

# The role of Advertising in the Aggregate Economy: the Work and Spend Cycle

Preliminary and Incomplete\*

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## Abstract

This paper investigates the effects of advertising in the aggregate. First, we construct a database at quarterly frequency for aggregate advertising expenditures in US economy, and we report on the three main empirical regularities observed: advertising is strongly procyclical, highly volatile and very persistent over the cycle.

Then, a dynamic stochastic general equilibrium model is developed to account for these facts. We suppose that advertising acts as a (additive) taste shock on individual goods demands; this is the main novelty of the model.

The implications of advertising in the model economy are the following: first, it increases the time devoted to work both in long-run and short-run; second, it increases aggregate consumption and output. We conclude that a *work and spend cycle* is apparent in our model, and this turns out to be an alternative explanation of why historically the aggregate hours worked have not fallen despite a raising trend of the real wages.

Finally, the model is shown to have a stronger propagation mechanism with respect to the standard RBC model, and the mark up turns out to be time-varying.

JEL Classification: D10, E32, J22

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Business Cycle fluctuations.

## 1 Introduction

Advertising has been traditionally analyzed in a microeconomics context. In the IO literature many papers have been devoted to explaining the role of advertising in the market competition, and its effect on social welfare. The tradition of advertising in macroeconomics, instead, has been rather limited. Aggregate advertising expenditures account for no more than 2.5 per cent of GDP in developed countries. Perhaps with this fraction in mind, macroeconomists have concentrated more on the study of variables such as consumption and investment rather than advertising.

There is, however, a relatively minor branch of the literature that has tried to explain the aggregate effects of advertising; i.e. its effects on macroeconomic variables (see Jacobson and Nicosia (1981) for a survey). Basically, the motivation behind a macroeconomic analysis of advertising is the following: by its own nature advertising is supposed to tilt the demand for an advertised good, and so to influence the consumption of that good. If such relationship were true for all the advertised goods, and it remained true at aggregate level, then advertising would have effects on aggregate demand, and consequently on output dynamics. In this perspective, advertising would belong to that set of variables which are not important as components of the output, but are important because they create an indirect mechanism that affects significantly aggregate dynamics, as in the case of inventories or menu-costs.

The main concern in the macroeconomic literature of advertising has been to show that the relationship advertising-consumption holds true at aggregate level. On the empirical end, it has been looked for evidences of such aggregate relationship mostly using econometric tools as cointegration analysis, or Granger causality.<sup>1</sup> Despite the large amount of evidences provided, none of those papers was conclusive. On the theoretical end, the causal relationship between advertising and consumption has been object of various conjectures; it was appealing to the most distinguished classical economists. Marshall (1918), Kaldor (1950), Galbraith (1967), Stigler (1961), Arrow (1962) and Solow (1968), among others, used to identify advertising as one of the variables that affect the aggregate demand. Yet, none of these conjectures led to a conclusive analytical model to test the different hypotheses and the implications of advertising in the aggregate.

The purpose of this paper is to provide such analysis using the framework of today's macroeconomic models. In details, we first build up an empirical dataset of the aggregate advertising expenditures at business cycle frequency in US market. The quarterly data of advertising expenditures are not available among the standard business cycle statistics, so we had to go through various sources to put together the dataset. In section 2 we explain the empirical work

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<sup>1</sup>See, for instance, Granger et al. (1980), Brack and Cowling (1983) or, more recently, Jung and Seldom (1995), Fraser and Paton (2003).

we carried on, together with a description of the data we achieved to collect, and the empirical facts that we have found there.

Next, we set up a dynamic stochastic general equilibrium model that takes advertising expenditures into account. In the literature there isn't a standard approach about the economic effects of advertising assumptions. The main assumption we do is that advertising shifts consumers' preferences as an endogenous taste shock. From this assumption we derive the key microeconomic relationship of the model: the impact of advertising on the demand of a single variety good. With this relationship at hand, a new problem of profit maximization is set up, where the firms are called to decide on both sales and advertising intensity, which are now complementary strategies. Finally, these relationships are plugged in an otherwise conventional multisector neoclassical growth framework so that the GE model can be solved and simulated.

The resulting equilibrium can match the empirical regularities identified in Section 2. More interestingly, in model economy advertising triggers a *work and spend cycle*:<sup>2</sup> agents work more in order to afford a higher level of consumption, whose need in terms of utility is in part due to the advertising signals they are exposed to. Such phenomenon works both in the long and in the short run, and it is a result that supports the conjectures of the Postmodernist Critique.<sup>3</sup>

Regarding the short run impact of advertising, we show that exogenous shocks are clearly amplified and further propagated when the firms are allowed to advertise. More in general, in the Impulse Response Functions – hours worked, consumption, output, etc. – the internal propagation mechanism of the standard RBC is endogenously magnified. From a macroeconomic point of view, this feature of the model is important because the RBC framework has often been criticized for the weakness of its propagation mechanism. Besides, this finding supports the intuition of Kaldor (1950):

*"... as a matter of fact, the scale of expenditures on advertising varies positively with the general level of economics activity, so that, in so far as the effect of marginal expenditures is positive, advertising itself tends to accentuate the amplitude of economic fluctuations..."*

Another interesting feature of our model is the time variability of the mark up. This result is due to the price elasticity of our demand function, which now depends on the level of advertising that may change in each period.

## 2 Stylized Facts about Aggregate Advertising

In this section we analyze the cyclical behavior of advertising expenditures compared with the GDP and its main components. We rely on two series of data about advertising. The first one reports the total yearly expenditures in advertising in all the media from 1948 to 2005. In the second one, we collected the

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<sup>2</sup>It owes its name to J. Schor (1992).

<sup>3</sup>See Benhabib and Bisin (2000).

quarterly figures of money spent by firms in the US market for the advertisements in American newspapers and Internet.<sup>4</sup> This is a partial series of total aggregate expenditures, since we gathered data only for two out of the seven main media that are usually referred to as the standard channels for advertisements.<sup>5</sup> Yet, our series accounts for almost 30% of the total. And was a valuable part of the present work to create the only series of quarterly figures of aggregate expenditures in advertising in US we are aware of. All the other available series of have figures only up to 1968, which is the last year when the federal administration collected data on advertising.

We begin our analysis providing some descriptive statistics of the yearly data. In panel 1 of Figure 1 we plot the annual ratio of total advertising expenditures to GDP in US economy in the period 1948-2005.

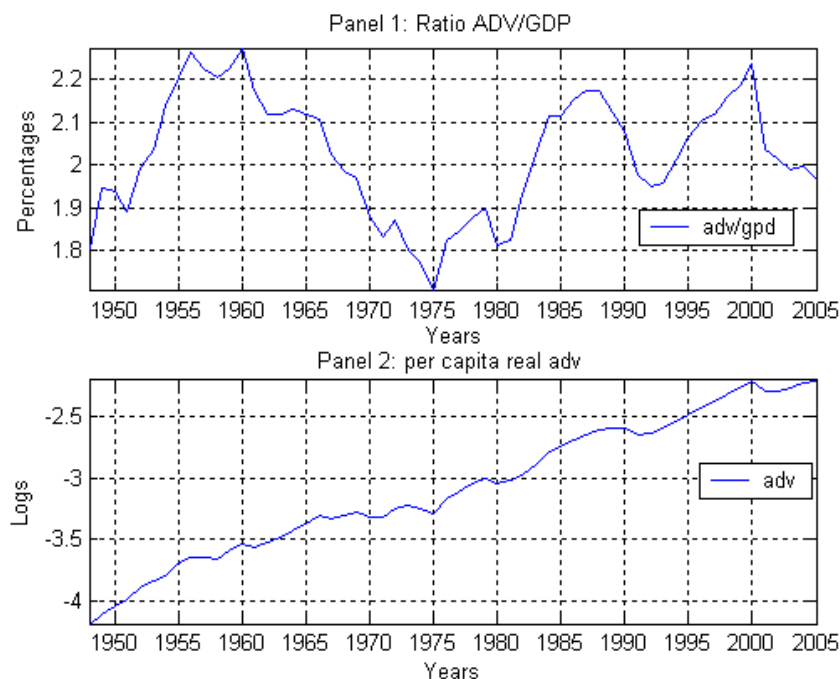


Figure 1:

This ratio fluctuates around 2% throughout all the sample, with peaks of almost 2.3%. In other words, it tells us that in US economy the advertising

<sup>4</sup>All the details about the data are reported in Appendix A.

<sup>5</sup>These media are: television, radio, newspapers, internet, billboards, direct mails, and outdoor advertising.

absorbed around 220 billions dollars in year 2000, and the message it gives us is twofold: first, advertising *per se* is a non-negligible industry for the US economy. Second, this money was spent to tilt consumers' demands of goods, and actually they seem big enough to have had consequences on the aggregate demand itself.

In general, the phenomenon of advertising is not US specific, but it is robust across countries, as is shown in Table 1.

**Table 1. International Advertising statistics**

Country	$mean \left( \frac{Adv}{Gdp} \right)$	$std.dev. \left( \frac{Adv}{Gdp} \right)$
France	0.718 %	0.077
Germany	0.877 %	0.017
Netherlands	0.835 %	0.030
Spain	1.100 %	0.288
UK	1.374 %	0.055
Europe	0.864 %	0.040

Yearly data, sample 1990-1996. Source Zenithmedia

Panel 2 of Figure 1 has the per capita real advertising expenditures: advertising displays a strong upward trend conditional on population growth. Thus, the phenomenon seems to enlarge in recent years.

We now switch to quarterly data. Panel 1 of Figure 2 plots the real advertising expenditures in newspapers and Internet along with the cyclical component of real GDP, for the period 1971-2005. All the variables are logged, and are detrended using a band pass filter.<sup>6</sup> In advertising series we took away the seasonal component.

<sup>6</sup>Since the band pass (Baxter and King, 1995) is an approximation of the optimal filter, we control for spurious relationships calculating the above statistics twice: with the band pass and with the Hodrick-Prescott filter. HP statistics are available upon request.

