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NON-SCALE ENDOGENOUS GROWTH EFFECTS OF SUBSIDIES FOR EXPORTERS

ÓSCAR AFONSO [1]
ARMANDO SILVA [2]

[1] CEFUP, NIFIP, OBEGEF, FACULDADE DE ECONOMIA, UNIVERSIDADE DO PORTO
[2] INSTITUTO POLITÉCNICO DO PORTO-ESEIG

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Non-scale endogenous growth effects of subsidies for exporters*

Oscar Afonso† and Armando Silva,‡

Abstract

We built a general equilibrium endogenous growth model in which final goods are produced either in the relatively skilled-labour intensive exports sector or in the relatively unskilled-labour intensive domestic sector. We show that, by affecting the technological-knowledge bias, subsidies explain the simultaneous rise in the exports sector, the skill wage premium and the economic growth rate. Then, we use a Portuguese longitudinal database (1996-2003) and implement a propensity score matching approach to shed light upon the causal nexus between production-related subsidies and exports. Our empirical results seem to prove the theoretical predictions: subsides generate the rise in the wage premium of exporters and the increase in the relative size of export sector, even if no impact of subsidies is found in the capacity of enhancing new exporters.

Keywords: Subsidies; Exports; Scale-invariant growth; Wages.

JEL classification: C61, J31, O13, O31, F13, F14, H29.

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† Faculdade de Economia, Universidade do Porto, CEFUP and OBEGEF. Corresponding author. Address: R. Roberto Frias, 4200-464 Porto, Portugal; email: oafonso@fep.up.pt

‡ Instituto Politécnico do Porto-ESEIG.

1. Introduction

Exports are crucial for the economic growth of most countries and it is well known that firms must overcome several difficulties and costs in order to be able to export. Some recent theoretical models (e.g., Melitz 2003; Chaney 2008) and some empirical studies (e.g., Wagner 2007) found entry sunk costs of exporting as decisive. Meanwhile, governments have designed several export promotion policies in order to delay with such costs and difficulties, even if direct export subsidization is forbidden by World Trade Organization (WTO) rules.

Theoretically, an export subsidy can be either specific or *ad valorem* payment to firms that ship goods abroad. Export subsidies could increase exports as they help to support some of the exporting costs, thus rising prices in the exporting country and inducing more sales and earnings for exporters. However, domestic consumers and the government could lose, and the net welfare may well be a loss as the consequence of the sum of the distortions in consumption, production and in terms of trade. Export subsidies also present some dangers when its allocation relies on subjective mechanisms based on arbitrary decisions, in which case the competition among firms to obtain them may generate negative effects (e.g., Mitra 2000).

Nevertheless, general production-related subsidies may play a relevant role in promoting exports, without violating WTO rules. There is however little evidence that government promotional policies for exporting are effective in removing or at least reducing such difficulties for exports (e.g., Gorg et al. 2008; Girma et al. 2009a, b). The lack of evidence may be caused by different institutional arrangements (both formal and informal, designed to help reduce the sunk costs of exporting), making it difficult to distinguish which mechanisms are effective in promoting exports and which are not.

International trade literature has given little attention to the role of endogenous technological knowledge (e.g., Rivera-Batiz and Romer 1991). Hence, we start the paper by developing a general equilibrium endogenous R&D growth model where, in line with Rodrik (2006),[4] final goods are produced either in the relatively skilled-labour intensive exports sector or in the relatively unskilled-labour intensive domestic sector. Each final good uses labour and quality-adjusted intermediate goods. Building on Acemoglu (2009, Ch. 15) scale-dependent horizontal R&D model, we remove scale effects, following the dominant literature on scale effects since Jones (1995), and we introduce vertical R&D (e.g., Acemoglu 2009, Ch. 14).

Proposals to promote exports include R&D funding. For example, Girma et al. (2009b) observe that more than half of Chinese subsidies are allocated to innovation and technology promotion, which reveal that: (i) innovation activities are focused on high-tech firms; (ii) selects targets for subsidizing are based on firm features correlated with exporting. In our model, due to the relationship between intermediate-goods production and R&D, R&D directed to improve "exporter" intermediate goods can be encouraged by either a direct subsidy or by a subsidy for the production of intermediate goods.

In our (empirically plausible) context where there is complementarity between inputs and substitutability between sectors, numerical calculations describing dynamic equilibrium towards a stable and unique steady state show that subsidies under the price-channel mechanism affect the technological-knowledge bias. This bias, in turn, affects in a positive way: (i) the exports sector; (ii) the relative demand for relatively skilled labour and thus the skill-premium – in line with the path seen in developed and developing countries, since the 1980s (e.g., Acemoglu 2009, Ch. 15); (iii) the growth rate (e.g., Acemoglu 2009, Part IV).

[4] These authors use the China to show that, in each country, skilled labor is affected to the exporter sector.

Following our theoretical model and a few and recent empirical studies that investigate the connections between production subsidies and exports, we then use large firm level datasets and matching procedures (e.g., Gorg et al. 2008, for Irish firms; Girma et al. 2009a, for German firms). The motivation is to present evidence of the links between production-related subsidies granted to Portuguese firms and their exports performance. We use the most representative panel data available for manufacturing firms in Portugal for the period 1996-2003 and we apply a propensity score matching approach to uncover the nexus of causality between subsidies and exports.

Thus, we present a dynamic general equilibrium model and an empirical analysis, based on Portuguese firms, in order to better analyze the relationships between subsidies and exports. The theoretical model is motivated by the fact that (i) full data on public subsidies designed to help exporting is scarce, making it hard to test; (ii) there is a methodological difficulty in such a test since it is impossible to observe firms with and without such subsidies and supports; (iii) the complexity may open paths to misuse abuse (e.g., Nogués 1989) and even makes it impossible, in practical terms, to control firms' subsidies. Bearing in mind all these facts, are public policies for export promotion ineffective or are we methodologically not able to find the proof of this fact?

In line with previous empirical studies involving few other countries, empirical findings reveal that production subsidies have little impact on the likelihood that domestic firms will begin to export. Nevertheless, in line with the predictions of our theoretical model, empirical results also show evidence that production subsidies increase the wage premium of exporters and the relative dimension of internationalized firms relative to domestic ones.

The paper is organised as follows. Section 2 presents the theoretical model. Section 3 derives the steady state. Section 4 analyses governmental intervention. Section 5 describes

the data used. Section 6 reveals some evidence on subsidies and exports in Portuguese firms. Section 7 shows econometric results. Section 8 extends the analysis of subsidy effects on other firms' variables. Section 9 concludes the paper.

