# DBCFT, Border Adjustments, and Trade

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**Abstract**

A destination based cash flow tax (DBCFT) with border adjustments has been proposed as an alternative to the US corporate income tax. Advocates have argued that the tax will eliminate incentives to shift the location of production to avoid taxes, and will not distort international trade flows. We establish conditions under which a DBCFT with border adjustments will be neutral, in the sense that it has no effect on equilibrium in the two countries, using two standard general equilibrium models of international trade. We first analyzed a specific factor model, both with and without international capital mobility. We then examine a monopolistic competition model with heterogeneous firms, considering both a short run model with a fixed number of firms and a steady state model with endogenous entry..

## 1 Introduction

The destination based cash flow tax (DBCFT) has been proposed by Auerbach et al (2016) and Auerbach and Devereux (2017) as a superior form of taxation to the current US system of corporate income taxations. Taxing income on a destination basis means that export sales are not subject to tax, and that firms are not allowed to deduct the cost of imported inputs from their taxable income. This differs from the corporate income tax, which taxes export sales and allows deduction of the cost of imported inputs. It also differs from the current US tax system by exempting foreign source income.

The cash flow feature of the DBCFT allows firms to immediately deduct purchases of capital goods, rather than requiring them to be expensed over time according to a depreciation schedule as in the corporate income tax. The corporate income tax will tax the normal return on capital and excess profits, whereas the cash flow tax is intended to only tax excess profits.[1]

Auerbach et al. argue that a destination based tax reduces the incentive to shift location of production in order to reduce the tax rate. In particular, they draw an analogy between the border adjustments in the DBCFT and the border adjustments frequently used by countries that impose a value added tax (VAT). The theoretical literature has shown that border adjustments under a VAT have no effect on resource allocation when they are uniformly applied across sectors.[2] This analogy has been used by others (eg.Feldstein (2017), Pomerleau and Entin (2017)) to argue further that the combination of not allowing deduction of imports and exempting exports from the cash flow tax will result in a neutral effect due to exchange rate adjustments, and will also raise revenue because the US currently runs a trade deficit.

Our goal in this paper is to examine how the adoption of a destination based tax system for capital income affects the pattern of international trade and investment in two standard general equilibrium models of international trade. In order to focus on the role of border adjustments, we

[1] The benefits of the cash flow tax are also intended the subsidy to debt finance inherent in the current system. We abstract from these issues in the current discussion in order to focus on the role of border adjustments.

[2] Grossman (1980) showed that a VAT is neutral, in the sense that it has no effect on resoruce allocation, whether it is applied on a source or destination basis. In contrast, a sales tax affects resource allocation when applied on a source basis with trade in intermediate goods, but not when it is applied on a destination basis. Feldstein and Krugman make a similar argument in a two period model. Costinot and Werning (2017) point out the link between these results and the Lerner Symmetry theorem.

compare a source based capital income tax that exempts foreign source income with a destination based system of capital income taxation.

We first consider a specific factor model particular with traded and non-traded goods. We first show that if capital is not mobile internationally, both a source based and destination based tax on capital income are neutral with respect to their effect on resource allocation. If sector-specific capital is mobile between countries, the destination based system of taxation continues to be neutral but the source based sytem of taxation does not.

We then consider the case of a heterogeneous firm model with multinational firms following Helpman, Yeaple, and Melitz (2006). This allows consideration of the effect of introducing imperfect competition and the choice between exporting and foreign direct investment for serving the foreign market in the presence of fixed costs of market entry. This model also allows consideration of the impact of taxation on the entry decision of firms. We show that in a short run model with a fixed number of firms, the destination based tax will have no effect on the exporting/foreign direct investment decision of firms. In a steady state model with endogenous entry, neutrality will require the full deductibility of fixed entry costs for firms that enter and fail.

## 2 A Static Specific Factor Model

In this section we use a specific factor model to examine the effects of changes in capital income taxation. We consider the case of a small country that produces 3 goods: a non-traded good ($n$), exportable ($x$), and import-competing good ($m$). We assume the absence of trade barriers or transport costs between countries, since our focus is on comparing how the allocation of capital varies with whether capital income is taxed on a source or destination basis. .

Goods in each sector are produced using mobile labor and sector-specific capital under conditions of constant return to scale and perfect competition in goods and factor markets. The quantity of labor is assumed to be a given endowment $L$ The quantity of sector specific capital in sector $i$ is denoted by $K_i$, and its return is assumed not to be deductible from either a source or destination based capital income tax. We hold the base of the tax constant in order to focus on the effect of the border adjustments on the allocation of capital.[3]

With constant returns to scale in each sector, the output of good $i$ can be expressed as

$$X_i = K_i f_i \left(l_i\right) \;\; i \in \{x, n, m\}$$

where $f_i(.)$ is a strictly concave function and $l_i \equiv \frac{L_i}{K_i}$. Letting $q_i$ be the after-tax return on the sale of a unit of good $i$ and $v_i$ the after tax cost of a unit of labor in sector i, we can express the return to the owner of a unit of sector $i$ capital as

$$\begin{aligned} r_i(z_i, v_i) &= \max_{l_i} \left(z_i f_i \left(l_i\right) - v_i l_i\right) \\ &= \left(\psi_i \left(\frac{v_i}{z_i}\right) - \frac{v_i}{q_i} \varphi_i \left(\frac{v_i}{z_i}\right)\right) q_i, \text{ for } i = m, n, x \end{aligned} \tag{1}$$

where $\varphi_i = f'^{-1}$ and $\psi(.) = f(g(.))$. The rental on capital is homogeneous of degree 1 in $(v_i, z_i)$, and the output of good $i$ can be expressed as $X_i = \psi_i \left(\frac{v_i}{z_i}\right) K_i$. We will consider two cases, one with home country capital immobile between countries and one where owners of $x$ sector capital can choose to locate their capital in either the home or foreign country.[4] Capital mobility requires

[3] The base for capital taxation differs between a cash flow tax and a more traditional corporate income tax due to the ability to expense capital goods. We discuss the role of the tax base in the next section.