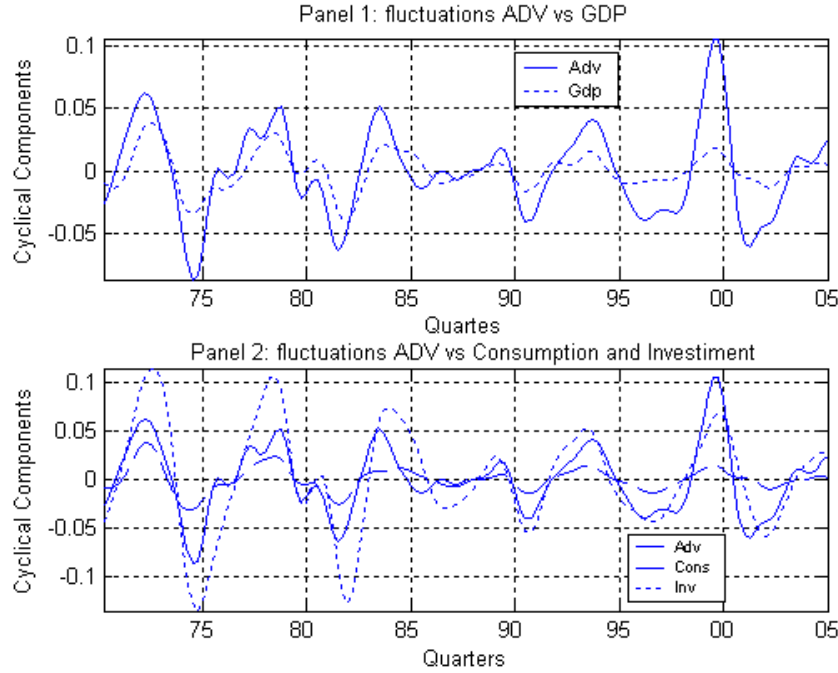


Figure 2.

Basically, panel 1 shows two facts:

- Advertising expenditures are procyclical.
- The advertising is more volatile than GDP, and this volatility has increased in the last part of the sample.

We check these two facts with the standard business cycle statistics.

**Table 2. Business cycle statistics (Quarterly data)**

$X_t$	$\sigma(X_t)$	$\frac{\sigma(X_t)}{\sigma(Gdp_t)}$	$\rho$	$\sigma(X_t, Gdp_t)$	$\sigma(X_t, Gdp_{t+1})$	$\sigma(X_t, Gdp_{t-1})$
GDP	1.54	1	0.93	1	0.93	0.93
Adv	3.61	2.34	0.93	0.80	0.82	0.69
$\frac{Adv}{Gdp}$	2.65	1.65	0.92	0.52	0.41	0.41
News. alone	3.05	1.99	0.92	0.83	0.85	0.71

Note: All variables are in logs, and are detrended using the Band Pass (6,32) filter.  $\rho$  is the sample first-order serial correlation coefficient. Adv is the sum of advertising expenditures in Newspapers and Internet. Data sample goes from 1971q1 to 2005q4

Table 2 confirms that advertising has a positive correlation coefficient of 0.8 with GDP, and it is 2.34 times more volatile than output. Plus, it appears to be very persistent over the cycle, with 0.9 point estimate of the first order autocorrelation. That is true both for aggregate series and for newspapers alone. Regarding the single components of our advertising series, Internet data do not make any sensible difference, except for bringing some extra volatility to the aggregate series.

Finally, the positive correlation (coeff. 0.52) of the ratio – advertising expenditures to GDP – on GDP itself, suggests that the advertising can't be assumed simply as a constant proportion of the output. In the next section, we set up a model where the firms' optimal policy rule for advertising is able to match this statistics.

As we said, we have only a partial series of advertising expenditures at quarterly frequencies. It can be questioned whether our figures are really representative of the total expenditures. To address an answer, we check the robustness of previous facts by computing the same statistics at annual frequencies, whose figures include the whole expenditures in all the media. The results are reported in Table 3.

**Table 3. Business cycle statistics (Yearly data)**

$X_t$	$\sigma(X_t)$	$\frac{\sigma(X_t)}{\sigma(Gdp_t)}$	$\rho$	$\sigma(X_t, Gdp_t)$
Gdp	1.40	1	0.07	1
Adv	2.40	1.70	0.16	0.69
$\frac{Adv}{Gdp}$	1.77	1.23	0.14	0.10
Newspapers	2.90	2.02	0.16	0.63
Magazines	3.60	2.53	0.19	0.76
Radio	2.40	1.68	0.12	0.57
Television	7.70	5.40	-0.03	0.54
Outdoor	3.80	2.65	0.01	0.51

Note: all variables are in logs, and are detrended with the Band Pass (2,8). Data sample goes from 1947 to 2005.

The annual figures confirm the quarterly data evidences. Total advertising expenditures are procyclical –  $cov(Adv_t, GDP_t) \simeq 0.7$  – and they are more volatile than output –  $\sigma(Adv_t)/\sigma(GDP_t) = 1.70$ . Most important, the comparison between the behavior of newspapers and the total advertising – i.e. standard deviation, autocorrelation, and correlation with GDP – indicates that the joint series of advertising in newspapers and internet can be considered a good proxy for total advertising.

To return to the quarterly series, we now investigate the relationships of advertising with consumption and investment. The literature about the macroeconomics effects of advertising has always focused on the relationship of advertising



on consumption. Since advertising is supposed to tilt consumers choices, it is natural to explain the effects of advertising on the aggregate economy through this channel.

Panel 2 in Figure 2 plots quarterly advertising along with consumption and investment. The advertising seems positively correlated with both consumption and investment. Plus, it appears to be more volatile than Consumption but less volatile than Investment. Table 4 provides the accompanying business cycle statistics.

**Table 4. Business Cycle Statistics (Quarterly data)**

$X_t$	Consumption			Invest.	
	Total	Non-dur.	Dur.	Serv.	Total
$\frac{\sigma(Adv_t)}{\sigma(X_t)}$	2.87	3.30	0.88	4.72	0.49
$\sigma(Adv_t; X_t)$	0.83	0.80	0.83	0.75	0.83

All variables are in logs, and are detrended with BP(6,32).

Data sample goes from 1971q1 to 2005q4

The correlation coefficient between advertising and consumption is 0.83, which is slightly higher than with GDP. The relative standard deviations is 2.87, i.e. advertising more than twice more volatile than consumption, but it has half the volatility of investment:  $\sigma(Adv_t)/\sigma(I_t) = 0.49$ . In details, the advertising is 4 times more volatile than Services, 3 times more volatile than non-durable consumption, and less volatile than durable goods (the relative standard deviation is equal to 0.88).

Interestingly, the advertising turns out to have a cyclical behavior similar to the investment variables, i.e. it is strongly procyclical and highly volatile. Nerlove and Arrow (1962) made the same point. They argued that a good advertising campaign could influence the demand for many periods of time. Thus, the advertising seems to add up to a stock rather than been a single-period-lasting flow.

Accordingly, we will model advertising to influence present and future demand of goods, and so the present and the future revenues of the firm that advertises. This point will be more clear in the section about the model. At the moment, we just anticipate that such temporal effect of advertising is captured by the concept of *the goodwill*,<sup>7</sup> where advertising is modeled like a flow that adds up into a stock that accumulates (and depreciates) as the time goes by, exactly as the stock of physical capital.

The last issue of this section is the dynamic cross correlations between advertising, consumption and investment, which are provided in Table 5. The

<sup>7</sup>This concept was introduced by Arrow (1962).

dynamic correlations show that advertising and consumption move contemporaneously (the stronger correlation occurs at  $k=0$ ), and the same is true for advertising and investment, even though in this case the evidence is weaker: the correlation coefficients at  $k=0$  and  $k=1$  are almost the same.

**Table 5. Dynamic cross correlations (quarterly data)**

$\sigma(\mathbf{X}_t, \mathbf{Gdp}_{t+k})$									
<b>k</b>	<b>-4</b>	<b>-3</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
Adv.	0.00	0.25	0.50	0.69	0.80	0.82	0.72	0.58	0.41
Cons	0.04	0.29	0.54	0.76	0.90	0.93	0.86	0.70	0.47
Inv	0.12	0.42	0.70	0.89	0.95	0.88	0.71	0.49	0.26
$\sigma(\mathbf{Adv}_t, \mathbf{Gdp}_{t+k})$									
Cons	0.25	0.47	0.67	0.79	0.83	0.78	0.65	0.48	0.30
Inv	0.06	0.30	0.52	0.71	0.83	0.82	0.72	0.54	0.33

All variables are in logs, and are detrended with BP(6,32).  
Data sample from 1971q1 to 2005q4.

Such time path of advertising contrasts with the one found in Blank (1962). He reported evidences that advertising tends to lag output, and similar results are found in Yang (1964). The difference may be due to the different data samples, or to the different detrending filters used in their papers.<sup>8</sup> Either way, our dynamic cross-correlation evidences dismiss the conventional idea that advertising can be a leading indicator of the cycle.

To summarize, our main findings are:

- The amount of resources invested in advertising is a non-negligible industry that accounts for around 2 per cent of GDP. Plus, the per capita real advertising series shows a strong upward trend in time.
- Advertising is strongly procyclical and highly volatile. This is true at both quarterly, and yearly frequencies. In quarterly data, advertising is quite persistent over the cycle.
- Advertising expenditures are positive correlated with both consumption, and investment. However, they are more volatile than consumption (and its non durable component), but less than investment, and durable consumption.

<sup>8</sup>Both the papers used first differenced data, which has been argued to be not a valid method to isolate the business cycle component in the time series.

- The dynamic cross-correlations show that advertising expenditures and total consumption tend both to lead GDP over the cycle, while the biggest cross-correlation between consumption and advertising is the contemporaneous one.

## 3 The model

### 3.1 Overview and basic assumptions

To investigate aggregate advertising, we propose a variant of the Real Business Cycle framework. The baseline is a stochastic neoclassical real growth model with monopolistic competition, two sectors – producing Consumption and Investment –, modified to capture the effects of advertising on the consumption goods.

In particular, we assume that consumption goods are produced by a continuum of single-good producers in a monopolistic competition sector. We model the effect of advertising within the demand of single variety as a taste shock that triggers *urge to consume* in the agent. Producers are aware of this persuasive power, and they use (costly) advertising as a complementary policy together with the pricing policy. The sector generates an amount of profits  $\Pi_t$ , which are redistributed lump-sum to the representative consumer in each period.

To keep the model as simple as possible, Investment, which is not the main issue, is an homogeneous good  $I_t$  produced by a perfectly competitive sector, whose demand function is not affected by advertising. It adds up to the capital stock  $K_t$ , which evolves accordingly to the standard Law of Motion. The representative agent invests to bring her purchasing power to future periods. The sector does not generate any profit, so it has no impact on the representative consumer’s budget constraint.

