $-(q + \chi/s) + \chi(1/s - 1) = -q - \chi = -1$, the relocation-revenue terms collapse and, multiplying by τ^2,

$$0 = \alpha\tau - s - \frac{1}{\sigma} - (\tau - 1) = -(1-\alpha)\tau + 1 - s - \frac{1}{\sigma}.$$

Using $1-s-1/\sigma = (1-\alpha)(\sigma-1)/\sigma$ gives $(1-\alpha)[-\tau+(\sigma-1)/\sigma] = 0$, hence $\tau = (\sigma-1)/\sigma$; symmetry gives $\tau^* = (\sigma-1)/\sigma$. Combining the two principles, $\tau^C = (\tau^*)^C = (\sigma-1)/\sigma$, i.e. $t^C = -1/\sigma$. □

Appendix C Proof of Proposition 2

Proof. The domestic first-order condition $dW_d^h/d\tau = 0$, using Appendix A, is

$$-\frac{M}{\tau} + \alpha M \frac{M/\tau^2}{M/\tau + M^*/\tau^*} - sq\frac{M}{\tau^2} - \frac{\kappa M}{\sigma\tau^2} + \frac{M}{\tau^2} = 0.$$

Multiplying by τ^2/M, using $M^* = \lambda M$ and $A_h = 1 - sq - \kappa/\sigma$,

$$\tau = A_h + \alpha\frac{\tau\tau^*}{\tau^* + \lambda\tau} \iff \lambda\tau^2 + [(1-\alpha)\tau^* - \lambda A_h]\tau - A_h\tau^* = 0.$$

The domestic's best response is therefore:

$$\tau^{BR} = \frac{-[(1-\alpha)\tau^* - \lambda A_h] + \sqrt{[(1-\alpha)\tau^* - \lambda A_h]^2 + 4\lambda A_h}}{2\lambda}$$

Recalling the foreign welfare is given by

$$W_d^f = -M^* \ln P_d^f + S^*\omega_d^f + K^f R_d + G_d^f$$

$dW_d^f/d\tau^* = 0$ and using Appendix A give:

$$\begin{aligned}
-M^*\frac{1}{P_d^f}\frac{\partial P_d^f}{\partial\tau^*} + S^*\frac{\partial\omega_d^f}{\partial\tau^*} + K^f\frac{\partial R_d}{\partial\tau^*} + \frac{\partial G_d^f}{\partial\tau^*} &= 0\\
\iff -M^*\left(\frac{1}{\tau^*} + \alpha\frac{1}{\omega_d^f}\frac{\partial\omega_d^f}{\partial\tau^*}\right) + S^*\frac{\partial\omega_d^f}{\partial\tau^*} + K^f\frac{\partial R_d}{\partial\tau^*} + \frac{\partial G_d^f}{\partial\tau^*} &= 0\\
\iff -M^*\left[\frac{1}{\tau^*} - \alpha\frac{M^*}{(\tau^*)^2 X_d}\right] - \chi(S+S^*)\frac{s}{S+S^*}\frac{M^*}{(\tau^*)^2} - (1-\kappa)\frac{M^*}{\sigma(\tau^*)^2} + \frac{M^*}{(\tau^*)^2} = 0&\\
-M^*\left[\frac{1}{\tau^*} - \alpha\frac{1}{\tau^*}\frac{\lambda\tau}{\tau^* + \lambda\tau}\right] - s\chi\frac{M^*}{(\tau^*)^2} - (1-\kappa)\frac{M^*}{\sigma(\tau^*)^2} + \frac{M^*}{(\tau^*)^2} = 0&
\end{aligned}$$

Multiplying by $\frac{(\tau^*)^2}{M^*}$, the previous equality writes:

$$-\tau^* + \alpha\frac{\lambda\tau\tau^*}{\tau^* + \lambda\tau} - s\chi - \frac{1-\kappa}{\sigma} + 1 = 0$$

