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# Product Differentiation, Fiscal Policy, and Free Entry

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ABSTRACT

Entry is recognized to be an important issue in macro models considering imperfectly competitive markets. However, two lines of research have been kept apart: the homogeneous-product oligopoly approach, where entry means more firms in the industry, and the monopolistic competition approach, where it means more brands. Our model tries to go beyond these limitations, considering a small open economy within a monetary union (characterised by a fixed exchange rate and perfect financial capital mobility). In this economy each industry produces a differentiated non-tradable good and is composed several Cournot competitors. Competition works at both the intraindustry and sector level. Decisions on both taxes and government expenditure are taken by the economy's government, i.e., fiscal policy is decentralised within the monetary union. Since the model generates multiple equilibria, three types of entry are considered: more firms (I), more industries (II), and a combination of both (III). Fiscal policy is shown to be effective on aggregate output under the three cases. Its effect on welfare is mainly walrasian in case II, but it can be keynesian when market power is high in cases I or III.

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# PRODUCT DIFFERENTIATION, FISCAL POLICY, AND FREE ENTRY*

Luís F. Costa

In this article we extend the intertemporal general equilibrium two-sector model for a small open economy, previously developed in Costa (1988). Product differentiation is introduced in the non-tradable good sector, where large firms compete over quantities. The exchange rate is fixed and financial capital is perfectly mobile. We study the macroeconomic effects of fiscal policy considering three different types of entry: new firms *per* industry, new industries, and a combination of both. A welfare analysis is also produced.

## 1. INTRODUCTION

ENTRY is recognised to be an important issue in macro models considering imperfectly competitive markets. However, two lines of research have been kept apart. The homogeneous-product oligopoly approach, where entry means more firms in the industry, can be found in Costa (1988), and in the Cournotian Monopolistic Competition model of Snower (1983). The monopolistic competition approach, where it means more brands, can be found in monopolistic competition models like Blanchard and Kiyotaki (1987), Dixon and Lawler (1996) , Dixon and Santoni (1995) , Heijdra and van der Ploeg (1996) , Rotemberg and Woodford (1995) , Startz (1989) , and Weitzman (1982)[1], and in the oligopoly with differentiated products model of Peretto (1996). For surveys see Dixon and Rankin (1994) and Dixon (1994). Our model tries to go beyond these limitations, considering a small open economy within a monetary union (characterised by a fixed exchange rate and perfect financial capital mobility). In this economy each industry produces a differentiated non-tradable good and is composed several *Cournot* competitors. Competition works at both the intra-industry and sector level. The size of non-tradable goods producers is assumed to be large also at the economy level and *Ford effects* are considered as in d'Aspremont et al. (1989). In addition, fiscal policy is decentralised within the monetary union, i.e., decisions on taxes and government expenditure are taken at the economy's level, and labour markets are competitive.

Since the model generates multiple equilibria, three types of entry are considered: more firms (I), more industries (II), and a combination of both (III). In case I, we

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[1] The latter is closer to spatial models than to pure monopolistic competition ones.

study the effects of fiscal policy when entry implies more firms per industry and a constant number of industries, as in the homogeneous-product oligopoly approach. In case II, entry means a change in the number of non-tradable goods, but not in the number of firms per industry, as in the monopolistic competition approach. Finally, in case III, we assume a special case of a simultaneous change of both numbers. In section 2, we derive the microeconomic foundations of the model. In section 3, we generate a benchmark initial steady state and we do a comparative statics analysis of small deviations in initial conditions for the three cases considered. In section 4, we briefly study the short-run features of the model. In section 5, we investigate the long-run effects of either temporary and permanent fiscal shocks, under the three types of entry. Finally, in section 6, we assess fiscal policy through household's intertemporal utility. Fiscal policy is shown to be effective on aggregate output under the three cases. Its effect on welfare is mainly walrasian in case II, but it can be keynesian when market power is high in cases I or III. Therefore, pure waste government spending can be used to increase households' welfare when the economy is in one considerably inefficient steady state and profits are likely to induce the entry of more firms in the existing non-tradable goods industries.

## 2. MICROECONOMIC FOUNDATIONS

There are two types of goods produced: a homogeneous tradable and $n$ brands of non-tradable good. The economy is small, so that the price of the tradable good is set in the international market. Labour is the only input and is sector specific. We refer to each type as 'tradable' and 'non-tradable' labour. Both labour markets are competitive. Government expenditure is pure waste, and is made in a basket of both types of goods. Lump sum taxes and seignorage are used to finance it. There is only an international bond, the exchange rate follows a flat shock-free path over time, financial capital is perfectly mobile, and labour internationally immobile.

### *2.1. Household behaviour*

The representative household maximises an additive intertemporal utility function over an infinite lifetime horizon

$$\max_{C_t,\, N_t^T,\, N_t^{NT},\, M_t/P_t} \sum_{t=0}^{\infty} \beta^t . \left\{ \frac{(C_t)^\gamma}{\gamma} - \frac{\xi}{\mu} . \left[ \left(N_t^T\right)^\mu + \left(N_t^{NT}\right)^\mu \right] + \frac{\chi}{1-\varepsilon} . \left( \frac{M_t}{P_t} \right)^{1-\varepsilon} \right\} \quad (1.)$$

where $0 < \beta < 1$ is the discount factor, $C_t$ is an aggregate consumption index, $N_t^s$ the quantity of type $e = T$ ('tradable'), $NT$ ('non-tradable') labour supplied, and $M_t/P_t$ the real money balances at the end of period $t$.[2] Also we suppose $\varepsilon > 0$, $\gamma \leq 0$,[3] $\chi$, $\xi \geq 0$, and $\mu > 1$. The consumption index, $C_t$, is Cobb-Douglas and homogenous of degree one (HoDO)

$$C_t = \left(C_t^T\right)^{\alpha}.\left(C_t^{NT}\right)^{1-\alpha} \tag{2.}$$

where $C_t^T$ is the consumption of tradable good, and $C_t^{NT}$ is a CES basket of $n$ non-tradable goods consumption, where there is no love for variety

$$C_t^{NT} = n^{\frac{1}{1-\sigma}}.\left[\sum_{j=1}^{n}\left(c_{j,t}^{NT}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{3.}$$

$c_{j,t}^{NT}$ ($j$ = 1, ..., $n$) is the consumption of type $j$ non-tradable good, and the $\sigma > 1$ is the reciprocal of the elasticity of substitution[4]. The budget constraint is given by

$$\begin{aligned}&\left(1+i_{t-1}\right).B_{t-1} + M_{t-1} + w_t^T.N_t^T + w_t^{NT}.N_t^{NT} + \Pi_t = \\ &= B_t + M_t + p_t^T.C_t^T + \sum_{j=1}^{n} p_{j,t}^{NT}.c_{j,t}^{NT} + P_t.\tau_t^h\end{aligned} \tag{4.}$$

where $i_t$ is the nominal interest rate paid on bonds held until the end of period $t$, $F_t$ the real domestic net foreign assets holdings, $M_t$ the money holdings, $w_t^e$ ($e = T, NT$) the wage rates for type $s$ labour, $\Pi_t$ the profit income, $p_t^T$ is the price of the tradable good in domestic currency, $p_{j,t}^{NT}$ ($j$ = 1,..., $n$) is the price of type $j$ non-tradable good, and $\tau_t^h$ a real lump-sum tax. The appropriate cost of living index, $P_t$, is given by

$$P_t = \iota.\left(p_t^T\right)^{\alpha}.\left(p_t^{NT}\right)^{1-\alpha} \quad , \quad p_t^{NT} = \left[\frac{1}{n}.\sum_{j=1}^{n}\left(p_{j,t}^{NT}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \qquad \text{a,b (5.)}$$

where $\iota = \alpha^{-\alpha}.(1-\alpha)^{\alpha-1}$ and $p_t^{NT}$ is the appropriate non-tradable good price index.

The household optimal decision in terms of consumption is made in three stages. First, it decides the consumption levels of aggregate consumption good, leisure and real money balances. Second, it decides the optimal composition of aggregate consumption between tradable and non-tradable good. Finally, it determines the

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[2] All stocks are measured at the end of the period denoted.

