Fiscal Devaluations: Static Analysis

Emmanuel Farhi
Harvard University

Gita Gopinath
Harvard University

Oleg Itskhoki
Princeton University

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Abstract

We show that even when the exchange rate cannot be devalued, a *small* set of *conventional* fiscal instruments can robustly replicate the real allocations attained under a nominal exchange rate devaluation in a dynamic New Keynesian open economy environment. We perform the analysis under alternative pricing assumptions—producer or local currency pricing, along with nominal wage stickiness; under arbitrary degrees of asset market completeness and for general stochastic sequences of devaluations. There are two types of fiscal policies equivalent to an exchange rate devaluation—one, a uniform increase in import tariff and export subsidy, and two, a value-added tax increase and a uniform payroll tax reduction. When the devaluations are anticipated, these policies need to be supplemented with a consumption tax reduction and an income tax increase. These policies are revenue neutral. In certain cases equivalence requires, in addition, a partial default on foreign bond holders. We discuss the issues of implementation of these policies, in particular, under the circumstances of a currency union.

This appendix offers a simple static model which provides an illustration for the more general results provided in Farhi, Gopinath, and Itskhoki (2013), henceforth FGI, in a much richer dynamic environment.

Our one-period (static) setup allows for arbitrary degree of price and wage stickiness, and we consider in turn the cases of producer and local currency price setting. The model features two countries: Home (H) and Foreign (F). Foreign follows a passive policy of fixed money supply M^*, while Home in addition to the money supply M can potentially use six different fiscal instruments: import and export tariffs, a value-added tax (with border adjustment[1]), a payroll tax paid by the producers, and consumption and income taxes paid by the consumers. We also capture in a stylized way various degrees of capital account openness: financial autarky (balanced trade), complete risk sharing with Arrow-Debreu securities, and an arbitrary exogenous net foreign asset position of the countries in home or foreign currency that allows us to study the valuation effects associated with devaluations.

Our central result is that there are two types of fiscal policies that can attain the same effects as a nominal devaluation while at the same time maintaining a fixed nominal exchange rate. We call these policies *fiscal devaluations*. The first policy involves an increase in import tariff coupled with an equivalent increase in export subsidy. The other policy involves an increase in the value-added tax coupled with an equivalent reduction in the payroll tax. Under balanced trade no other fiscal instrument is needed, while with perfect international risk sharing adjustments in consumption and income taxes are also required.

An expansion in the home money supply may or may not be needed in addition to fiscal policy, however this adjustment happens automatically if the government chooses an exchange rate peg as its monetary policy (which in particular is the case for members of a currency union). As an alternative setup we could consider a cashless economy with an exchange rate peg (or an interest rate rule in a dynamic environment). All our equivalence results hold *a fortiori* in a cashless economy that is described by the same equilibrium system but without a money demand equation and exogenous money supply.

For simplicity, we start from a situation where taxes are zero, however, our results generalize straightforwardly to a situation where initial taxes are not zero. Indeed, our results characterize the required *changes* in taxes for a fiscal devaluation. For example, a payroll subsidy should be interpreted as a reduction in payroll taxes if the economy starts in a situation where payroll taxes are positive. Similarly, a VAT should be interpreted as an increase in the VAT if the economy starts in a situation with a positive VAT (the generalization with non-zero initial taxes is described in footnote 22 in FGI).

[1]VAT is reimbursed to the exporters and levied on the importers when the good crosses the border.

1 Model setup

Our static model features two countries and two goods, one produced at home and the other produced at foreign. Goods are produced from labor using a linear technology with productivity A and A^* respectively.

Consumers derive utility from both goods and disutility from labor. For simplicity of exposition we adopt separable constant-elasticity preferences over consumption and leisure and a Cobb-Douglas consumption aggregator over the home and the foreign good. As we show in FGI, our results fully generalize to an environment with a general non-separable utility $U(C,N)$, a general consumption aggregator over multiple home and foreign goods, some of which are non-tradable (see footnote 12 in FGI), and a general production function with idiosyncratic productivity shocks.

Specifically, the utility of a home representative household is given by

$$U = \frac{1}{1-\sigma}C^{1-\sigma} - \frac{\kappa}{1+\varphi}N^{1+\varphi},$$

where N is the labor supply and C is the consumption aggregator. We allow for home bias in preferences and denote by γ the share of domestic goods in consumption expenditure in each country:

$$C = C_H^{\gamma} C_F^{1-\gamma} \qquad \text{and} \qquad C^* = C_H^{*1-\gamma} C_F^{*\gamma},$$

where C and C^* are home and foreign aggregate consumption respectively. The associated price indexes are

$$P = \left(\frac{P_H}{\gamma}\right)^{\gamma}\left(\frac{P_F}{1-\gamma}\right)^{1-\gamma} \qquad \text{and} \qquad P^* = \left(\frac{P_H^*}{1-\gamma}\right)^{1-\gamma}\left(\frac{P_F^*}{\gamma}\right)^{\gamma}.$$

Here P_H and P_F are home-currency prices of the two goods before the consumption tax, but inclusive of the value-added tax and tariffs.[2] Similarly, starred prices are foreign-currency prices of the two goods. Since these price indexes do not incorporate the consumption tax, they must be adjusted for the consumption tax in order to obtain the consumer prices of the home and foreign consumption baskets.