[4] Our choice of $x$ sector capital as the mobile factor is done to simplify the discussion. With labor treated homogeneously across sectors by tax regimes, movement of $x$ capital is sufficient to eliminate the incentive to move capital in the $m$ sector.

the equalization of after tax returns to $x$ capital across countries, $r(z_x, v_x) = r_x(z_x^*, v_x^*)$.

We can use the firm and household optimization problems to characterize the goods market and labor market equilibria for the home country. The labor market equilibrium requires that the sum of labor demands for traded and non-traded goods equal labor supply. For the case of capital mobility we allow capital owners in the $x$ sector to choose to locate their capital either in the home or foreign country, with $K_F$ denoting the quantity of $x$ sector capital located in the foreign country. The labor market equilibrium will be

$$L = \sum_{i=m,n} K_i \varphi_i \left( \frac{v_i}{z_i} \right) + \left( K_x - K_F \right) \varphi_x \left( \frac{v_x}{z_x} \right), \tag{2}$$

Labor demands are decreasing functions of the respective sectoral real wages.

Home country preferences are described by the expenditure function $E\left(p_n, p_m, p_x, U\right)$, which is assumed to be homogeneous of degree one and strictly concave in prices and increasing in $U$. Home country demand functions for the respective goods are $D_i\left(p_n, p_m, p_x, U\right) = E_{p_i}\left(p_n, p_m, p_x, U\right)$. Household income consists of labor income, capital income, and transfers from the government. The household budget constraint can be expressed as

$$E(p_n, p_m, p_x, U) = wL + \sum_{i=n,m,x} r_i(z_i, v_i) K_i + T, \tag{3}$$

where $T$ is the capital tax revenue that is assumed to be redistributed to households in lump sum fashion.

The market clearing condition for non-traded goods requires that the home demand equal the home supply,

$$E_{p_n}(p_n, p_m, p_x, U) - X_n\left(\frac{v_n}{z_n}\right) = 0. \tag{4}$$

For a given tax system and no mobility of capital, we can use (2), (4) and (3) to solve for $w_F$, $p_n$, and $U$, with $K_F \equiv 0$. If $x$ sector capital is mobile internationally, we can use (2), (4) and (3) to solve for $K_F$, $p_n$, and $U$, with the additional condition that $r(z_x, v_x) = r_x(z_x^*, v_x^*)$.

## 2.1 Source Based Taxation

Under a source based tax system, owners of capital in the home country will be taxed at a rate $t_S$ on all sales generated by capital located in the home country. Labor costs will be deductible from income for capital located at home, so the return to a unit of capital in sector $i$ on domestic sales is $(1 - t_S)r_i(p_i, w_i)$. The real cost of labor to capital owners in each sector is $w/p_i$ with the source based tax.

Export sales from sector $x$ will also be taxed at rate $t_S$, so the return to a unit of capital selling in the export market is $(1 - t_S)r_x(p_x^*, w_i)$, where $p_x^*$ is the after tax return from a unit of export sales in the foreign market. In order for a sector $x$ firm to be indifferent between exporting and selling domestically, we must have $p_x = p_x^*$. Similarly, the price of imported goods will be $p_m = p_m^*$, since there are no taxes on imported goods. Thus, the source based tax system has no effect on the price of traded goods.

in the case of capital mobility, we assume that foreign source income is exempted from home country taxes, so sector $x$ capital owners owe tax at rate $t^*$ on earnings on foreign income. Assuming that the tax on export sales to the foreign market is the same as that on sales from FDI, the return from locating capital in the foreign country is $r_x(p_x^*, v^*)$. The condition for the owners of home country capital in the $x$ sector to be indifferent between serving the foreign market by export or foreign production when there is capital mobility is $(1 - t_S)r(p_x^*, w_S) = r_x(p_x^*, v^*)$.

The following result, proven in the Appendix, characterizes the effect of changes in a source based tax rate:

**Proposition 1** *: Source based capital taxation*

*(i) If capital is immobile internationally, an increase in a source based tax on capital will have no effect on the wage rate or price of non-traded goods. The tax has no effect on the allocation of labor between sectors or on home country welfare.*

*(ii) If capital in the $X$ sector is mobile internationally, an increase in a source based tax will result in a decrease in the home country wage rate and an increase in $K_F$.*

With capital immobile, it is readily verified that the effect of an increase in $t_S$ is borne entirely by capital owners. The income of capital owners declines because they are unable to escape the tax by changing the location of capital, but aggregate demand remains constant under the assumption of lump sum redistribution of capital to households and identical tastes across households. The wage rate and price of non-traded goods unaffected, so the capital tax has no effect on resource allocation.

With capital mobility and exemption of foreign source income, in contrast, owners of $x$ capital can escape the tax by moving their capital to the foreign country. An increase in the tax rate must be accompanied by a reduction in the domestic wage in order to make capital owners indifferent between locating in the home and foreign countries. Welfare of the home country falls, because capital owners do not take account of the loss of tax revenue in making their location decision.

### 2.1.1 Destination Based Tax System

Under a destination based tax system in the home country, capital owners only pay tax on sales in the local market. Letting $t_D$ be the tax rate under a destination based tax system, a capital owner in sector $x$ will earn a return $r_x(p_x, w)(1 - t_D)$ from sales in the home market and a return $r_x(p_x^*, (1 - t_D)w)$ from sales in the export market. In order for capital owners to be indifferent between export and domestic sales, $p_x = \frac{p_x^*}{(1-t_D)}$.

For the $m$ sector, we assume that a foreign firm exporting to the home market sells through a perfectly competitive intermediary that sells to home consumers at a price of $p_m$. We simplify by assuming zero labor costs for importers, so that the unit cost is the price of the foreign exporter,$p_m^*$. Since the cost of imports is not deductible, the zero profit condition for importers will require $p_m = \frac{p_m^*}{1-t_D}$. The effect of the border adjustments is to raise prices of all traded goods by a factor of $\frac{1}{1-t_D}$. The condition for capital mobility in this case is $r_x(p_x^*, (1 - t_D)w) = r_x(p_x^*, v^*)$, which requires $w(1 - t_D) = v^*$ as in the case of source based taxation.