[3] We exclude the range (0,1] from the domain of $\gamma$. This implies an elasticity of intertemporal substitution smaller or equal than one. Since empirical evidence suggests this elasticity to be small, and numerical experiments for positive values of $\gamma$ do not generate significant differences, we use this simplified version. For more details see Costa (1988).

[4] We can see Costa (1988) as a special case of this model when $\sigma = 1$.

optimal composition of the non-tradable good index. The household is a price taker in labour and financial markets, and has no influence on the firm's decisions. We can summarise its behaviour with the following set of equations

$$C_{t+1} = \left[ \frac{P_t}{P_{t+1}} . \beta . (1+i_t) \right]^{\frac{1}{1-\gamma}} . C_t \tag{6.}$$

$$C_t^T = \alpha . \left( \frac{p_t^T}{P_t} \right)^{-1} . C_t \tag{7.}$$

$$C_t^{NT} = (1-\alpha) . \left( \frac{p_t^{NT}}{P_t} \right)^{-1} . C_t \tag{8.}$$

$(e = T, NT)$ $$N_t^e = \left[ \frac{1}{\xi} . C_t^{\gamma-1} . \frac{w_t^e}{P_t} \right]^{\frac{1}{\mu-1}} \tag{a,b (9.)}$$

$$\frac{M_t}{P_t} = \left[ \frac{1}{\chi} . C_t^{\gamma-1} . \frac{i_t}{1+i_t} \right]^{-\frac{1}{\varepsilon}} \tag{10.}$$

$(j = 1, ..., n)$ $$c_{j,t}^{NT} = \left( \frac{p_{j,t}^{NT}}{p_t^{NT}} \right)^{-\sigma} . \frac{C_t^{NT}}{n} \tag{11.}$$

Equation (6.) is the aggregate consumption Euler equation. Equations (7.) and (8.) are the tradable and non-tradable good demands. (9.)represents the labour supplies. Equation (10.) represents real money balances demand. Finally, (11.) gives us the demand for each brand of non-tradable good. Additionally, we have to consider the transversality condition for non-human wealth.

### *2.2. The tradable good sector*

The representative firm in this sector maximises the present value of its real profits

$$\max_{q_t^T} \sum_{t=0}^{\infty} a_t . \left[ \frac{p_t^T . q_t^T - w_t^T . N_t^T}{P_t} \right] \tag{12.}$$

where $a_t = \prod_{s=0}^{t} 1/(1+r_s)$ for $t \geq 1$, and $a_0 = 1$, is the discount factor, $r_t = (1+i_t). P_t / P_{t+1} - 1$ is the real interest rate, and $q_t^T$ stands for the firm's output. We assume a Cobb-Douglas technology

$$q_t^T = 1.\left(N_t^T\right)^{\phi} \tag{13.}$$

where $0 < \phi \leq 1$ implies non-increasing returns to scale. Considering the firm is a price taker in the tradable good, 'tradable' labour, and financial markets, we have a static optimisation problem with the following first order conditions

$$q_t^T = \left[ \frac{1}{\phi} \cdot \frac{w_t^T}{p_t^T} \right]^{\frac{\phi}{1-\phi}} \tag{14.}$$

$$N_t^T = \left[ \frac{1}{\phi} \cdot \frac{w_t^T}{p_t^T} \right]^{-\frac{1}{1-\phi}} \tag{15.}$$

Equation (14.) gives us the domestic supply for tradable good. Equation (15.) is the 'tradable' labour demand.

## *2.3. The government*

Government purchases both types of goods with the same preferences as the household. Its aggregate consumption, $G_t$ gives no utility to the household, and does not affect firms' productivity. Government expenditure is financed levying a real lump sum tax on the household, $\tau_t^h$, and a lump-sum corporate tax on each firm in the non-tradable good sector, $\tau_t^{NT}$. Since we have $m$ firms in each one of the $n$ non-tradable good industries, total real tax revenues are given by $\tau_t = \tau_t^h + m.n.\tau_t^{NT}$. Also, seignorage is a source of income. Considering we have a representative infinite living household, ricardian equivalence holds in this model. Therefore, there is no lost in ignoring government borrowing. Also, we assume the government/central bank is responsible for keeping the exchange rate level, and commits itself to a time-invariant net foreign assets stock. Thus, the budget constraint is $G_t = \tau_t + \Delta M_t/P_t$, and demand functions are similar to (7.) and (8.).

## *2.4. The non-tradable good sector*

In this sector, firms 1 to $m$ produce the brand 1, firms $m$+1 to 2.$m$ produce the brand 2 and so forth. Hence, firms ($j$-1).$m$+1 to $j.m$ are the producers of good $j$ ($j$ = 1, ..., $n$). Firm $i \in \mathcal{J}_j = \{(j-1).m+1, ..., j.m\}$[5] maximises its present discounted value of real profits

$$\begin{matrix} j = 1, \ldots, n \\ i \in \mathcal{J}_j \end{matrix} \qquad \max_{q_{i,t}^{NT}} \sum_{t=0}^{\infty} a_t . \left[ \frac{p_{j,t}^{NT} . q_{i,t}^{NT} - w_t^{NT} . N_{i,t}^{NT}}{P_t} - \tau_t^{NT} \right] \tag{16.}$$

[5] We use $\mathcal{J}_j$ to represent non-tradable good industry $j$=1, ..., $n$.

where $q_{i,t}^{NT}$ is its output, and $N_{i,t}^{NT}$ is 'non-tradable' labour input. The firm is a price taker in the relevant labour market. The lump-sum corporate tax is the source of a fixed cost as we can find either in Costa (1988) and Snower (1983)[6]. We assume the following technology

$$\begin{array}{l} j=1,\ldots,n \\ i\in \mathcal{I}_j \end{array} \qquad q_{i,t}^{NT}=1.\,N_{i,t}^{NT} \tag{17.}$$

Firm *i* competes over quantities assuming other firms' actions (productions), within the industry, are given to itself. However, since each type of non-tradable good is an imperfect substitute of the others, competition goes beyond the intra-industry level and exists at the inter-industry level as well. We assume firm *i* takes prices in other industries as given. Consequently, we presuppose a market structure that does not correspond to the traditional <u>Cournot</u> oligopoly. We will call it <u>Cournotian Oligopolistic Competition</u>. Each firm competes for the residual demand existing for its type of good, at the industry level, and, simultaneously, for the residual demand for all non-tradable goods, at the sector level. If we consider the limit of this structure when *n* tends to infinity, we have <u>Cournotian Monopolistic Competition</u>, using the classification of the general equilibrium concepts under imperfect competition in d'Aspremont et al. (1997). In Table 1 we present some special cases of market structures for the non-tradable good sector, arising from the framework we described. Using our framework, the model shown in Costa (1988) can be viewed as a special case of the present one when we consider *n*, the number of industries in the sector, to be equal to one. In the same way, models considering monopolistic competition in the non-tradable good sector can be considered a limit case of this model when *m*, the number of firms <u>per</u> industry, is one and *n* is large. The walrasian case is also a limit case when we consider *m* to be large, whatever the number of industries in the sector[7].

**[INSERT** Table 1 **HERE]**

Looking at another dimension of the problem, the size of the non-tradable good sector in the economy is an important issue to define firms' behaviour. If 1-$\alpha$, which is a measure of the sector's importance in the economy, is significantly different from zero, both the aggregate consumption and price index cannot be seen as exogenous variables by the individual producer. As in Costa (1988), we follow d'Aspremont et al. (1989) when we assume there are <u>Ford effects</u> on these two aggregate variables to be considered at the microeconomic level. Let us analyse the behaviour of firm *i* in

[6] We discuss the reason for this choice in detail in the first of these papers.