Given such framework, we derived a nonconventional demand schedule for consumption goods, and we plug it in an otherwise conventional Multisectorial Real Business Cycle model. In the model economy the firms use the advertising in a way that makes it procyclical, and highly volatile, as we found it in actual data. This is the first result we obtain. The other findings in terms of aggregate dynamics are presented in section 4.

### 3.2 The demand of goods and the role of advertising

Key ingredient of this model, we now study the effect of advertising on consumer’s demand. The advertising acts as an endogenous taste shock on the consumption of individual goods. So, the more the firm spends to advertise the good, the higher it fosters the sales, but with a decreasing returns effect. This assumption is well documented and supported at firm level by a large number of empirical studies,<sup>9</sup> and it is one of the few empirical evidences about advertising that is not source of controversy in the literature.

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<sup>9</sup>See Bagwell (2005) Section 3.2 for a survey of these studies.

Once one accepts the positive relationship between advertising intensity and sales, it is quite immediate to show that the advertising must be an argument in the utility function of the agent, as long as we consider an equilibrium model with Walrasian demand functions. In particular, in order to obtain a demand with the characteristics described above, the advertising must be a complementary argument of the consumption in the utility function. In particular, out of various options, we find that the best candidate given our assumption of advertising as taste shock is a preferences system à la Stone-Geary, where the utility of a good is measured by the distance from the actual consumption to the minimum subsistence level. The standard interpretation of "minimum subsistence level" is the level for the agent to survive, which is hard to have a literal interpretation in contemporaneous economies. More reasonably, the minimum subsistence level of consumption of an individual good nowadays is function of different variables, like how vivid is the good in the memory of the consumer when he shops; and/or how many usages are possible of that good with respect to other similar goods; and/or whether there is a social status associate with the consumption of that specific good. Thus, the advertising seems precisely the sort of variable that can affect the minimum subsistence level either because it hits the consumer with new information about the good, or because it shows to her some added value in purchasing the advertised good.

Our second and last assumption about advertising regards its temporal effect. The evidence that the effects of an advertising campaign on sales lasts in time is another reliable empirical regularity that we borrowed from the empirical microeconomic literature in order to build up our model.<sup>10</sup> In particular, when the agent consumes a good she perceives a level of utility which is likely to be affected not only by the current advertising expenditures, but also by the past advertisements, with an intensity that fades out as the time goes by. Hence, we assume that current and past advertisements add up to create the reputation of a good, the producer's *goodwill*, and we define it as the intangible stock of advertising that affects the consumer's utility at time  $t$ . Such stock is supposed to summarize the effects of current and past advertising outlays on the demand.<sup>11</sup>

For the good  $i$  at time  $t$ , the law of motion of the goodwill  $G_{i,t}$  is:

$$G_{i,t} = (1 - \delta_g) G_{i,t-1} + Z_{i,t} \quad (1)$$

where  $Z_{i,t}$  is the current advertising outlays, and  $\delta_g$  is the depreciation rate of the goodwill.

We use these two assumptions to modify the standard monopolistic competition framework. As usual, there is a continuum of imperfect substitute goods indexed  $i$  in the interval  $(0, 1)$ . The consumer chooses her optimal (intratemporal) consumption basket by solving the standard expenditure minimization

<sup>10</sup>In particular, see Clark (1976) for a survey of the empirical results about the temporal effects of the advertising.

<sup>11</sup>We owe the formulation of the concept to Arrow and Nerlove (1962), which defined the Law of Motion of the *goodwill* in the continuum.

problem.<sup>12</sup> Accordingly with the Stone-Geary preferences system, the consumer derives her utility from an object  $\tilde{C}_t$  defined as:

$$\tilde{C}_t = \left( \int_0^1 (C_{i,t} - G_{i,t}^\theta)^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (2)$$

where  $\varepsilon > 1$  is the usual price elasticity of the demand, and  $\theta \leq 1$  is a structural parameter that controls for the intensity of the advertising in the utility function.

In the consumer's optimization problem  $G_{i,t}$  is given because the level of goodwill is decided by the firms. Thus, she chooses the best combination of goods  $C_{i,t}$  to minimize the total expenditures, given the levels of utility  $\tilde{C}_t$  and goodwills  $G_{i,t}$ . As result we find the system of demand equations:

$$C_{i,t} = \left( \frac{P_{i,t}}{P_t} \right)^{-\varepsilon} \tilde{C}_t + G_{i,t}^\theta \quad \forall i \in (0, 1) \quad (3)$$

where  $P_{i,t}$  is the price of good  $i$  at time  $t$ , and  $P_t$  is the price aggregator. This last is shown to be the Lagrange multiplier of the minimization problem, or:<sup>13</sup>

$$P_t = \left[ \int P_{i,t}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}} \quad (4)$$

Equation (3) is a key relationship in the advertising model; first, it shows that the goodwill raises the level of the demand, with concave effect for  $\theta < 1$ . As a consequence, the firm has now two complementary policies to push the demand.

Second, advertising affects the price elasticity of the demand, and makes it time dependent. The demand schedule (3) is composed by two terms: the first one,  $(P_{i,t}/P_t)^{-\varepsilon} \tilde{C}_t$ , which has elasticity  $\varepsilon$ , and the second one,  $G_{i,t}^\theta$ , which is totally inelastic. Thus, the resulting price elasticity of the demand of good  $i$  is a weighted average of the two. In details, from (3) we obtain the price elasticity:

$$|\eta_{c,p}| = \varepsilon \left( 1 - \frac{G_{i,t}^\theta}{C_{i,t}} \right) \quad (5)$$

For sake of comparison, the price elasticity of demand in the standard model of RBC with monopolistic competition is  $|\varepsilon|$ , which clearly is bigger than  $|\eta_{c,p}|$ .<sup>14</sup> The finding of a steeper demand schedule for an advertised good is a well know effect in the literature, named *the fidelization of the consumer*.

<sup>12</sup>A detailed derivation of the model is provided in Appendix B.

<sup>13</sup>As in the standard expenditure minimization problem (Dixit-Stiglitz, 1977), the Lagrange multiplier is the increase in consumer's expenditures for a marginal increase in the utility. The multiplier is omogeneous of degree one in all the prices  $P_{i,t}$  and, therefore, it fulfils the requirements to be the consumption price index of the model economy.

<sup>14</sup>Our model nests the standard one as a particular case. In facts, when the goodwill as no effect on the demand ( $\theta = 0$ ), the mark up is constant and equal to  $\varepsilon/(\varepsilon - 1)$  as in the standard case.

More interestingly from the point of view of this paper, the demand elasticity (5) implies that the mark up is time dependent in the model economy. Such implication matches the last empirical findings about the time variation of the mark up in US economy, and so doing it may address a solution to the recent critics to constant mark up in the standard RBC model. While this is an important issue, we don't pursue it in this paper, but we leave it for further researches.

### 3.3 The producers behavior in the Consumption sector and the optimal Advertising level

The Consumption sector is a monopolistic competition market with a continuum of firms indexed by  $i \in (0, 1)$ , where each firm produces a differentiated good using a Cobb-Douglas production function. Part of the product is used to pay the cost of advertising. Specifically,

$$Y_{i,t}^c = U_t^c A_t N_{i,t}^{\alpha_c} K_{i,t}^{1-\alpha_c} - Z_{i,t} \quad (6)$$

where  $A_t$  is the technology shock common to the two sectors, and  $U_t^c$  is a sector specific shock on consumption. Notice that the level of advertising  $Z_{i,t}$  is measured in units of good produced.

From the production function (6), we derived the total cost function for the firm:

$$TC(Y_{i,t}^c) = \underbrace{\left( B_c \frac{R_t^{1-\alpha_c} W_t^{\alpha_c}}{A_t U_t^c} \right)}_{\equiv MC_{i,t}} (Y_{i,t}^c + Z_{i,t}) \quad (7)$$

where  $B_c = \left( \frac{1-\alpha_c}{\alpha_c} \right)^{\alpha_c} \left( \frac{1}{1-\alpha_c} \right)$  is a constant term.<sup>15</sup> From (7) is apparent that the advertising does not enter into the marginal cost of the firm. We don't want, indeed, advertising to be a production factor. That structuring is in accordance with the Corporate Finance practice, where advertising is treated as a financial cost and not as a production cost. Plus, it stresses the difference of advertising from other non-pricing policies of the firm, like the R&D. In short, we develop a model where the advertising absorbs resources, but it does not change the structure of the production cost.

Let's now consider the firm's profit maximization. The producer has two complementary policies, the price and the expenditures in advertising, and she uses them jointly to maximize the infinite flow of future profits subject to the demand schedule (3), and the law of motion of the goodwill (1). The problem can't be written as a sequence of static (in period) maximizations as in the standard monopolistic competition case, because the law of motion of the goodwill makes the decision in  $t$  affecting the optimization in  $t + 1$ . Formally,

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<sup>15</sup>See Appendix B.2

the dynamic programme is:

$$\begin{aligned}
& \underset{\{P_{i,t+j}, G_{i,t+j}\}_{j=0}^{\infty}}{\text{Max}} \sum_{j=0}^{\infty} \beta^j E_t [P_{i,t+j} C_{i,t+j} - TC_{i,t+j}^c(C_{i,t+j})] \\
& \text{s.t.} \quad C_{i,t} = \left( \frac{P_{i,t}}{P_t} \right)^{-\varepsilon} \tilde{C}_t + G_{i,t}^{\theta} \\
& \text{and} \quad G_{i,t} = (1 - \delta_g) G_{i,t} - Z_{i,t} \\
& \text{and} \quad TC_{i,t}^c = MC_{i,t}(Y_{i,t}^c + Z_{i,t})
\end{aligned}$$

From the associated system of First Order Conditions we derived two rules. First, the optimal pricing rule:<sup>16</sup>

$$P_{i,t}^* = \underbrace{\left( \frac{\varepsilon \left( 1 - \frac{G_{i,t}^{\theta}}{C_{i,t}} \right)}{\varepsilon \left( 1 - \frac{G_{i,t}^{\theta}}{C_{i,t}} \right) - 1} \right)}_{\equiv \mu_{i,t}} MC_{i,t} \quad (8)$$

The rule (8) resembles much the pricing in standard case: the firm sets the optimal price equal to the marginal cost times a mark up coefficient,  $\mu_{i,t}$ . But in this case the mark up is time varying, because here the price elasticity of the demand is not constant anymore, as we pointed out in section 3.2. Hence, an important corollary of the advertising model is the microfundation of the variability of the mark up in the cycle. Such corollary is specially interesting in relation to the recent literature about the time variability of the mark up and the so-called *deep habits* of the consumers.<sup>17</sup> Therefore, it will be object of further investigations.