With Cobb-Douglas preference aggregators, we can write the market clearing conditions for the two goods in the following way:

$$Y = \gamma\frac{PC}{P_H} + (1-\gamma)\frac{P^*C^*}{P_H^*} \qquad \text{and} \qquad Y^* = (1-\gamma)\frac{PC}{P_F} + \gamma\frac{P^*C^*}{P_F^*}, \tag{1}$$

[2] We assume that consumption subsidies are paid to consumers, while VAT is levied on producers. With flexible prices, the incidence of taxation is irrelevant and the two exactly offset each other. However, with nominal price stickiness incidence matters and the VAT and consumption subsidy no longer offset each other in the short run (e.g., see Poterba, Rotemberg, and Summers, 1986). In Section 4.3 of FGI, we discuss the tax pass-through assumptions necessary for our equivalence results and reviews related empirical evidence.

where Y is production of the home good and PC is the before-consumption-tax expenditure of home consumers, and similarly for foreign. Here $\gamma PC/P_H$, for example, is home demand for the home-produced good. Note that a consumption tax enters both the numerator and the denominator in this expression and hence cancels out.

We introduce money into the model by means of cash-in-advance constraints:

$$\frac{PC}{1+\varsigma^c} \leq M \qquad \text{and} \qquad P^*C^* \leq M^*, \tag{2}$$

where ς^c is a consumption subsidy at home. In FGI, we provide a generalization to the case of dynamic interest-elastic money demand.

In this static economy, home households face the following budget constraint:

$$\frac{PC}{1+\varsigma^c} + M + T \leq \frac{WN}{1+\tau^n} + \frac{\Pi}{1+\tau^d} + B^p, \tag{3}$$

where τ^n is the labor-income tax, τ^d is the dividend-income tax, T is a lump-sum tax, and B^p are home household net foreign assets, possibly state-contingent, converted into home currency, WN is labor income and Π is firm profits introduced below. In this static section, τ^d plays almost no role. For example, we could either set it to $\tau^d = 0$ or to $\tau^d = \tau^n$. The only results that would be affected are those on the revenue impact of fiscal devaluations (Proposition 5). For this reason, we do not specify dividend tax adjustment until our discussion of this proposition. This irrelevance of dividend tax does not carry over to the dynamic analysis in FGI, where we specify it from the outset, due to the second-order effects of this tax on dynamic price setting.

The home government budget constraint is given by

$$M + T + TR + B^g \geq 0, \tag{4}$$

where B^g is home government net foreign assets converted into home currency and TR stands for all non-lump-sum fiscal revenue of the home government.[3] The two budget constraints together define the country-wide budget constraint, where $B = B^p + B^g$ are the total home-country net foreign assets. The foreign household and government budget constraints are symmetric with the exception that Foreign does not use fiscal instruments. This assumption

[3] Specifically, we have

$$TR = \left(\frac{\tau^n}{1+\tau^n}WN + \frac{\tau^d}{1+\tau^d}\Pi - \frac{\varsigma^c}{1+\varsigma^c}PC\right) + \left(\tau^v P_H C_H - \varsigma^p WN\right) + \left(\frac{\tau^v + \tau^m}{1+\tau^m}P_F C_F - \varsigma^x \mathcal{E} P_H^* C_H^*\right),$$

where the first two terms are the income taxes levied on and the consumption subsidy paid to home households; the next two terms are the value-added tax paid by and the payroll subsidy received by home firms; the last two terms are the import tariff and the VAT border adjustment paid by foreign exporters and the export subsidies to domestic firms, as we discuss below.

is made only for ease of exposition and has no consequence for our results, as long as foreign responds symmetrically to a fiscal as well as nominal devaluation. International asset market clearing requires $B + B^*\mathcal{E} = 0$ state by state, where B^* is foreign-country net foreign assets converted into foreign currency and $\mathcal{E}$ is the nominal exchange rate. In this static setting, we take the asset positions B and B^* as exogenous, and we endogenize savings and portfolio choice decisions in the dynamic analysis in FGI.

We analyze first the case of producer currency pricing and then the case of local currency pricing, allowing for an arbitrary degree of price stickiness. In both cases we also allow for an arbitrary degree of wage stickiness. For each case, we consider in turn various assumptions about international capital flows starting from the case of financial autarky and balanced trade. In all these cases, we characterize combinations of tax changes and money supplies in the home country that perfectly replicate the real effects of a devaluation of the home currency, but maintaining a constant nominal exchange rate.

2 Producer currency pricing

We assume that prices and wages are partially (or fully) sticky in the beginning of the period, before productivity shocks and government policies are realized.