[7] In this case, we have to consider the fixed cost to be zero.

industry *j*. The objective market demand clearing the market for non-tradable good *j*, given equations (8.), (11.) and their homologous for government, corresponds to the following pair of equations

$$\begin{matrix} j=1,\dots,n \\ i\in \mathcal{J}_j \end{matrix} \qquad q^{NT}_{i,t} = \left(\frac{p^{NT}_{j,t}}{p^{NT}_t}\right)^{-\sigma} . \frac{D^{NT}_t}{n} - \sum_{k\in \mathcal{J}_j\setminus\{i\}} q^{NT}_{k,t} \quad , \quad D^{NT}_t = (1-\alpha).\left(\frac{p^{NT}_t}{P_t}\right)^{-1}.Q_t \qquad \text{a,b (18.)}$$

where $D^{NT}_{j,t} = c^{NT}_{j,t} + g^{NT}_{j,t}$ is the total demand for non-tradable good of type *j*, $g^{NT}_{j,t}$ is government demand for the same type, $D^{NT}_t = C^{NT}_t + G^{NT}_t$ is total demand for composite non-tradable good, $G^{NT}_t$ is the government non-tradable good consumption index, and $Q_t = C_t + G_t$ is total domestic demand for aggregate consumption good.

We now assume a symmetric equilibrium to hold in each market for a non-tradable good type. Therefore, in market *j* every firm must produce the same quantity and, consequently, posts the same price $q^{NT}_{i,t} = q^{NT}_{h,t}, \forall i \neq h \in \mathcal{J}_j$. Given identical technologies and demands, it is easy to see symmetry holds across non-tradable goods' markets as well. Firm *i*'s maximisation program is constituted by equations (2.) and (3.), and their correspondent definitions for government, giving us the Ford effects via aggregate consumption; (5.) which take into account the Ford effects through the aggregate price level; (16.), defining the objective function; (17.), the production function; (18.)the market demand for this type of good; and the symmetry conditions due to identical preferences between the household and government $c^{NT}_{j,t} / C^{NT}_t = g^{NT}_{j,t} / G^{NT}_t$ and $C^{NT}_t / C_t = G^{NT}_t / G_t$. Assuming the firm takes the real interest rate as given, the intertemporal maximisation problem coincides with a static one, and the corresponding first order conditions under a symmetric equilibrium, are given by equations (19.) and (20.). We supposed the pure non-co-operative equilibrium to be the one to hold, since we face a multiple equilibria problem arising from the Folk theorem.

The price setting condition is given by

$$\begin{matrix} j=1,\dots,n \\ i\in \mathcal{J}_j \end{matrix} \qquad p^{NT}_{j,t} = \frac{1-\eta_{i,t}}{1+\nu_{i,t}-\eta_{i,t}}.w^{NT}_t = \frac{1-\alpha+\sigma.m}{\sigma.m-\alpha}.w^{NT}_t \qquad (19.)$$

where $\nu_{i,t}$ is the reciprocal of demand elasticity faced by this firm. Likewise, $\eta_{i,t}$ is the elasticity giving us the proportional change in the aggregate price level when firm *i* increases its production by one percent, assuming the other firms to maintain the same production level, i.e., $\eta_{i,t} = \left(\partial P_t / \partial q^{NT}_{i,t}\right).\left(q^{NT}_{i,t} / P_t\right)$. Under the symmetric equilibrium assumption, $\nu_{i,t} = -1/(\sigma.m)$ and $\eta_{i,t} = -(1-\alpha)/(\sigma.m)$. First, we can easily see the limit of price-wage ratio when $\sigma$ tends to one, i.e., when non-tradable goods tend to be perfect substitutes, corresponds to the ratio obtained in Costa (1988). Second, since the price-wage ratio depends negatively on σ, for the same values of α and *m*, product differentiation reduces the market power of the individual firm. The economic intuition lies on the competition with firms in other industries and not only within the same industry[8]. The other first order condition gives us firm *i*'s labour demand driven by the need to clear demand in its market for the price it sets

$$\underset{i \in \mathcal{I}_j}{\overset{j=1,\dots,n}{}} \qquad N_{i,t}^{NT} = 1.\, q_{i,t}^{NT} \qquad (20.)$$

We assume the number of firms per industry, *m*, and the number of industries in the sector, *n*, cannot change immediately, due to the existence of a one-period lag to set-up or close down an existing firm. However, when we impose a zero profit condition in the steady state, we face another multiple equilibria problem. The partial equilibrium in the market for good *j* implies a reduced form for firm *i*'s real (static) profits which is of type $\pi_{i,t}^{NT} = \ell\left(m, n, D_t^T, p_t^T, w_t^{NT}, \tau_t^{NT}, \alpha, \sigma\right)$, and $D_t^T = C_t^T + G_t^T$. Firm *i*'s profit function is decreasing on both *n* and *m*, as we would expect. Given the values for the parameters and the exogenous variables, and for the same *n*, an increase in *m* decreases both the market power and, under a symmetric equilibrium, the average market demand for this type of good. We can observe this relationship through the following partial derivative

$$\frac{\partial \pi_{i,t}^{NT}}{\partial m} = -\frac{a(.)}{n} \cdot \frac{g(m,.)^{\alpha-1}}{m^2 . (1-\alpha+\sigma . m)^2} \cdot \left[ 2.\sigma . m - \frac{\alpha . (1-\alpha)}{\sigma . m - \alpha} \right] < 0$$

where $a(.) = \iota^{(1-\alpha)/\alpha} . p_t^T . D_t^T . w_t^{NT\ \alpha-1}/n > 0$, $g(m,.)$ is the price-wage ratio and $m \geq 2$. Considering the same *m*, an increase in *n*, under a symmetric equilibrium, decreases the average demand for each industry and, therefore, the profits of each firm, as we can see using

$$\frac{\partial \pi_{i,t}^{NT}}{\partial n} = -\frac{a(.)}{n^2} \cdot \frac{g(m,.)-1}{m . \left[g(m,.)\right]^{2-\alpha}} < 0$$

Let us imagine we departure from a zero profit situation. Then an unanticipated shock hits firm *i*, generating positive profits for the initial values of *n* and *m*. The situation before the shock is represented by point A in Fig. 1. Any point on the BCD schedule is a zero profit equilibrium. We are going to consider three cases: (i) in case I,

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[8] If we consider the Lerner index, $\mu^L_{i,t}$, as a more appropriate measure of market power, we reach the same conclusion as we observe that

$$\mu_{i,t}^L = \frac{\sigma . m - \alpha}{\alpha} < \lim_{\sigma \to 1} \mu_{i,t}^L = \frac{m-\alpha}{\alpha} \qquad \underset{i \in \mathcal{I}_j}{\overset{j=1,\dots,n}{}}$$

the number of industries is fixed and entry means more firms in each industry. This corresponds to the shift from A to D. Notice the model in Costa (1988) uses the expression 'free entry' in this sense and for the special case when $n$ = 1; (ii) in case II, the number of firms per industry is fixed and entry means more brands in the non-tradable good sector. This corresponds to the shift from A to B. A model of monopolistic competition would be a special case when $m$ = 1; (iii) in case III, we assume $n = k.m$ and, consequently, entry means more firms per industry and more industries as well. Of course there would be much more cases to deal with, including the consideration of the limit case of monopoly, the upper limit for profits and represented by point M, but we think these three cases are sufficient to give us an extensive cover of the most interesting cases occurring in real economies.

**[INSERT** Fig. 1 **HERE]**

Equilibrium in the 'non-tradable' labour market is given by the market clearing condition equalising supply, which is described by (9.)b, and its demand given by

$$N_t^{NT} = \sum_{j=1}^{n} \sum_{i=(j-1).m+1}^{j.m} N_{i,t}^{NT} \tag{21.}$$

## 3. A BENCHMARK INITIAL STEADY STATE

### *3.1. Finding a closed form solution to the model*

At the macroeconomic level, we can define an aggregate output concept as

$$Y_t = \frac{p_t^T}{P_t}.q_t^T + \sum_{j=1}^{n}\left[\frac{p_{j,t}^{NT}}{P_t}.\left(\sum_{i=(j-1).m+1}^{j.m} q_{i,t}^{NT}\right)\right] \tag{22.}$$

We suppose the rest of the world supplies or purchases any quantity of the tradable good at the current price level. Net exports, $X_t$, are the difference between domestic supply and demand for the tradable good $X_t = q_t^T - D_t^T$, and an aggregate budget constraint for domestic agents, adding up individual constraints is given by

$$C_t + G_t = Y_t + r_{t-1}.F_{t-1} - \Delta F_t \qquad (23.)[9]$$

where $F_t=B_t/P_t$ represents real net foreign assets held by the household. In the steady state we rule out unlimited Ponzi borrowing schemes considering the intertemporal budget constraint which follows from (23.)