These equilibrium conditions can be used to establish the following neutrality result for the effect of changes in the cash flow tax:

**Proposition 2** *Destination Based Capital Tax*

*(i) In the case without capital mobility, an increase in the cash flow tax will raise the wage rate and price of non-traded goods proportionally, so that* $w(1-t_D)$ *and* $\frac{w}{p_n}$ *are unaffected by the change in tax rate. Resource allocation and the home country utility level are unaffected by the change in* $t_D$*. The nominal return to each type of capital is unaffected by the tax rate change, so that the real return to capital falls proportionally.*

*(ii) The result on* $p_n$ *and* $w$ *with capital mobility is the same as without capital mobility.*

In the case of a closed economy, a cash flow tax has an effect on trade that is similar to a simultaneous import tariff and export subsidy at the same rate. Since prices of both traded goods rise proportionally, there is no effect of the change on the relative incentive to produce traded goods.

In contrast to the case of a source based tax, the neutrality result for tax rate changes extends to the case with capital mobility. With a destination based tax, both the returns to exporting and the returns to locating abroad are unaffected by the cash flow tax. The return to foreign location is unaffected because it depends only on foreign tax policy, while the return to exporting is unaffected because the rising wages are offset by the export subsidy. This differs from the case of a source based tax, where the increase in the home capital tax rate will make exporting less attractive relative to locating abroad at a given wage rate.

We make several observations regarding the neutrality result. If export sales are sufficiently large that $D_x - wl_xK_x < 0$, the taxable cash flow of exporters will be negative and the government will have to pay a subsidy of $t\left(D_x - wl_xK_x\right)$ to owners of export capital to obtain the neutrality result. The cash flow tax is equivalent to one in which exports are subsidized by an amount $\frac{tp_x^*}{1-t}$ per unit and the firm is taxed on all sales. If the government does not allow negative tax payments, then the export sector will not obtain the full benefit of the subsidy if export sales are sufficiently large. For example, suppose that there is no demand for $x$ in the home country and all output is exported. The return to a unit of home capital in that case will be $\max_{l_x}\left(p_x^* f_x\left(l_x\right) - wl_x\right)$, which is unaffected by the tax. Without a subsidy to capital owners in the export sector, the DBCFT will be similar to an import tariff because it raises labor demand in the import-competing sectors and drives up the wage paid by exporting firms.

The result for the cash flow tax is similar to the neutrality result obtained for a value added tax with border tax adjustments obtained by Feldstein and Krugman (1990). Under a value added tax, there is no deduction for labor costs so the real wage of workers and capital owners are both reduced. However, the greater revenue collection under a value added tax allows consumption levels to be maintained. The cash flow tax is thus equivalent to a value added tax combined with a subsidy to employment in this benchmark model.

Finally, note that this result can be extended to an intertemporal model in which trade balances in does not necessarily balance in each period. In this case the current tax revenue generated by the border adjustment for a country that runs a current trade deficit will be offset by negative tax revenue from the border adjustment in future periods with trade surpluses.

# 3 Monopolistic Competition with Heterogeneous Firms

In this section we consider a the impact of a change in a destination based tax in a monopolistic competition model with heterogeneous firms that can serve foreign markets either by export or by foreign direct investment, as in Helpman, Melitz, and Yeaple (2003). The non-neutrality of a switch from a source based tax system to a destination based tax system will be hold for reasons similar to those in the specific factor model, so we focus in this section on the conditions required for neutrality of a destination based tax.

This model introduces two elements not present in the specific factor model. One is that firms are imperfectly competitive. The other is that the potential for firm entry and exit allows the tax to affect the supply of the taxed factor of production.

### 3.1 Short Run Equilibrium

We begin with a short run equilibrium in which there is a fixed measure $M$ of home firms and $M^*$ foreign firms in operation, each selling its own version of a differentiated product. We will assume that the variable and fixed costs of firms in the market are deductible from tax, so that in the short run the tax will fall on the return to firms that incurred sunk entry costs and chose to stay in the market. The short run analysis thus introduces the role of imperfect competition, while holding the number of potential producers constant as in the specific factors model.

There is a single factor of production in each country, labor, whose supply is exogenously given by $L$. Each of the existing firms has a firm-specific unit labor requirement for output, $a$, which is exogenously given. The labor demand by a home country firm of ability $a$ selling in its domestic market is given by $l_d(a) = aq_d + f$, where $q_d$ is the quantity sold in the domestic market, and $f$ is the per period fixed labor requirement of operation.

If a home firm also chooses to export to the foreign market, it incurs a fixed cost of exporting and transport costs of shipping the goods to the foreign country. The transport costs are assumed to be of the iceberg type, so that $\tau > 1$ units must be shipped for each 1 unit of sales in the foreign market. The fixed costs associated with exporting are assumed to require $f_x$ units of labor, which are assumed to be incurred in the foreign country. The labor demand of a home firm selling $q_x$ units in the foreign market is thus $a\tau q_x$ at home and $f_x$ in the foreign country.

If a home firms chooses to serve the foreign market through a foreign subsidiary, it avoids the transport costs of shipping between markets but bears the fixed labor costs in the foreign country associated with setting up and operating a foreign production facility, $f_m$. The labor demand for serving the foreign market with a subsidiary in the foreign country producing $q_m$ units of output is $f_m$ in the home country and $aq_x + f_m$ in the foreign country.

We assume that the fixed cost parameters of production for the foreign firm are the same as for the home firms. The productivity parameter is assumed to have support $[a_{\min}, a_{\max}]$, with the probability density function denoted $\mu(a)$ for home firms and $\mu^*(a)$ for foreign firms.