2. The theoretical model

2.1. Product and factor markets

Each perfectly competitive final good $n \in [0, 1]$ is produced either by the Domestic or the Exports sector. The former (latter) uses unskilled (skilled) intensive labour, L (H), and a continuum set of intermediate goods, $j \in [0, J]$ ($j \in]J, 1]$). The output of n, Y_n, at time t is given by:

$$Y_n(t) = A\left\{\left[\int_0^J \left(q^{k(j,t)}\, x_n(k, j, t)\right)^{1-\alpha} dj\right]\left[(1-n)\, l L_n\right]^{\alpha} + \left[\int_J^1 \left(q^{k(j,t)}\, x_n(k, j, t)\right)^{1-\alpha} dj\right]\left[n\, h\, H_n\right]^{\alpha}\right\}. \quad (1)$$

$A > 1$ is the exogenous productivity level. In the Schumpeterian tradition, integrals denote the aid of intermediate goods: each j quantity, x, is quality-adjusted; the quality upgrade is $q > 1$, and k is the top rung at t. The expressions with exponent $\alpha \in]0, 1[$ represent the role of labour inputs. An absolute productivity advantage of H over L is accounted for by $h \geq l = 1$. A relative productivity advantage of either labour type is captured by the terms n and (1-n), which implies that H is relatively more productive in final goods indexed by larger ns, and *vice-versa*. The optimal choice for the sector at time t is reflected in the endogenous threshold final good $\bar{n}$, where the switch of production from L to H is advantageous. It follows from profit maximisation by producers of final goods, profit maximisation by monopolist firms of intermediate goods and full-employment equilibrium in factor markets, given labour supply and technological knowledge:

$$\bar{n}(t) = \left\{1 + \left[\frac{Q_H(t)}{Q_L(t)}\frac{h\, H}{L}\right]^{\frac{1}{2}}\right\}^{-1}, \text{ where:} \quad (2)$$

$$Q_L(t) \equiv \int_0^J q^{k(j,t)[(1-\alpha)/\alpha]}\,dj \text{ and } Q_H(t) \equiv \int_J^1 q^{k(j,t)[(1-\alpha)/\alpha]}\,dj \qquad (3)$$

are aggregate quality indexes, evaluating the technological knowledge in each range of intermediate goods, and $D \equiv Q_H/Q_L$ is the technological-knowledge bias. $\bar{n}$ is small (the number of Exports final goods is large) when D is highly biased, H and/or h are large.

Defining the aggregate output, Y – resources for intermediate-goods production, X, R&D, R, or consume, C –,[5] as the numeraire,

$$Y(t) \equiv \int_0^1 p_n(t)\,Y_n(t)\,dn = \exp\left[\int_0^1 \ln Y_n(t)\,dn\right], \text{ since } \exp\int_0^1 \ln p_n(t)\,dn = 1, \qquad (4)$$

where $p_n(t)$ is the n price. $\bar{n}$ can be expressed in terms of L and H final-goods price indexes, p_L and p_H, since in $\bar{n}$ a L and H firm should break even,

$$\begin{cases} p_L = p_n(1-n)^{\alpha} = \exp(-\alpha)\,\bar{n}^{-\alpha} \\ p_H = p_n\,n^{\alpha} = \exp(-\alpha)\,(1-\bar{n})^{-\alpha} \end{cases} \text{ and thus } P(t) \equiv \frac{p_H(t)}{p_L(t)} = \left[\frac{\bar{n}(t)}{1-\bar{n}(t)}\right]^{\alpha}. \qquad (5)$$

From (5), small $\bar{n}$ implies a small relative H final-goods price: the demand for each $j \in]J, 1]$ is low, which, as will be apparent below, affects R&D direction; thus, labour endowments, h and l influence the R&D direction through the price channel.

As Y is input of j and the government can pay an ad-valorem fraction, s_x, of each firm's cost, $(1\text{-}s_x)$ is the after-subsidy marginal cost. j embodies a costly R&D design recovered by protected (patent law) profits for a certain time in the future. Monopolistic profit-maximisation price yields $p = \frac{1\text{-}s_X}{1\text{-}\alpha}$, which, with $s_x < \alpha$, is a mark-up on 1, stable over t, across j and for all k. Since the leader is the only one legally allowed to produce top quality, it uses limit pricing $p = q(1 - s_x)$ to capture the whole market.

Y and X (and R) are function of Q_L and Q_H. For example, Y is:

[5] We consider the simplifying assumption that foreign trade is balanced at all moments in time.

$$Y(t) \equiv \int_0^1 p_n(t)\, Y_n(t)\, dn = \exp(-1)\, A^{1/\alpha} \left[\frac{1-\alpha}{q(1-s_x)}\right]^{\frac{1-\alpha}{\alpha}} \left[\left(Q_L(t)\ L\right)^{\frac{1}{2}} + \left(Q_H(t)\, h\, H\right)^{\frac{1}{2}}\right]^2. \qquad (6)$$

The price paid per labour unit, w_m ($m = L, H$), is equal to its marginal product. From (6), the skill-premium, W, is:

$$W(t) \equiv \frac{w_H(t)}{w_L(t)} = \left(D(t)\frac{h\ L}{H}\right)^{\frac{1}{2}}. \qquad (7)$$

Thus, for example, an increase in h is a static benefit, see (6), which, due to the existing complementarity between inputs, falls $\bar{n}$, see (2), and increases W, see (7).

2.2. R&D sector

R&D outcomes are designs to improve indexes in (3) – e.g., Acemoglu 2009, Ch. 14; in j at t, a firm engaged in R&D that uses $y(k, j, t)$ flow of Y upgrades the next quality, $k(j, t)+1$, with instantaneous probability:

$$pb(k, j, t) = y(k, j, t) \cdot \beta q^{k(j,t)} \cdot \zeta^{-1} q^{-\alpha^{-1}k(j,t)} \cdot m^{-1}, \text{ where:} \qquad (8)$$

$m = L$ if $0 < j \leq J$ and $m = H$ if $J < j \leq 1$; $\beta q^{k(j,t)}$, $\beta > 0$, is the learning effect from past R&D; $\zeta^{-1} q^{-\alpha^{-1}k(j,t)}, \zeta > 0,$ is the adverse effect of progressive complexity; m^{-1} is the adverse market-size effect.