[9] For sake of simplicity, we assume the representative household's share on foreign firms to be zero.

$$C^* + G^* = Y^* + r^*.F^* \tag{24.}$$

where variables with asterisks represent their steady state equilibrium values. We assume the necessary condition for a zero growth steady state in a small open economy with perfect capital mobility holds, $i^*=r^*=(1-\beta)/\beta$, where the interest rate as to be equal to domestic household rate of time preference. As in Obstfeld and Rogoff (1995), Sutherland (1996) , and Costa (1988), we assume $G^* = F^* = 0$, in order to obtain a closed form solution to the steady state model. The correspondent steady state path will be our benchmark[10]. When we consider either $n$ to be exogenous or to be proportional to $m$, we can reduce the steady state system to a two-equation system with two variables to be determined, $C$ and $m$, for convenience. In both cases (I and III), we cannot obtain a closed form solution for the whole system and, consequently, we have to obtain $m$ through numerical methods. When we consider $m$ to be an exogenous variable (case II), we obtain a closed form solution for the reduced model determining $C$ and, in this case, $n$. For the benchmark steady state we derive a solution for $C$ given $m$ and $n$ which, in any of the three cases considered, will be determined jointly by this equation and the zero profit condition. Steady state real aggregate consumption is thus given by

$$C^* = \left[ \left( f(m).\xi \right)^{\alpha-1} . \left( \frac{\alpha.\phi}{\xi} \right)^{\alpha.\phi} \right]^{\frac{1}{\rho}} \tag{25.}$$

where $f(m) = (1-\alpha+\sigma.m)/[(1-\alpha).(\sigma.m-\alpha)]$ and $\rho = \mu-\gamma.[1-\alpha.(1-\phi)] > 0$. The aggregate consumption (and output) level in this equilibrium is greater than when we consider a single homogeneous non-tradable good, given the same value for $m$. The reason lies on the effect of product differentiation on the market power of the individual firm, reducing it and, therefore, reducing the imperfect competition inefficiency level in the economy. We can easily demonstrate that considering

$$\frac{\partial C^*}{\partial f(m,.)} = -\frac{(1-\alpha).C^*}{\rho.\ f(m,.)} < 0 \ \text{ and } \ \frac{\partial f(m,.)}{\partial \sigma} = -\frac{m}{(\sigma.m-\alpha)^2} < 0$$

Finally, using (25.) in the zero profit condition

[10] The balance budget constraint and our assumption of an exogenous fiscal policy imply the positive tax revenue from the non-tradable good sector has to be offset by benefits granted to the household so that $n.m.\tau^{NT} = -\tau^h$.

$$\begin{array}{l} j=1,\ldots,n \\ i\in \mathcal{J}_j \end{array} \qquad \pi_i^* = 0 \Leftrightarrow \frac{\xi . C^{*1-\gamma} . (n.m)^{\mu-1} . q_i^{NT^*\mu}}{(\sigma . m - \alpha)} = \tau^{NT} \quad (26.)$$ [11]

Let us compare the benchmark steady state levels for some of the variables (e.g. aggregate consumption) with the one in Costa (1988). In that case, we use the same set of parameter values, except for σ, which has to be greater than one with product differentiation. The difference between the two situations lies in the value for $f(.)$. Since $C^*$ is decreasing in $f(.)$ , and $f(.)$ is decreasing in $\sigma.m$, it is easy to see that: (i) if $\sigma < m_H/m$, where $m_H$ is the number of non-tradable good firms considering a homogeneous non-tradable good[12], the benchmark steady state level for aggregate consumption would be lower under imperfect substitutability; (ii) if $\sigma = m_H/m$ the benchmark steady state level for aggregate consumption would be the same in both models; (iii) if $\sigma > m_H/m$ the benchmark steady state level for aggregate consumption would be higher under imperfect substitutability. Notice that $m_H/m > 1$, given the slope of the isoprofit schedule in the ($m$, $n$) space, and $m$ can be endogenous (cases I and III) or exogenous (case II), in the model with product differentiation. Therefore, none of these cases can be ruled out a priori.

### *3.1.2. Comparing different initial steady states*

The first step in the analysis of the general equilibrium in this economy consists on a comparative statics investigation of a log-linear version of the model. We look upon the effects of slightly different initial conditions on the general equilibrium set. We use the values obtained for the benchmark steady state and the relevant behavioural equations, to derive a log-linearised version of the system around that particular equilibrium point. However, as we demonstrated before, general equilibrium depends on the assumptions we make about entry in the non-tradable good sector. Therefore, we have to consider three different log-linearised models corresponding to the cases we proposed to study. Variables with hats represent its long-run percentage deviation from the benchmark steady state and can be defined as $\hat{H}^* = dH^* / H^*$. An exception has to be made for $\hat{G}^*$ and $\hat{F}^*$ because its equilibrium values in the benchmark steady state were set to zero. Therefore, we define its permanent log-deviations with respect to the consumption of composite good $\hat{G}^* = dG^* / C^*$ and $\hat{F}^* = dF^* / C^*$. The system of equations we obtain is the following, assuming $\hat{p}^{T^*} = 0$

$$\hat{Q}^* = \frac{1-\beta}{\beta} . \hat{F}^* + \hat{Y}^* \quad (27.)$$

[11] The value for $q_i^{NT^*}$ can easily be obtained using $C^*$.

[12] The number is given by the limit of $m$ when σ tends to unity.

$$\hat{P}^* = \frac{1-\alpha}{\alpha.\mu}.\left[(\mu-1).\hat{Q}^* + (1-\gamma).\hat{C}^* - b_2.\hat{m}^*\right] \tag{28.}$$

$$\hat{C}^* = \hat{Q}^* - \hat{G}^* \tag{29.}$$

$$\begin{cases} \hat{m}^* = \dfrac{b_1}{1-b_1.b_2}.\left(\hat{Q}^* - \hat{n}^*\right) & \Leftarrow \text{case I} \\ \hat{n}^* = \hat{Q}^* - \dfrac{1-b_1.b_2}{b_1}.\hat{m}^* & \Leftarrow \text{case II} \\ \hat{m}^* = \dfrac{k_1}{1-k_1.b_2}.\hat{Q}^* & \Leftarrow \text{case III} \end{cases} \tag{30.}$$

$$\hat{Y}^* = \frac{1-\alpha}{\mu}.\left(\hat{Q}^* + b_2.\hat{m}^*\right) - \frac{\alpha.\phi}{\mu-\phi}.\hat{P}^* - \frac{(1-\gamma).b_3}{\mu.(\mu-\phi)}.\hat{C}^* \tag{31.}$$

The values for the new parameters, considering $m \geq 2$, are given by $b_1 = (\sigma.m-\alpha)/(2.\sigma.m-\alpha)$, $1/3 \leq b_1 \leq 1/2$, $b_2 = \sigma.m/[(\sigma.m-\alpha).(1+\sigma.m-\alpha)]$, $0 < b_2 \leq 1$, $k_1 = b_1/(1+b_1)$ and $b_3 = \mu.[1-\alpha.(1-\phi)]-(1-\alpha).\phi > 0$. We can compare these parameters with their homologous from Costa (1988), for the same values of $m$ and $\alpha$, which are given by the limit when $\sigma$ tends to unity $a_1 = \lim_{\sigma\to 1} b_1 > b_1$ and $a_2 = \lim_{\sigma\to 1} b_2 < b_2$ ($m = m_H$)[13]. To obtain the previous steady-state system, first we substitute all the industry and sector variables, excepting $m$ and $n$, leaving only the macroeconomic relevant variables. Equation (27.) is the log-linear form of (24.). Equation (28.), arises from (5.) and from the reduced form for $\hat{p}^{NT^*}$. We obtain (30.) using the zero profit condition in (26.), and (31.) is the log-linear version of (22.). We use the following notation for static multipliers