2.1 Wage setting

We adopt the following specification for the equilibrium wage rate:

$$W = \bar{W}^{\theta_w} \left[\mu_w \frac{1+\tau^n}{1+\varsigma^c} \kappa P C^\sigma \left(\frac{Y}{A} \right)^\varphi \right]^{1-\theta_w}, \tag{5}$$

where $\theta_w \in [0,1]$ is the degree of wage stickiness, with $\theta_w = 1$ corresponding to fixed wages and $\theta_w = 0$ corresponding to fully flexible wages. Accordingly, $\bar{W}$ is the preset wage, while the term in the square bracket is the flexible wage. We denote by $\mu_w \geq 1$ the wage markup which may arise under imperfectly competitive labor market. The remaining terms in the square brackets define the consumer's marginal rate of substitution between labor and consumption, where τ^n is an income tax and ς^c is a consumption subsidy.[4] A symmetric equation (without taxes) characterizes the wage in the foreign country. This wage setting specification is motivated by the Calvo wage-setting model with monopsonistic labor supply of multiple types and a fraction $1-\theta_w$ of types adjusting wages after the realization of the shocks (see the dynamic model in FGI).

[4]With a linear production technology, labor supply N equals Y/A.

2.2 Price setting

Under producer currency pricing, a home producer sets the same producer price, inclusive of the value-added tax, in home currency for both markets according to:

$$P_H = \bar{P}_H^{\theta_p} \left[\mu_p \frac{1-\varsigma^p}{1-\tau^v} \frac{W}{A} \right]^{1-\theta_p}, \tag{6}$$

where $\theta_p \in [0,1]$ is the measure of price stickiness, $\bar{P}_H$ is the preset price and the term in the square bracket is the flexible price, by analogy with wage setting (5). We denote by $\mu_p \geq 1$ the price markup, while the remaining terms in the square bracket are the firm's marginal cost, where ς^p is a payroll subsidy and τ^v is a value-added tax.[5] The foreign good price, P_F^*, is set symmetrically in the foreign currency, but with no payroll or value-added taxes. Note that by choosing θ_w and θ_p we can consider arbitrary degrees of wage and price stickiness.[6] Furthermore, our results do not depend on whether foreign has the same or different price and wage stickiness parameters.

2.3 International prices

Finally, we discuss international price setting. Under our assumption of PCP, home producers receive the same price from sales at home and abroad. Exports entail a subsidy, ς^x, and also the value-added tax is reimbursed at the border. Therefore, the foreign-currency price of the home good is given by

$$P_H^* = P_H \frac{1}{\mathcal{E}} \frac{1-\tau^v}{1+\varsigma^x}, \tag{7}$$

where $\mathcal{E}$ is the nominal exchange rate measured as units of home currency per unit of foreign currency so that higher values of $\mathcal{E}$ imply a depreciation of home currency. Expression (7) is a variant of the *law of one price* in our economy with tariffs and taxes. Similarly, the home-currency price of the foreign good is given by

$$P_F = P_F^* \mathcal{E} \frac{1+\tau^m}{1-\tau^v}, \tag{8}$$

where τ^m is the import tariff, and the value-added tax is levied on imports at the border.[7]

[5] Under PCP, the profits of a home firm can be written as $\Pi = (1-\tau^v)P_H Y - (1-\varsigma^p)WN$, where $Y = AN$ is total output of the firm.

[6] The case of $\theta_w = 1$ can also be interpreted as binding downward wage rigidity or minimum wage.

[7] P_F denotes the price to consumers before the consumption tax. The way we defined taxes, foreign firms receive $(1-\tau^v)P_F/(1+\tau^m)$ in home currency per unit exported, while the home government's revenue is $(\tau^v+\tau^m)P_F/(1+\tau^m)$ per unit imported.

2.4 Capital account openness

We now spell out various assumptions regarding capital account openness. Consider first the case of financial autarky, or balanced trade, which we model by imposing $B = B^p + B^g \equiv 0$ in (3)–(4), and consequently $B^* \equiv 0$. A constant zero net foreign asset position implies balanced trade, $P^*_F C_F = P^*_H C^*_H$. This can be alternatively stated as:[8]

$$P^* C^* = P^*_F Y^*, \tag{9}$$

that is, the equality of total consumption expenditure and total production revenues in foreign. When trade is balanced and the import tariff equals the export subsidy ($\tau^m = \varsigma^x$), the home government makes no revenues from trade policy, and as a result $PC = P_H Y$ also holds in equilibrium (to verify this, combine (3) and (4) and impose $\tau^m = \varsigma^x$).

Next consider the case of perfect risk sharing. In this case, at the beginning of the period, before the realization of productivity and policy, private agents can trade Arrow-Debreu securities. The optimal risk sharing condition is the so-called Backus-Smith condition

$$\frac{1}{\lambda}\left(\frac{C}{C^*}\right)^{\sigma} = \frac{P^*\mathcal{E}}{P}(1+\varsigma^c) \equiv \mathcal{Q}, \tag{10}$$

where $\mathcal{Q}$ is the *consumer-price* real exchange rate and λ is the constant of proportionality. Without consequences for our results, we normalize $\lambda = 1$. Net foreign asset positions of the countries must be such that consumption satisfies (10) state by state.