Second, we obtained the optimal advertising policy of the firm:

$$\underbrace{\left( \mu_{i,t} - 1 \right) MC_{i,t} \cdot \frac{\partial C_{i,t}}{\partial G_{i,t}} + \beta (1 - \delta^g) E (MC_{i,t+1})}_{\text{marginal benefit}} = \underbrace{MC_{i,t}}_{\text{marginal cost}} \quad (9)$$

Equation (9) is a special case of the dynamic Dorfman-Steiner condition provided in Arrow and Nerlove (1962). It states that the firm invests in advertising until the marginal benefit of an extra unit of advertising equals the marginal costs of producing it. Because of the Law of Motion of the goodwill, the marginal benefit has two components: one is the increase in the revenues associated with a marginal increase in advertising; the other one is the discounted opportunity cost for producing the (depreciated) goodwill that survives tomorrow.

<sup>16</sup>See Appendix B.2 for the details of the derivations.

<sup>17</sup>See Ravn et al. (2005), forthcoming RES.

### 3.4 The complete model

To complete the design of the general equilibrium we need few more relationships. First, we characterize the consumer's intertemporal allocation of consumption and saving. From this exercise we obtain the aggregate labor supply and the aggregate demand schedule (the euler equation). Next, we place these relationships, together with the firms' optimal policies (8) and (9) within a standard multisector framework. Finally, we solve the model to find the non-cooperative symmetric equilibrium.<sup>18</sup> The equilibrium relationships make the influence of advertising on the model economy transparent.

It is worth noticing that the framework must fulfill some reasonable conditions about aggregate advertising.

1. The consumption in equilibrium cannot coincide with the aggregate demand. Against this option, Jung and Seldom (1995) argued that a positive effect of advertising on consumption is not enough to draw conclusions about the macroeconomic effects of advertising, because this last is likely to crowd out the Investments. Thus a one sector model with bonds, rather than a two sector model with investment, would not have been the appropriate choice here because the net supply of bonds is always zero in equilibrium, and the aggregate demand coincides with aggregate consumption. Hence, we introduced the Investment sector.
2. While it is reasonable to suppose that advertising affects Consumption, it is highly improbable that advertising affects also Investment. As claimed by Jung and Seldom, any effect of advertising on Investment must be indirect, and we will investigate the dynamics of the model to see whether the crowding out effect exists or not.
3. As a matter of fact, in present model advertising behaves as a taste shock. The comparison of the general equilibrium IRFs between an endogenous advertising shock and an exogenous taste shock it is an interesting exercise. Indeed, any qualitative difference of the two responses can be used in the estimation of the DSGE in order to disentangle the endogenous component of a demand shock from the exogenous (pure) taste shock.

Also, we don't need neither money nor nominal rigidities, because in first approximation we are interested in real effects of advertising. Finally, the assumption of monopolistic competition is not essential. Any framework with a downward slope demand function is suitable for our purposes. We chooses monopolistic competition because this approach has become widely accepted in the literature.

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<sup>18</sup>For the interested reader, the detailed derivation of all the equations is provided in Appendix B.



### 3.4.1 The Aggregate demand

Once the optimal composition of the goods aggregator is chosen, the consumer maximizes the intertemporal utility function. We follow the traditional formulation of the intertemporal problem in the RBC, where the representative consumer is an infinitely-lived agent who consume, work, and save. The utility is a CRRA separable function of two arguments: the consumption aggregator  $\tilde{C}_t$ , and the labor  $N_t$ . In fact, the consumer is endowed with one (normalized) unit of time, which can be devoted to work or leisure. As usual, the utility is time separable.

The consumer holds only one asset, the real capital. Using the conditional demand (3) the nominal budget constraint in each period can be written as:

$$\int_0^1 P_{i,t} C_{i,t} di + P_t^I I_t \leq W_t N_t + R_t K_t + \Pi_t \quad (10)$$

where we denote  $\Pi_t$  the profits of consumption sector.

We solve the intertemporal utility maximization problem in the appendix B.1. The first order conditions tell us how advertising affects the consumer's decisions about aggregate consumption. The Lagrangian multiplier of the problem,

$$\lambda_t = \tilde{C}_t^{-\sigma} \quad (11)$$

is the marginal utility of the consumer. The object  $\tilde{C}_t$  defined in (2) depends not only on consumption level, but also on goodwill. Therefore the marginal utility is now affected by variations of aggregate goodwill. In particular, insofar as  $\tilde{C}_t$  has negative first derivative with respect to the goodwill, advertising has a positive effect on marginal utility.

Besides, the labor supply schedule is the usual one,

$$\gamma N_t^\varphi = W_t \lambda_t \quad (12)$$

so as it is the euler equation,

$$1 = \beta E \left[ \frac{P_t}{P_{t+1}} \frac{\lambda_{t+1}}{\lambda_t} \frac{1}{P_t^I} (P_{t+1}^I (1 - \delta) + R_{t+1}) \right] \quad (13)$$

except for the fact that here advertising modifies both the labor supply and the level of consumption through its effect on marginal utility.

### 3.4.2 Partial Equilibrium analysis

We now analyse what happens to the consumer when all the firms invest an extra unit of advertising, i.e.  $\Delta Z_{i,t} > 0$ . Given the law of motion of goodwill (1), if  $Z_{i,t}$  increases then  $G_{i,t}$  raises at contemporaneous time. Thus,  $\tilde{C}_t$  decreases and the marginal utility  $\lambda_t$  increases because of (11). In equation (12) when  $\lambda_t$  increases, the agents evaluate more consumption relative to leisure, which in turns makes the agent more willing to work for any given level of wage.

Consider now the euler equation (13). An increase in  $Z_{i,t}$  will raise both  $\lambda_t$  and  $\lambda_{t+1}$ , since the goodwill is an autoregressive process. Holding everything else constant, consumption picks in  $t$ , and then follows a decreasing monotone time-path back to the steady state.

Since the advertising increases both the labor supply and the consumption, it triggers a "*work and spend cycle*" – which owes its name to J. Schor (1992). One relevant contribution of this paper is that we obtained such result using just few standard assumptions about advertising at individual good level rather than building up an ad-hoc formulation of advertising in the aggregate.

### 3.4.3 The General Equilibrium

To close the model we need to impose the two market clearing conditions for the factor markets (capital and labor), two for the goods markets (investment and consumption goods), and two resources constraints for the production factors:

Finally, the exogenous shocks are assumed to satisfy:

$$\begin{aligned} A_t &= (A_{t-1})^{\rho^a} e^{\varepsilon_t^a} \\ U_t^c &= (U_{t-1}^c)^{\rho^c} e^{\varepsilon_t^c} \\ U_t^I &= (U_{t-1}^I)^{\rho^I} e^{\varepsilon_t^I} \\ \Delta_t &= (\Delta_{t-1})^{\rho^\Delta} e^{\varepsilon_t^\Delta} \end{aligned}$$

where  $\rho^a, \rho^c, \rho^I, \rho^\Delta \in (0, 1)$  and  $\begin{pmatrix} \varepsilon_t^a \\ \varepsilon_t^c \\ \varepsilon_t^I \\ \varepsilon_t^\Delta \end{pmatrix} \sim N \left[ \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \sigma_a^2 & 0 & 0 & 0 \\ 0 & \sigma_c^2 & 0 & 0 \\ 0 & 0 & \sigma_I^2 & 0 \\ 0 & 0 & 0 & \sigma_\Delta^2 \end{pmatrix} \right]$

It can be shown that the equilibrium is symmetric for all the firm, since they all face the same marginal cost. This implies that all the prices are equals, which, in turns, lead to the same goodwill and consumption level for all the firms. A formal proof of the existence of the symmetric equilibrium is given in Appendix B.3.

## 4 Results

In what follows we show how advertising affects the model economy, and we provide some interpretations of the results.

### 4.1 Long run effects: The Steady-State

In this section we investigate impact of advertising in the long run. We perform the task analyzing how advertising changes the steady state of the model.

The first thing we observed is the increase in the steady state mark up  $\mu$ . Defining  $\mu_{std}$  the mark up in the standard two sector model, the following inequality holds:

$$\mu = \frac{\varepsilon \left(1 - \frac{G^\theta}{C}\right)}{\varepsilon \left(1 - \frac{G^\theta}{C}\right) - 1} > \frac{\varepsilon}{\varepsilon - 1} \equiv \mu_{std} \quad \forall G > 0 \quad (14)$$

where  $G$  is the steady state level of the goodwill. In the model solution we ruled out the trivial case  $G = 0$ .

Equation (14) tells us that advertising changes the perceived goods differentiation, so increasing the degree of monopoly power of the firms. An important implication, the factor price levels in steady state all diminish, i.e. wage, interest rate, and relative price of investment.<sup>19</sup> In turns, this means that the economy loses efficiency. Advertising does not modify the ratio of capital to total labor (as well as the ratios of the productive factors to total labor), and then the above condition also implies that all the productive factors level increase with advertising (see Appendix C.). Thus, the SS level of capital increases and moves away from the golden rule level.

We now turn to one of the crucial findings of the paper: the level of labor in equilibrium. The labor supply schedule can be written as,

$$\gamma N^\varphi = \left(1 - \frac{G^\theta}{C}\right)^{-\sigma} C^{-\sigma} W \quad (15)$$

Advertising operates on (15) in two opposite directions. On one side, it increases the steady state level of the labor  $N$ , proportionally to the coefficient  $\left(1 - \frac{G^\theta}{C}\right)^{-\sigma} > 1$ ,<sup>20</sup> on the other side, as we said above it diminishes  $W$ , so decreasing  $N$ . The total impact will depend on the relative forces of these two factors. In order to assess it, we compute the analytical derivative of  $N$  w.r.t  $G$  and we obtain the following result:

**Proposition 1** *Given a price elasticity of the consumption demand  $\varepsilon_A = \varepsilon \left(1 - \frac{G^\theta}{C}\right) \in (1, \varepsilon]$ , a sufficient condition for advertising to unequivocally increase the level of Hours worked in the long run, is that  $\sigma \geq \frac{1}{\varepsilon_A - 1}$ .*

**Proof.** See Appendix C. ■

<sup>19</sup>See Appendix C. for the mathematical details.

