DBCFT, Border Adjustments, and Trade

Eric W. Bond and Robert Driskill

Vanderbilt University

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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 as a replacement for the current US system of corporate income taxation. Under the DBCFT proposed by Auerbach (2010) and Auerbach et al (2016), a firms taxable cash flow is the difference between sales in the local market and purchases of local inputs. One way in which the cash flow tax would differ from the current

US corporate system is that it would tax on the basis of location in which sales take place, rather than on worldwide sales as in the current US corporate tax. Export sales are thus not subject to tax. It also differs from the corporate income tax in that it does not allow firms to deduct the cost of imported inputs.

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). Feldstein and Krugman (1990) use a two period trade model traded and non-traded goods to show that the use of a VAT that is applied symmetrically across sectors will be neutral in its effect, in the sense that changes in the tax rate will have no effect on resource allocation. In particular, the exemption of exports from taxation is necessary for the neutrality result.[1]

Feldstein (2017) argues 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, but that it will also raise revenue because the US currently runs a trade deficit. Similar comments have been made by other commentators (e.g. Pomerleau and Entin (2017)).

Our purpose in this paper is to examine the neutrality of a DBCFT in a general equilibrium model. We begin by considering a static specific factor model with traded and non-traded goods. We show that the effect of the DBCFT is neutral in the sense that it leaves prices and quantities unaffected when consumers have identical and homothetic preferences and tax revenues are redistributed in a lump sum fashion. This neutrality also extends to the case in which owners of sector

[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.

specific capital can move capital to the foreign market. The DBCFT reduces the return to owners of sector specific capital. However, the neutrality result will require a negative tax payment by firms if export sales are a sufficiently large share of tax revenues. The border adjustment itself does not raise tax revenue, since it is equivalent to an import tariff and export subsidy at equal rates. In the case of a trade imbalance, this result will extend to the case where the intertemporal budget constraint is satisfied.

We also consider the effect of the DBCFT in a model heterogeneous firm monopolistic competition model, where firms can choose to serve foreign markets by exports or foreign direct investment. We show that the neutrality result continues to hold in a short run model with a fixed number of firms, with tax revenue raised from existing firms whose productivity level exceeds that of the marginal firm. We also analyze the steady state equilibrium where entrants earn zero expected profits. In this case the neutrality result will hold if the losses of failed firms whose productivity is below the threshold are subsidized to offset the expected tax revenues to successful firms. The neutrality result thus requires that the tax raise no revenue.

2 A Static Specific Factor Model

In this section we consider a destination based cash flow tax (DBCFT) with border tax adjustments. The cash flow tax allows deductions for purchases of labor, capital goods, and material inputs. To analyze the effects of a DBCFT, we need a model that distinguishes taxed and untaxed factors. A simple first step is to use a 3 good model with a non-traded good (n), exportable (x), and import-competing good (m), where goods in each sector are produced using mobile labor and sector-specific capital in each sector. The quantity of labor is assumed to be a given endowment

L, which is exempted from the tax. The quantity of sector specific capital in sector i is denoted by K_i and is assumed not to be deductible from tax. [2] We assume initially that capital is immobile between countries.

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 $l_i \equiv \frac{L_i}{K_i}$. For firms in sectors m and n, after tax profits will be $\left(p_i X_i - wL_i\right)(1-t)$, where p_i is the consumer price of good i and w the wage rate. For a firm in the exportable sector, only domestic sales are taxed. Letting μ denote the share of sales in the domestic market, the after tax profits of a firm in the export sector will be $(1-\mu)p_x^* X_x + (1-t)(\mu p_x X_x - wL_X)$ for $\mu p_x X_x - wL_X \geq 0$. In order to have firms be indifferent between exporting and selling in the domestic market, the domestic price must satisfy $p_x = \frac{p_x^*}{1-t}$. We can then write the after tax return to a unit of capital in sector i with a DBCFT as

$$\begin{aligned} r_i(p_i, w, t) &= \max_{l_i} \left(p_i f_i\left(l_i\right) - wl_i\right)(1-t) \qquad (1) \\ &= \left(\psi_i\left(\frac{w}{p_i}\right) - \frac{w}{p_i} g_i\left(\frac{w}{p_i}\right)\right) p_i(1-t), \text{ for } i = m, n, x \end{aligned}$$

where $g_i = f'^{-1}$ and $\psi(.) = f(g(.))$. The rental on capital is homogeneous of degree 1 in (w, p_i), and the output of good i can be expressed as $X_i = \psi_i\left(\frac{w}{p_i}\right) K_i$.