Home country consumers have a CES utility function $U = \left(\int_{I\cup I_x^*} c(i)^\rho di\right)^{\frac{1}{\rho}}$, which can be represented by the expenditure function, $E = UP$,where $P \equiv \left(\int_{I\cup I_x^*} p(i)^{1-\sigma} di\right)^{\frac{1}{1-\sigma}}$ and $\sigma = 1/(1-\rho)$. These preferences yield demand functions for an individual firm selling in the home market of $Ap^{-\sigma}$, where $A = P^\sigma U$ is a common factor reflecting the level of home expenditure and the competitiveness of the home market place.

Firms in each country must decide whether to produce in their own market, and if they do produce whether to also sell to the other market. We characterize decisions for firms in the home country market, with the conditions in the foreign market being symmetric.

Sales in the home market will consist of sales by home firms, sales by foreign firms that export, and sales by foreign firms that have a foreign subsidiary. The profits of a representative firm of each type with unit labor input requirement $a$ is given by

$$\begin{aligned}
\pi_d(a) &= \max_{p_d} \left( (p_d(i) - aw)\, A{p_d}^{-\sigma} U - wf \right)(1-t) \\
\pi_x^*(a) &= \max_{p_x^*} \left(p_x^*(1-t) - \tau a\right) A p_x^*(i)^{-\sigma} - w(1-t) f_x \qquad (5) \\
\pi_m^*(a) &= \max_{p_m^*} \left(p_m^* - aw\right)(1-t) A p_m^*(i)^{-\sigma} - w(1-\lambda_m)(1-t) f_m
\end{aligned}$$

where $w$ is the home country wage rate and foreign labor is chosen as numeraire. We assume that domestic firms and foreign multinationals are able to deduct their variable labor costs and any fixed costs that are incurred home country. Foreign exporters can only deduct any of the fixed cost component that is incurred in the home country.

The profit maximizing prices for the respective firm types in the home market will be

$$p_d(a) = p_m^*(a) = \tfrac{wa}{\rho} \quad p_x^*(a) = \tfrac{\tau a}{\rho(1-t)} \tag{6}$$

Prices are a constant markup over variable costs, with the price being the same (given $a$) for home producers and foreign multinationals whose variable costs are in terms of home labor. Letting $I_d = \{a | \pi_d(a) = 0\}$ and

$$P = \frac{w}{\rho}\left(M\widetilde{a} + M^*\widetilde{a}_m^* + \left(\frac{\tau}{w(1-t)}\right)^{1-\sigma} M^*\widetilde{a}_x^*\right)^{\frac{1}{1-\sigma}} \tag{7}$$

where $\widetilde{a} = \int_{a\in I_d} a^{1-\sigma}\mu(a)da$ is a an aggregate productivity measure for home firms that reflects both the number and individual productivity of home firms in the domestic market. Similarly, $\widetilde{a}_j^* = \int_{a\in I_j^*} a^{1-\sigma}\mu^*(a)da$ is the corresponding aggregate productivity measure for foreign firms that choose to sell in mode $j = m, x$.

The profits for a home firm will be $\pi_d(a) = \left((1-\rho)\left(\frac{aw}{\rho}\right)^{1-\sigma} A - wf\right)(1-t)$. Firms will only stay in the market if profits are non-negative, so the requirement for a home firm to stay in the home market is

$$a \leq \overline{a}_d \equiv \rho\left(\frac{U(1-\rho)}{f}\right)^{\frac{1}{\sigma-1}}\left(\frac{P}{w}\right)^{\frac{\sigma}{\sigma-1}} \tag{8}$$

Neutrality requires that $U$ and $\overline{a}_d$ remain constant as a result of a tax policy change, so a change in the tax will be neutral iff $P$ and $w$ change proportionally.

A foreign firm will serve the home market if $\max[\pi_x^*(a), \pi_m^*(a)] \geq 0$. The profits from operating a subsidiary in the home market decline more rapidly with $a$ than to profits from exporting,

$\frac{d\pi_m^*(a)}{da} < \frac{d\pi_x^*(a)}{da}$, iff $\tau > w(1-t)$. We will focus on values of $t$ in the neighborhood $t = 0$, where $w = 1$ under our symmetry assumptions, so that $\frac{\tau}{1-t} > w$ will be satisfied. With this condition, If a firm with labor requirement $a'$ prefers FDI to exporting, then so will all firms with $a < a'$ when this condition is satisfied. Similarly, if a firm with $a'$ prefers staying out of the market to exporting,, then so will all firms with $a > a'$.

The unit labor requirement at which foreign firms are indifferent between exporting and FDI is the solution to $\pi_x^*(a) = \pi_m^*(a)$,which yields

$$\overline{a}_m^* = \rho \left[ \frac{((1-t)P)^\sigma U(1-\rho) \left( (w(1-t))^{1-\sigma} - \tau^{1-\sigma} \right)}{w(1-t)(f_m - f_x)} \right]^{\frac{1}{\sigma-1}}. \tag{9}$$

Greater fixed costs of a subsidiary relative to exporting and lower trade costs make serving the market through FDI less attractive, reducing $\overline{a}_m^*$.Observe that from the definition of $P$, $\overline{a}_m^*$ is an increasing function of $w(1-t)$. A higher after-tax wage at home makes the home firms less competitive, which makes exporting to the market more profitable for foreign firms.

The unit labor requirement at which foreign firms are indifferent between exporting and not selling in the home market is the solution to $\pi_x^*(a) = 0$,

$$\overline{a}_x^* = \frac{\rho}{\tau} \left[ \frac{((1-t)P)^\sigma U(1-\rho)}{w(1-t)f_x} \right]^{\frac{1}{\sigma-1}}. \tag{10}$$

Increases in trade costs and increases in the competitiveness of the home market (i.e. decreases in $P$) will lower the threshold level of $a$ at which foreign firms find it profitable to serve the home market by export. As in the case of the export cutoff value, $\overline{a}_x^*$ is an increasing function of $w(1-t)$.