That is

$$\tau^* = \alpha \frac{\lambda \tau \tau^*}{\tau^* + \lambda \tau} + A_f \Longleftrightarrow (\tau^*)^2 + \tau^* \left[\lambda \tau (1-\alpha) - A_f\right] - \lambda \tau A_f = 0,$$

where $A_f = 1 - s\chi - \frac{1-\kappa}{\sigma.}$

The foreign best-response is therefore given by:

$$\tau^{BR,*} = \frac{-\left[\lambda \tau (1-\alpha) - A_f\right] + \sqrt{\left[\lambda \tau (1-\alpha) - A_f\right]^2 + 4\lambda \tau A_f}}{2}$$

Now we turn of given the expression of τ and τ^* at equilibrium. Recalling that from the two first-order conditions, we:

$$\tau = A_h + \alpha \frac{\tau \tau^*}{\tau^* + \lambda \tau}; \qquad \tau^* = A_f + \alpha \frac{\lambda \tau \tau^*}{\tau^* + \lambda \tau}$$

Let define the following variable $r \equiv \frac{\tau^*}{\lambda \tau}$, therefore from the domestic first-order condition we have

$$\tau = A_h + \alpha \frac{\tau(r\lambda\tau)}{r\lambda\tau + \lambda\tau} = A_h + \alpha \frac{r\tau}{1+r} \Longleftrightarrow \tau = \frac{A_h (1+r)}{1 + r(1-\alpha)}$$

The same reasoning for the foreign first-order condition leads to:

$$\tau^* = A_f + \alpha \frac{\lambda \tau \tau^*}{\tau^* + \lambda \tau} \Longleftrightarrow r\lambda\tau = A_f + \alpha \frac{\lambda\tau(r\lambda\tau)}{r\lambda\tau + \lambda\tau} \Longleftrightarrow \tau = \frac{A_f(1+r)}{r\lambda(1+r-\alpha)}$$

Therefore we have:

$$\frac{A_h (1+r)}{1+r(1-\alpha)} = \frac{A_f(1+r)}{r\lambda(1+r-\alpha)} \Longleftrightarrow A_h r \lambda (1+r-\alpha) = A_f \left[1 + r(1-\alpha)\right]$$

Then r is the root of the following quadratic equation:

$$\lambda A_h r^2 + (1-\alpha)(\lambda A_h - A_f) r - A_f = 0$$

By definition r is positive so its expression is given by :

$$r^* = \frac{-(1-\alpha)(\lambda A_h - A_f) + \sqrt{(1-\alpha)^2(\lambda A_h - A_f)^2 + 4\lambda A_h A_f}}{2\lambda A_h} \tag{30}$$

Therefore in the destination principle:

$$\tau_d^N = \frac{A_h\left(1+r^*\right)}{1+r^*\left(1-\alpha\right)}, \quad \text{and} \quad \tau_d^{N,*} = \frac{A_f\left(1+r^*\right)}{1+r^*-\alpha}$$

□

Appendix D Proof of Proposition 3

Proof. Using the results in subsection (3.5) in the origin principle, we can therefore write:

$$\begin{aligned} S\omega_o^h + K^h R_o + G_o^h &= S\frac{s(M+M^*)}{S}\frac{1}{\tau+B\tau^*} + \frac{K^h}{\sigma\bar{K}}\frac{(M+M^*)(1+B)}{\tau+B\tau^*} + (\tau-1)\frac{M+M^*}{\tau+B\tau^*} \\ &= \frac{M+M^*}{\tau+B\tau^*}\underbrace{\left[s+\frac{\kappa}{\sigma}(1+B)+\tau-1\right]}_{A_o^h} \end{aligned}$$

Then:

$$\frac{\partial A_o^h}{\partial \tau} = \frac{\kappa}{\sigma}\frac{\partial B}{\partial \tau} + 1; \quad \text{and} \quad \frac{\partial\left(\frac{M+M^*}{\tau+B\tau^*}\right)}{\partial \tau} = -\frac{M+M^*}{\left(\tau+B\tau^*\right)^2}\left(1+\tau^*\frac{\partial B}{\partial \tau}\right)$$