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

[2] In the steady state interpretation of the static model, this capital represents factors that were not expensed at the time of purchase.

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 $p_m = \frac{p_m^*}{1-t}$. The effect of the border adjustments is to raise prices of all traded goods by 1 factor of $\frac{1}{1-t}$.

Home country preferences are described by the expenditure function $E(p_n, p_m, p_x, U)$, 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 $D_i(p_n, p_m, p_x, U) = E_{p_i}(p_n, p_m, p_x, U)$.

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. Choosing the foreign price of the imported good as numeraire, the labor market is in equilibrium when

$$L = K_n g_n \left(\frac{w}{p_n}\right) + K_m g_m \left(w(1-t)\right) + K_x g_x \left(\frac{w(1-t)}{p_x^*}\right) \tag{2}$$

Labor demands are decreasing functions of the respective sectoral real wages. The market clearing condition for non-traded goods requires that the home demand equal the home supply,

$$E_{p_n}(p_n, \frac{1}{1-t}, \frac{p_x^*}{1-t}, U) - X_n \left(\frac{w}{p_n}\right) = 0 \tag{3}$$

Household income consists of the sum of factor income and taxes that are rebated to households. 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,

$$T = t\left(\sum_{i=n,m,x} p_i D_i - wL\right) \tag{4}$$

We can use (4) to express the budget constraint as

$$E(p_n, p_m, p_x, U)(1-t) = wL(1-t) + \sum_{i=n,m,x} r_i(w, p_x, t)K_i. \tag{5}$$

Substituting in (5) using (1) and (2), the budget constraint is equivalent to the trade balance condition,

$$\sum_{i=m,x} p_i^* \left(D_i(p_n, p_m, p_x, U) - X_i\left(\frac{w}{p_i}\right)\right) = 0 \tag{6}$$

For a small open economy, facing given world prices for traded goods, we can use (2), (3) and (6) to solve for w, p_n, and U. These equilibrium conditions can be used to establish the following neutrality result for the effect of changes in the cash flow tax:

Proposition 1 *An increase in the cash flow tax that is rebated to households in a lump sum fashion will raise the wage rate and price of non-traded goods proportionally, so that $w(1-t)$ and $\frac{w}{p_n}$ are unaffected by the change in tax rate. The nominal return to each type of capital is unaffected by the tax rate change, so that the real return to capital falls proportionally.*

Proof. Consider an initial value t_0 for the cash flow tax and the corresponding equilibrium values (p_n^0, w^0, U^0) that clear non-traded goods and labor markets. If the cash flow tax is increased to t_1, we conjecture a new equilibrium in which there is a proportional increase in the wage rate and the price of non-traded goods, $w^1 = \frac{w^0}{1-t}$, $p_n^1 = \frac{p_n^0}{1-t}$, and $U^1 = U^0$. Since the real wages facing capital owners are unaffected by these changes, the labor demands in (2) will be unaffected and labor market equilibrium will be satisfied at the new prices with the initial quantities. Since all consumer prices have increased proportionally and D_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, demands for traded goods are homogeneous of degree 0 in prices and the outputs of traded goods depend only on the real wage, so the trade balance condition will also be satisfied at the new prices with the initial quantities of imports and exports. The constancy of the nominal return to capital then follows from (1). ■

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 the neutrality result would fail to hold in the presence of a transfer 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 fro 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, in contrast to the argument of Feldstein (2017).

2.1 Static Model with Capital Mobility - DBCFT in both

With capital mobility, the owner of a unit of x capital can choose to serve the foreign market from the home country or the foreign country. We assume that the foreign market has a DBCFT at rate t^*, so the seller receives a price of $p_x^*(1-t^*)$ if the foreign market is served by export. The no arbitrage condition for selling x between the home and foreign market requires $p_x^*(1-t^*) = p_x(1-t)$, so the return to capital from exporting is $r(p_x, w, t)$.