At $t = 0$, the requirement for the countries will be entirely symmetric under our assumptions and wage rates will be equalized in equilibrium. We will assume that the values of $f_x, f_m,$ and $\tau$ are such that $a_{\min} < \overline{a}_m^* < \overline{a}_x^*$, so that foreign firms with $a \in [a_{\min}, \overline{a}_m^*]$ will serve the home market by FDI and firms with $a \in [\overline{a}_m^*, \overline{a}_x^*]$ will serve the home market by export.

We have noted that the cutoff values $\{\overline{a}_m^*, \overline{a}_x^*\}$ for foreign firm entry decisions are a function of $w(1-t)$, and that the cutoff for domestic firms is a function of $w/P$. Combining these observations with the definition of $P$ from (7) yields the following result on the neutrality of a decrease in $(1-t)$ accompanied by an equal proportional increase in $w$.

**Lemma 3** *At given $U$, a change in $t$ accompanied by a change in the wage such that $w(1-t)$ remains constant is consistent with constant values of the thresholds $(\overline{a}_d, \overline{a}_m^*, \overline{a}_x^*)$ and constant $w/P$.*

An increase in the home tax rate will reduce the cost of home labor, since it is deductible from taxes and export income is not taxed. The adjustment in the wage thus holds the after-tax cost of labor constant. The price of home goods and foreign goods will rise proportionally in this case from (6), since foreign exporters cannot deduct their labor costs and foreign subsidiaries must pay the higher home wage. Thus, cutoffs are unaffected and the home country price index rises proportionally with wages.

A similar analysis for the foreign market, which is detailed in the Appendix, shows that the profit maximizing prices for the foreign market are given by

$$p_x(a) = \tfrac{w(1-t)a\tau}{\rho} \quad p_m(a) = p_d^*(a) = \tfrac{a}{\rho}$$

The conjectured wage change in response to the change in the tax rate will leave all prices in the foreign country unaffected. We can use a similar argument to that above to establish that the cutoff value for foreign firms to sell in their domestic market, $\overline{a}_d^*$, and for home firms to serve the export market by exporting and FDI, $\overline{a}_m$ and $\overline{a}_x$, are functions of $w(1-t)$. We then have a similar neutrality result for the foreign market,

**Lemma 4** *At given $U^*$, a change in $t$ accompanied by a change in the wage such that $w(1-t)$ remains constant is consistent with constant values of the thresholds $(\overline{a}_d^*, \overline{a}_m, \overline{a}_x)$ and constant $P^*$.*

In contrast to the home market, where all prices rise proportionally, prices in the foreign market are unaffected by the tax change.

In order to establish that this wage adjustment represents a new equilibrium with the initial utility levels, it remains to show that the labor markets clear in each country and the budget constraints are satisfied with the initial utility levels. The home labor market equilibrium condition requires that the demand for labor for variable and fixed input requirements over active firms equal the labor supply,

$$\begin{aligned}\frac{L}{M} &= \int_{a_{\min}}^{\overline{a}_d} \left(aAp_d^{-\sigma} + f_d\right)\mu(a)da + \int_{\overline{a}_m}^{\overline{a}_x} aA^* p_x^{*-\sigma}\mu(a)da \qquad (11)\\ &+ \left(\frac{M^*}{M}\right)\left(f_x \int_{\overline{a}_m^*}^{\overline{a}_x^*} \mu^*(a)da + \int_{a_{\min}^*}^{\overline{a}_m^*} \left(aAp_m^{*-\sigma} + f_m\right)\mu^*(a)da\right)\end{aligned}$$

The first line represents the demand for home labor by home firms for domestic sales and export sales. The second line is the demand for labor by subsidiaries of foreign firms and the fixed costs of foreign exporters incurred in the home market. The wage adjustments will keep the demand for each variety constant in the home market at given $U$ and $U^*$, since $Ap_d^{-\sigma} = U\left(\frac{p_d}{P}\right)^{-\sigma}$ remains constant when all prices by the same proportion. Similarly, demands for goods remain constant in the foreign country at given $U^*$, $A^*p_j^{-\sigma} = U^*\left(\frac{p_j}{P^*}\right)^{-\sigma}$ for $j = x, m$ because prices of all domestic and foreign varieties are constant in the foreign market. With demands for each variety constant and the set of firms active in each market constant, the labor market will clear at given $U$ and $U^*$.

The home country budget constraint is $E = UP = wL + M\overline{\pi} + T$,where

$$\overline{\pi} = \left( \int_{a_{\min}}^{\overline{a}_d} \pi_d(a)\mu(a)da + \int_{\overline{a}_m}^{\overline{a}_x} \pi_x(a)\mu(a)da + \int_{\overline{a}_{\min}}^{\overline{a}_m} \pi_x(a)\mu(a)da \right)$$

is average after tax profit and $T$ is tax revenue. Tax revenue is collected on all expenditures, with a deduction for all wage payments, so $T = (E - wL)(1 - t)$. The budget constraint can then be written as

$$UP(1-t) = w(1-t)L + M\overline{\pi} \tag{12}$$

The average after tax profit of home country firms is unaffected by the equal proportional changes in $w$ and $(1-t)$ : profits in the foreign market are unaffected and pre-tax profits in the home market rise proportionally with $w$. It then follows that the budget constraint is satisfied at the initial $U$, since $(1-t)w$ and $P(1-t)$ are constant by Lemma 3.