Finally, consider the case where home's net foreign assets B are composed of an arbitrary portfolio of home-currency (B^h) and foreign-currency (B^{f*}) assets:

$$B = B^h + B^{f*}\mathcal{E},$$

Combining the foreign country budget constraints with asset market clearing, we obtain the equilibrium condition in this case which generalizes (9):[9]

$$P^* C^* = P^*_F Y^* - \frac{B^h}{\mathcal{E}} - B^{f*}. \tag{11}$$

[8] Consider the foreign budget constraints in this case:

$$\begin{aligned} P^*C^* + M^* + T^* &= W^*N^* + \Pi^* = P^*_F Y^*, \\ M^* + T^* &= 0. \end{aligned}$$

Subtracting one from the other, we immediately obtain (9). We can write $P^*C^* = P^*_H C^*_H + P^*_F C^*_F$ and $P^*_F Y = P^*_F(C_F + C^*_F)$, which together with (9) implies trade balance $P^*_F C_F = P^*_H C^*_H$, that is the equality of foreign export revenues and foreign import expenditure.

[9] The same condition can be derived from the home budget constraints (3)–(4), a consequence of Walras Law.

3 Fiscal devaluations

We have fully described the equilibrium structure of the PCP economy under various asset market structures. We now characterize the equilibrium nominal exchange rate. We have:[10]

Lemma 1 *In a static PCP economy, the equilibrium nominal exchange rate is given by:*
(i) *under balanced trade,*

$$\mathcal{E} = \frac{1-\tau^v}{1+\tau^m}\frac{M}{M^*}(1+\varsigma^c). \tag{12}$$

(ii) *with complete international risk-sharing,*

$$\mathcal{E} = \frac{M}{M^*}\mathcal{Q}^{\frac{\sigma-1}{\sigma}}, \qquad \textit{where} \qquad \mathcal{Q} = \frac{P^*\mathcal{E}}{P}(1+\varsigma^c). \tag{13}$$

(iii) *when the foreign asset position is a portfolio of home- and foreign-currency assets,*

$$\mathcal{E} = \frac{\frac{1-\tau^v}{1+\tau^m}M(1+\varsigma^c) - \frac{1}{1-\gamma}B^h}{M^* + \frac{1}{1-\gamma}B^{f*}}, \tag{14}$$

where B^h and B^{f*} are respectively home- and foreign-currency assets of home.

Equations (12)–(14) are derived from the budget constraint of Home (or equivalently, Foreign, one of which is redundant by Walras Law), and one can think of the exchange rate in this model as the relative price which ensures that the country budget constraints are satisfied. In the case of complete asset markets, the country budget constraint is replaced by the Backus-Smith condition. In all cases, the nominal exchange rate depends on monetary and fiscal policy. However this relationship is different across the three asset market setups. In the case of balanced trade this relationship is most direct, while in the other two cases it is partially mediated by the adjustment to shocks of prices or net foreign liabilities. Naturally, (12) is a special case of (14) with $B^h \equiv B^{f*} \equiv 0$.

We can now formulate our main result. A nominal devaluation of size δ is the outcome of an increase in the home money supply M so that $\Delta\mathcal{E}/\mathcal{E} = \delta$, without any change in taxes. We define a *fiscal devaluation* of size δ to be a set of fiscal polices, together with an adjustment in money supply, which implements the same consumption, labor, and output allocation as a nominal devaluation of size δ, but holding the nominal exchange rate fixed.

[10]Proof of Lemma 1: (i) follows from trade balance (9), cash-in-advance (2) and market clearing (1). Combining these three and the law of one price (8) yields (12). (ii) follows from complete risk-sharing condition (10) and cash-in-advance (2) after rearranging terms and using the definition of the real exchange rate. (iii) follows from (11), together with (2), (1) and (8), just like in (i).

We introduce two propositions that describe fiscal devaluations under various asset market structures:

Proposition 1 *In a static PCP economy under balanced trade or foreign-currency net foreign assets position (arbitrary B^{f*} and $B^h \equiv 0$), a fiscal devaluation of size δ can be attained by the following set of fiscal policies:*

$$\tau^m = \varsigma^x = \delta, \qquad \varsigma^c = \tau^n = \varepsilon, \qquad \textit{and} \qquad \frac{\Delta M}{M} = \frac{\delta - \varepsilon}{1+\varepsilon}, \tag{FD$'$}$$

or

$$\tau^v = \varsigma^p = \frac{\delta}{1+\delta}, \qquad \varsigma^c = \tau^n = \varepsilon, \qquad \textit{and} \qquad \frac{\Delta M}{M} = \frac{\delta - \varepsilon}{1+\varepsilon}, \tag{FD$''$}$$

where ε can be chosen arbitrarily, including $\varepsilon = 0$ and $\varepsilon = \delta$.

Proof: Note that both (FD$'$) and (FD$''$) have the same effect on international prices in (7) and (8) as a nominal devaluation $\Delta\mathcal{E}/\mathcal{E} = \delta$. Furthermore, for given P_H and P_F^*, from (2) and (1) we see that a nominal and a fiscal devaluation will have the same effect on consumption and output in the two countries as long as the change in $M(1+\varsigma^c)$ is the same for all devaluation policies. Given prices, consumption and output, wage setting in (5) is the same across all devaluations. Given wages, price setting in (6) is the same across all devaluations. We went full circle, and now only need to check that fiscal devaluations keep the nominal exchange rate unchanged. In the case of balanced trade and foreign-currency debt, a nominal devaluation requires $\Delta M/M = \Delta\mathcal{E}/\mathcal{E} = \delta$, while fiscal devaluations hold $\mathcal{E}$ constant and set, according to (12) and (14), $\big(M'(1+\varsigma^c) - M\big)/M = \delta$, where $M' = M + \Delta M$. Given $\varsigma^c = \varepsilon$, we obtain the expression for $\Delta M/M$. $\blacksquare$