The R&D incentive for follower firms relies on the expected monopoly profits flow, $V(k, j, t)$, which relies on its duration, on the interest rate, r, and on the profits at each t, $\Pi(k, j, t)$:[6]

$$\Pi(k, j, t) = \bar{m}\, m\, (1-s_{x,m})^{\alpha^{-1}(\alpha-1)}\ (q-1)\left[\frac{p_m(t)\, A(1-\alpha)}{q}\right]^{\alpha^{-1}} q^{k(j,t)\,\alpha^{-1}(1-\alpha)}, \text{ where} \qquad (9)$$

$\bar{m} = h$ for $m = H$, $\bar{m} = l = 1$ for $m = L$, and s_x can be m-specific. The resulting V is:

$$V(k, j, t) = \frac{\Pi(k, j, t)}{r(t) + pb(k, j, t)}. \qquad (10)$$

Under free-entry R&D equilibrium, expected returns are equal to the resources spent,

[6] Due to the Arrow effect, leaders do not undertake R&D (e.g., Acemoglu 2009, Ch. 14).

$$pb(k,j,t)\,V(k+1,j,t) = (1-s_r)\,y(k,j,t)\text{, where:} \tag{11}$$

s_r is a governmental ad-valorem subsidy to R&D, which can be *m*-specific. Equilibrium can be translated in the technological-knowledge path (Technology-curve):

$$\hat{Q}_m(t) = \left\{ \underbrace{\frac{\beta}{\zeta}\left(\frac{1-s_{x,m}}{1-s_{r,m}}\right)\left(\frac{q-1}{q}\right)\left[\frac{p_m(t)\,A\,(1-\alpha)}{1-s_{x,m}}\right]^{\alpha^{-1}}\overline{m} - r(t)}_{\equiv pb_m} \right\}\left[q^{\alpha^{-1}(1-\alpha)}-1\right]\cdot \tag{12}$$

pb_m is the equilibrium *m*-specific *pb*, given *r* and p_m, which is independent from *j* and *k* since the quality-rung effect in (9) and (8)-(ii) is offset by its effect in (8)-(iii). In line with, e.g., Jones (1995), (8)-(iv) offsets the scale effect in (9); computing $pb_H - pb_L$, *D* is thus particularly induced by subsidies under the price-channel mechanism.

2.3. Consumers

Fixed infinitely-lived households unelastically supply *L* or *H*, and choose a consumption plan to maximize $U(t)=\int_0^{\infty}\left[\frac{C(t)^{1-\theta}-1}{1-\theta}\right]exp(-\rho t)\,dt$ subject to the standard no Ponzi games condition and to the budget constraint $\dot{K}(t) = r(t)K(t) + w_m(t)\,m - C(t) - T(t)$, which yields the consumption growth rate (Euler curve):

$$\hat{C}(t) = \frac{r(t)-\rho}{\theta}\text{, where:} \tag{13}$$

$\rho > 0$ is the subjective discount rate; $\theta > 0$ is the relative risk aversion coefficient; *K* is the total asset holdings, with return *r*, in the form of ownership of leaders (and not in public debt owned by individuals, since, according to a simplifying assumption, the government budget is always balanced); (ii) *T* is a lump-sum tax to finance subsidies.

3. Steady-state equilibrium

Q_L and Q_H must grow at the same rate since (i) *Y* has constant returns to scale in inputs, (ii) *Y*, *X*, *R* and *C* are multiples of Q_L and Q_H, and (iii) in steady-state aggregates grow at the

same rate. From (12), $\hat{Q}_H = \hat{Q}_L$ if $\frac{p_H}{p_L} = \left(\frac{1-s_{x,H}}{1-s_{x,L}}\right)^{1-\alpha}\left(\frac{1-s_{r,H}}{1-s_{r,L}}\right)^{\alpha} h^{-\alpha}$; since r is unique, the steady-state growth rate, g^*, is thus also unique. Also, from (2) and (5), $\frac{p_H}{p_L} = \left(D\frac{hH}{L}\right)^{-(\alpha/2)}$.

Consider, e.g., $pb_H > pb_L \Rightarrow \frac{p_H}{p_L} > \left(\frac{1-s_{x,H}}{1-s_{x,L}}\right)^{1-\alpha}\left(\frac{1-s_{r,H}}{1-s_{r,L}}\right)^{\alpha} h^{-\alpha}$. $pb_H > pb_L$ implies that $\hat{Q}_H > \hat{Q}_L$ and, since $\frac{p_H}{p_L} = \left(D\frac{hH}{L}\right)^{-(\alpha/2)}$, $\hat{p}_H < \hat{p}_L$. Thus, $\frac{p_H}{p_L}$ falls towards $\frac{p_H}{p_L} = \left(\frac{1-s_{x,H}}{1-s_{x,L}}\right)^{1-\alpha}\left(\frac{1-s_{r,H}}{1-s_{r,L}}\right)^{\alpha} h^{-\alpha}$, which attenuates the rate at which D is rising. Thus, while $\hat{Q}_H > \hat{Q}_L$, $\hat{Q}_H - \hat{Q}_L$ is falling until achieving a stable g^*, where $\hat{Q}_H^* = \hat{Q}_L^*$, which, by (15), also implies a stable r^*:

$$g^* = \hat{Q}_H^* = \hat{Q}_N^* = \hat{Y}^* = \hat{X}^* = \hat{R}^* = \hat{C}^* = \frac{r^* - \rho}{\theta} \Rightarrow \hat{p}_H^* = \hat{p}_L^* = \hat{\bar{n}}^* = W^* = 0. \qquad (14)$$

Hence, by $s_{x,m}$ and $s_{r,m}$, the government positively affects g^*, by encouraging R&D: $s_{x,m}$ boost profits (9) and $s_{r,m}$ decreases the R&D cost, see (11).

4. Government intervention

As r is unique, (12) is used to analyse the effect upon $\bar{n}$ and W, of the D path given by

$$\hat{D}(t) = \frac{\beta}{\zeta}\left(\frac{q-1}{q}\right)\left(A(1-\alpha)\right)^{\frac{1}{\alpha}} \exp(-\alpha) \left\{ h\left(\frac{1-s_{x,H}}{1-s_{r,H}}\right)\left(\frac{1}{1-s_{x,H}}\right)^{\frac{1}{\alpha}}\left[1+\left(D(t)\frac{hH}{L}\right)^{-\frac{1}{2}}\right]^{\alpha} - \left(\frac{1-s_{x,L}}{1-s_{r,L}}\right)\left(\frac{1}{1-s_{x,L}}\right)^{\frac{1}{\alpha}}\left[1+\left(D(t)\frac{hH}{L}\right)^{-\frac{1}{2}}\right]^{\alpha} \right\}, \qquad (15)$$

using the 4th-order Runge-Kutta numerical method and the baseline values in Table 1.