It is assumed that the home country production technology is embodied in a unit of capital, so that the return to an owner of x capital locates in the foreign market will be $r(p_x^*, w^*, t^*) = p_x^*(1-t^*)\left(\psi_x\left(\frac{w^*}{p_x^*}\right) - \frac{w^*}{p_x^*}g_i\left(\frac{w^*}{p_x^*}\right)\right)$. The home country seller of good x will be indifferent between locating capital in the home and foreign countries if the returns are equalized, which requires

$$w = w^*\left(\frac{1-t^*}{1-t}\right). \tag{7}$$

Home wages are deductible when exporting and foreign wages are deductible when producing in the foreign country, so (7) ensures that the after tax cost of labor is equalized between the two markets. This condition will also ensure that foreign capital owners for good m are indifferent between producing at in the foreign or home country for sales in the home country market. We assume that n sector capital is immobile internationally.

Letting F_i be the amount of home sector i capital located in the foreign country and F_i^* the amount of foreign sector i capital located in the home country for $i \in \{m, x\}$, the home country labor market with capital mobility is

$$L = \sum_{i \in \{n,m,x\}} (K_i - F_i)\, g_i \left(\frac{w}{p_i} \right) + \sum_{i \in \{m,x\}} F_i^* g_i^* \left(\frac{w}{p_n} \right) \tag{8}$$

Home country output of traded good i will be $X_i(\frac{w}{p_i}, F_i, F_i^*) = (K_i - F_i)\, \psi_i \left(\frac{w}{p_i} \right) + F_i^* \psi_i^* (\frac{w}{p_i})$.

Home country income consists of income from factors located at home and abroad plus tax revenues, so the budget constraint can be expressed using (4) as

$$E(p_n, p_m, p_x, U)(1-t) = wL(1-t) + \sum_{i=n,m,x} r_i(w, p_x, t) K_i + \sum_{i=m,x} r_i(w^*, p_i^*, t^*) F_i \tag{9}$$

Substituting using the labor market equilibrium (8) and the return to capital (1), the budget constraint is equivalent to the requirement of current account balance,

$$\sum_{i=m,x} \left(p_i^* \left(D_i(p_n, p_m, p_x, U) - X_i(\frac{w}{p_i}, F_i, F_i^*) \right) + r_i^*(w, p_i, t) F_i^* - r_i(w^*, p_i^*, t^*) F_i \right) = 0. \tag{10}$$

The labor market equilibria, goods market equilibria, and budget constraints for each country can be combined with the arbitrage conditions to solve for goods prices, wage rates, factor flows, and utility levels. Since owners of both m and x capital in each country are indifferent between locating in home and foreign country in an equilibrium, it can be shown that there will be a continuum of equilibrium allocations of capital between countries that yield the same equilibrium prices and quantities.

Proposition 2 *If capital is mobile between countries and each country imposes a cash flow tax, an increase in the home country cash flow tax that is rebated to households in a lump sum fashion will raise the wage rate and price of non-traded goods proportionally, so that $w(1-t)$ and $\frac{w}{p_n}$ are unaffected by the change in tax rate. The nominal return to each type of home country capital is unaffected by the tax rate change, so that the real return to capital falls proportionally. Foreign country capital owners are unaffected by the change.*

Proof. As in the case without capital mobility, we consider an initial value t_0 for the cash flow tax and the corresponding equilibrium values (p_n^0, w^0, U^0) and conjecture a new equilibrium with tax rate t_1 and equilibrium values $w^1 = \frac{w^0}{1-t}$, $p_n^1 = \frac{p_n^0}{1-t}$, and $U^1 = U^0$. The labor market (8) and non-traded goods markets (3) will clear at the initial quantities. Finally, the current account balance (10) will also be satisfied at initial quantities because expenditure, revenue, and returns to capital are homogeneous of degree one in prices and wages. ■

As in the case without capital mobility, we can show that a change in t is neutral in the sense that it has no effect on quantities and utility levels in each country. Home country capital owners experience a decrease in their real return due to the tax increase. Their nominal return is unaffected, but the real return declines because of the increase in prices of goods in the home country. Interestingly, however, the tax does not reduce the real return of foreign capital owners with capital located in the home country. For foreign capital owners with capital located in the home country, the real return is unaffected because there is no change in goods prices in the foreign country where their consumption takes place.