Proposition 2 *In a static PCP economy under complete international risk-sharing, a fiscal devaluation of size δ can be attained by the following set of fiscal policies:*

$$\tau^m = \varsigma^x = \delta, \qquad \varsigma^c = \tau^n = \delta, \qquad \textit{and} \qquad \frac{\Delta M}{M} = \frac{\sigma - 1}{\sigma}\frac{\Delta\mathcal{Q}}{\mathcal{Q}}, \tag{FD$'$}$$

or

$$\tau^v = \varsigma^p = \frac{\delta}{1+\delta}, \qquad \varsigma^c = \tau^n = \delta, \qquad \textit{and} \qquad \frac{\Delta M}{M} = \frac{\sigma - 1}{\sigma}\frac{\Delta\mathcal{Q}}{\mathcal{Q}}, \tag{FD$''$}$$

where $\Delta\mathcal{Q}/\mathcal{Q}$ is the change in the real exchange rate following a nominal devaluation of the exchange rate of size δ.

Proof: The proof follows along the exact same lines as that of Proposition 1. The difference is the following. Under complete international risk sharing, nominal and fiscal devaluations must have the same effect on the real exchange rate $\mathcal{Q}$ in order to keep the relative consumption of the two countries unchanged, as follows from the risk-sharing condition (10). From (13), under nominal devaluation the change in M equals the change in $\mathcal{E}/\mathcal{Q}^{\frac{\sigma-1}{\sigma}}$, while under fiscal devaluation the change in M must equal the change in $\mathcal{Q}^{-\frac{\sigma-1}{\sigma}}$. In all cases, $\mathcal{E}(1+\varsigma^c)$ and $M(1+\varsigma^c)$ are unchanged, and therefore indeed consumption and output allocations must be the same. ■

The first type of fiscal devaluation (FD′) relies on an import tariff τ^m combined with a uniform export subsidy ς^x, a policy advocated early on by Keynes and recently studied in Staiger and Sykes (2010). The second fiscal devaluation policy (FD″) is driven by a value-added tax τ^v with border adjustment,[11] combined with a payroll subsidy ς^p. Of course, an appropriate combination of these two fiscal devaluation policies would also attain the same result. Another implication of these results is that a combination of a VAT and a payroll subsidy can synthesize the joint effects of an import tariff and a uniform export subsidy.

The key to understanding the mechanism behind these fiscal devaluations is their effect on the terms of trade. For concreteness, we define the terms of trade as

$$\mathcal{S} \equiv \frac{P_F^*}{P_H^*} = \frac{P_F^*}{P_H}\mathcal{E}\frac{1+\varsigma^x}{1-\tau^v}, \tag{15}$$

where the second equality follows from the law of one price (7). Therefore, given P_F^*/P_H, the terms of trade can be equivalently affected by a nominal or a fiscal devaluation. The remainder of the fiscal policies in (FD′) and (FD″) are needed to offset the additional consequences of fiscal devaluations, in particular to make sure that P_F^*/P_H remains the same as under a nominal devaluation. Thus, an increase in the export subsidy must be accompanied by an increase in the import tariff in order to ensure the same movement in international prices as under a nominal devaluation (see (8)). Similarly, an increase in the VAT must be offset by a reduction in the payroll tax in order to neutralize the effects on price setting absent under a nominal devaluation (see (6)).

We now discuss the role of consumption subsidies. From (2) and (1), we see that the effect of a consumption subsidy on consumption and output is the same as the effect of an expansion in money supply. Indeed, under balanced trade and foreign-currency risk-free debt, a consumption subsidy is not essential and it can be replaced by an increase in money supply (corresponding to $\varepsilon = 0$ in Proposition 1).[12] From (12) and (14) note that this

[11] In contrast to the results in Grossman (1980) and Feldstein and Krugman (1990) derived under flexible exchange rate and prices, border adjustment is indispensable for our results.

[12] Conversely, under these circumstances a fiscal devaluation can be attained with no change in the home money supply, by using instead the consumption subsidy and income tax (the case of $\varepsilon = \delta$). Under complete markets, however, both the use of a consumption subsidy and a change in the home money supply are needed.

expansion in money supply does not lead to a movement in the nominal exchange rate as long as $M(1+\tau^c)$ increases in proportion to the import tariff or value-added tax. A fiscal devaluation without a consumption subsidy requires an increase in the money supply in order to keep trade balanced (otherwise there would be a trade surplus). Another way of looking at it is that a nominal devaluation is a consequence of expansionary demand-side policy (increase in M), which must also be part of a fiscal devaluation in order to replicate the same effects on consumption and output.