$$\sigma_{H,h} = \left.\frac{\hat{H}^*}{\hat{h}^*}\right|_{\substack{\hat{G}^*=0 \\ \hat{F}^*=0}}, \quad \sigma_{H,G} = \left.\frac{\hat{H}^*}{\hat{G}^*}\right|_{\substack{\hat{F}^*=0 \\ \begin{cases}\hat{n}^*=0 \Leftarrow \text{case I} \\ \hat{m}^*=0 \Leftarrow \text{case II} \\ \hat{n}^*=\hat{m}^* \Leftarrow \text{case III}\end{cases}}} \quad \text{and } \sigma_{H,F} = \left.\frac{\hat{H}^*}{\hat{F}^*}\right|_{\substack{\hat{G}^*=0 \\ \begin{cases}\hat{n}^*=0 \Leftarrow \text{case I} \\ \hat{m}^*=0 \Leftarrow \text{case II} \\ \hat{n}^*=\hat{m}^* \Leftarrow \text{case III}\end{cases}}}$$

for $h = n$ (case I), $m$ (case II). Table 2 show us the static multipliers for $H = Y, C, m$ and $P$, and where

$$v_s = \begin{cases} b_1.b_2 \Leftarrow \text{case I} \\ 0 \quad\; \Leftarrow \text{case II} \\ k_1.b_2 \Leftarrow \text{case III} \end{cases} \text{ and } \Delta_s = (1-v_s).\rho - (1-\alpha).v_s = \begin{cases} \Delta_1 \Leftarrow \text{case I} \\ \rho \;\Leftarrow \text{case II} \\ \Delta_3 \Leftarrow \text{case III} \end{cases}$$

**[INSERT** Table 2 **HERE]**

[13] If we want to generate benchmark initial steady states where the number of firms per industry is the same, we have to allow for different fixed costs.

The determinant of the system, $\Delta_s$, is positive, and it is easy to observe that $\rho > \Delta_3 > \Delta_1 > \Delta = \lim_{\sigma \to 1} \Delta_1$.[14]

### *3.1.3. Case I: n is exogenous*

Here we consider entry affects the number of firms per industry, but not the number of non-tradable good industries, which we assume to be exogenously determined. This version of equation (30.) determines $\hat{m}^*$ given $\hat{n}^*$. First, let us study the effects of considering a larger number of non-tradable good types in the economy. The obvious effect of a greater value for *n* is the consequent reduction in the value for *m* under a zero profit equilibrium. The static multiplier is $\sigma_{m,n}=-\rho.b_1/\Delta_1<0$. The immediate consequence of the smaller *m* is a higher market power for each firm. Thus, the aggregate production of (composite) non-tradable good is smaller and is sold at a higher price, inducing a higher aggregate price index, i.e., $\sigma_{P,n}=(1-\alpha).(\mu-\gamma.\phi).b_1.b_2/(\mu.\Delta_1)\geq 0$. Even considering effect on the tradable good equilibrium production is positive, we obtain a negative effect on aggregate output and consumption arising from the larger inefficiency level in the economy: $\sigma_{Y,n}=\sigma_{C,n}=-(1-\alpha).b_1.b_2/\Delta_1\leq 0$.

Second, let us now analyse the effect on the initial steady state values of marginally different level of government expenditure. Considering another initial steady state where the non-tradable good is homogeneous, i.e., $\sigma$ tends to one, and the fixed cost, $\tau_H^{NT}$, is such that $m_H$, the number of firms in the sector, is equal to $m.\sigma$, the values from the benchmark steady state with differentiated products. In this special case, the price-wage ratio is the same in both models and, consequently, all variables present the same initial values. Furthermore, the parameter values in the log-linearised steady state model are the same since $a_1 = b_1$ and $a_2 = b_2$. Therefore, the model with a single homogeneous non-tradable good produces exactly the same outcome as the one we present here. However, we also want to compare the static multipliers in this model with the one in Costa (1988) when the set of parameter values is the same, of course excepting $\sigma$ and *n*. We know a smaller value for *m* is generated, i.e., $m<m_H$ and $\sigma>1$. Unfortunately, $b_1$ and $b_2$ depend on $\sigma.m$ which can be smaller, equal or greater than $m_H$. Therefore, anything is possible in terms of ranking the static multipliers in both

[14] It is easy to demonstrate that $\Delta_1$ is greater than $\Delta$, for $m=m_H$, the determinant of the system matrix in Costa (1988). The main step to consider is to recognise that

$$\frac{\partial(b_1.b_2)}{\partial\sigma} = -\frac{m.\left[2.\sigma^2.m^2+\alpha.(1-\alpha)\right]}{(2.\sigma.m-\alpha)^2.(1-\alpha+\sigma.m)^2} < 0$$

and, therefore, $b_1.b_2 < a_1.a_2$. We showed in the above-mentioned article it is impossible for $\Delta$ to be non-positive, given $\gamma \leq 0$.

cases. A larger government expenditure level would have a positive impact on the profits in the non-tradable good sector and, therefore, would generate a larger initial $m$. Considering the effect on aggregate consumption is $\sigma_{C,G} = \sigma_{Y,G} - 1$, it is not possible to rule out either crowding out or crowding in of private consumption due to a larger initial government consumption level. Given the effect on output and market power, and the particular structure of the labour market, the negative multiplier for aggregate prices is replicated in this model.

Third, we have to analyse the effect of a different initial endowment of net foreign assets. A positive initial level of net foreign assets, of one per cent of aggregate consumption, is an extra source of income for the household. Therefore, considering the elasticity of intertemporal substitution is less than unity, the household is willing to supply less labour of both types and aggregate output is lower. This is due to the effect on aggregate consumption[15]. A higher level of wealth induces a bigger consumption level and, consequently, a negative effect on labour supplies. The effect on $m$ and on the aggregate price index is positive.

### *3.1.4. Case II: m is exogenous*

In this case we assume entry affects the number of non-tradable goods in the economy, and therefore the number of industries in the Cournot sector, but not the number of firms existing in each industry, which we assume to be determined exogenously. The steady state log-linearised system remains the same, but equation (30.) has now a different interpretation, when we take into account $\hat{n}^*$ is the endogenous variable in the zero profit condition and $\hat{m}^*$, entering (28.) as well, is not determined in the system. First, let us study the effect of a larger $m$ in the initial steady state. The consequence of this change in initial conditions on $n$ is given by $\sigma_{n,m}=-[\rho.(1-b_1.b_2)+\alpha.b_1.b_2]/(\rho.b_1)<0$. The static multiplier is different from $-1/b_1$ since $m$ influences market power and, therefore, price and output in the non-tradable good sector. Given the lower market power, aggregate output and consumption are higher as the multipliers show $\sigma_{Y,m}=\sigma_{C,m}=(1-\alpha).b_2]/\rho\geq 0$. The aggregate price index is lower due to the indirect effect through price-wage ratio: $\sigma_{P,m}=-(1-\alpha).(\mu-\gamma.\phi).b_2/(\mu.\rho)\leq 0$. Second, we study the effects of a different initial fiscal policy in the initial steady state. A higher value for $G^*$ stimulates profits and, therefore, induces entry in the non-tradable good sector. Entry means, in this case, a larger $n$: $\sigma_{n,G}=(1-\gamma).[1-\alpha.(1-$

[15]We expect this multiplier to be non-positive for $\gamma \leq 0$ and for a plausible set of values for the other parameters. The relevant constraint implies that the increase in the household's steady state aggregate consumption cannot exceed the (new) real interest income. Notice that this restriction is somehow equivalent to impose a marginal propensity to consume less or equal than unity. For more details, see Costa (1988).

$\phi)]/\rho \geq 0$. However, since the price-wage ratio is not affected by changes in $n$, deviations from the benchmark initial steady state attributable to a distinct fiscal policy, are not affected by product differentiation and its relevant static multipliers correspond to their homologous in the homogeneous good model, when we rule out entry. Third, a higher initial level of net foreign assets would induce more firms to be in the sector, which would mean more types of non-tradable good: $\sigma_{n,F}=(1-\beta).(\mu-\phi)]/(\beta.\rho)\geq 0$. Again, the other static multipliers remain indifferent to the introduction of non-tradable good brands.

### *3.1.5. Case III: n/m is exogenous*

When we analyse the last of the three cases considered, entry in the non-tradable good sector means, simultaneously, a change in the number of firms per industry and in the number of industries. We assume both numbers move together according to a proportional relation where $n = k.m$, $k > 0$. Therefore, we add an extra independent equation to the steady state system, allowing us to determine both numbers as endogenous variables. This fact alters the form of equation (30.) in the log-linearised system. First, when we consider the initial steady state changes arising from a different initial fiscal policy. The static multipliers are similar to those presented in case I, even if they show different values. Notice, in this case, the entry incentive has to be shared between firms and industries. Second, a higher initial level of net foreign assets still has positive effects on $m$, aggregate consumption and prices. Again, the effect on aggregate output is negative.