2.2 Static Model with Capital Mobility - DBCFT home, VAT foreign

We now turn to the case where the foreign country has a VAT rather than a cash flow tax, and show that changes in t are neutral in this case as well.

If the home country owners in sector i locate their capital in the foreign country, their return under a foreign VAT is

$$\begin{aligned}
\rho_i(w^*, p_i^*(1-t_v^*)) &= \max_{l_i} p_i^* f_i(l_i)(1-t_v^*) - w^* l_i \qquad (11) \\
&= \left(\psi_i\left(\frac{w^*}{p_i^*(1-t_v^*)}\right) - \frac{w^*}{p_i^*(1-t_v^*)} g_i\left(\frac{w^*}{p_i^*(1-t_v^*)}\right)\right) p_i^*(1-t_v^*), \text{ for } i = m, x
\end{aligned}$$

If the home country capital owners export to the foreign market, they receive a price of $p_i^*(1-t_v^*)$ per unit and can deduct domestic wages from their tax bill. If they sell in the home market, they receive a price of $p_x(1-t)$. Indifference between selling in the two markets yields $p_i = \frac{p_i^*(1-t_v^*)}{1-t}$,so substituting this price in (1) yields the after tax return per unit of capital from exporting to be $r_i\left(\frac{p_i^*(1-t_v^*)}{1-t}, w, t\right)$. Home capital owners in sectors m and x will be indifferent between locating in exporting and FDI if

$$w(1-t) = w^*. \qquad (12)$$

A similar argument establishes that foreign owners of m sector capital will be indifferent between locating in home and foreign if (12) holds. As in the case of two countries using cash flow taxes, the arbitrage condition requires that the cost of labor be equalized across the two countries.

Proposition 3 *Let sector specific capital in traded goods sectors be mobile between countries, with home imposing a DBCFT and foreign imposing a VAT. An increase in the cash flow tax at home* *that is rebated to households in a lump sum fashion will raise the wage rate and price of non-traded goods proportionally, so that $w(1-t)$ and $\frac{w}{p_n}$ are unaffected by the change in tax rate. Foreign wages and prices and the level of capital flows are unaffected by the change in the home cash flow tax.*

Proof. As in the case without capital mobility, we conjecture that all home country prices and wages increase proportionally as a result of the change in the cash flow tax and that foreign prices and wages are unaffected. With the assumption of given foreign prices and wages, an increase in the cash flow tax will result in proportional increases in w, p_x, and p_m from the no arbitrage conditions for traded goods and capital. Factor demands in each country are unaffected with the conjectured price changes, since these changes leave w/p_i and w^*/p_i^* unaffected for all i. Similarly, demands for goods in each country are unaffected at given utility levels in each country because relative prices remain constant in each country. Nominal returns to capital in each country are unaffected by the conjectured price changes, so the trade balance condition is also satisfied at the initial trade volumes and factor movements. ■

By the arbitrage condition (12), an increase in the home country cash flow tax will result in an increase in w to keep $w(1-t)$ constant. It then follows using the same arguments as in the case where the foreign country has a cash flow tax that the equilibrium quantities are unaffected by the change in the home country cash flow tax.

3 Monopolistic Competition with Heterogeneous Firms

In this section we consider a the impact of a change in a DBCFT 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). This model introduces two elements not present in the specific factor model. One is that firms are imperfectly competitive, so that the tax has the potential to affect firm markups. 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, a fraction $\lambda_x \in [0, 1]$ is home country labor and the remainder is purchased in the foreign market. We allow for fixed costs incurred in both markets to reflect the fixed costs of shipping arrangements at home and the fixed costs of distribution networks in the foreign country. The labor demand of a home firm selling q_x units in the foreign market is thus $a\tau q_x + \lambda_x f_x$ at home and $(1-\lambda_x)f_x$ 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 associated with setting up and operating a foreign production facility, f_m. As in the case of fixed exporting costs, we assume that a share λ_m are incurred in the home country. The home country fixed costs represent costs of coordination and communication between home foreign production activities. The labor demand for serving the foreign market with a subsidiary in the foreign country producing q_m units of output is $\lambda_m f_m$ in the home country and $aq_x + (1-\lambda_m)f_m$ 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