With complete international risk-sharing, a consumption subsidy is needed even if we allow the home money supply to adjust. This is because the proposed tariff and VAT changes, although they affect the terms of trade in the same way as a nominal devaluation, have the opposite effect on the real exchange rate. Using the definition of the real exchange rate in (10) together with (7)–(8), we can write

$$\mathcal{Q} = \mathcal{S}^{2\gamma-1}\frac{(1-\tau^v)(1+\varsigma^c)}{(1+\varsigma^x)^\gamma(1+\tau^m)^{1-\gamma}}.$$

Therefore, given the movement in terms of trade $\mathcal{S} = P_F^*/P_H^*$, fiscal devaluations, *in the absence of consumption subsidies*, lead to an appreciation of the real exchange rate $\mathcal{Q} = P^*\mathcal{E}/P$. Both fiscal and nominal devaluations make home exports cheaper relative to foreign exports. However, nominal devaluations achieve this outcome by making all home-produced goods relatively cheaper, while fiscal devaluations make home consumption relatively more expensive by taxing imports. This leads to a differential movement in the real exchange rate, which *under complete markets* affects the relative consumption allocation across countries.[13] A consumption subsidy is then needed to mimic the depreciation of the real exchange rate which happens under a nominal devaluation. In turn, this consumption subsidy limits the need for a monetary expansion since it has the same effect on consumption through the cash-in-advance constraint (2). Finally, an income tax τ^n is only needed to offset the labor wedge created by the consumption subsidy, as can be seen from (5).

In FGI, in a dynamic environment, we study the intermediate environments with incomplete asset markets and endogenous savings and portfolio choice decisions, to assess whether the less constrained implementation of Proposition 1 is the norm or rather an exception. We conclude that Proposition 1 applies under a mild form asset market incompleteness, provided the devaluation is unanticipated.

Also note that both proposed fiscal devaluations are long-run neutral, in the sense that they have no effect on consumption and output allocation when prices and wages are fully

[13]Under balanced trade the relative consumption allocation does not depend on the real exchange rate. This is why a fiscal devaluation does not necessarily need to mimic the behavior of the real exchange rate, and consumption subsidies can be dispensed with.

flexible. Propositions 1 and 2 apply to arbitrary degrees of wage and price stickiness. When prices or wages are sticky, fiscal devaluations have the same real effects on the economy as those brought about by a nominal devaluation driven by an expansion in the money supply. It is important to note however that the effects of a δ-devaluation (nominal or fiscal) are different for different asset market structures.[14]

Valuation Effects

Exchange rate movements affect the real value of the debt that Home owes to Foreign depending on the currency denomination of the debt.[15] When the debt is denominated in foreign currency (that is, $B^{f*} < 0$), Proposition 1 holds. On the other hand, when debt is (partially or wholly) denominated in home currency ($B^h \neq 0$), the fiscal instruments specified in Proposition 1 no longer suffice. Instead they must be supplemented with a partial default $d = \delta/(1+\delta)$, or a tax, on the home-currency-denominated debt of the home country held by foreign, in order to replicate the effects of a devaluation. That is, the post-devaluation debt position of home becomes $(1-d)B^h = B^h/(1+\delta)$. The difference in the equivalence proposition between foreign- and home-currency denominated debt can be understood by studying the foreign budget constraint (11). When $B^h = 0$ then a nominal devaluation has no effect on the foreign-currency value of the debt. If instead $B^h < 0$ a nominal devaluation reduces the foreign-currency value of the debt owed by home to foreign to $B^h/(1+\delta)$. The partial default d is then needed to exactly mimic this reduction in the foreign-currency value of debt in a fiscal devaluation when the exchange rate is held fixed.

An alternative approach to understanding the difference is to study home's consolidated budget constraint which is given by,

$$-\mathcal{E}B^{f*} - B^h = \frac{1-\tau^v}{1+\tau^m}(P_H Y - PC).$$

If Home has positive debt, repayment requires $(P_H Y - PC) > 0$. If this debt is denominated in foreign currency, then a devaluation has the direct effect of raising the local currency value of the debt $-\mathcal{E}B^{f*}$, and increases the payments in local currency to the foreign country. This same effect follows an increase in a uniform import tariff-cum-export subsidy or an increase in value-added tax-cum-payroll tax reduction. Now if the debt is denominated in home

[14] Under different asset market structures, a given devaluation is attained by a different expansion in the money supply. Specifically, under balanced trade a δ-devaluation requires $\Delta M/M = \delta$, or alternatively $\varsigma^c = \delta$. However, under complete international risk sharing, a nominal devaluation is associated with a depreciation of the real exchange rate that in turn may limit or amplify the required money supply expansion (see (13)).

[15] For discussion of valuation effects see, for example, Gourinchas and Rey (2007).

currency, a devaluation has no direct effect on the value of debt in home currency, but the increase in taxes will raise the transfers to the foreign country. To undo this requires a partial default/tax on foreign holders of home debt.

We summarize this discussion in:

Proposition 3 *With home-currency debt ($-B^h \neq 0$), a fiscal devaluation of size δ can be attained by the same set of fiscal policies as in Proposition 1, combined with a partial default on the home-currency denominated debt of the home country, $d = \delta/(1+\delta)$, and a suitable adjustment in the money supply.*[16]

Note that this partial default is a direct transfer of wealth from foreign to home households. When home has home-currency assets ($B^h > 0$), equivalence requires debt forgiveness to foreign that reduces home's assets to the level $(1-d)B^h$. An implication of this analysis is that in the case when there are heterogenous agents in the economy with different portfolios of foreign- and home-currency assets, exchange rate devaluations will effect the cross-sectional distribution of wealth differently from a fiscal devaluation, unless all agents with home-currency liabilities partially default on them with the *haircut* given by $d = \delta/(1+\delta)$.