<sup>20</sup>Recall that with Stone-Geary preferences, for the utility function to be well-defined, it must always be that  $C_t \geq G_t^\theta$ ; otherwise the model would have negative utility. This condition, together with the assumption that  $G > 0$ , implies that  $0 < \frac{G^\theta}{C} \leq 1$ . Hence,  $0 \leq \left(1 - \frac{G^\theta}{C}\right) > 1$  and the statement in the text follows.

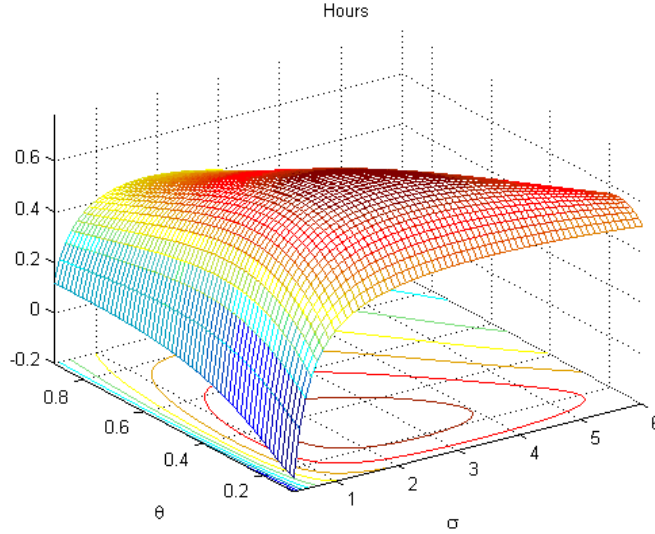


Figure 3. Sensitive Analysis. The value of  $\frac{\partial N}{\partial Z}$  for the range of parameters  $\sigma$  (the inverse of the Intertemporal Elasticity of Substitution) and  $\theta$  (advertising intensity).

Figure (3) shows the steady state reaction of Hours worked to a marginal increase of advertising. Proposition 2. gives a sufficient condition to have  $\frac{\partial N}{\partial Z} > 0$ , but the figure shows that this condition holds also when  $\sigma < 1$  insofar as the value of  $\theta$  is big enough. Hence, we can conclude that advertising increases the aggregate labor under a very wide parametrization, and in particular under the standard calibration used in the macroeconomic models.

As last issue, we assess the conventional statement that advertising absorbs resources in the economy. The consumption market clearing condition can be used to find an expression for the steady state value of consumption, i.e.

$$C = N \left( \frac{N_c}{N} \right) \left( \frac{K_c}{N_c} \right)^{1-\alpha_c} - Z \quad (16)$$

The effect of advertising on consumption level in the long run is twofold. It positively affects the labor supply  $N$  so pushing up  $C$ , but at the same time it directly crowds out the consumption ( $-Z$ ). As in the previous case, the actual impact depends on the model parametrization. In Figure (4) we graph the numerical derivative of consumption  $C$  with respect to advertising  $Z$ .

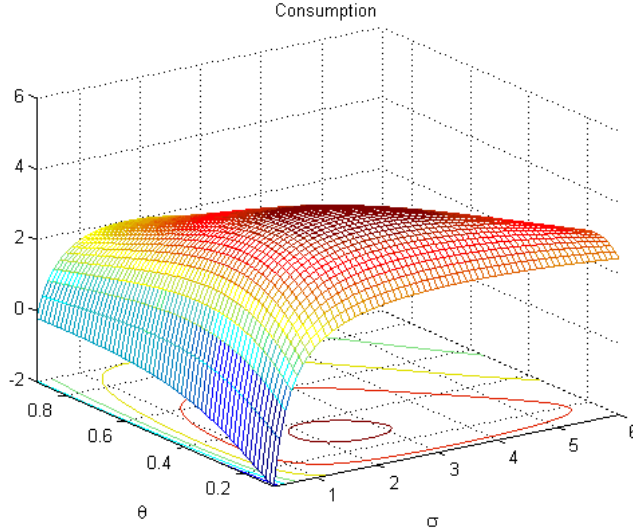


Figure 4. Sensitive Analysis. The value of  $\frac{\partial C}{\partial Z}$  for a reasonable range of parameters  $\sigma$  (the inverse of the Intertemporal Elasticity of Substitution) and  $\theta$  (advertising intensity).

In facts, the derivative  $\frac{\partial C}{\partial Z}$  is almost always positive: the advertising tends to push up the consumption in the long run. Consequently, its positive effect on labor tends to over compensate the crowding out of consumption, so that the net effect it is positive.

Beyond the net effect on consumption level, advertising also affects the relative composition of GDP in the economy. In details, the ratio of consumption to GDP can be recovered from equation

$$\frac{C}{Y} = 1 - p^I I \quad (17)$$

Again, the actual impact of advertising on this ratio depends on the calibration. From Figure (5) it turns out that  $\frac{C}{Y}$  increases with the effect of advertising. Therefore, we observe in relative terms a crowding out effect of advertising on investment. However the same it is not true in absolute levels, i.e. the steady state level of investment is still higher than the one in the benchmark model. Thus, it seems that the argument of Jung and Seldom (see section 3.1) holds only in relative terms; that is, in the long run advertising crowds out the investment on consumption ratio.

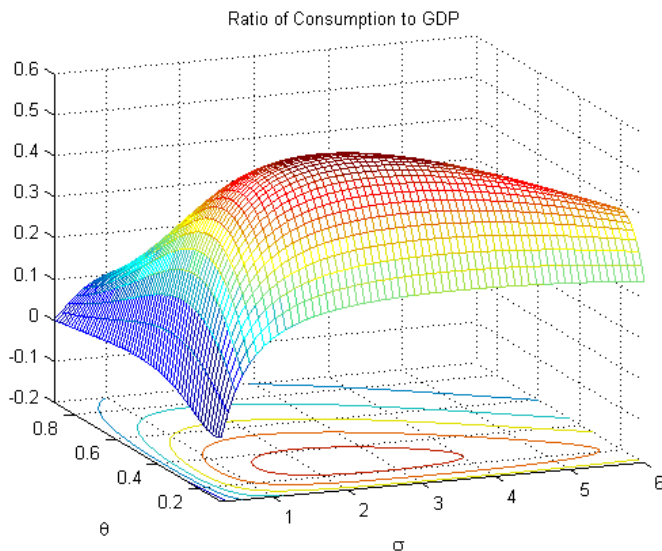


Figure 5. Sensitive Analysis. The value of  $\frac{\partial C}{\partial Z}$  for a reasonable range of parameters  $\sigma$  (the inverse of the Intertemporal Elasticity of Substitution) and  $\theta$  (advertising intensity).

In conclusion, it worth notice that the increase in  $\frac{C}{Y}$  is an evidence that supports the conjecture of Galbraith (1967), who argued that the more the countries get wealthier the more their economy gets consumption based for the growing expenditures of firms in advertising. however, is compensated in terms of aggregate output by the higher level of equilibrium labor.

## 4.2 Short run effects: the Aggregate Dynamics

We characterize the quantitative response of the advertising model to a variety of exogenous shocks. A loglinear approximation of policy functions in the neighborhood of the steady state is computed. Then, the model is calibrate to match US economy characteristics. We choose fairly standard values for the taste and technology parameters: the ratio of consumption on GDP is around 75%, the labor share in consumption sector production function  $\alpha_c$  is the standard  $2/3$ , while the same share in investment sector  $\alpha_I$  is smaller, i.e.  $1 - 2/3$ , as in the standard calibration of the two sectors RBC. The value of the goodwill depreciation is chosen to match the average duration of the effects of an advertising campaign on consumers' minds, which are been shown to last for around 3 quarters.<sup>21</sup> The following tables summarizes the whole set of calibration parameters.

<sup>21</sup>See Clarks (1976).

**Table 6. Calibrations**

Symbol	Value	Description
$\beta$	0.987	Subjective discount factor
$\delta_k$	0.025	Capital depreciation rate
$\alpha_c$	0.62	Labor intensity in consumption sector
$\alpha_i$	0.42	Labor intensity in investment sector
$\delta_g$	0.3	Goodwill depreciation rate
$N$	1/3	Steady state fraction of hours worked on total time
$\varepsilon$	5	Elasticity of substitution across varieties
$\theta$	0.927	Intensity of advertising
$\rho_a, \rho_c, \rho_i, \rho_\Delta$	0.94	Persistence of exogenous shocks
$\sigma$	2	Inverse of intertemporal elasticity of substitution
$\varphi$	1	Inverse of Frisch elasticity of labor supply
$\frac{\Delta}{C}$	0.1	Steady state ratio of taste shock to consumption

Figure 6. and 7. outline the aggregate dynamics of our model economy. Three sources of aggregate fluctuations are considered: a technology shock, a taste preferences (i.e. demand) shock, and finally an idiosyncratic shock to the consumption sector. We plot the model Impulse Response Functions (IRFs) together with the IRFs of the standard two sectors RBC model, in order to have a benchmark case for comparison. The continuous line is the advertising model, the dashed line is the standard RBC model. Recall that with the standard model the mark up is constant.

Figure 6 show that under all three shocks the advertising is procyclical (as in the stylized facts), with the higher response at time 0, as in the typical time-path of investment variables. In the case of positive technology shock – the first row of Figure 6. – the marginal cost of producing advertising diminishes, and for the firm is cheaper to advertise. Moreover, the marginal benefit of advertising raises when the consumption demand is increased by the shock. A lower marginal cost and an higher marginal benefit jointly push up the equilibrium level of advertising. While the effect on marginal cost is specific of the technology shock, the one on the marginal benefit is common among all the three cases, since every shock pushes up consumption, so explaining why advertising always reacts procyclically.

The procyclical behavior of advertising is the key to understand the propagation mechanism apparent in the IRF of consumption. In response to a shock the expenditures in consumption are amplified and made more persistent than in the benchmark case. At time  $t = 0$ , the resulting higher level of advertising increases the goodwill, so pushing up the marginal utility of the consumer. She reacts by raising her consumption at contemporaneous time; afterward, the euler equation (46) together with the law of motion of the goodwill, guarantees that the effect lasts in times. Eventually, the volatility of consumption fluctuations is magnified, as conjectured by Kaldor.