Therefore

$$\begin{aligned} \frac{\partial(S\omega_o^h + K^h R_o + G_o^h)}{\partial \tau} &= \tfrac{M+M^*}{\tau+B\tau^*}\tfrac{\partial A_o^h}{\partial \tau} + A_o^h\tfrac{\partial\left(\frac{M+M^*}{\tau+B\tau^*}\right)}{\partial \tau} \\ &= \tfrac{M+M^*}{\tau+B\tau^*}\tfrac{\partial A_o^h}{\partial \tau} - A_o^h\tfrac{M+M^*}{\left(\tau+B\tau^*\right)^2}\left(1+\tau^*\tfrac{\partial B}{\partial \tau}\right) \\ &= \tfrac{M+M^*}{\tau+B\tau^*}\left[\tfrac{\partial A_o^h}{\partial \tau} - \tfrac{A_o^h}{\tau+B\tau^*}\left(1+\tau^*\tfrac{\partial B}{\partial \tau}\right)\right] \end{aligned}$$

The first derivative of (21) in the origin principle in respect of τ is therefore

$$F_o^h(\tau,\tau^*) \equiv \frac{\partial W_o^h}{\partial \tau} = -M\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} + \frac{M+M^*}{\tau+B\tau^*}\left[\frac{\partial A_o^h}{\partial \tau} - \frac{A_o^h}{\tau+B\tau^*}\left(1+\tau^*\frac{\partial B}{\partial \tau}\right)\right]$$

where from Appendix A

$$\begin{aligned} (1-\sigma)\frac{1}{P_o^h}\frac{\partial P_o^h}{\partial \tau} &= \frac{1}{N_o^h}\frac{\partial N_o^h}{\partial \tau} + \frac{1-\sigma}{\tau} + \alpha(1-\sigma)\frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau} \\ &+ \frac{Z}{1+Z}\left[\frac{1}{B}\frac{\partial B}{\partial \tau} - \frac{1-\sigma}{\tau} + \alpha(1-\sigma)\left(\frac{1}{\omega_o^f}\frac{\partial \omega_o^f}{\partial \tau} - \frac{1}{\omega_o^h}\frac{\partial \omega_o^h}{\partial \tau}\right)\right], \end{aligned}$$

and $Z = B(\tau^*/\tau)^{1-\sigma}(\omega_o^f/\omega_o^h)^{\alpha(1-\sigma)}$, $\quad \frac{\omega_o^f}{\omega_o^h} = \left(\frac{\tau^*}{\tau}\right)^{-1/s}$; $\quad$ and $\quad \frac{\partial B}{\partial \tau} = \frac{B}{s\tau}$

The same reasoning in the foreign country gives:

$$\begin{aligned} S^*\omega_o^f + K^f R_o + G_o^f &= S^* \tfrac{s(M+M^*)}{S^*} \tfrac{B}{\tau + B\tau^*} + \tfrac{1-\kappa}{\sigma} \tfrac{(M+M^*)(1+B)}{\tau + B\tau^*} + (\tau^* - 1) \tfrac{B(M+M^*)}{\tau + B\tau^*} \\ &= \tfrac{M+M^*}{\tau + B\tau^*} \underbrace{\left[sB + \frac{1-\kappa}{\sigma}(1+B) + B(\tau^* - 1) \right]}_{A_o^f} \end{aligned}$$

Since

$$\frac{\partial A_o^f}{\partial \tau^*} = B + \frac{\partial B}{\partial \tau} \left(s + \frac{1-\kappa}{\sigma} + \tau^* - 1 \right); \quad \frac{\partial \left(\frac{M+M^*}{\tau + B\tau^*} \right)}{\partial \tau^*} = -\frac{M+M^*}{(\tau + B\tau^*)^2} \left(B + \tau^* \frac{\partial B}{\partial \tau^*} \right)$$

we therefore have:

$$\begin{aligned} \frac{\partial \left(S^*\omega_o^f + K^f R_o + G_o^f \right)}{\partial \tau^*} &= \tfrac{M+M^*}{\tau + B\tau^*} \tfrac{\partial A_o^f}{\partial \tau^*} - A_o^f \tfrac{M+M^*}{(\tau + B\tau^*)^2} \left(B + \tau^* \tfrac{\partial B}{\partial \tau^*} \right) \\ &= \tfrac{M+M^*}{\tau + B\tau^*} \left[\tfrac{\partial A_o^f}{\partial \tau^*} - \tfrac{A_o^f}{\tau + B\tau^*} \left(B + \tau^* \tfrac{\partial B}{\partial \tau^*} \right) \right] \end{aligned}$$

Therefore, the first derivative of (22) in respect of τ^* give the following expression in the origin principle:

$$F_o^f(\tau, \tau^*) \equiv \frac{\partial W_o^f}{\partial \tau^*} = -M^* \frac{1}{P_o^f} \frac{\partial P_o^f}{\partial \tau^*} + \frac{M+M^*}{\tau + B\tau^*} \left[\frac{\partial A_o^f}{\partial \tau^*} - \frac{A_o^f}{\tau + B\tau^*} \left(B + \tau^* \frac{\partial B}{\partial \tau^*} \right) \right]$$

Considering the first-order conditions proves this Proposition 3. □

Appendix E Propositions 4

Proof. By Propositions 2 and 3, the symmetric destination Nash and origin Nash taxes are given by is

$$\tau_d = \frac{(\sigma - 1)\left[\sigma(s-2) + 1\right]}{\sigma\left(s\sigma - 2\sigma + 2\right)}; \quad \tau_o = \frac{(\sigma - 1)\left(s^2\sigma + s - \sigma\right)}{\sigma\left(s^2\sigma - \sigma + 1\right)}. \tag{31}$$

We now compare welfare under the two principles. In the symmetric economy, if both countries set the same tax factor τ, destination and origin taxation generate the same allocation:

$$N^h = N^f = \frac{1}{2}, \qquad \omega^h = \omega^f = \frac{2s}{\tau}, \qquad R = \frac{2}{\sigma\tau}, \qquad G = \frac{\tau - 1}{\tau}.$$

Therefore, welfare can be written as a common function of the common tax factor:

$$W(\tau) = -\ln(\tau\omega^{\alpha}) + \frac{1}{2}\omega + \frac{1}{\sigma\tau} + \frac{\tau - 1}{\tau}, \qquad \omega = \frac{2s}{\tau}. \tag{32}$$

Substituting $\omega = 2s/\tau$, and dropping constants independent of τ, we obtain

$$W(\tau) = (\alpha - 1)\ln\tau + \frac{-1 + s + 1/\sigma}{\tau} + \text{constant}.$$

Hence

$$W'(\tau) = \frac{\alpha - 1}{\tau} - \frac{-1 + s + 1/\sigma}{\tau^2}.$$

Recalling $s = \frac{\alpha(\sigma-1)}{\sigma}$, the unique root of $W'(\tau) = 0$ is therefore given by:

$$\widehat{\tau} = \frac{\sigma - 1}{\sigma}.$$

Moreover,

$$W'(\tau) = \frac{(1-\alpha)(\widehat{\tau} - \tau)}{\tau^2}.$$

Since $\alpha < 1$, the welfare function is strictly increasing for $\tau < \widehat{\tau}$ and strictly decreasing for $\tau > \widehat{\tau}$.

We next show that both decentralized Nash tax factors lie above $\widehat{\tau}$. From (31),

$$\tau_d - \widehat{\tau} = -\frac{\sigma - 1}{\sigma\Big(s\sigma - 2\sigma + 2\Big)}.$$

Because $s < \frac{\sigma-1}{\sigma}$, we have $s\sigma - 2\sigma + 2 < 1 - \sigma < 0$. Therefore,

$$\tau_d > \widehat{\tau}.$$

Similarly, from (31),

$$\tau_o - \widehat{\tau} = \frac{(s-1)(\sigma-1)}{\sigma\Big(s^2\sigma - \sigma + 1\Big)}.$$