### *3.1.6. Comparing the three cases*

Finally, let us compare the values for the static multipliers amongst the three cases considered and with the findings in Costa (1988). A different initial fiscal policy as differentiated impacts on the key endogenous variables. Multipliers are sorted in Table 3. We obtain a clear pattern for the effects of a larger government expenditure on these variables, where we can conclude the sensitivity of these static multipliers decreases when the importance of the number of industries in the free entry process increases (and the importance of the number of firm per industry decreases). The same pattern is observed for the static net foreign assets multipliers for the aggregate consumption, aggregate price index and the number of firms per industry. This also applies unambiguously to aggregate output.

**[INSERT** Table 3 **HERE]**

## 4. SHORT-RUN ANALYSIS

If an unexpected shock occurs, both *n* and *m* remain unchanged during that period, i.e., entry can only happen in the following one. Log-linearising the short-run system around the benchmark steady state path we obtain a set of equations very similar to (27.) to (31.). Assuming both the nominal interest rate and the price of the tradable good remain at their benchmark steady-state values, we obtain

$$\hat{F}_t = \frac{1}{\beta}.\hat{F}_{t-1} + \hat{Y}_t - \hat{Q}_t \tag{32.}$$

$$\hat{P}_t = \frac{1-\alpha}{\alpha.\mu}.\left[(\mu-1).\hat{Q}_t + (1-\gamma).\hat{C}_t - b_2.\hat{m}_t\right] \tag{33.}$$

$$\hat{Q}_t = \hat{G}_t + \hat{C}_t \tag{34.}$$

$$\hat{C}_{t+1} = \hat{C}_t - \frac{1}{1-\gamma}.\left(\hat{P}_{t+1} - \hat{P}_t\right) \tag{35.}$$

$$\begin{cases} \hat{m}_{t+1} = \dfrac{b_1}{1-b_1.b_2}.\left(\hat{Q}_{t+1} - \hat{n}_{t+1}\right) & \Leftarrow \text{case I} \\ \hat{n}_{t+1} = \hat{Q}_{t+1} - \dfrac{1-b_1.b_2}{b_1}.\hat{m}_{t+1} & \Leftarrow \text{case II} \\ \hat{m}_{t+1} = \dfrac{k_1}{1-k_1.b_2}.\hat{Q}_{t+1} & \Leftarrow \text{case III} \end{cases} \tag{36.}$$

$$\hat{Y}_t = \frac{1-\alpha}{\mu}.\left(\hat{Q}_t + b_2.\hat{m}_t\right) - \frac{\alpha.\phi}{\mu-\phi}.\hat{P}_t - \frac{(1-\gamma).b_3}{\mu.(\mu-\phi)}.\hat{C}_t \tag{37.}$$

where variables with hats represent its short-run percentage deviation from the benchmark steady state path, and are defined as $\hat{H}_t = dH_t / H^*$. Again, $\hat{G}_t$ and $\hat{F}_t$ are defined respectively as $dG_t / C^*$ and $dF_t / C^*$. Equation (32.) is the log-linear version of (23.), and highlights the fact that $F_t$ is an endogenous variable in the short-run system. Equation (34.) is identical to (29.), but defines $Q_t$, the domestic aggregate demand, instead of $C_t$, which is now given by (35.), the log-linear version of (6.), the Euler equation. Equations (33.) and (37.) are similar to (28.) and (31.). Finally, equation (36.), reflects the dynamic pattern of entry. As in Costa (1988), Obstfeld and Rogoff (1995) and Sutherland (1996), inter alia, the presence of a unit root in this type of models is inevitable. However, we restrict our analysis to either unanticipated one-period temporary or permanent fiscal shocks, i.e., log-deviations from the benchmark steady state path for $G_t$ are of type $\hat{G}_t = 1$ for $t = 1$, $\hat{G}_t = 0$ for $t \geq 2$ and the shock is temporary (Temp), and $\hat{G}_t = 1$, for $t \geq 1$ and the shock is permanent (Perm). Furthermore, $\hat{n}_t = 0$ in case I, $\hat{m}_t = 0$ in case II, and $\hat{n}_t = \hat{m}_t$ in case III. Assuming the economy is on its benchmark steady state in $t$ = 0, we can concentrate the dynamic features of the model in $t$ = 1, and a new steady sate is reached no later than $t$ = 2. Therefore, we can ignore time subscripts for the short-run variables. The solution to net foreign assets log-deviation is given by $\hat{F}^* = \hat{F} = \hat{Y} - \hat{C} - \hat{G}$. We can compute a closed form solution to this value, given our assumptions about the shocks, equations (27.) to (31.), (32.) to (37.), and the transversality condition for the household wealth

$$\hat{F} = -R_0 + R_1 . \hat{G}^* \tag{38.}$$

where $R_0$ and $R_1$ are both non-negative. We present the expressions for these parameters in Appendix A. The following features can be observed: (i) $\hat{F}|_{\text{Case II}} \leq \hat{F}|_{\text{Case III}} \leq \hat{F}|_{\text{Case I}} \leq 0$ for a temporary shock ($\hat{G}^* = 0$), (ii) $\hat{F}|_{\text{Case I}} \leq \hat{F}|_{\text{Case III}} \leq \hat{F}|_{\text{Case II}} = 0$ for a permanent shock ($\hat{G}^* = 1$), and, since $R_1$ is non-negative, $\hat{F}|_{\text{Case I}}$ for a permanent shock is always greater or equal than its value for a temporary shock. See Appendix B for proof.

## 5. LONG-RUN ANALYSIS

### *5.1. A temporary fiscal shock*

From the solution of the short-run model we know an unexpected one per cent increase in government consumption generates a permanent foreign debt situation, i.e., $\hat{F}^* = \hat{F} = -R_0 \leq 0$. Since we assume no further shocks will happen in period $t$ = 2, the long-run effect on the endogenous variable $\hat{H}^*$ is due only to the 'surprise effect' and, consequently, we have $\hat{H}^* = \sigma_{H,F} . \hat{F}^*$. Thus, a temporary positive fiscal shock increases output, decreases consumption and prices in period $t$ = 2, for the three cases considered. When we allow $m$ to change, the negative wealth effect implies negative profits in the Cournot sector and the zero profit condition induces a decrease in $m$ and, as a result, an increase in her market power. The new long-run equilibrium is Pareto-dominated by the initial one.

### *5.2. A permanent fiscal shock*

A permanent fiscal shock has differentiated effects on the value of the state variable, net foreign assets, in the three cases considered. In case II, $R_0 = R_1$ and, therefore, $\hat{F} = 0$. Moreover, the macroeconomic variables jump to their new long-run equilibrium in period $t$ = 1.[16] When we consider $\gamma = 0$, we also obtain $\hat{F} = 0$, in all the three cases.

[16] The non-tradable good industry variables are affected in period $t$ = 2 by the new value of $n$.

The particular value assumed for the elasticity of intertemporal substitution (one) equals the elasticity of intratemporal substitution between tradables and non-tradables, which implies additional effort in period $t = 1$, in order to smooth the consumption path[17].