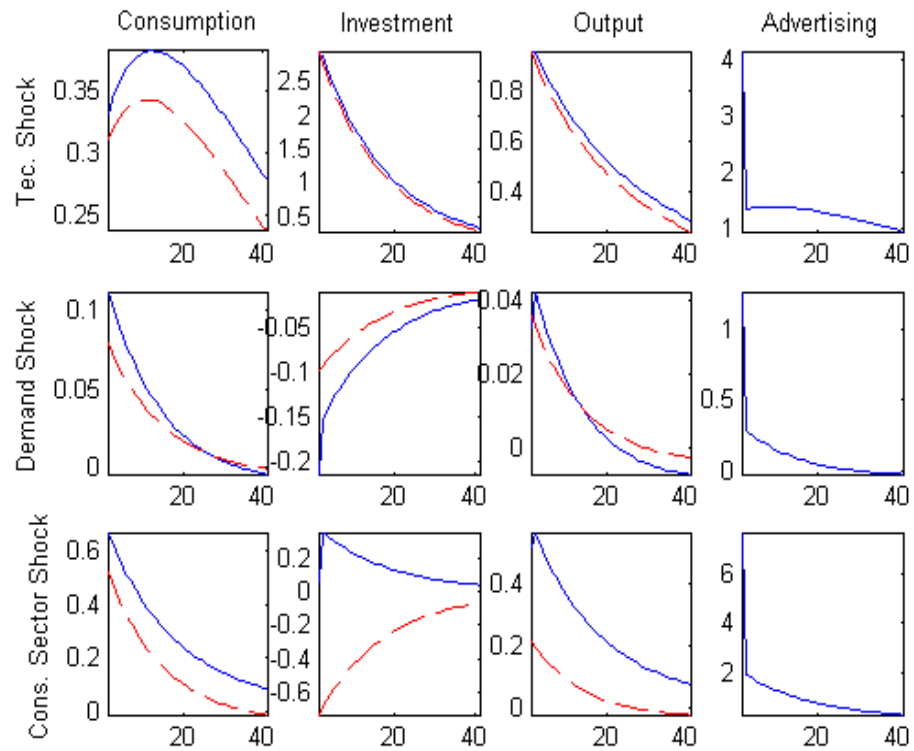


Figure 2: Figure 6. Impulse-response functions. Solid line model with advertising. Dashed line standard two sector model.



Interestingly, such propagation mechanism works also for the aggregate output. That's not trivial because the advertising crowds out the real investment expenditures, i.e.  $P_t^I \times I_t$ , and also it absorbs resources itself from the aggregate production, as turns out from the combination of equations (51) and (58) (see Appendix B.4). Yet, Figure 6 shows that the net effect is positive in terms of output volatility. Thus, our model economy, endowed with the same resources than the benchmark economy, seems able to afford an higher level of consumption and output, and also to produce the extra resources that are wasted for the unproductive advertising.

This observation leads us to explain the key point of the mechanism at issue: the effects of advertising on labor. In facts, in presence of advertising the consumer is willing to work more in order to buy more, because the marginal rate of substitution between leisure and labor is now lower, and she evaluates less her free time in terms of consumption.

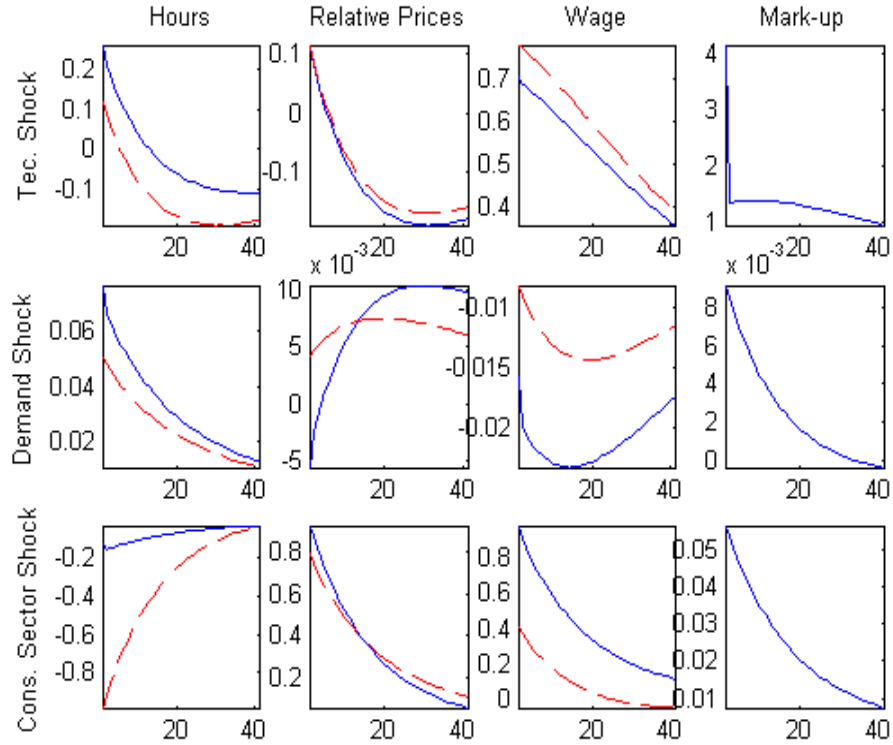


Figure 3: Figure 7. The Panel $_{i,j}$  refers to the IRF of the variable in column  $j$  to the shock in row  $i$ . All panels: time horizon in quarters on x-axis.

The mechanism is known in the literature as the *work and spend cycle* and has been supported by various empirical works, like Brack and Cowling (1983) for US economy, and Fraser and Paton (2003) for UK.

In conclusion, we are supporting the idea that the consumer wants more goods when they are advertised, and to afford them she is willing to work more. As a matter of fact, if we are right we should observe a stronger reactions of consumption and output when the consumer is less reluctant to work. In other words, when the elasticity of labor is higher. Figure 8. and 9. plot, respectively, the IRFs of consumption and output for different values of the Fisher elasticity of labor  $\frac{1}{\phi}$ .

$\phi = 0$  is the classical linear case of Hansen and Prescott (1982),  $\phi = 1$  is the log-labor case, and  $\phi = 1.3$  is the standard macroeconomic calibration used by Chari et al. (2000).

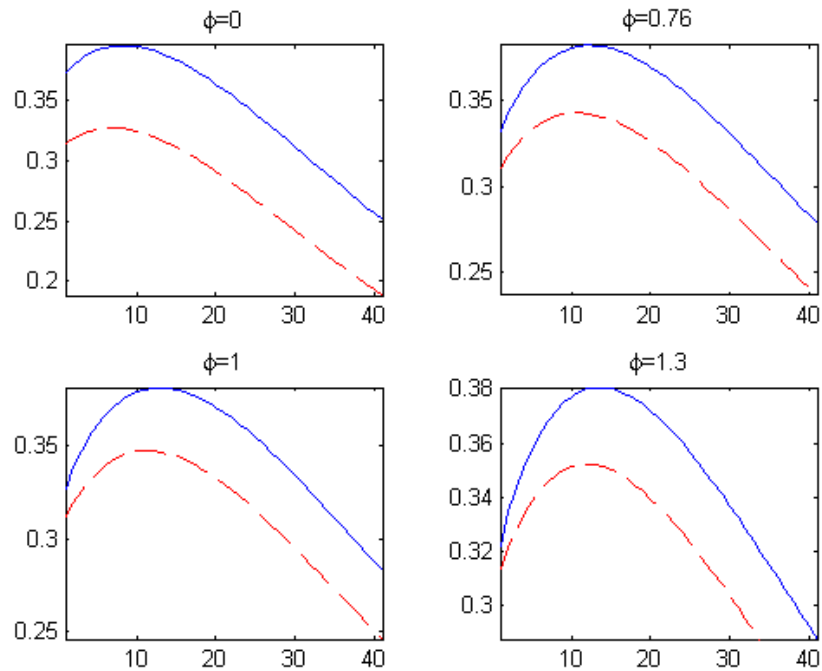


Figure 8. Sensitive analysis. IRF of Consumption for different values of the Frisch labor elasticity  $\frac{1}{\phi}$ .

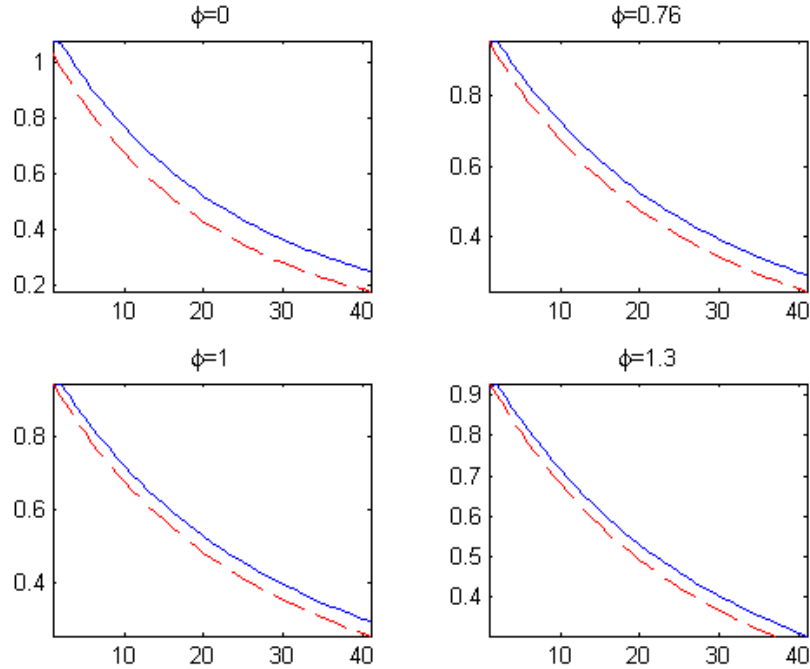


Figure 9. Sensitive analysis. IRF of Gdp for different values of the Frisch labor elasticity  $\frac{1}{\phi}$ .

The results goes in the right direction. The mechanism is stronger for smaller vales of  $\phi$ , which is the inverse of the labor elasticity, so the results of the model are consistent with the work and spend cycle explanation.

## 5 Conclusions

In this paper, we assessed the ability of aggregate advertising expenditures to affect the aggregate economy, by modelling advertising within a DSGE model. A central finding of our investigation is that advertising expenditures have a non-negligible impact on the aggregate economy in both long run and short run.