Table 1. Baseline parameters and labour levels

Parameter	Value
h	1.05
α	0.70
Q	3.33

Parameter	Value
β	1.60
ζ	4.00
θ	1.50

Parameter	Value
ρ	0.02
$s_{x,m}, s_{r,m}$	0.00
T	0.00

Variables	Value
A	1.50
H	0.68
L	1.00

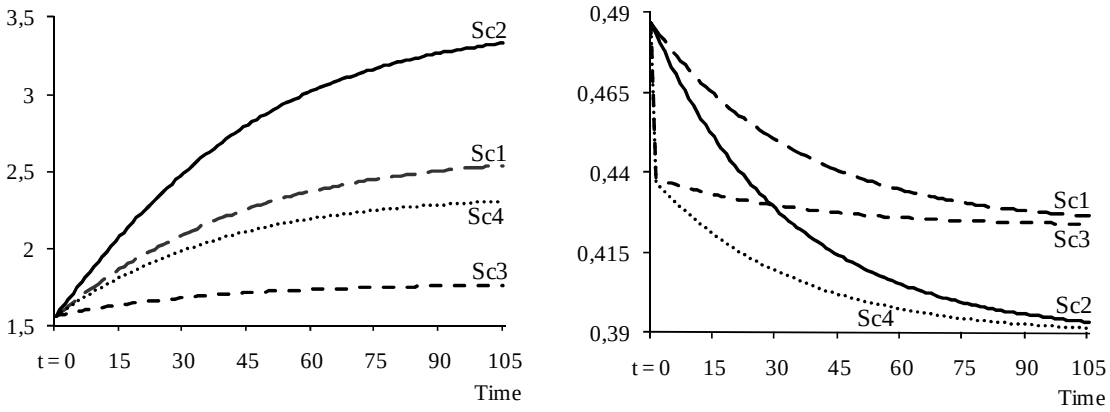
Note: Values are in line with our assumptions ($h > 1$, $\beta > 0$ and $\zeta > 0$), Acemoglu (2009) and to calibrate g^* around 2.5% under (Scenario, Sc0) no governmental intervention.

Figures 1a, 1b and 1c compare the baseline steady-state paths of D, $\bar{n}$ and W with those arising from a change at $t = 0$ where: Sc1, $s_{x,H} = 0.2$; Sc2, $s_{r,H} = 0.2$; Sc3, $s_{x,H} = 0.2$ and

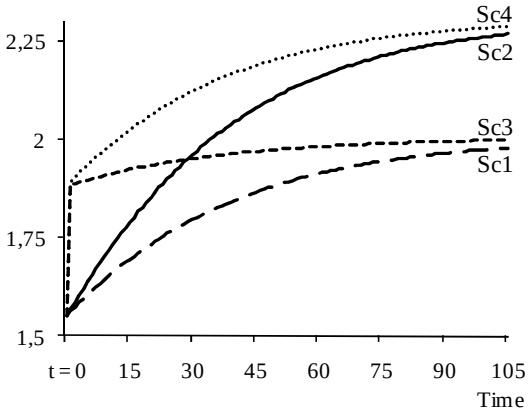
$h = 1.55$; Sc4, $s_{r,H} = 0.2$ and $h = 1.55$. Thus, in Sc3 and Sc4, we consider that subsidies also improve the absolute advantage of high-skilled labour; i.e., the advantage of labour used in the exports sector. Table 2 shows initial and final steady states.

Figure 1. Transitional dynamics of:

1a. *D* **1b. $\overline{n}$**



1c. *W*



Subsidies accentuate *D*: Sc1, Sc3 and Sc4 increases the size of profits for the producers of $j \in]J, 1]$, and Sc2 and Sc4 decreases the cost of *H*-specific R&D. Towards the new steady state, such bias increases the supply of *H*-intermediate goods, thus raising the use of the exports sector, see (2), and lowering the relative *P* price, see (5). *P* drops continuously towards the steady-state, which implies that *D* is rising, but at a decreasing rate. *D* is thus motivated by the price channel, since there are stronger incentives to

improve high-price goods. The effect upon D is stronger through direct R&D subsidy and without the level effect induced by h, due to the effect upon P.

Table 2. Initial and final steady-state values

Variable	Initial steady-state values	Steady-state value under each Scenario, Sc			
		Sc1	Sc2	Sc3	Sc4
D	1.56	2.54	3.33	1.76	2.30
$\overline{n}$	0.49	0.43	0.39	0.43	0.39
W	1.55	1.98	2.27	2.00	2.29

Competitiveness of the Exports sector is favoured in Sc2 and Sc4; in Sc2 mainly due to the path of D and in Sc4 owing to the level effect; the same happens for W, since in Sc2 and Sc4 the relative demand for H is strongly stimulated.

5. Data

In empirical terms, production subsidies are a type of financial assistance that firms receive from domestic authorities and the European Union aimed at lowering their production costs and prices of the goods produced or even at providing a proper payment for productive factors. In accounting terms, they represent assistance in the form transfer of resources, in return for past or future compliance under certain conditions related to firm's activities. These production subsidies are not specifically created to promote exports.

Our data source is the Portuguese National Statistics Institute (INE) balance sheet information (IAE).[7] The IAE provides information on firms' balance sheets,[8] and uses a survey sample of all Portuguese manufacturing firms, from 1996-2003. We used the variables employees, turnover, production subsidies, imports, exports, foreign capital,

[7] According to a Protocol established between the INE and the Faculty of Economics at the University of Porto, the authors have access to the data under specific rules of data confidentiality protection. Thus, without additional permission of the INE, data are available upon request only to confirm results.

[8] Since 2004, the INE has changed its methodology and works with all Portuguese manufacturing firms, but until 2004 the data used is the data available. The INE ensures the representativity of the sample used.

capital, labour costs, employees devoted to R&D activities and earnings. Firms are classified according to their main activity, as identified by INE's standard codes (CAE) that are correlated with Eurostat Nace 1.1 taxonomy. Despite being unbalanced, our database contains information for an average of 4,500 firms per year. Tangible fixed assets at book value (net of depreciation) are used as proxy for capital. Nominal variables are measured in 1996 Euros and are deflated by using INE's 2-digit industry-level price indexes.

Since we needed a firm-level productivity measure and since it is highly probable that profit-maximizing firms immediately adjust their input levels each time they observe productivity shocks, productivity and input choices are likely to be correlated and thus Total Factor Productivity (TFP) estimation involves problems. Such as done by several authors (e.g., Maggioni 2009), TFP is estimated by using the semi-parametric method of Levinsohn and Petrin (2003). This method recognizes the simultaneity bias as firms observe the productivity shocks, but econometricians do not.

Hence, we compute TFP as the residual of a Cobb-Douglas production function in which the firm value added is the independent variable, and capital, labour and unobservable productivity level are the dependent ones. This method assumes that intermediate inputs present a monotonic positive relationship with productivity and thus could be used as proxies for TFP. Given data availability, we use intermediate inputs as the deflated values of "supplies and services consumed from thirds" at book value. We estimate a production function for every 2-digit sector separately.

6. Evidences on exports and subsidies

Throughout the period 1996-2003, 26% of Portuguese firms received production-related subsidies at least for one year (Table 3); of the firms receiving subsidies, 80% were already exporters. The status of subsidized firms is highly stable: subsidy support was persistent as

31% of all subsidized firms have obtained operating subsidies every year and more than half of the firms had subsidies for at least 6 years out of 8 (Table 4).

Table 3 – Production Subsidies in Portuguese firms, 1996-2003

Firms with subsidies	Firms without subsidies	Total of firms observed
2,831 (26%)	7,922 (74%)	10,753 (100%)

Source: Own calculations.