Since $s < 1$, the numerator is negative. Also, we have

$$s^2\sigma - \sigma + 1 = \frac{\sigma - 1}{\sigma}\left[\alpha\left(\sigma - 1\right) - \sigma\right] < 0.$$

Thus the denominator is negative, and therefore

$$\tau_o > \widehat{\tau}.$$

Both τ_d and τ_o lie on the decreasing branch of $W(\tau)$. Consequently,

$$W_o^h > W_d^h \quad \Longleftrightarrow \quad W(\tau_o) > W(\tau_d) \quad \Longleftrightarrow \quad \tau_o < \tau_d.$$

It remains to compare τ_o and τ_d. Using again (31), a direct simplification gives

$$\tau_o - \tau_d = \frac{(2s-1)(\sigma-1)(s\sigma-\sigma+1)}{\sigma\Big(s\sigma-2\sigma+2\Big)\Big(s^2\sigma-\sigma+1\Big)}. \tag{33}$$

On the admissible range,

$$s\sigma-\sigma+1<0, \qquad s\sigma-2\sigma+2<0, \qquad s^2\sigma-\sigma+1<0.$$

Therefore the denominator of (33) is positive, while the factor $s\sigma-\sigma+1$ in the numerator is negative. Hence

$$\operatorname{sign}(\tau_o-\tau_d) = \operatorname{sign}\left(\frac{1}{2}-s\right).$$

Thus

$$\tau_o < \tau_d \quad \Longleftrightarrow \quad s > \frac{1}{2}.$$

Since both taxes lie above $\widehat{\tau}$, this implies

$$W_o^h > W_d^h \quad \Longleftrightarrow \quad s > \frac{1}{2}.$$

Likewise,

$$W_o^h < W_d^h \quad \Longleftrightarrow \quad s < \frac{1}{2}.$$

At $s=1/2$, equation (33) gives $\tau_o=\tau_d$, and therefore $W_o^h = W_d^h$.

The foreign-country result follows immediately by symmetry. □

E.1 Additional materials

Table 6: Skill intensity: taxes, allocation, prices, returns, fiscal revenue, and welfare dominance.

Panel A. Taxes and allocation

α	s	τ_d^h	τ_o^h	N_d^h	N_o^h	ω_d^h	ω_o^h	ΔW^h	Prefers
0.400	0.300	0.9062	0.9489	0.5000	0.5000	0.6621	0.6323	−0.0053	Destination
0.500	0.375	0.9167	0.9423	0.5000	0.5000	0.8182	0.7959	−0.0027	Destination
0.600	0.450	0.9286	0.9384	0.5000	0.5000	0.9692	0.9591	−0.0008	Destination
0.667	0.500	0.9375	0.9375	0.5000	0.5000	1.0667	1.0667	0.0000	*tie*
0.700	0.525	0.9423	0.9377	0.5000	0.5000	1.1143	1.1197	0.0003	Origin
0.800	0.600	0.9583	0.9423	0.5000	0.5000	1.2522	1.2735	0.0007	Origin
0.900	0.675	0.9773	0.9570	0.5000	0.5000	1.3814	1.4106	0.0005	Origin

Panel B. Price index, capital return, and fiscal revenue

α	s	P_d^h	P_o^h	R_d	R_o	G_d^h	G_o^h	ΔW^h	Prefers
0.400	0.300	0.7684	0.7899	0.5517	0.5269	−0.1034	−0.0539	−0.0053	Destination
0.500	0.375	0.8292	0.8407	0.5455	0.5306	−0.0909	−0.0612	−0.0027	Destination
0.600	0.450	0.9113	0.9152	0.5385	0.5328	−0.0769	−0.0657	−0.0008	Destination
0.667	0.500	0.9787	0.9787	0.5333	0.5333	−0.0667	−0.0667	0.0000	*tie*
0.700	0.525	1.0165	1.0150	0.5306	0.5332	−0.0612	−0.0664	0.0003	Origin
0.800	0.600	1.1472	1.1434	0.5217	0.5306	−0.0435	−0.0612	0.0007	Origin
0.900	0.675	1.3071	1.3043	0.5116	0.5225	−0.0233	−0.0449	0.0005	Origin