We allow producer's advertising to positively affect the consumer demand of each single variety good, accordingly with a Stone Geary preferences system. In aggregate terms, we find that advertising affects the total consumption as if it was an exogenous demand shock. As conjectures by Galbraith (1967), our model predicts that advertising not only affects the total amount of consumption expenditures but also the composition of the output.

In the short run advertising modifies the marginal utility of consumption inducing a urge in consumption. At the same time, advertising modifies the marginal rate of substitution between consumption and leisure inducing a stronger

substitution effect. Consequently, the household is willing to work more to consume more. Such an effect allowed us to identify the mechanism through which advertising hits the economy. In fact, advertising increases the fluctuations of both consumption and leisure, and so amplifies the fluctuations of the economy, like suggested by Kaldor (1950).

In the long run, for the relevant range of calibrations, the advertising also has a positive effect both on consumption and labor. Moreover, the ratio of consumption to GDP increases with advertising. Consequently, like in Galbraith (1967), our model predicts that advertising tends to generate an economy more consumption-based.

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## A Source of Data

### A.1 Quarterly Data

- **Advertising expenditures in news paper advertising:** Newspaper association of America. Available data sample from 1971q1 to 2005q4. The data have been seasonal adjusted using (matlab code) X11. Web site :<http://www.naa.org/>
- **Advertising expenditures in internet:** Interactive Advertising Bureau. Available data sample from 1996.q1 to 2005.q1 Web site: [http://www.iab.net/resources/ad\\_revenue](http://www.iab.net/resources/ad_revenue)
- **All the Macrodta:** Federal Reserve Bank of St. Luise. Web site: <http://research.stlouisfed.org/fred2>  
In FRED II:
- **GDP:** Real Gross Domestic Product (GDPC96)
- **Consumption and components:** Real Personal Consumption Expenditures and components (PCEC96)
- **Investment:** Real Private Fixed Investment (FPICA)
- **Deflator:** GDP Implicit Price Deflator (GDPDEF)

### A.2 Yearly Data

- **Total advertising expenditures and its components:** Universal McCann. Coen's Annual Report.
- **International Advertising Expenditures:** Zenithmedia Web Page <http://www.asianmediaaccess.com.au/ftimes/adspend/gdp.htm>

## B The Model

### B.1 The Consumers' problem

To choose the optimal basket of consumption in each period  $t$ , the representative household solves a constrained minimization problem:

$$\begin{aligned} & \min_{C_{i,t}} \int_0^1 P_{i,t} C_{i,t} di \\ s.t. & \left( \int_0^1 C_{i,t} - G_{i,t}^\theta \frac{\varepsilon-1}{\varepsilon} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \geq \tilde{C}_t \end{aligned}$$

where  $\tilde{C}_t$  is the minimum ammount of utility required.

From the First Order Conditions (FOCs) of the minimization one can derive the system of conditional demands, i.e.

$$C_{i,t} = \left( \frac{P_{i,t}}{P_t} \right)^{-\varepsilon} \tilde{C}_t + G_{i,t}^\theta \quad \forall i \in (0, 1) \quad (18)$$

together with the Consumption Price Index,

$$P_t = \left[ \int P_{i,t}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}} \quad (19)$$

Next step, the consumer undertakes the intertemporal decision about how much to consume and save. The intertemporal optimization programme is solved maximizing the utility function under the infinite sequence of budget constraints (10) for  $t = 0, \dots, \infty$ , and under the standard law of motion for the capital.

$$\begin{aligned} \max_{\{\tilde{C}_t, N_t\}_{t=0}^\infty} E_0 & \left[ \sum_{t=0}^{\infty} \beta^t \left( \frac{(\tilde{C}_t - \Delta_t)^{1-\sigma} - 1}{1-\sigma} - \gamma \frac{N_t^{1+\varphi} - 1}{1+\varphi} \right) \right] \quad (20) \\ \text{s.t.} \quad & P_t \tilde{C}_t + \int_0^1 P_{i,t} G_{i,t}^\theta di + P_t^I I_t \leq W_t N_t + R_t K_t + \Pi_t^{22} \\ & \text{and} \quad K_{t+1} = (1-\delta) K_t + I_t \quad (21) \end{aligned}$$

In the utility function (20) we add an aggregate (exogenous) taste preference shock  $\Delta_t$ , which will be useful to investigate the similitudes between the endogenous taste preference shock advertising, and the exogenous aggregate taste shock that is usually used in macroeconomic modeling.

From the associated FOCs of the above problem we obtain the consumer's shadow value of consumption,

$$\lambda_t = (\tilde{C}_t - \Delta_t)^{-\sigma}$$

the labor supply schedule,

$$\gamma N_t^\varphi (\tilde{C}_t - \Delta_t)^\sigma = \frac{W_t}{P_t} \quad (22)$$

and the Euler Equation

$$(\tilde{C}_t - \Delta_t)^{-\sigma} = \beta E_t \left[ \frac{P_t}{P_{t+1}} \frac{(\tilde{C}_{t+1} - \Delta_{t+1})^{-\sigma}}{P_t^I} (P_{t+1}^I (1-\delta) + R_{t+1}) \right] \quad (23)$$



## B.2 The firms in Consumption sector

The  $i$ -th firm chooses the best factors allocation by minimizing expenditures for purchasing Labor and Capital, subject to the production technology. Formally,

$$\min_{\{N_{i,t}^c, K_{i,t}^c\}} W_t N_{i,t}^c + R_{i,t} K_{i,t}^c \quad (24)$$

$$s.t. \quad Y_{i,t}^c = A_t U_t^c N_{i,t}^{\alpha_c} K_{i,t}^{1-\alpha_c} - Z_{i,t} \quad (25)$$

The FOCs associated with this problem are:

$$W_t = \alpha_c M C_t A_t U_t^c N_{i,t}^{\alpha_c - 1} K_{i,t}^{1-\alpha_c} \quad (26)$$

$$R_t = (1 - \alpha_c) M C_t A_t U_t^c N_{i,t}^{\alpha_c} K_{i,t}^{-\alpha_c} \quad (27)$$

To obtain the total cost function (7) that we used in the text, one must plug (26) and (27) in the objective function (24). Then, he has to use the production function (25) to substitute out for  $N_{i,t}^c$  and  $K_{i,t}^c$ .

Further step, the firm chooses the optimal production level. One can show that with the demand function (18) the firm prefers a price plan to a quantity plan.<sup>23</sup> The dynamic nature of the goodwill makes the problem intertemporal. Formally,

$$\begin{aligned} & \underset{\{P_{i,t+j}\}_{j=0}^{\infty}, \{G_{i,t+j}\}_{i=0}^{\infty}}{\text{Max}} \quad \sum_{j=0}^{\infty} \beta^j E_t [P_{i,t+j} C_{i,t+j} - T C_{i,t+j}^c(Y_{i,t+j}^c)] \\ & s.t. \quad C_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon} \tilde{C}_t + g_{i,t}^{\theta} \\ & \text{and} \quad G_{i,t} = (1 - \delta_g) G_{i,t} - Z_{i,t} \\ & \text{and} \quad T C_{i,t}^c = \underbrace{\left(B_c \frac{R_t^{1-\alpha_c} W_t^{\alpha_c}}{A_t U_t^c}\right)}_{\equiv M C_{i,t}} (Y_{i,t}^c + Z_{i,t}) \end{aligned}$$

The FOCs are

$$P_{i,t} - M C_{i,t} = \lambda_t \quad (28)$$

$$P_{i,t} C_{i,t} = \varepsilon \lambda_t \left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon} \tilde{C}_t \quad (29)$$

$$\theta \lambda_t G_{i,t}^{\theta-1} + \beta(1 - \delta_g) E_t [M C_{i,t+1}] = M C_{i,t} \quad (30)$$

Plugging equation (18) in (29), and using the result to substitute out  $\lambda_t$  in (28), we get the optimal pricing rule:

$$P_{i,t}^* = \underbrace{\left(\frac{\varepsilon \left(1 - \frac{G_{i,t}^{\theta}}{C_{i,t}}\right)}{\varepsilon \left(1 - \frac{G_{i,t}^{\theta}}{C_{i,t}}\right) - 1}\right)}_{\equiv \mu_{i,t}} M C_{i,t} \quad (31)$$

<sup>23</sup>The condition is given in Reis (2004).

Likewise the standard monopolistic competition case, we define the mark up as the coefficient of proportionality between price and marginal cost.

Equation (30) can be written as

$$(\mu_{i,t} - 1) MC_{i,t} \cdot \frac{\partial C_{i,t}}{\partial G_{i,t}} + \beta (1 - \delta^g) E(MC_{i,t+1}) = MC_{i,t} \quad (32)$$

Thus, (32) has the interpretation that producers spend in advertising up to the moment when the marginal cost of an extra unit (RHS of 32) is equal to its marginal benefits in terms of revenues (LHS).

### B.3 The firms in Investment sector

The Investment good is produced with a standard Cobb-Douglas technology,

$$Y_{i,t}^I = A_t U_t^I N_{i,t}^{\alpha_I} K_{i,t}^{1-\alpha_I} \quad (33)$$

where  $A_t$  is the (neutral) technology shock,  $U_t^I$  is a sector specific shock, and  $\alpha^I$  is the sector specific intensity of labor.

Since the market is in perfect competition, the price of investment is equal to the marginal cost. Now, given (33), one can show that the total cost function is:

$$TC(Y_t^I) = B_I \frac{R_t^{1-\alpha_I} W_t^{\alpha_I}}{A_t U_t^I} Y_t^I \quad (34)$$

where, likewise the consumption sector cost function,  $B_I = \left(\frac{1-\alpha_I}{\alpha_I}\right)^{\alpha_I} \left(\frac{1}{1-\alpha_I}\right)$ . So, the derivative of (34) w.r.t.  $Y_t^I$  is the price of the Investment good  $P_t^I$ , or

$$P_t^I = B_I \frac{R_t^{1-\alpha_I} W_t^{\alpha_I}}{A_t U_t^I} \quad (35)$$

In the solution of the model we normalize the price for the consumption aggregator (19) to one, so eventually (35) is also the relative price of investment.

In conclusion, equations (18), (19), (B.1), (21), (22), (23), (25), (26), (27), (31), (32), (33), (35), together with the market clearing conditions on goods markets,

$$Y_t^I = I_t \quad (36)$$

$$Y_{i,t}^c = C_{i,t} + Z_{i,t} \quad \forall i \in (0, 1) \quad (37)$$

and the market clearing conditions on factor markets,

$$N_t = \int_0^1 N_{i,t} di + N_t^I \quad (38)$$

$$K_t = \int_0^1 K_{i,t} di + K_t^I \quad (39)$$

completely define the unique equilibrium for this economy.