$$
\begin{aligned}
\pi_d(a) &= \max_{p_d} \left(\left(p_d(i) - aw \right) A p_d{}^{-\sigma} U - wf \right) (1-t) \\
\pi_x^*(a) &= \max_{p_x^*} \left(\left(p_x^*(1-t) - \tau a \right) A p_x^*(i)^{-\sigma} - w(1-\lambda_x)(1-t) + \lambda_x \right) f_x \\
\pi_m^*(a) &= \max_{p_m^*} \left(p_m^* - aw \right) (1-t) A p_m^*(i)^{-\sigma} - (w(1-\lambda_m)(1-t) + \lambda_m) f_m
\end{aligned} \tag{13}
$$

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

$$
p_d\left(a\right) = p_m^*(a) = \tfrac{wa}{\rho} \quad p_x^*\left(\varphi\right) = \tfrac{\tau a}{\rho(1-t)} \tag{14}
$$

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

$$
P = \frac{w}{\rho} \left(M\widetilde{a} + M^*\widetilde{a}_m^* + \left(\frac{\tau}{w(1-t)} \right)^{1-\sigma} M^*\widetilde{a}_x^* \right)^{\frac{1}{1-\sigma}} \tag{15}
$$

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

$$a \leq \overline{a}_d \equiv \rho \left(\frac{U(1-\rho)}{f}\right)^{\frac{1}{\sigma-1}} \left(\frac{P}{w}\right)^{\frac{\sigma}{\sigma-1}} \tag{16}$$

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

$$\overline{a}_m^* = \rho \left[\frac{((1-t)P)^{\sigma}\, U(1-\rho)\left((w(1-t))^{1-\sigma} - \tau^{1-\sigma}\right)}{(w(1-\lambda_m)(1-t) + \lambda_m f_m - (w(1-\lambda_x)(1-t) + \lambda_x)\, f_x}\right]^{\frac{1}{\sigma-1}}. \tag{17}$$

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 $\pi_x^*(a) = 0$,

$$\overline{a}_x^* = \frac{\rho}{\tau}\left[\frac{((1-t)P)^\sigma\, U(1-\rho)}{(w(1-\lambda_x)(1-t)+\lambda_x)\, f_x}\right]^{\frac{1}{\sigma-1}}. \tag{18}$$

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 τ 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 (15) yields the following result on the neutrality of a decrease in $(1-t)$ accompanied by an equal proportional increase in w.

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 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 (14), 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

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

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 5 *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,

$$\frac{L}{M} = \int_{a_{\min}}^{\overline{a}_d} \left(aAp_d^{-\sigma} + f_d\right) g(a)da + \lambda_m f_m \int_{a_{\min}}^{\overline{a}_m} g(a)da + \int_{\overline{a}_m}^{\overline{a}_x} \left(aA^* p_x^{*-\sigma} + \lambda_x f_x\right) g(a)da \quad (19)$$

$$+ \left(\frac{M}{M^*}\right) \left((1-\lambda_x) f_x \int_{\overline{a}_m^*}^{\overline{a}_x^*} g^*(a)da + \int_{a_{\min}^*}^{\overline{a}_m^*} \left(aAp_m^{*-\sigma} + (1-\lambda_m) f_m\right) g^*(a)da\right)$$

The first line represents the demand for home labor by home firms for domestic sales, for export sales, and for the fixed costs of subsidiaries. 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

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

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

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

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 4.

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 6 *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 Melitz (2003), we assume a fixed cost of entry, F, and productivity distributions $G(\varphi)$ among potential entrants in the home country. Since entrants only learn their productivity value after entry, only those with values exceeding $\underline{\varphi}$ will remain in the market. The distribution of productivities among existing firms at home will be $\mu(\varphi) = g(\varphi)/(1 - G(\underline{\varphi}))$, where the solution for the threshold productivity for remaining in the industry, $\underline{\varphi}$, is the same as in the short run model.

There is assumed to be an exogenously given rate of firm failure of δ at each point in time, so that the expected profit to a firm from entering is $\overline{\pi}(1 - G(\underline{\varphi}))/\delta$. The zero profit condition for potential entrants is that expected profit equal the cost of entry,

$$\overline{\pi}(1 - G(\underline{\varphi}))/\delta = w(1-t)F \tag{20}$$

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 $\underline{\varphi}$.