The foreign labor market will clear and the budget constraint for the foreign country will be satisfied at the initial $U^*$, which yields the following result:

**Proposition 5** *Suppose that there is an initial home tax rate $t^0$ that yields equilibrium values $(w^0, U^0, U^{*0})$ with a fixed number of firms $(M, M^*)$. A change in the tax rate to $t^1$ will result in an equilibrium with a new wage rate satisfying $w^1(1-t^1) = w^0(1-t^0)$. Equilibrium quantities and aggregate utility levels in each country will be unaffected. The tax will reduce the real return to operating firms.*

### 3.2 Steady State Equilibrium

We conclude with a discussion of the steady state equilibrium, which endogenizes the mass of firms in each country through free entry. Following Helpman, Melitz and Yeaple (2006), we assume a fixed cost of entry, $F$, and a unit labor requirement distribution $G(a)$ among potential entrants in the home country. Since entrants only learn their labor requirement after entry, only those with values exceeding $\overline{a}_d$ will remain in the market. The distribution of productivities among existing firms at home will be $\mu(a) = g(a)/G(\overline{a}_d)$, where the solution for the threshold productivity for remaining in the industry, $\overline{a}_d$, is the same as in the short run model.

There is assumed to be an exogenously given rate of firm failure of $\delta$ at each point in time, so that the expected profit to a firm from entering is $\overline{\pi}G(\overline{a}_d)/\delta$. The zero profit condition for potential entrants is that expected profit equal the cost of entry,

$$\overline{\pi}G(\overline{a}_d)/\delta = w(1-t)F \tag{13}$$

where we assume that entry costs are also deductible from taxable income. Note that this requires that the government pay a subsidy of $twF$ to firms whose productivity draw is below $\overline{a}_d$.

In order to maintain the steady state mass of firms each period, there must be entry of $\delta M/G(\overline{a}_d)$ each period. The demand for labor in the home market in the steady state will be given by augmenting (11) by the demand home labor to start new firms, $\delta MF/G(\overline{a}_d)$.

The budget constraint for the home country requires that expenditure equal income plus tax revenues. Using the fact that firms are earning zero profits and tax revenue is given by (**??**), the home budget constraint can be written as

$$UP = wL \tag{14}$$

Similar relations can be derived for the foreign country.

The equilibrium determines $(w, M, M^*, U, U^*)$ using the budget constraints, free entry conditions, and the home labor market equilibrium. As in the analysis of the short run model, we assume the existence of equilibrium at an initial tax rate and conjecture that a change in the tax rate accompanied by a wage adjustment to keep $w(1-t)$ constant will have no effect on the steady state quantities. This yields the following neutrality result, which is proven in the Appendix.

**Proposition 6** *Suppose that there is an initial home tax rate $t^0$ that yields steady state equilibrium values $(w^0, U^0, U^{*0}, M^0, M^{*0})$. A change in the tax rate to $t^1$ will result in an equilibrium with a new wage rate satisfying $w^1(1-t^1) = w^0(1-t^0)$. Equilibrium quantities and aggregate utility levels in each country will be unaffected by the change. The cash flow tax generates no revenue, because the tax revenues collected from existing firms exactly match the labor subsidies paid to failed entrants.*

**Proof.** The invariance of firms profits and the entry threshold to the change in the tax rate when wages adjust proportionally ensures that the zero profit condition (13) is satisfied at the initial utility levels and measure of firms. Similarly, the labor market equilibrium will be satisfied at the initial employment levels because $\frac{w}{P}$ and $\frac{w(1-t)\tau}{P^*}$ are both invariant to the change in tax. The home country budget constraint will also be satisfied, since $P$ and $w$ both change by the same proportion.

■

The cash flow tax is essentially a tax on excess profits. Since expected profits are equal to zero in the steady state with free entry, a cash flow tax will raise zero revenue.

If the government fails to full subsidize failing firms in the steady state, then the cash flow tax will raise positive revenue. The introduction of a cash flow tax in that case will not be neutral, since it will discourage entry by lowering the expected return to entry. In this case the threshold for remaining in the market will increase, which will raise the average productivity of firms in the market and affect the volume of trade and investment.

## 4 Conclusions

We have examined the neutrality of a DBCFT in some prominent general equilibrium trade models. For the case of the specific factor model, we have shown that the introduction of a DBCFT will generate revenue without distorting resource allocation in the case where capital is immobile between countries as well as in the case where it is mobile between countries. It should be emphasized that this result requires that the supply of capital be fixed and that the tax be applied uniformly across sectors. Furthermore, the government must be willing to subsidize firms whose export sales are sufficiently large that the tax bill is negative.

We also established a neutrality result for the case of monopolistic competition with a fixed number of heterogeneous firms as well as in the case where the number of firms is endogenously determined. The case where the number of firms is endogenously determined relaxes the assumption that the factors being taxed are in fixed supply, although the neutrality result in this case requires that the government pay subsidies to firms that experience losses and exit the industry. Neutrality with the endogenous determination results in zero tax collections from the firms, because firms have zero expected profits ex ante. The potential non-neutrality from failure to pay subsidies does not arise from the border adjustment in this case.

Our analysis has maintained the assumption that intra-firm transactions reflect the true allocation of costs between parent and subsidiary. However, the incentives for firms to engage in transfer pricing in order to reallocate income between locations is also affected by the tax system. This issue is addressed by Bond and Gresik (2017) for the case of a firm choosing between oursourcing and forming a subsidiary to produce an intermediate input in a low tax country.

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## Appendix

**Proof of Proposition 1:** Using the arbitrage conditions for traded goods and the fact that tax collections from unit of sector $i$ capital will be $t_S r_i(p_i, w)$, we can write the system of equilibrium conditions under a source based tax system as

$$\begin{aligned}
L &= K_n\varphi_n\left(\frac{w}{p_n}\right) + K_m\varphi_m\left(\frac{w}{p_m^*}\right) + (K_x - K_F)\,\varphi_x\left(\frac{w}{p_x^*}\right) \\
E_{p_n}(p_m^*, p_m, p_x^*, U) &= X_n\left(\frac{w}{p_n}\right) \\
E(p_m^*, p_n, p_x^*, U) &= wL + \sum_{i=n,m,x} r_i(p_i, w_i)K_i - t_S r_x(p_x^*, v^*)K_F
\end{aligned} \tag{15}$$

(i) Without capital mobility, $K_F = 0$ and the system of equilibrium conditions is independent of the source based tax rate, $t_S$. Therefore, a set of values $(w^0, p_n^0, U^0)$ that solves the system for an initial tax rate $t_S^0$ will be a solution for all values of the tax rate. The after tax rate of capital owners will fall by the full amount of the tax, but aggregate income is unaffected because the tax revenues are rebated to households in a lump sum fashion.