Table 4 – Subsidy persistency in Portuguese firms, 1996-2003

Number of years with subsidy	8	7	6	5	4	3	2	1
% of firms subsidized	31%	9%	9%	10%	10%	12%	9%	10%

Source: Own calculations.

On average, for that period, subsidies were 1.4% of sales for subsidized firms, but there was time heterogeneity (Table 5). Sector heterogeneity was also observed: food and beverage and furniture and recycling received the highest amounts of subsidies per sales and, in most cases, the highest amounts of subsidies per employee (Appendix A).

Table 5 – Subsidies per year and employee

Year	1996	1997	1998	1999	2000	2001	2002	2003
Share of subsidies on sales (%)	1.8%	1.8%	1.4%	1.3%	1.1%	2.2%	0.9%	0.8%
Subsidy per employee (€)	232	243	280	258	291	178	185	189

Source: Own calculations.

For Portuguese firms, trade and subsidies are much more concentrated than sales or employment, as measured by the Theil index for inequality assessment (Table 6).

Table 6 – Concentration of Portuguese firms' employees, sales, trade and production subsidies (average 1996-2003)

Variable	Theil Index
Employees	0.68
Sales	1.43
Exports	2.33
Imports	2.52
Subsidies	2.35

Source: Own calculations.

For the same period, we linked firm heterogeneity with trade status. In each year, all firms were classified into four mutually exclusive groups: Non-Traders (NT), Only Exporters (OE), Only Importers (OI) and Two-Way Traders (TWT). In our database about 74% of firms are engaged in external trade: the propensity to export (import) was, on average, 63% (69%). Between 1996 and 2003, the degree of Portuguese firm's engagement grew: in 1996, TWT represented 45% of firms and, in 2003, they corresponded to 53%. There is also clear evidence that the NT and TWT status are highly stable, while the OE and OI status are unstable. However, the time persistency of our exporting firms was, on average, 3.8 over 8 years of our sample data-time lag. Moreover, 18% of firms were exporters for every single year of the whole period, "persistent exporters", while 25% exported in only one single year.

Subsidies and exports are positively related (Table 7). In column 1 and line 1, we use as dependent variables a dummy for exporter status in each year and in column 1 and line 2, a variable for export shares in total sales; each of those variables are regressed upon a constant, a dummy for subsidized firms, sector codes and size. In column 2 similar regressions are performed, but firm fixed effects are added. We perform regressions using logit models for export status dummy and fractional logit models for export shares.[9] All regression coefficients are positive and statistically significant, even when controlling for firm fixed effects and sectoral and time effects.

Positive coefficients mean that subsidized firms are probably more exporters (first line of regressions) and, among exporters, they present a higher share of exports relative to total sales (second line of regressions). The consistency of such coefficients is confirmed by the fact that, although not reported, such correlation is observable for each and every

[9] We use fractional logit models since the share of exports in total sales is a percentage variable with a high probability at zero due to the large share of firms with no exports (e.g., Papke and Wooldrige 1996).

year between 1996 and 2003. However, those positive coefficients do not mean that there is any causal relationship between subsidies and exports.

Table 7 – Subsidies and exports (average 1996-2003)

	Independent variable: Subsidized firms (dummy)	Independent variable: Subsidized firms (dummy) (firms fixed effects)
Dependent variable: Exports (Dummy)	0.566 (0.00)	0.131 (0.10)
Dependent variable: Exports (Share)	0.271 (0.00)	0.112 (0.09)

Source: Own calculations.

Notes: We report bootstrapped standard errors (500 replications).

7. Evaluating the effects of subsidies on exports

To study the causal effects of production-related subsidies upon the probability to export and upon export shares of total sales, we use a different methodology, beyond regression analysis. The positive relationship may be the result of both causality directions: (i) a production subsidy may help certain firms bear with the fixed costs related to the beginning of exporting or to deal with difficulties in some markers; moreover, subsidies have the ability to reduce certain costs for existing exporters, thus inducing an increase in the share of exports in total sales; (ii) new exporting firms or firms exporting to some destinations may gain the right to collect subsidies that governments use to reward such performances. Thus, the causality may run in both directions.

There are also other firms' features beyond subsidies and exports that can affect both: Girma et al. (2009a) mention as an example the effect of R&D activities. It is also crucial to consider that subsidies are not randomly given. They are instead allocated following a governmental conscious selection. We can consider two opposite selection methods: (i) one assumes that subsidies are granted conditionally on the observation of

certain criteria,[10] such as the export of certain goods, the types of workforce employed, the markets achieved, the types of firms or sales from certain regions; (ii) the other selection method assumes that subsidies are granted on the basis of firms' connectedness and proximity with the government or public officials and related members.

Despite being opposites, both introduce a selection criterion for subsidized firms, thus requiring methods other than simple regression analysis to properly evaluate the effects of subsidies upon firms' performance. By assuming that subsidies (whatever form they take) are not randomly given, one cannot assess their effects simply by a simple comparison between subsidized and non-subsidized firms. This situation calls for the use of matching methods (e.g., Girma et al. 2009a). Indeed, the ideal method would be to compare, in a given year, the firm' performance (e.g., exports) under public subsidy with its performance without public subsidy (the counterfactual situation).

Since the information on the counterfactual situation will never be available, some authors (e.g., Heckman et al. 1998), argue that an adequate way to obtain an appropriate evaluation on the effects of the subsidies is to build a "control group" of firms that did not receive subsidies in that year, but which are as similar as possible to those firms receiving subsidies at that moment (the treated ones or starters).

By using matching techniques, we hope to build consistent counterfactuals to every subsidy "starter", while using a generic non-subsidized firm. The comparison group would not allow us to make causal inferences, since the observed differences after subsidies could exist previously in a pre-subsidy period and remain after it. Assuming the possibility of building such a control group, we would then match every treated with one or some control firm (the most similar to the former) and we would thus assume those differences between

[10] The complexity of those criteria can create negative effects of subsidies upon firms' performances as some of them feel discouraged from applying for subsides (e.g., Helmers and Trofimenko 2009).

future performances to be the result of the treatment (subsidy) that one firm received and the other (control) did not.

We are interested in two complementary approaches: (i) in line with our theoretical model, we intend to assess the impact of subsidies upon the probability that non-exporting firms will begin to export; (ii) additionally to assess the effects of subsidies upon the exporting performance of existing exporters.

To apply such a methodology, we consider for the first case, as the treated group for every year from 1998 to 2002, firms that in each year fill the following cumulative conditions: without subsidies in the two years before, one year before and in the year under consideration, and never exported until that year. For each year, the control group is formed by firms that: (i) had no subsidies in 1996-2002; (ii) did not export until the year under analysis. Appendix B presents the number of treated and control firms.