Notes: Panel A reports the tax/allocation objects. Panel B adds the requested objects: the Home price index P_k^h, the economy-wide capital return R_k, and Home fiscal revenue G_k^h, with $k \in \{d, o\}$ denoting the destination and origin principles. These levels show which equilibrium channel moves when the primitive changes. Lower P_k^h raises the price-index component of welfare; higher R_k benefits Home in proportion to κ; and higher G_k^h raises the fiscal-revenue component. The benchmark row is the symmetric economy, where $\Delta W^h = 0$ (*tie*).

Table 7: Elasticity of substitution: taxes, allocation, prices, returns, fiscal revenue, and welfare dominance.

Panel A. Taxes and allocation

σ	s	τ_d^h	τ_o^h	N_d^h	N_o^h	ω_d^h	ω_o^h	ΔW^h	Prefers
2.000	0.333	0.8750	0.9286	0.5000	0.5000	0.7619	0.7179	−0.0088	Destination
3.000	0.444	0.9167	0.9298	0.5000	0.5000	0.9697	0.9560	−0.0013	Destination
3.500	0.476	0.9286	0.9336	0.5000	0.5000	1.0256	1.0202	−0.0004	Destination
4.000	0.500	0.9375	0.9375	0.5000	0.5000	1.0667	1.0667	0.0000	*tie*
4.500	0.519	0.9444	0.9413	0.5000	0.5000	1.0980	1.1017	0.0002	Origin
5.000	0.533	0.9500	0.9448	0.5000	0.5000	1.1228	1.1290	0.0003	Origin
6.000	0.556	0.9583	0.9510	0.5000	0.5000	1.1594	1.1684	0.0003	Origin

Panel B. Price index, capital return, and fiscal revenue

σ	s	P_d^h	P_o^h	R_d	R_o	G_d^h	G_o^h	ΔW^h	Prefers
2.000	0.333	0.7299	0.7445	1.1429	1.0769	−0.1429	−0.0769	−0.0088	Destination
3.000	0.444	0.8981	0.9023	0.7273	0.7170	−0.0909	−0.0755	−0.0013	Destination
3.500	0.476	0.9444	0.9461	0.6154	0.6121	−0.0769	−0.0712	−0.0004	Destination
4.000	0.500	0.9787	0.9787	0.5333	0.5333	−0.0667	−0.0667	0.0000	*tie*
4.500	0.519	1.0052	1.0041	0.4706	0.4722	−0.0588	−0.0624	0.0002	Origin
5.000	0.533	1.0263	1.0244	0.4211	0.4234	−0.0526	−0.0584	0.0003	Origin
6.000	0.556	1.0577	1.0549	0.3478	0.3505	−0.0435	−0.0515	0.0003	Origin

Notes: Panel A reports the tax/allocation objects. Panel B adds the requested objects: the Home price index P_k^h, the economy-wide capital return R_k, and Home fiscal revenue G_k^h, with $k \in \{d, o\}$ denoting the destination and origin principles. These levels show which equilibrium channel moves when the primitive changes. Lower P_k^h raises the price-index component of welfare; higher R_k benefits Home in proportion to κ; and higher G_k^h raises the fiscal-revenue component. The benchmark row is the symmetric economy, where $\Delta W^h = 0$ (*tie*). Along this column $s = \frac{2}{3} \cdot \frac{\sigma-1}{\sigma}$ crosses $\frac{1}{2}$ exactly at $\sigma = 4$, so the symmetric economy itself moves through the dominance threshold.

Table 8: Skilled-labor asymmetry: taxes, allocation, prices, returns, fiscal revenue, and welfare dominance.