The effect of a one per cent permanent increase in government consumption on $m$ is given by $\hat{m}^* = \sigma_{m,G} + \sigma_{m,F}.\hat{F}^*$. However, since both multipliers are positive, we face two opposite effects on $m$: (i) the permanent fiscal expansion has a direct effect increasing profits and inducing new firms to enter each market, and (ii) the permanent reduction on the net foreign assets level reduces profits and induces firms to leave. We can compute the reduced form for the steady-state change in $m$

$$\hat{m}^* = u_s.\left(1-\hat{C}^*\right) \quad \text{where} \quad u_s = \begin{cases} b_1/\Delta_1 & \Leftarrow s = \text{I} \\ 0 & \Leftarrow s = \text{II} \\ k_1/\Delta_3 & \Leftarrow s = \text{III} \end{cases}$$

Even if we cannot demonstrate $\hat{C}^* > -1$ holds in general, we expect it to hold for plausible values of the parameters[18]. Thus, under this assumption, fiscal policy has a positive impact on $m$ in cases I and III and, no impact in case II. Furthermore, it is clear-cut that $\hat{m}^*\big|_{\text{Case I}} > \hat{m}^*\big|_{\text{Case III}} > \hat{m}^*\big|_{\text{Case II}} = 0$. Now, it is easy to analyse the impact of fiscal policy on the other variables since we can separate the effect of entry from the no-entry effect. Therefore, the impact of a permanent fiscal shock on the aggregate output is given by $\hat{Y}^* = \sigma_{Y,G} + \sigma_{Y,F}.\hat{F}^*$ which is equivalent to

$$\hat{Y}^* = \frac{(1-\gamma).\left[1-\alpha.(1-\phi)\right]}{\rho} + \frac{1-\beta}{\beta}.\frac{\gamma.\left[1-\alpha.(1-\phi)\right]-\phi}{\rho}.\hat{F}^* + \frac{(1-\alpha).z_s}{\rho}.\hat{m}^*$$

where $z_s = b_2$ in cases I and III, and $z_s = 0$ in case II. Since the first term in the right-hand side of the equation does not depend on the type of entry considered, we can concentrate on the second and third terms. Thus, in case II, the effect of a permanent one per cent increase in government expenditure is given by the first term alone. The rank for the second term is case I, case III and case II (zero), according to the order of the change in net foreign assets. In cases I and III, $(1-\alpha).b_2/\rho$ is the same, but more firms <u>per</u> industry enter the non-tradable goods markets in the first one. Therefore, we can conclude that, given the assumptions made, $\hat{Y}^*\big|_{\text{Case I}} > \hat{Y}^*\big|_{\text{Case III}} > \hat{Y}^*\big|_{\text{Case II}} \geq 0$.

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[17] See Costa (1988) and Obstfeld and Rogoff (1996) pp. 232-235 for more details.

[18] Numerical experiments, even considering extreme values for the parameters, where not able to generate an equilibrium where $C^* \leq -1$.

The third variable to study is aggregate consumption. Using equation (27.), we can observe the effect of a one per cent permanent increase in government consumption. When we allow *m* to vary (cases I and III), we have to consider two effects: (i) output is bigger and, as a consequence, consumption tends to be higher; (ii) net debt is also larger, opposing the previous effect. Therefore, we cannot unambiguously rank this variable for the three cases[19]. Finally, we analyse the effect on the aggregate price index. As we did for the aggregate output, we can obtain a reduced form for this effect, given by

$$\hat{P}^* = -\frac{(1-\gamma).(1-\alpha).(1-\phi)}{\rho} + \frac{1-\beta}{\beta}.\frac{(1-\alpha).(\mu-\phi).(\mu-\gamma)}{\alpha.\mu.\rho}.\hat{F}^* - \\ -\frac{(1-\alpha).(\mu-\gamma.\phi).z_s}{\mu.\rho}.\hat{m}^*$$

Even if entry means more industries and not more firms <u>per</u> industry in the non-tradable goods sector (case II), a permanent fiscal shock reduces permanently the aggregate price level. When we allow *m* to vary, the market power decreases and so does the level of net foreign assets, introducing extra sources of price reduction. Therefore, we notice that $\hat{P}^*|_{\text{Case I}} < \hat{P}^*|_{\text{Case III}} < \hat{P}^*|_{\text{Case II}} \leq 0$.

## 6. WELFARE ANALYSIS

### *6.1. Utility flows*

We know, from Costa (1988), utility decreases in the short run due to the decrease in consumption and in both types of leisure. Also, we know a temporary fiscal shock reduces the household's steady state utility flow due to the permanent reduction in the net foreign asset level, which induces a steady state aggregate consumption and both types of leisure decrease. Considering entry of firms in each non-tradable good industry, worsens the situation since firms tend to leave their market in this situation (cases I and III). When we consider a permanent fiscal shock, the steady state utility level may improve if two conditions hold: the aggregate output static fiscal multiplier is bigger than one, i.e., we observe crowding-in in consumption, and the increase in utility due to a consumption (and real money balances) increase is large enough to compensate the reduction generated by the increase in working time. The change in the steady state utility level is given by

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[19] Also, we cannot guarantee the effect will be non-negative.

$$dU^* = -\frac{1}{\rho}\left[e_1 - \frac{1-\beta}{\beta}.\, e_2.\, \hat{F}^* - e_3.\, z_2.\, \hat{m}^*\right] \tag{39.}$$

where
$$e_1 = u_C.\left[\mu - 1 + \alpha.(1-\phi)\right] + (1-\gamma).\left(u_{N^T} + u_{N^{NT}}\right) > 0$$
$$e_2 = u_C.\,\mu.\,\alpha.(1-\phi) + u_{N^T}.\,\varphi - u_{N^{NT}}.\,\gamma.\,\alpha.(\mu - \phi) > 0$$
$$e_3 = \frac{1}{\mu}.\left[(1-\alpha).\left(u_C - \gamma.\,u_{N^T}\right) + u_{N^{NT}}.(\mu - \gamma.\,\alpha.\,\phi)\right] > 0$$

The expressions for $u_C = C^{*\gamma} + \chi.(1-\gamma)/\xi.(M^*/P^*)$, $u_{NT} = \xi.N^{T*}$ and $u_{NNT} = \xi.N^{NT*}$, are all positive. When entry does not affect *m*, case II, is easy to see the effect of a permanent fiscal shock on the utility is unambiguously negative. However, in cases I and III, the reduction on the price-wage ratio, created by entry of new firms in each industry, produces a positive impact on utility which may increase the steady state utility flow.

### *6.2. Intertemporal utility*

When we consider the stream of discounted utility flows, we know the difference between the three cases considered lies on the steady state utility level. Therefore, the rank for welfare is the same as for the steady state utility flows, i.e., only cases I and III can generate a positive change. A third necessary condition for fiscal policy to improve welfare is needed: the discounted gains in the steady state flow have to overrun the short-run lost of utility. This condition is, like Costa (1988), equivalent to $dU^* > -(1-\beta)/\beta.dU$, where $dU$ is the change in the utility in period $t = 1$.

## 7. CONCLUSIONS

In this work we present a dynamic general equilibrium two-sector model for a small open economy considering product differentiation in the non-tradable good sector. Considering imperfect substitution between the several types of non-tradable good allow us to nest in a single framework the models of monopolistic competition in the Blanchard and Kiyotaki (1987) tradition, and those involving homogeneous products oligopolies following d'Aspremont et al. (1989), as in the case of Costa (1988). We noticed that entry is a much more complex issue when it may mean changes in the number of industries (*n*), changes in the number of firms per industry (*m*) or a combination of both. The presence of product differentiation implies a multiple equilibria problem due to the trade-off between the two above-mentioned numbers in the zero profit condition.

In the long-run, we study the effects of fiscal policy considering three cases of entry: case I where *n* is fixed, case II where *m* is fixed, and case III where *n*/*m* is fixed.

The outcomes of case I are similar to those of Costa (1988) when there is entry. Case II is also similar to the above-mentioned model, but considering entry is absent. The third case lies in between. This result depends strongly on the assumption that the household has no love for variety. Therefore, fiscal policy is more effective, under plausible assumptions, when entry means more firms per industry than when it means more brands. This applies for aggregate output and price index and, under particular assumptions, for household consumption and welfare as well. It is possible for the government to improve welfare using fiscal policy in cases I and III, but not in case II. Once again the assumption about love for variety is crucial. The subset of the parameters' space for which a welfare improvement happens when there is a different fiscal policy is more restricted in case III since part of the entry stimulus is directed to change the number of non-tradable good industries.