When studying the effects of subsidies on already exporters, we consider as the treated group of firms, for every year from 1998 to 2002, the firms that in each year fill the following cumulative conditions: without subsidies in the two years before, one year before and in the year under consideration, and with exports in the previous year. The control group is formed by the firms that: (i) have no subsidies in the whole period 1996-2002; (ii) exported in the previous year. Appendix C presents the number of treated and control firms.

We start by estimating the propensity score, which is performed by using a probit regression of a dummy variable equal to 1 if a firm is subsidized (treated) in that year and 0 otherwise. Such dummy is, as a base model, regressed on several variables lagged by one year (to respect the Conditional Independence Assumption). These variables are assumed

to be relevant in the selection of firms to be subsidized:[11] number of employees, TFP, wages, a dummy for the existence of R&D workforce, a foreign capital dummy, earnings, sales and two digit sector dummies. To free up the functional form of the propensity score, we also included higher order polynomials and interaction terms. In the search for a higher quality match, different specifications were used for different years and that option revealed to be more adequate than by using just a single specification for all time cohorts of treated and control firms.

When performing these estimations for each year, we observed the importance of the covariates for the dependent variables; although with some heterogeneity, we detect some regularities as firms' sector, previous importer status and foreign capital share were most often important factors in explaining firms' probability for receiving subsidies (Appendix D). Otherwise, the efficiency level, the presence of R&D within the firm and wages were not significant in explaining the probability of a firm to receive subsidies.

Then, several algorithms could be used to establish the match between treated and control firms. We tested, with similar results, the use of two of those weighting schemes: kernel matching and nearest neighbour matching. Given their better properties upon variance, we will present results based on the Epanechnikov kernel.[12]

In order to assess the matching quality we implemented a balancing test proposed by Becker and Ichino (2002) and a standard *T*-test for equality of means. Matching quality is confirmed: Appendices D and E show the high percentage reduction in bias between treated and controls achieved after matching, thus ensuring we chose the right specification for propensity score. We also ensure the common support condition, which means that we

[11] By using general production subsidies, we consider as determinants for subsidy selection common variables mostly used in the previous empirical works (e.g., Girma et al. 2009; Gorg et al. 2008).

[12] We use a bandwidth of 0.001. Results show little sensibility on the weighting regime used or within the bandwidth interval.

drop subsidy starters which presented in each year a propensity score higher (lower) than the maximum (minimum) score for non-subsidized firms.

Since our purpose is to evaluate the effects of subsidies upon the probability of a domestic firms to start exporting and upon the share of exports of already exporting firms, we compute the average treatment effect upon the treated (ATT) as follows:[13] (i) for the first case, we are interested in the differences between the percentage of export starters (the outcome variable) among subsidized firms (treated) and the same percentage for non treated firms; (ii) for the second case, ATT means the difference in the change of the share of exports in total sales (the outcome in question) between the treated firms (new subsidized in each year) and the same outcome for matched non treated firms (firms that remain non-subsidized in that year).

We assess ATT both for *t* and for the next three years: *t*+1, *t*+2 and *t*+3. When performing that second ATT we are controlling for unobservable, time-invariant differences between treated and non-treated firms; thus, we implement a difference-in-differences matching estimator, as suggested by Blundell and Costa Dias (2000) and Heckman et al. (1998). Hence, we compare the change in exports' performance between the group of new subsidized and the most similar group of non-subsidized firms.

Results for the pooled sample of all years' causal effects of subsidies upon the propensity to start to export are reported in Table 8.

Table 8 – Causal effects of subsidies on starting to export, 1998-2002

	ATT (prob.exp$_t$)	ATT (prob.exp$_{t+1}$)	ATT (prob.exp$_{t+2}$)	ATT (prob.exp$_{t+3}$)
Pooled sample	-0.026^{+}	-0.152*	-0.052^{+}	0.007^{+}
	(0.077)	(0.086)	(0.087)	(0.016)

Source: Own calculations.
Notes: We report bootstrapped standard errors (500 replications). If nothing else is mentioned coefficients are significant at 1%. ** means significant at least at 5%. * means coefficients are significant at least at 10%. $^{+}$ means coefficients are not significant.

[13] We use psmatch2 command (version 3.0) for Stata 10.1.

In this empirical analysis the time span used is too short when compared with the period of transitional dynamics observed in section 4; such difference must be taken into account when comparing the two types of results obtained by subsidies. we find no evidence of the effect of subsidies to enhance internationalization. Indeed, there is some evidence suggesting that subsidies could even imply a drop in firms' exports probability, mainly one year after the subsidy is received.[14] The poor effects of subsidies may result from the fact that they were improperly designed to specifically enhance exportsAt the other level, results for the causal effects of subsidies upon the share of exports in total sales are reported in Table 9.

Table 9 – Causal effects of subsidies on export shares, 1998-2002

	ATT (Exp Share$_t$)	ATT (Exp Share$_{t+1}$)	ATT (Exp Share$_{t+2}$)	ATT (Exp Share$_{t+3}$)
Pooled sample	0.013^{+}	0.074^{+}	-0.073^{+}	-0.119^{+}
	(0.076)	(0.011)	(0.131)	(0.137)

Source: Own calculations.
Notes: see Table 8.

There is no evidence that subsidies increase the share of exports in total sales, for the year subsidies start and for the next three years. In a complementary analysis and since subsidies present a relevant heterogeneity in values per employee, average levels by year (Table 5) and average levels by industry (Appendix A), it would be interesting to carry out an analysis on the effects of subsidies by also using a continuous treatment approach, varying between zero and a certain maximum level. However, the use of a generalized propensity score is hampered by the highly skewed subsidies' distribution per employee and even by the dominant share of non-subsidized firms.

[14] Although not reported, we have also tested similar effects for each of the single years of the sample, but no effects are observed.

To study the impact of subsidy levels upon the causality nexus with the probability of exporting and with the share of exports in total sales, we repeated all previous tests but with disaggregating the data: at one hand, we added an additional condition to treated firms – treated firms have to receive, in each year, a subsidy per employee higher than the double of each year's average subsidy per employee – to evaluate only highly subsidized firms and not all subsidized firms. This computation meant a reduction in treated firms by an average of 40%. The results of such causality effects of high subsidies upon the usual two dependent variables are expressed in Table 10, but no effects effects were detected.

Table 10 – Causal effects of high subsidies p.e., 1998-2002

	ATT (prob.exp$_t$)	ATT (prob.exp$_{t+1}$)	ATT (prob.exp$_{t+2}$)	ATT (prob.exp$_{t+3}$)
Propensity to export	-0.115$^+$	-0.091$^+$	0.071$^+$	0.031$^+$
	(0.108)	(0.104)	(0.114)	(0.04)
Export share	(0.031)$^+$	-0.177$^+$	0.091$^+$	0.014$^+$
	(0.112)	(0.154)	(0.142)	(0.089)

Source: Own calculations.
Notes: see Table 8.