4 Local currency pricing

We now consider briefly the alternative case of local currency pricing, and show that the results fully generalize without change. This is surprising because the mechanism of a nominal devaluation under LCP is quite different from that under PCP. While under PCP a nominal devaluation affects international relative consumer prices, under LCP it affects the profit margins of the firms. In both cases, these are exactly the effects attained by a fiscal devaluation.

Formally, the international law of one price (7)–(8) no longer holds and firms set prices separately for domestic and foreign consumers. In line with the logic of local currency pricing, we assume that prices are preset inclusive of all taxes and subsidies, apart from the consumption subsidy given directly to the consumers. Conditions (7)–(8) are replaced with

[16] The required adjustment in the money supply can be inferred from equation (14), given the desired size of the devaluation, fiscal policies used, and the amount of home-currency debt.

the following price-setting equations:

$$P_H^* = \bar{P}_H^{*\theta_p} \left[\mu_p \frac{1-\varsigma^p}{1+\varsigma^x} \frac{1}{\mathcal{E}} \frac{W}{A} \right]^{1-\theta_w}, \tag{16}$$

$$P_F = \bar{P}_F^{\theta_p} \left[\mu_p \frac{1+\tau^m}{1-\varsigma^v} \mathcal{E} \frac{W^*}{A^*} \right]^{1-\theta_w}, \tag{17}$$

that parallel (6). From (16)–(17) we see that as international prices adjust, they are affected in the same way by fiscal and nominal devaluations. However when prices are fixed, neither devaluation has an effect on international prices.

With fixed prices, however, profits must adjust. For example, the profits of a representative foreign firm are given by

$$\Pi^* = P_F^* C_F^* + P_F C_F \frac{1}{\mathcal{E}} \frac{1-\tau^v}{1+\tau^m} - W^* N^*.$$

From this expression it is clear that a fiscal devaluation affects profits Π^* in the same way as a nominal devaluation.

All other equilibrium conditions remain unchanged under LCP, including the country budget constraints. With this we can characterize equilibrium nominal exchange rate under LCP:

Lemma 2 *Lemma* 1 *applies to the case of LCP as well, and the nominal exchange rate is given by* (12)*,* (13) *or* (14) *depending on the structure of the asset market.*

Proof: The proof for the case of complete markets does not rely on the type of price setting, PCP or LCP. The case of trade balance and non-zero net foreign liabilities is more involved. Consider the household and government budget constraints in foreign:

$$\begin{aligned} P^*C^* + M^* + T^* &= W^*N^* + \Pi^* + B^{p*}, \\ M^* + T^* + B^{g*} &= 0. \end{aligned}$$

Combining this with the expression for Π^* above, we obtain

$$P^*C^* = P_F^* C_F^* + P_F C_F \frac{1}{\mathcal{E}} \frac{1-\tau^v}{1+\tau^m} - \frac{B^h}{\mathcal{E}} - B^{f*},$$

where we have used the fact that $B^* = B^{p*} + B^{g*} = -B/\mathcal{E} = -B^h/\mathcal{E} - B^{f*}$ in equilibrium. Now use cash-in-advance (2) and Cobb-Douglas demand for home and foreign goods to obtain

$$M^* = \gamma M^* + (1-\gamma) M (1+\varsigma^c) \frac{1}{\mathcal{E}} \frac{1-\tau^v}{1+\tau^m} - \frac{B^h}{\mathcal{E}} - B^{f*},$$

which immediately implies (14), and hence (12) as a special case when $B^h \equiv B^{f*} \equiv 0$ and trade is balanced. ■

With Lemma 2, we can immediately generalize the results in Proposition 1, 2 and 3 to the case of LCP (the proof follows exactly the same steps as above):

Proposition 4 *With LCP, fiscal policies* (FD′) *and* (FD″) *constitute fiscal devaluations under balanced trade, complete international risk sharing, and foreign-currency risk-free debt, just like under PCP: Propositions 1, 2 and 3 apply.*

We have identified a robust set of fiscal policies—fiscal devaluations—which achieve the same allocations as nominal devaluations, but keep the exchange rate unchanged. It is important to note that the allocations themselves are very different under LCP and PCP. As surveyed in Lane (2001), a monetary expansion under PCP has a positive spillover for the foreign country through a depreciation of the home terms of trade. Under PCP, nominal devaluation generates a production boom at home and a consumption boom worldwide. By contrast, a monetary expansion under LCP is beggar-thy-neighbor due to a terms of trade depreciation of foreign and a reduction in foreign firms' profit margins.[17] Under LCP, a nominal devaluation generates a consumption boom at home and a production boom worldwide. It is immediate to extend our results to environments with a mix of producer and local currency pricing, as for example in Devereux and Engel (2007).