## B.4 The Symmetric Equilibrium

We now prove the existence of the symmetric equilibrium.

First, notice that all the firms face the same marginal cost, i.e.  $MC_{t,i} \equiv B_c \frac{R_t^{1-\alpha} W_t^{\alpha c}}{A_t U_t^\varepsilon} = MC_t \forall i \in (0, 1)$ . Then, obtain an explicit value for the optimal stock of goodwill substituting equation (28) in (30):

$$G_{i,t} = \left[ \frac{MC_t - \beta(1 - \delta_g)E_t [MC_{t+1}]}{\theta (P_{i,t} - MC_t)} \right]^{\frac{1}{\theta-1}} = g(P_{i,t}; MC_t; E_t [MC_{t+1}]) \quad (40)$$

Finally, substitute (40) in equation (18), and obtain:

$$P_{i,t}^* = \frac{\varepsilon (P_{i,t} - MC_t) \left( \frac{P_{i,t}}{P_t} \right)_t^{-\varepsilon} \tilde{C}_t}{\left( \frac{P_{i,t}}{P_t} \right)_t^{-\varepsilon} \tilde{C}_t + G_{i,t}} = p(\tilde{C}_t; MC_t; E_t [MC_{t+1}]) \quad (41)$$

Equation (41) shows that the optimal price does not depend on index  $i$ . So, the equations (40) and (41) give the equilibrium levels for price and goodwill stock, which are independent of the index  $i$ , and therefore common among all the firms.

Eventually, the symmetric equilibrium of the model is fully described by the following system of equations:

$$p_{i,t} = p_t = 1 \forall t \geq 0 \text{ e } \forall i \in [0, 1] \quad (42)$$

$$P_t = \left[ \int_0^1 p_{i,t}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}} = p_t = 1 \quad (43)$$

$$\tilde{C}_t = C_t - G_t^\theta - \Delta_t \quad (44)$$

$$\gamma N_t^\varphi = (C_t - G_t^\theta - \Delta_t)^{-\sigma} W_t \quad (45)$$

$$(C_t - G_t^\theta - \Delta_t)^{-\sigma} = \beta E_t \left[ \frac{(C_{t+1} - G_{t+1}^\theta - \Delta_{t+1})^{-\sigma}}{P_t^I} (P_{t+1}^I (1 - \delta_k) + R_{t+1}) \right] \quad (46)$$

$$\mu_t = \frac{\varepsilon \left( 1 - \frac{G_t^\theta}{C_t} \right)}{\varepsilon \left( 1 - \frac{G_t^\theta}{C_t} \right) - 1} \quad (47)$$

$$G_t = (1 - \delta_g)G_{t-1} + Z_t \quad (48)$$

$$K_{t+1} = (1 - \delta_k)K_t + I_t \quad (49)$$

$$Y_t^I = I_t \quad (50)$$

$$C_t = Y_t^c - Z_t \quad (51)$$

$$Y_t^c = A_t U_t^c (N_t^c)^{\alpha_c} (K_t^c)^{1-\alpha_c} \quad (52)$$

$$N_t^I + N_t^c = N_t \quad (53)$$

$$K_t^I + K_t^c = K_t \quad (54)$$

$$MC_t = \frac{1}{\mu_t} \quad (55)$$

$$\theta(\mu_t - 1)MC_t G_t^{\theta-1} + \beta(1 - \delta_g)E_t[MC_{t+1}] = MC_t \quad (56)$$

$$\frac{K_t^c}{K_t^I} = \left( \frac{1 - \alpha_c}{\alpha_c} \right) \left( \frac{\alpha_I}{1 - \alpha_I} \right) \frac{N_t^c}{N_t^I} \quad (57)$$

$$C_t + P_t^I I_t = Y_t \quad (58)$$

$$P_t^I = \mu_t^{-1} \left( \frac{1 - \alpha_c}{1 - \alpha_I} \right) \left( \frac{K_t^I}{K_t^c} \right) \frac{Y_t^c}{I_t} \quad (59)$$

## C Steady State

Now we show how advertising affects the steady state values of wage, interest rate and relative price of investment.

From equation (26) we have

$$W = \alpha_c \mu^{-1} \left( \frac{K^c}{N^c} \right)^{1-\alpha_c} \quad (60)$$

and from (27)

$$R = (1 - \alpha_c) \mu^{-1} \left( \frac{K^c}{N^c} \right)^{-\alpha_c} \quad (61)$$

and from (59)

$$p^I = \mu^{-1} \left( \frac{1 - \alpha_c}{1 - \alpha_I} \right) \left( \frac{K^c}{N^c} \right)^{-\alpha_c} \left( \frac{K^I}{N^I} \right)^{\alpha_I} \quad (62)$$

Now, the euler equation (46) can be used to determine the steady-state ratio of the investment sector capital to the total capital of the economy

$$\frac{K^I}{K} = \frac{\beta\delta_k(1-\alpha_I)}{1-\beta(1-\delta_k)} \quad (63)$$

Using the investment production function (33) we get:

$$\frac{K_I}{N_I} = \left(\frac{\delta_k K}{K^I}\right)^{-\frac{1}{\alpha_I}} \quad (64)$$

and from the equilibrium condition in the factors market (57), we finally get:

$$\frac{K^c}{N^c} = \left(\frac{1-\alpha_c}{\alpha_c}\right) \left(\frac{\alpha_I}{1-\alpha_I}\right) \frac{K^I}{N^I} \quad (65)$$

Hence, from equations (63), (64), and (65) is apparent that advertising does not enters or modifies the steady-state ratios of the productive factors. Indeed, such values are exactly the same as in the standard two sectors model. Consequently, advertising affects the steady states of the wage (60), interest rate (61), and relative price of investment (62) only through its effect on the steady state mark up

$$\mu = \frac{\varepsilon \left(1 - \frac{G^\theta}{C}\right)}{\varepsilon \left(1 - \frac{G^\theta}{C}\right) - 1} \quad (66)$$

In particular, since  $\frac{\partial \mu}{\partial G} > 0$ , then the advertising increases the steady state values of wage, interest rate, and relative price of investment.

**Proof. Proposition 2.**

First notice that in the standard two sector model the consumer intratemporal condition, the wage equation, and the ratio of consumption to labor can be written in the following way:

$$N_s = \left[ \left( \frac{C_s}{N_s} \right)^{-\sigma} \frac{1}{\gamma} \right]^{\frac{1}{\sigma+\varphi}} W_s^{\frac{1}{\sigma+\varphi}} \quad (67)$$

$$W_s = \alpha_c \mu_s^{-1} \left( \frac{K_{c,s}}{N_{c,s}} \right)^{1-\alpha_c} \quad (68)$$

$$\frac{C_s}{N_s} = \left( \frac{N_{c,s}}{N_s} \right) \left( \frac{K_{c,s}}{N_{c,s}} \right)^{1-\alpha_c} \quad (69)$$

where we denote the variables in the standard two sector model with the subscript  $s$ .

Second, rewrite the labor supply schedule (15) as

$$N = \left[ \frac{1}{\gamma} \left( 1 - \frac{G^\theta}{C} \right)^{-\sigma} C^{-\sigma} W \right]^\varphi \quad (70)$$

and use the mark up equation (66) to write

$$\left(1 - \frac{G^\theta}{C}\right) = \frac{1}{\varepsilon} \left(\frac{\mu}{\mu-1}\right) \quad (71)$$

Plugging (71) into (70), it is possible to find the long run labor supply as function of the consumption to labor ratio, and the wage:

$$N = \left[ \frac{1}{\gamma} \left(\frac{C}{N}\right)^{-\sigma} \right]^{\frac{1}{\varphi+\sigma}} \left\{ \left[ \frac{1}{\varepsilon} \left(\frac{\mu}{\mu-1}\right) \right]^{-\sigma} W \right\}^{\frac{1}{\varphi+\sigma}} \quad (72)$$

Next, using the production function in consumption sector, we observe that the ratio of consumption to labor is given by the following equation:

$$\frac{C}{N} = \left(\frac{N_c}{N}\right) \left(\frac{K_c}{N_c}\right)^{1-\alpha_c} - \frac{Z}{N} \quad (73)$$

Since advertising does not modify the ratios among the productive factors, it is trivial to verify that the following inequality holds:

$$\frac{C_s}{N_s} > \frac{C}{N}$$

$$\left[ \left(\frac{C_s}{N_s}\right)^{-\sigma} \frac{1}{\gamma} \right]^{\frac{1}{\sigma+\varphi}} < \left[ \frac{1}{\gamma} \left(\frac{C}{N}\right)^{-\sigma} \right]^{\frac{1}{\varphi+\sigma}} \quad \forall \sigma, \varphi > 0$$

Consequently, from equations (70) and (67) turns out that a sufficient condition for labor to increase with advertising is

$$\left\{ \left[ \frac{1}{\varepsilon} \left(\frac{\mu}{\mu-1}\right) \right]^{-\sigma} W \right\} \geq W_s \quad (74)$$

Plugging (60) and (68) into (74), we observe that the above sufficient condition is satisfied if the following inequality holds:

$$\left[ \varepsilon \left(\frac{\mu-1}{\mu}\right) \right]^\sigma \geq \frac{\mu}{\mu_s} \quad (75)$$

Let  $\varepsilon_A$  the elasticity of substitution across varieties in the model with advertising, and use equation (71) to write:

$$\left(\frac{\mu-1}{\mu}\right) = \frac{1}{\varepsilon \left(1 - \frac{G^\theta}{C}\right)} = \frac{1}{\varepsilon_A} \quad (76)$$

Plugging (76) into (75), and take the logs of both sides, we finally get:

$$\sigma \ln \left(\frac{\varepsilon}{\varepsilon_A}\right) \geq \ln \left(\frac{\mu}{\mu_s}\right)$$

Thus, the sufficient condition for advertising to increase the long run level of labor, is that the inverse of the intertemporal elasticity of substitution is greater than the ratio of the variation of the mark up on the variation of the elasticity:

$$\sigma \geq \frac{\ln\left(\frac{\mu}{\mu_s}\right)}{\ln\left(\frac{\varepsilon}{\varepsilon_A}\right)} \quad (77)$$

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