(ii) With capital mobility, the equalization of returns between home and foreign markets for good $x$ requires that $\frac{dw}{dt_s}\frac{1-t_S}{w} = -\frac{1}{\theta_{Lx}}$where $\theta_{Lx} = \frac{wl_x}{(1-t_S)r(p_x^*,w)}$ is labor's share in unit costs in the $x$ sector. In contrast to the case without capital mobility, the change in the tax rate must reduce the return to labor in order to make $x$ capital owners indifferent between locating at home and in the foreign country. Totally differentiating the budget constraint yields $E_U(p_m^*, p_n, p_x^*, U)dU = -t_S r_x(p_x^*, v^*)dK_F$

**Proof of Proposition 2:** Since cash flow taxes apply only on domestic sales, total tax collections will equal the tax on domestic sales less a deduction for all wage payments, $T = t\left(\sum_{i=n,m,x} p_i D_i - wL\right)$. Using this expression for tax revenues and the arbitrage conditions for a destination based tax in the equilibrium conditions yields

$$
\begin{aligned}
L &= K_n\varphi_n\left(\frac{w}{p_n}\right) + K_m\varphi_m\left(\frac{w(1-t_D)}{p_m^*}\right) + (K_x - K_F)\,\varphi_x\left(\frac{w(1-t_D)}{p_x^*}\right) \\
E_{p_n}(\frac{p_m^*}{(1-t_D)}, p_n, \frac{p_x^*}{(1-t_D)}, U) &= X_n\left(\frac{w}{p_n}\right) \\
E(\frac{p_m^*}{(1-t_D)}, p_n, \frac{p_x^*}{(1-t_D)}, U)(1-t_D) &= wL(1-t_D) + r_m(p_m^*, w(1-t_D))K_m + (1-t_D)r_n(p_n, w)K_n + r_x(p_x^*, w(
\end{aligned}
$$

(i) Consider an initial value $t_D^0$ for the destination based tax and the corresponding equilibrium values $(p_n^0, w^0, U^0)$ that clear non-traded goods and labor markets. If the tax is changed to $t_D^1$, we conjecture a new equilibrium in which there is a proportional change in the wage rate and the price of non-traded goods satisfying, $w^1 = \frac{w^0(1-t_D^0)}{1-t_D^1}$, $p_n^1 = \frac{p_n^0(1-t_D^0)}{1-t_D^1}$, and no change in the utility level, $U^1 = U^0$. Since the real wages facing capital owners are unaffected by these changes, the labor market equilibrium will be satisfied at the new prices with the initial quantities. Since all consumer prices have increased proportionally and $E_{p_n}$ is homogeneous of degree 0 in prices, equilibrium in non-traded goods markets will also be satisfied with the original quantity at the new prices. Finally, the budget constraint will be satisfied revenue is given by $T = t\left(\sum_{i=n,m,x} p_i D_i - wL\right)$, so the budget constraint can be written as

Observe that since this result holds for $t_S = 0$, the equilibrium is the same as with a source based tax.

(ii) We conjecture the same price and wage adjustment as in the case without capital mobility. The equalization of the return to $x$ capital across countries requires that $w(1-t_D) = v^*$, which is unaffected by the change in $t_D$. The argument is then identical to that in the case without capital mobility.

**Proof of Proposition 5:**

We begin by characterizing the equilibrium in home and foreign goods and labor markets. In the home market, we can substitute the profit maximizing prices from (6) into the respective firm profit functions (5) to obtain

$$\pi_d(a) = \left(P^{\sigma}U(1-\rho)\left(\tfrac{wa}{\rho}\right)^{1-\sigma} - wf\right)(1-t)$$
$$\pi_x^*(a) = P^{\sigma}U(1-\rho)(1-t)\left(\tfrac{\tau a}{\rho(1-t)}\right)^{1-\sigma} - w(1-t)f_x$$
$$\pi_m^*(a) = P^{\sigma}U(1-\rho)(1-t)\left(\tfrac{wa}{\rho}\right)^{1-\sigma} - w(1-t)f_m$$

The marginal home firm, $\overline{a}_d$, is obtained by solving $\pi_d(a) = 0$, which yields (8). The foreign firm indifferent between exporting and FDI satisfies, $\overline{a}_m^*$, is the solution to $\pi_x^*(a) = \pi_m^*(a)$ in (9). The marginal foreign exporter, $\overline{a}_x^*$, solves $\pi_x^*(a) = 0$ in (10).

For the foreign market, profits of foreign producers and home exporters are given by

$$\pi_d^*(a) = \max_{p_d^*}\left((p_d^* - a)\left(\tfrac{p_d^*}{P^*}\right)^{-\sigma}U^* - f\right)$$
$$\pi_x(a) = \max_{p_x}\left((p_x - \tau wa(1-t))\left(\tfrac{p_x}{P^*}\right)^{-\sigma}U^* - f_x\right)$$
$$\pi_m(a) = \max_{p_m}\left((p_m - a)\left(\tfrac{p_m}{P^*}\right)^{-\sigma}U^* - f_m\right)$$

The profit maximizing prices and optimal profits of the respective types will be

$$\begin{aligned}
p_d^*(a) &= \tfrac{a}{\rho} & \pi_d^*(a) &= \left(P^{*\sigma}U^*(1-\rho)\left(\tfrac{a}{\rho}\right)^{1-\sigma} - f\right)\\
p_x(a) &= \tfrac{w(1-t)\tau a}{\rho} & \pi_x(a) &= P^{*\sigma}U^*(1-\rho)\left(\tfrac{aw\tau(1-t)}{\rho}\right)^{1-\sigma} - f_x\\
p_m(a) &= \tfrac{a}{\rho} & \pi_m(a) &= P^{*\sigma}U^*(1-\rho)\left(\tfrac{a}{\rho}\right)^{1-\sigma} - f_m
\end{aligned} \tag{17}$$