Panel A. Taxes and allocation

q	τ_d^h	τ_o^h	N_d^h	N_o^h	ω_d^h	ω_o^h	ΔW^h	Prefers
0.250	1.0541	0.8704	0.2500	0.3456	1.0962	1.3582	−0.0015	Destination
0.350	1.0095	0.8898	0.3500	0.4116	1.0770	1.2211	0.0060	Origin
0.450	0.9622	0.9191	0.4500	0.4711	1.0678	1.1136	0.0032	Origin
0.500	0.9375	0.9375	0.5000	0.5000	1.0667	1.0667	0.0000	*tie*
0.550	0.9122	0.9590	0.5500	0.5289	1.0678	1.0227	−0.0036	Destination
0.650	0.8595	1.0142	0.6500	0.5884	1.0770	0.9400	−0.0100	Destination

Panel B. Price index, capital return, and fiscal revenue

q	P_d^h	P_o^h	R_d	R_o	G_d^h	G_o^h	ΔW^h	Prefers
0.250	1.1206	1.0133	0.5481	0.4913	0.0513	−0.0880	−0.0015	Destination
0.350	1.0607	0.9902	0.5385	0.5192	0.0094	−0.0942	0.0060	Origin
0.450	1.0052	0.9799	0.5339	0.5318	−0.0393	−0.0811	0.0032	Origin
0.500	0.9787	0.9787	0.5333	0.5333	−0.0667	−0.0667	0.0000	*tie*
0.550	0.9529	0.9799	0.5339	0.5318	−0.0963	−0.0461	−0.0036	Destination
0.650	0.9031	0.9902	0.5385	0.5192	−0.1635	0.0173	−0.0100	Destination

Notes: Panel A reports the tax/allocation objects. Panel B adds the requested objects: the Home price index P_k^h, the economy-wide capital return R_k, and Home fiscal revenue G_k^h, with $k \in \{d, o\}$ denoting the destination and origin principles. These levels show which equilibrium channel moves when the primitive changes. Lower P_k^h raises the price-index component of welfare; higher R_k benefits Home in proportion to κ; and higher G_k^h raises the fiscal-revenue component. The benchmark row is the symmetric economy, where $\Delta W^h = 0$ (*tie*).

Table 9: Market-size asymmetry: taxes, allocation, prices, returns, fiscal revenue, and welfare dominance.

Panel A. Taxes and allocation

λ	τ_d^h	τ_o^h	N_d^h	N_o^h	ω_d^h	ω_o^h	ΔW^h	Prefers
0.500	1.0581	0.8981	0.5000	0.5508	0.7696	0.8776	0.0085	Origin
0.750	0.9846	0.9187	0.5000	0.5217	0.9270	0.9730	0.0049	Origin
1.000	0.9375	0.9375	0.5000	0.5000	1.0667	1.0667	0.0000	*tie*
1.250	0.9039	0.9543	0.5000	0.4832	1.1950	1.1590	−0.0032	Destination
1.750	0.8582	0.9825	0.5000	0.4585	1.4297	1.3414	−0.0016	Destination
2.500	0.8158	1.0147	0.5000	0.4345	1.7473	1.6113	0.0199	Origin

Panel B. Price index, capital return, and fiscal revenue

λ	P_d^h	P_o^h	R_d	R_o	G_d^h	G_o^h	ΔW^h	Prefers
0.500	0.8886	0.8104	0.3848	0.3984	0.0549	−0.0894	0.0085	Origin
0.750	0.9361	0.8959	0.4635	0.4663	−0.0156	−0.0791	0.0049	Origin
1.000	0.9787	0.9787	0.5333	0.5333	−0.0667	−0.0667	0.0000	*tie*
1.250	1.0179	1.0590	0.5975	0.5997	−0.1063	−0.0530	−0.0032	Destination
1.750	1.0891	1.2127	0.7148	0.7313	−0.1653	−0.0235	−0.0016	Destination
2.500	1.1834	1.4286	0.8736	0.9270	−0.2258	0.0236	0.0199	Origin

Notes: Panel A reports the tax/allocation objects. Panel B adds the requested objects: the Home price index P_k^h, the economy-wide capital return R_k, and Home fiscal revenue G_k^h, with $k \in \{d, o\}$ denoting the destination and origin principles. These levels show which equilibrium channel moves when the primitive changes. Lower P_k^h raises the price-index component of welfare; higher R_k benefits Home in proportion to κ; and higher G_k^h raises the fiscal-revenue component. The benchmark row is the symmetric economy, where $\Delta W^h = 0$ (*tie*).