In order to maintain the steady state mass of firms each period, there must be entry of $\delta M/(1-G(\underline{\varphi}))$ each period. The demand for labor in the home market in the steady state will be given by augmenting (19) by the demand home labor to start new firms, $\delta MF/(1-G(\underline{\varphi}))$.

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

$$UP = wL \tag{21}$$

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 7 *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 (20) 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 non-neutrality resulting from the failure to fully subsidize losses is not associated with the border adjustment.

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.

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Appendix

Proof of Proposition 6:

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 (14) into the respective firm profit functions (13) to obtain

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

The marginal home firm, $\overline{a}_d$, is obtained by solving $\pi_d(a) = 0$, which yields (16). The foreign firm indifferent between exporting and FDI satisfies, $\overline{a}_m^*$, is the solution to $\pi_x^*(a) = \pi_m^*(a)$ in (17). The marginal foreign exporter, $\overline{a}_x^*$, solves $\pi_x^*(a) = 0$ in (18).

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

$$\pi_d^*(a) = \max\nolimits_{p_d^*}\left((p_d^* - a)\left(\tfrac{p_d^*}{P^*}\right)^{-\sigma}U^* - f\right)$$
$$\pi_x(a) = \max\nolimits_{p_x}\left((p_x - \tau wa(1-t))\left(\tfrac{p_x}{P^*}\right)^{-\sigma}U - (w\lambda_x + (1-\lambda_x))\,f_x\right)$$
$$\pi_m(a) = \max\nolimits_{p_m}\left((p_m - a)\left(\tfrac{p_m}{P^*}\right)^{-\sigma}U - (w\lambda_m + (1-\lambda_m))\,f_m\right)$$

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

$$\begin{array}{ll} p_d^*(a) = \frac{a}{\rho} & \pi_d^*(a) = \left(P^{*\sigma}U^*(1-\rho)\left(\frac{a}{\rho}\right)^{1-\sigma} - f\right) \\ p_x(a) = \frac{w(1-t)\tau a}{\rho} & \pi_x(a) = P^{*\sigma}U^*(1-\rho)\left(\frac{aw\tau(1-t)}{\rho}\right)^{1-\sigma} - \left(w(1-\lambda_x)(1-t)+\lambda_x\right)f_x \\ p_m(a) = \frac{a}{\rho} & \pi_m(a) = P^{*\sigma}U^*(1-\rho)\left(\frac{a}{\rho}\right)^{1-\sigma} - (w(1-\lambda_m)(1-t)+\lambda_m)f_m \end{array} \quad (22)$$

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

$$P^* = \frac{w(1-t)\tau}{\rho}\left(M\widetilde{a}_x + \left(\frac{1}{w(1-t)\tau}\right)^{1-\sigma}(\widetilde{a}_d^* M^* + \widetilde{a}_m M)\right)^{\frac{1}{1-\sigma}} \tag{23}$$

Using (22), the solutions for the marginal domestic, exporting and subsidiary firms in the market will be

$$\overline{a}_d^* = \rho\left(\frac{U^*(1-\rho)}{f}\right)^{\frac{1}{\sigma-1}} P^{*\frac{\sigma}{\sigma-1}}$$

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

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

The marginal home exporter and the marginal foreign seller are determined by the conditions $\underline{a}_x = \frac{\tau}{\rho}\left(\frac{f_x\sigma}{U^*}\right)^{\frac{1}{\sigma-1}}\left(\frac{w(1-t)}{P^*}\right)^{\frac{\sigma}{\sigma-1}}$ and . It will be assumed that the fixed and variable costs associated with exports are sufficiently large that $\underline{\varphi}_x^* > \underline{\varphi}^*$ and $\underline{\varphi}_x > \underline{\varphi}$. The foreign country price index will be

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 4 and 5 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 (**??**). For the foreign country, we have

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

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

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 7:

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,

$$\overline{\pi}^*(1 - G^*(\underline{\varphi}))/\delta = F. \tag{24}$$

and the budget constraint for the foreign country,

$$U^* P^* = L^*. \tag{25}$$

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

(15) and (23), 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 (21) and (25) 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 (20) 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 (24) 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. $||$