At other hand, to take advantage of a sector analysis for the whole period 1998-2002, we performed a separate ATT for each of the available 23 two-digit industries. Concerning the probability of starting to export for domestic firms, the number of observations per sector did not allow us to carry out the analysis to all sectors.[15] However, we detected that the probability of domestic firms to become exporters was in fact increased for sectors related with the machinery cluster and involving all types of machines (electrical type, office type, motor vehicles and general machinery). Reversely, for the food and beverage sector, the subsidies even reduced the probability of domestic firms becoming exporters. For all other sectors, no evidence of any kind of effects was observed.

[15] Given the small number of observations, we decided not to present the results in the form of table.

Concerning the change in export shares of already exporting firms, the available data allowed us to perform separate ATT computations for the majority of two digit industries. Results (in Appendix E) show that: (i) there are positive effects of subsidies upon export shares for basic metals, general machinery and electrical machinery; (ii) some sectors show negative effects of subsidies upon the share of exports in total sales (food and beverages, textiles, pulp and paper, fabricated metal products). However, given the dimension of our sample for most groups, extra precaution is needed regarding general conclusions.

Complementarily, we have also performed two more tests: (i) firstly, we divided firms in two groups based on the initial TFP level; we observed, for firms with higher TFP levels, that subsidies generated a positive impact upon export shares, while for other firms there was no effect. Thus, we argue that subsidies have higher ability to cause positive effects upon exports when firms possess a superior absorptive ability (Table 11); (ii) in the second test, we assessed the effects of subsidies, conditional to the initial earnings level (Table 12), suggests that grants generate negative effects upon the probability for exporting of firms with positive earnings (in the first two years after subsidies are granted), while in firms with negative earnings no positive effects are detected.

Table 11 – Causal effects of subsidies on the probability of exporting (segmented analysis: TFP levels), 1998-2002

	ATT (prob.exp$_t$)	ATT (prob.exp$_{t+1}$)	ATT (prob.exp$_{t+2}$)	ATT (prob.exp$_{t+3}$)
Firms with higher TFP	0.043	0.076*	0.067^{+}	0.046^{+}
	(0.021)	(0.043)	(0.085)	(0.073)
Firms with lower TFP	-0.122^{+}	0.171^{+}	0.091^{+}	0.121^{+}
	(0.126)	(0.161)	(0.101)	(0.131)

Source: Own calculations.
Notes: see Table 8.

Table 12 – Causal effects of subsidies on the probability of exporting (segmented analysis: earnings), 1998-2002

	ATT (prob.exp$_t$)	ATT (prob.exp$_{t+1}$)	ATT (prob.exp$_{t+2}$)	ATT (prob.exp$_{t+3}$)
Firms with negative earnings	0.043$^+$	-0.163$^+$	0.063$^+$	0.073$^+$
	(0.115)	(0.123)	(0.083)	(0.093)
Firms with positive earnings	-0.192	-0.271	0.091	0.121
	(0.086)	(0.101)	(0.101)	(0.131)

Source: Own calculations.
Notes: see Table 8.

8. Assessing the effects of subsidies on general firm performances

Production subsidies in our database are not specifically oriented to enhancing export. They are, in general, dedicated to promoting employment, to support specific industries (eventually in some regions) and to help specific firms in difficulties. Hence, it would be of great interest to analyze their impact on general firm performances.

According to the European Union Treaty, any sort of State aid to firms have in common the fact that they are granted by a member State or through State resources and that they favour certain undertakings or the production of certain goods, but they may also distort or threaten to distort competition, affecting trade between member States. Thus, state interventions could be needed to reach a better allocation of resources, but they may also harm the competition environment with negative consequences.

In this framework the consequences of subsidies to firms could be either positive or negative and previous studies are not sufficiently decisive: for example, Bergström (1998) and Skuras et al. (2004) found that subsidized investments under regional development frameworks (structural fund programs) were ineffective.

Gadd et al. (2009) present a summary on previous studies: (i) some positive effects on employment and on the dynamics of turnover and employment are reported for subsidized firms; (ii) negative effects on productivity growth rates are also observed in subsidized firms. Using a propensity score matching approach, the study of Gadd et al.

(2009) for Swedish firms, concluded that subsidies enhanced employment growth levels of subsidized firms, but there was no positive effect on firms' productivity.

Using our database for Portuguese manufacturing firms, we performed other ATT computations to assess the effect of subsidies on other variables: wages, sales, R&D employment, employment, TFP and imports. Table 13 presents the effects of subsidies on domestic firms and Table 14 presents the same effects, but on already exporters.

The general conclusion is that subsidies generate more positive effects on firms already dedicated to exports and fewer effects on domestic firms. Such positive effects are observed in exporters' employment, sales, efficiency (TFP) and R&D employment. For domestic firms, subsidies seem to "decrease" relative wages of newly subsidized firms, to increase firms' ability to import and also to improve firms's R&D ability.

When comparing domestic firms and firms dedicated to exports, we notice that subsidies seem to produce an increase in the wage premium in favour of exporters (as subsidies generate wage decreases in domestic firms and no significative effects in exporters), which is coherent with our theoretical result. Moreover, there is also an increase in exporters' sales relative to domestic firms, thus meaning that exporters increase their market share, which is in accordance with the model´s intuition. Moreover, for both group of firms, subsidies seem to reduce firms' earnings some years after subsidies are granted.[16]

We argue that, for domestic firms, some subsidies could be used to partially supporting the costs of some imported materials. Such effects are observed one year after subsidies have been granted. However, in spite of such positive effects, it does not produce any impact on those firms' exporting abilities.

[16] Given data limitations we could not test this hypothesis any further. Anyway, we can argue that subsidies do harm firms' profits three years after having been received since the persistency of subsidies creates negative behaviors conducing to less efficiency in some firms.

Table 13 – Effects of subsidies, pooled 1998-2002, for domestic firms

	Wages	Sales	Employees	R&D empl.	TFP	Imports	Earnings
$Year_t$	-0.042*	0.004+	0.046*	0.333*	0.243+	-0.681+	0.025+
	(0.022)	(0.056)	(0.022)	(0.201)	(0.485)	(0.52)	(0.092)
$Year_{t+1}$	-0.053*	0.048+	0.031*	-0.081+	-0.048+	0.321*	-0.042+
	(0.027)	(0.075)	(0.015)	(0.231)	(0.067)	(0.211)	(0.087)
$Year_{t+2}$	-0.032+	-0.042+	0.062+	-0.031+	-0.962+	0.542*	-0.031+
	(0.034)	(0.091)	(0.052)	(0.161)	(0.923)	(0.321)	(0.102)
$Year_{t+3}$	0.001+	0.123+	0.011+	0.011+	-0.124+	0.043+	-0.212*
	(0.012)	(0.231)	(0.142)	(0.131)	(0.165)	(0.054)	(0.159)

Source: Own calculations.
Notes: see Table 8.