Table 10: Capital ownership: taxes, allocation, prices, returns, fiscal revenue, and welfare dominance.

Panel A. Taxes and allocation

κ	τ_d^h	τ_o^h	N_d^h	N_o^h	ω_d^h	ω_o^h	ΔW^h	Prefers
0.250	0.9979	0.9838	0.5000	0.4391	1.0738	0.9544	-0.0009	Destination
0.400	0.9622	0.9586	0.5000	0.4757	1.0678	1.0179	-0.0001	Destination
0.500	0.9375	0.9375	0.5000	0.5000	1.0667	1.0667	0.0000	*tie*
0.550	0.9249	0.9257	0.5000	0.5121	1.0670	1.0933	0.0001	Origin
0.700	0.8862	0.8855	0.5000	0.5486	1.0712	1.1844	0.0012	Origin
0.850	0.8459	0.8378	0.5000	0.5857	1.0809	1.2967	0.0042	Origin

Panel B. Price index, capital return, and fiscal revenue

κ	P_d^h	P_o^h	R_d	R_o	G_d^h	G_o^h	ΔW^h	Prefers
0.250	1.0465	0.9751	0.5369	0.5434	-0.0021	-0.0155	-0.0009	Destination
0.400	1.0052	0.9781	0.5339	0.5349	-0.0393	-0.0422	-0.0001	Destination
0.500	0.9787	0.9787	0.5333	0.5333	-0.0667	-0.0667	0.0000	*tie*
0.550	0.9658	0.9786	0.5335	0.5337	-0.0812	-0.0812	0.0001	Origin
0.700	0.9278	0.9764	0.5356	0.5397	-0.1285	-0.1356	0.0012	Origin
0.850	0.8909	0.9715	0.5404	0.5535	-0.1822	-0.2104	0.0042	Origin

Notes: Panel A reports the tax/allocation objects. Panel B adds the requested objects: the Home price index P_k^h, the economy-wide capital return R_k, and Home fiscal revenue G_k^h, with $k \in \{d, o\}$ denoting the destination and origin principles. These levels show which equilibrium channel moves when the primitive changes. Lower P_k^h raises the price-index component of welfare; higher R_k benefits Home in proportion to κ; and higher G_k^h raises the fiscal-revenue component. The benchmark row is the symmetric economy, where $\Delta W^h = 0$ (*tie*).

Table 11: Per-capita skilled–unskilled incidence gap $\delta_{S\text{-}U}$ as the fiscal-assignment share θ varies ($\psi_s = 0.30$).

Case	$\theta = 0.00$	$\theta = 0.25$	$\theta = 0.50$	$\theta = 0.75$	$\theta = 1.00$	θ^*
Benchmark	0.0000	0.0000	0.0000	0.0000	0.0000	–
Low σ	-0.0358	-0.0174	0.0010	0.0194	0.0377	0.487
High σ	0.0205	0.0109	0.0013	-0.0083	-0.0179	0.533
Low q	0.4610	0.2952	0.1294	-0.0365	-0.2023	0.695
High q	-0.3953	-0.1801	0.0352	0.2505	0.4657	0.459
Large foreign market	-0.4924	-0.1954	0.1016	0.3986	0.6956	0.414
High κ	0.2561	0.2225	0.1890	0.1554	0.1219	–

Notes: Each entry is $\delta_{S\text{-}U}(\theta, \psi_s)$. A sign change across a row means the rebate rule alone flips which group gains per head; θ^* is the neutralizing share when it lies in $[0, 1]$ ("–" otherwise). Equal per-capita redistribution is $\theta = \psi_s = 0.30$.

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