The optimal prices for the foreign market an use the prices to solve for the price index for the foreign market,

$$P^* = \frac{w(1-t)\tau}{\rho}\left(M\widetilde{a}_x + \left(\frac{1}{w(1-t)\tau}\right)^{1-\sigma}(\widetilde{a}_d^* M^* + \widetilde{a}_m M)\right)^{\frac{1}{1-\sigma}} \tag{18}$$

Using (17), the solutions for the marginal domestic, exporting and subsidiary firms in the market will be

$$\overline{a}_d^* = \rho\left(\frac{U^*(1-\rho)}{f}\right)^{\frac{1}{\sigma-1}} P^{*\frac{\sigma}{\sigma-1}}$$
$$\overline{a}_x = \frac{\rho}{w(1-t)\tau}\left[\frac{P^{*\sigma}U^*(1-\rho)}{f_x}\right]^{\frac{1}{\sigma-1}}.$$
$$\overline{a}_m = \rho\left[\frac{P^{*\sigma}U^*(1-\rho)\left(w^{1-\sigma}(1-t)-\tau^{1-\sigma}\right)}{f_m-f_x}\right]^{\frac{1}{\sigma-1}}.$$

It will be assumed that the fixed and variable costs associated with exports are sufficiently large that $\overline{a}_m^* < \overline{a}_x^* < \overline{a}_d^*$ and $\overline{a}_m < \overline{a}_x < \overline{a}_d$.

In the short run with fixed $M$ and $M^*$, the endogenous variables are $w$, $U$, and $U^*$. The endogenous variables can be solved from the home labor market equilibrium condition and the budget constraints. It is clear from the results of Lemmas 3 and 4 that for given $U$ and $U^*$, labor demand is unaffected by the tax change if $w(1-t)$ remains constant.

The home budget constraint is given by (12). For the foreign country, we have

$$U^*P^* = L^* + M^*\overline{\pi}^*$$

where $\overline{\pi}^* = \left(\int_{a_{\min}}^{\overline{a}_d^*} \pi_d^*(a)\mu(a)da + \int_{\overline{a}_m^*}^{\overline{a}_x^*} \pi_x^*(\varphi)\mu(a)da + \int_{\overline{a}_{\min}}^{\overline{a}_m^*} \pi_m^*(a)\mu(a)da\right)$.

Assume an initial tax rate $t^0$ and with corresponding equilibrium values $(w^0, U^0, U^{*0})$. We want to show that if the tax rate changes from $t^0$ to $t^1$, then there will be an equilibrium with $w^1(1-t^1) = w^0(1-t^0)$, $U^1 = U^0$, and $U^{*1} = U^{*0}$ and unchanged quantities. Using the solution for the price indices and the threshold values, we have that $\frac{w^0}{P^0} = \frac{w^1}{P^1}$ and $\frac{w^0(1-t^0)}{P^{*0}} = \frac{w^1(1-t^1)}{P^{*1}}$, which ensures that the labor market equilibrium is satisfied at the new prices and utility levels with unchanged labor allocations across firms. The home budget constraint will also be satisfied because $P^0(1-t^0) = P^1(1-t^1)$ and $\overline{\pi}^0 = \overline{\pi}^1$. Finally, the foreign budget constraint is satisfied because $P^{*0} = P^{*1}$ and $\overline{\pi}^{*0} = \overline{\pi}^{*1}$.||

**Proof of Proposition 6**:

A steady state equilibrium is one in which firms have zero expected profits from entry in each country, labor market equilibrium holds at home, and the budget constraint is satisfied in each country. In addition to the home country conditions presented in the text, we also have the zero expected profit condition for the foreign country,

$$\overline{\pi}^*(1 - G^*(\overline{a}_d^*))/\delta = F. \tag{19}$$

and the budget constraint for the foreign country,

$$U^* P^* = L^*. \tag{20}$$

Assuming that there is an initial equilibrium with home tax $t^0$ and equilibrium values $(w^0, M^0, M^{*0}, U^0, U^{*0})$. We conjecture a new equilibrium at tax rate $t^1$ with equilibrium values $\left(w^1 = \frac{w^0(1-t^0)}{(1-t^1)}, M^0, M^{*0}, U^0, U^{*0}\right)$ and verify that these values satisfy the equilibrium conditions.

Observe that as in the short run case, the threshold values for production in domestic and export markets are unaffected because $w(1-t)$ remains the same after the tax rate change. Using (7) and (18), we have $P^0(1-t^0) = P^1(1-t^1)$ and $P^{*0} = P^{*1}$ from the constancy of $w(1-t)$ and the assumption of a constant measure of firms in each country. These results ensure that (14) and

(20) are also satisfied at the conjectured values.

The home labor market equilibrium is satisfied at the conjectured values because $\frac{w^0}{P^0} = \frac{w^1}{P^1}, \frac{w^0(1-t^0)}{P^{*0}} = \frac{w^1(1-t^1)}{P^{*1}}$, and $(M, M^*, U, U^*)$ remain constant. The constancy of $\frac{w}{p}$, $w(1-t)$, and $\frac{w(1-t)}{P^*}$ ensures that profits of an individual home firm are the same with the new cash flow tax, so $\overline{\pi}^0 = \overline{\pi}^1$ and (13) will be satisfied. The profits of a foreign firm also remain constant due to the constancy of $P^*$ and $(1-t)P$, so $\overline{\pi}^{*0} = \overline{\pi}^{*1}$ and (19) will be satisfied a the conjectured prices. Thus, the change in the tax rate is neutral in the steady state because equilibrium values of $(M, M^*, U, U^*)$ are unchanged.

Tax revenue is given by $t(UP - wL)$ in the steady state, which will equal 0 from the home budget constraint. $||$