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## APPENDIX A

The reduced form for the parameters giving us $\hat{F}^* = \hat{F}$ are $R_0 \geq R_1$

$$R_0 = \frac{\alpha.\mu.\beta.(1-\gamma).\Delta_s}{D_s} \quad , \quad R_1 = \frac{\alpha.\beta.(1-\gamma).\rho.\left[\mu.(1-v_s)-(1-\alpha).v_s\right]}{D_s} \qquad s = \text{I, II, III}$$

where $D_s = \Theta_s.\Delta_s + S_s.v_s$ is assumed to be positive. The new parameters are given by

$$\Theta_s = \varphi.(1-v_s)-(1-\alpha).v_s \quad , \quad \varphi = (\mu-\gamma)-\alpha.\gamma.(\mu-1) > 0 \quad , \quad S_s = s_1 - s_2.v_s \qquad s = \text{I, II, III}$$

$$s_1 = (\rho+1-\alpha).\varphi+(1-\alpha).\gamma.\alpha.\beta.(\mu-\phi) \ , \ s_2 = (\rho+1-\alpha).(\varphi+1-\alpha) > 0$$

The complexity for the expression of $D_s$ does not allow us to demonstrate it is always positive. However, numerical experiments for plausible values of the parameters did not generate an equilibrium able to produce $D_s \leq 0$.

## APPENDIX B

For temporary fiscal shocks, we know $\hat{F} \leq 0$, therefore:

$$\frac{\hat{F}|_{\text{Case II}}}{\hat{F}|_{\text{Case I}}} = 1 - \frac{(1-\alpha).\alpha.\gamma.(\mu-\phi).(1-\beta).b_1.b_2}{\varphi.\Delta_1} \geq 1 \Rightarrow \hat{F}|_{\text{Case II}} \leq \hat{F}|_{\text{Case I}}$$

$$\frac{\hat{F}|_{\text{Case III}}}{\hat{F}|_{\text{Case I}}} = 1 - \frac{(1-\alpha).\alpha.\gamma.(\mu-\phi).(1-\beta).\rho.b_1^{\,2}.b_2^{\,2}}{\Delta_1.D_3.(1+b_1.b_2)} \geq 1 \Rightarrow \hat{F}|_{\text{Case III}} \leq \hat{F}|_{\text{Case I}}$$

$$\frac{\hat{F}|_{\text{Case II}}}{\hat{F}|_{\text{Case III}}} = 1 - \frac{(1-\alpha).\alpha.\gamma.(\mu-\phi).(1-\beta).k_1.b_2}{\varphi.\Delta_3} \geq 1 \Rightarrow \hat{F}|_{\text{Case II}} \leq \hat{F}|_{\text{Case III}}$$

For permanent fiscal shocks, we know $\hat{F}|_{\text{Case II}} = 0$, therefore:

$$\hat{F}|_{\text{Case I}} = \frac{\alpha.\beta.\gamma.(1-\gamma).(1-\alpha).b_1.b_2.\left[1-\alpha.(1-\phi)\right]}{D_1} \leq 0 \Rightarrow \hat{F}|_{\text{Case I}} \leq \hat{F}|_{\text{Case II}}$$

$$\hat{F}|_{\text{Case III}} = \frac{\alpha.\beta.\gamma.(1-\gamma).(1-\alpha).k_1.b_2.\left[1-\alpha.(1-\phi)\right]}{D_3} \leq 0 \Rightarrow \hat{F}|_{\text{Case III}} \leq \hat{F}|_{\text{Case II}}$$

$$\frac{\hat{F}|_{\text{Case I}}}{\hat{F}|_{\text{Case III}}} = \left(1+\frac{z}{D_1}\right).(1+b_1) \geq 1 \Rightarrow \hat{F}|_{\text{Case I}} \leq \hat{F}|_{\text{Case III}}\,, \quad z = \frac{b_1^{\,2}.b_2^{\,2}.\left\{\varphi.\rho+(1-\alpha).\left[\rho-\gamma.\alpha.\beta.(\mu-\phi)\right]\right\}}{1+b_1.b_2} \geq 0$$

# TABLES

## TABLE 1

### TYPOLOGY OF MARKET STRUCTURES FOR THE NON-TRADABLE GOOD SECTOR

| $n \rightarrow$ <br> $m \downarrow$ | One | Few | Many |
|---|---|---|---|
| One | Monopoly [a] | Bertrand Oligopoly with Differentiated Goods [a] | Monopolistic Competition |
| Few | Cournot Oligopoly with One Homogeneous Good [a] | Cournotian Oligopolistic Competition [a] | Cournotian Monopolistic Competition |
| Many | Perfect Competition | Perfect Competition | Perfect Competition |

[a] If the sector is large in the economy, there are Ford effects which have to be considered.

## TABLE 2

### STEADY STATE STATIC MULTIPLIERS[a]

| | $\hat{G}^*$ | $\hat{F}^*$ |
|---|---|---|
| $\hat{Y}^*$ | $\sigma_{Y,G}^{(s)} = \frac{1-\gamma}{\Delta_s}.\left[1-\alpha.(1-\phi)\right].(1-v_s) \geq 0$ | $\sigma_{Y,F}^{(s)} = \frac{1-\beta}{\beta.\Delta_s}.\left\{\left[\gamma.(1-\alpha.(1-\phi))-\phi\right].(1-v_s)-(1-\alpha).v_s\right\} < 0$ [b] |
| $\hat{C}^*$ | $\sigma_{C,G}^{(s)} = \sigma_{Y,G}^{(s)} - 1$ | $\sigma_{C,F}^{(s)} = \frac{1-\beta}{\beta.\Delta_s}.(\mu-\phi).(1-v_s) \geq 0$ |
| $\hat{P}^*$ | $\sigma_{P,G}^{(s)} = -(1-\alpha).\frac{1-\gamma}{\mu.\Delta_s}.\left[\mu.(1-\phi).(1-v_s)+\phi.v_s\right] \leq 0$ | $\sigma_{P,F}^{(s)} = (1-\alpha).\frac{1-\beta}{\beta.\Delta_s}.\frac{\mu-\phi}{\mu.\alpha}.\left[(\mu-\gamma).(1-v_s)-v_s\right] \geq 0$ |
| $\hat{m}^*$ | $\sigma_{m,G}^{(s)} = \frac{1-\gamma}{\Delta_s.b_2}.v_s.\left[1-\alpha.(1-\phi)\right] \geq 0$ [b] | $\sigma_{m,F}^{(s)} = \frac{1-\beta}{\beta.\Delta_s.b_2}.v_s.(\mu-\phi) \geq 0$ [c] |

[a] For $s$ = cases I, II and III.

[b] Assuming the marginal propensity to consume of interest income is less than one.

[c] Rigorously, these multiplier have no meaning for $s$ = case II.

TABLE 3

STATIC FISCAL MULTIPLIERS COMPARED

| Endogenous variable | Multipliers in the three cases considered |
|---|---|
| $\hat{Y}^*$ | Case I > Case III > Case II |
| $\hat{C}^*$ | Case I > Case III > Case II |
| $\hat{P}^*$ | Case I < Case III < Case II |
| $\hat{m}^*$ | Case I > Case III > Case II (0) |

FIGURES

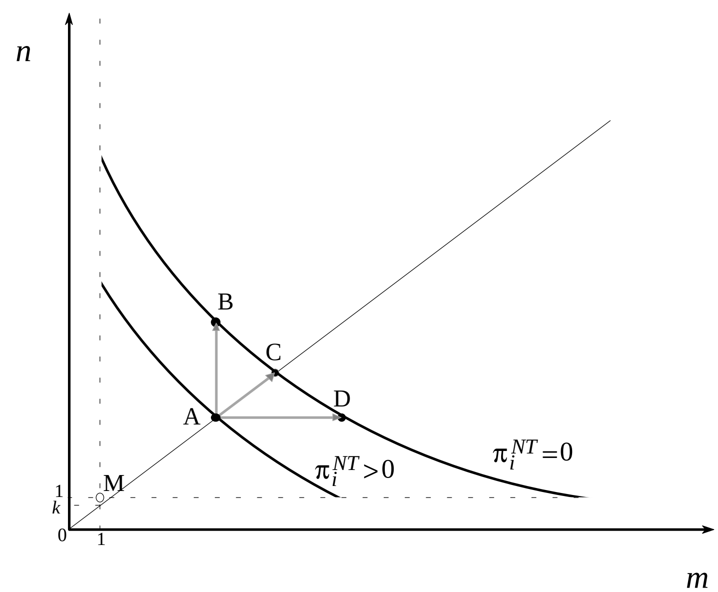


FIG. 1. ZERO PROFITS IN THE NON-TRADABLE GOOD SECTOR