Overall, effects (positive and negative) seem to be more robust for domestic firms than for already exporters. Such superior strength of subsidies' effects also seems to perform more clearly in the year after subsidy reception than in the same year it occurs.

Table 14 – Effects of subsidies, pooled 1998-2002, for firms initially already exporters

	Wages	Sales	Employees	R&D empl.	TFP	Imports	Earnings
$Year_t$	0.017+	0.032+	0.064*	0.173*	0.035*	-0.028+	0.016+
	(0.052)	(0.027)	(0.041)	(0.111)	(0.022)	(0.112)	(0.112)
$Year_{t+1}$	0.002+	0.067	0.036*	0.021+	0.034+	0.042+	-0.062+
	(0.017)	(0.033)	(0.013)	(0.031)	(0.027)	(0.081)	(0.143)
$Year_{t+2}$	0.005+	-0.036+	-0.006+	0.031+	0.054*	-0.078+	-0.052+
	(0.013)	(0.028)	(0.019)	(0.061)	(0.037)	(0.065)	(0.142)
$Year_{t+3}$	0.014+	0.062	0.037+	0.001+	0.024+	0.001+	-0.332*
	(0.017)	(0.034)	(0.028)	(0.031)	(0.027)	(0.121)	(0.189)

Source: Own calculations.
Notes: see Table 8.

9. Concluding remarks

The main purpose of this paper is to theoretically and empirically discuss the the effects of public policies for promoting exports. This discussion has not been dealt with by the literature on international trade or by the widespread literature on wage inequality. That is why we developed a dynamic general-equilibrium growth model with two sectors: the exports sector and the domestic sector. Growth is driven by Schumpeterian-R&D applied

to quality-adjusted intermediate goods that complement labour. It is assumed that R&D directed towards the exports sector is encouraged by public policies, and we analyse the effects of a government intervention through an increase in public policies promoting R&D.

Despite the complexity added to the production side of our economy, we reach a solution that delivers a unique and stable steady-state general equilibrium. We then carry out numerical analyses to solve the transitional dynamics towards the steady state. Government intervention, which promotes R&D in the exports sector, intensifies the technological-knowledge bias in favour of the exports side, which causes an increase in: (i) the competitiveness of the exports side; (ii) the wage premium in favour of exports workers; (iii) the economic growth rate. Consequently, at least temporary increases in taxes seem to arise as a valid argument to finance public policies promoting R&D.

Then, we empirically study for the very first time for Portuguese firms the link between production subsidies and exports. Although they are positively related, the link between these variables may suffer from endogeneity and sample selection. To really uncover their relationship, we apply a propensity score matching approach to reveal the causal effects of subsidies upon exports.

In line with most of the theoretical predictions our empirical results found that subsidies: increase the wage premium of firms already dedicated to exports and also increase the relative weight of exports when compared with domestic sales. Moreover, we also found a rise in the importance of R&D variable for both sectors, even if no increase in the technological- knowledge bias was empirically proved. Such fact could again suggest the misuse of the distribution of production subsidies in Portuguese manufacturing firms.

At another level, our empirical results also showed that: (i) subsidies received by domestic firms had few impact upon their capacity to become exporters; (ii) granted to

existing exports firms show no significant effects upon their exporting performances. Nevertheless, we also found some evidence that for some specific sectors and cohorts, firms´ subsidies create positive effects, namely for firms with superior efficiency levels.

Appendix A – Average 1996 - 2003

Sector code	Sector Description	Subsidies / Sales (%)	Subsidies per employee
15	Food, beverages	3.1	2870
17	Textiles	0.6	250
18	Wearing apparel	1.1	263
19	Leather	0.6	223
20	Wood	0.7	338
21	Pulp and paper	0.3	280
22	Printing	2.2	652
24	Chemicals	0.6	567
25	Rubber, plastic	0.4	285
26	Non-metalic mineral product	0.8	307
27	Basic metals	0.3	191
28	Fabricated metal products	0.5	230
29	Machinery	0.6	256
30	Office machinery and computers	0.7	585
31	Electrical machinery	0.3	223
32	TV and communication equipment	0.5	330
33	Medical, precision and optical instruments	0.8	438
34	Motor vehicles	0.9	390
35	Other transport equipment	1.2	802
36	Furniture	4.4	302
37	Recycling	11.2	3204
	Average	**1.4**	**891**

Source: Own calculations.

Appendix B – Treated and control firms for matching (starting to export)

	Treated	Control
1998	22	160
1999	17	261
2000	14	172
2001	11	125
2002	15	114

Source: Own calculations.
Note: firms without subsidies in each year: 677.

Appendix C – Treated and control firms for matching

(Export share)

	Treated	Control
1998	108	478
1999	132	491
2000	78	478
2001	75	482
2002	78	483

Source: Own calculations.
Note: firms without subsidies in each year: 677.

Appendix D – Important variables in the probability of receiving subsidies

Years	Variables
1998	R&D (+), Imports (+),
1999	Imports (+), forcap (+)
2000	Sectoral dummies;
2001	Sectoral dummies; Imports (+)
2002	Sectoral dummies; forcap

Source: Own calculations.

Appendix E – Causal effects of subsidies on export shares, 1998-2002

Sector code	Sector Description	Growth exp.share, *t*	Growth exp.share, *t*+1
15	Food, beverages	0.002^{+}	**-0.134***
17	Textiles	0.264^{+}	**-0.178***
18	Wearing apparel	-0.469^{+}	-0.078^{+}
19	Leather	-0.103^{+}	0.249^{+}
20	Wood	-0.079^{+}	0.275^{+}
21	Pulp and paper	**-0.338***	**-0.053****
22	Printing	0.029^{+}	-0.005^{+}
24	Chemicals	-0.082^{+}	-0.053^{+}
25	Rubber, plastic	-0.782^{+}	-0.806^{+}
26	Non-metalic mineral product	0.151^{+}	-0.094^{+}
27	Basic metals	0.147^{+}	**0.211***
28	Fabricated metal products	**-2.145***	**-2.219***
29	Machinery	-0.262^{+}	0.652^{+}
30	Office machinery and computers	n.a.	n.a.
31	Electrical machinery	**0.902***	-0.153^{+}
32	TV, communication equipment	-0.015^{+}	-0,152^{+}
33	Medical, precision, optical instruments	-0.015^{+}	-0,152^{+}
34	Motor vehicles	-7.841^{+}	-10.12^{+}
35	Other transport equipment	n.a.	n.a.
36	Furniture	-1.65^{+}	0.082^{+}
37	Recycling	n.a.	n.a.

Source: Own calculations.

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Faculdade de Economia da Universidade do Porto
Rua Dr. Roberto Frias, 4200-464 Porto | Tel. 225 571 100
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