5 Revenue Neutrality

Finally, we show that the fiscal devaluation policies are government revenue neutral and require no additional financing:

Proposition 5 *Under both PCP and LCP, as regards non-lump-sum tax revenue TR:* (FD′) *is revenue-neutral if all taxes are adjusted by the same amount ($\varepsilon = \delta$) or if trade is balanced, and in both cases, if the dividend tax is set to $\tau^d = \varepsilon$;* (FD″) *is revenue-neutral if all taxes are adjusted by the same amount ($\varepsilon = \delta$), but dividend tax is set to $\tau^d = 0$.*

[17] Home terms of trade under LCP are given by

$$\mathcal{S} = \frac{P_F}{P_H^*}\frac{1}{\mathcal{E}}\frac{1-\tau^v}{1+\tau^m},$$

and nominal (as well as fiscal) devaluation leads to its appreciation, in contrast to the PCP case where the terms of trade depreciates (see (15)), as emphasized in Obstfeld and Rogoff (2000).

Proof: In general, non-lump-sum revenues TR are given by

$$TR = \left(\frac{\tau^n WN}{1+\tau^n} + \frac{\tau^d \Pi}{1+\tau^d} - \frac{\varsigma^c PC}{1+\varsigma^c}\right) + \left(\tau^v P_H C_H - \varsigma^p WN\right) + \left(\frac{\tau^v + \tau^m}{1+\tau^m} P_F C_F - \varsigma^x \mathcal{E} P_H^* C_H^*\right),$$

Under (FD′), profits are given by

$$\Pi = P_H C_H + (1+\delta)\bar{\mathcal{E}} P_H^* C_H^* - WN,$$

both under PCP and LCP, where $\bar{\mathcal{E}}$ is the constant value of the nominal exchange rate. Under LCP, P_H^* is the sticky consumer price, while under PCP it is given by the law of one price $P_H^* = P_H/[\bar{\mathcal{E}}(1+\delta)]$, where P_H is the sticky producer price. Furthermore, tax revenues in this case are given by

$$\begin{aligned} TR &= \frac{\tau^d}{1+\tau^d}\Pi + \frac{\varepsilon}{1+\varepsilon}\big(WN - PC\big) + \frac{\delta}{1+\delta} P_F C_F - \delta \bar{\mathcal{E}} P_H^* C_H^* \\ &= \left[\frac{\tau^d}{1+\tau^d} - \frac{\varepsilon}{1+\varepsilon}\right]\Pi + \left[\frac{\delta}{1+\delta} - \frac{\varepsilon}{1+\varepsilon}\right]\big(P_F C_F - (1+\delta)\bar{\mathcal{E}} P_H^* C_H^*\big), \end{aligned}$$

where the second equality substitutes in the expression for profits and rearranges terms using $PC = P_H C_H + P_F C_F$. We also used $\varsigma^c = \tau^n = \varepsilon$ with either $\varepsilon = \delta$ as in Proposition 2 or as a free parameter as in Proposition 1. Hence, we can always set $\tau^d = \varepsilon$ and $\varepsilon = \delta$, and have $TR = 0$. If we choose $\varepsilon = 0$, TR has the same sign as the trade balance of foreign.

Similarly, in the case of (FD″)

$$\begin{aligned} TR &= \frac{\tau^d}{1+\tau^d}\Pi + \frac{\varepsilon}{1+\varepsilon}\big(WN - PC\big) + \frac{\delta}{1+\delta}\big(P_H C_H - WN\big) + \frac{\delta}{1+\delta} P_F C_F \\ &= \left[\frac{\delta}{1+\delta} - \frac{\varepsilon}{1+\varepsilon}\right]\big(PC - WN\big) + \frac{\tau^d}{1+\tau^d}\Pi. \end{aligned}$$

With $\varepsilon = \delta$ and $\tau^d = 0$, $TR = 0$. When $\varepsilon < \delta$ and $\tau^d = 0$, $TR \geq 0$ whenever $PC > WN$. ■

The key conclusion here is that our proposed fiscal devaluations can always be implemented with a balanced budget, an important property for a viable devaluation policy under most circumstances. Note that by focusing on non-lump-sum government revenues TR, we have effectively excluded seigniorage from our analysis of revenue neutrality.[18] However, apart from seigniorage, TR defines the primary fiscal surplus of the home country.

Finally, we emphasize the robustness of our revenue-neutrality result. First, it applies equally to both PCP and LCP environments. Second, this argument directly extends to a dynamic environment (see FGI) since a dynamic fiscal devaluation can be implemented with $TR = 0$ period-by-period.[19]

[18] Note that lump-sum taxes in our analysis are only used in order to transfer the seigniorage revenues back to the public.

[19] Period-by-period neutrality is no longer true when a fiscal devaluation does not involve consumption subsidies and income taxes. As shown in the proof, when $\varsigma^c = \tau^n = \tau^d = 0$ under (FD′), government

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revenues from a fiscal devaluation are proportional to home trade deficit. Therefore, the net present value of revenues from fiscal devaluation, by the intertemporal budget constraint, must be proportional to the initial net foreign assets of home. Under (FD$''$), the same is true when $\varsigma^c = \tau^n = 0$ and $\tau^d = -\delta/(1+\delta)$, that is, when a dividend income subsidy is in place. With $\tau^d = 0$, revenues from the fiscal devaluation are greater (more positive or less negative) in proportion to the aggregate profits of the economy.