BANK OF GREECE
EUROSYSTEM

Working Paper

Markups and fiscal policy: analytical framework and an empirical investigation

Georgios Christou
Panagiotis Chronis

221

MARCH 2017

BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

Printed in Athens, Greece
at the Bank of Greece Printing Works.

ISSN 1109-6691

MARKUPS AND FISCAL POLICY: ANALYTICAL FRAMEWORK AND AN EMPIRICAL INVESTIGATION

Georgios Christou
Athens University of Economics and Business (former)

Panagiotis Chronis
Bank of Greece

ABSTRACT

The paper focuses on the effects of fiscal policy on the industry-specific profit margin of a sector of an economy. This is a deviation from the existing literature, which focuses mainly on the effects of fiscal policy on the profit margin of the economy as a whole. In this work the price cost margin at the industry level is expressed as a function of the fiscal balance and other market variables such as industry share and price which are usually absent in a macro-analysis environment. Using a panel of ten European Union member countries for the period 1988-2005 we obtain the statistical results that support the existence of a non trivial relationship between price cost margin and fiscal policy, as it is expressed by the fiscal balance of a country. There are differences, however, between countries as well as industries reflecting different production and labor market conditions.

JEL classifications: H60, H62, L13, L16

Keywords: fiscal balance, price cost margin, market share, manufacturing

Acknowledgments: We thank, Vassilis Droucopoulos, Heather Gibson, Margarita Katsimi, Dimitrios Hadzinikolaou for useful comments and suggestions. All remaining errors are ours. The views expressed in the paper are those of the authors and not necessarily reflect the views of the Bank of Greece.

Correspondence:
Panagiotis Chronis,
Economic Analysis and Research Department
Bank of Greece,
21, E. Venizelos Avenue,
Athens 102 50, Greece,
tel. +30 210 3202368
email: pchronis@bankofgreece.gr

1. Introduction

In their well-known papers, Barro (1989) and Baxter and King (1993), following the neoclassical framework of Aschauer (1983), find that under the assumption of perfectly competitive markets a tax financing government spending reduces output and capital accumulation. Dixon and Rankin (1995), relaxing the assumption of perfectly competitive markets and following Spence (1976) and Dixit and Stiglitz (1977), discuss the macroeconomic effects of imperfectly competitive markets with increasing returns to scale. Their analysis is based on the assumption that the markup of price over marginal cost or the price-cost margin (PCM) is exogenous, which implies that the intensity of competition and the industry markup are unaffected by firm entry or exit. However, Yangru Wu and Junxi Zhang (2000), by stipulating that policies that induce entry or exit affect competition, output as well as capital accumulation, argue that changes in the tax rates are related to changes in the capital stock, consumption, industry concentration and price-cost margin. In the same vein, Dixon (1987), Mankiw (1989), Martinez and Dixon (2003), Molana and Moutos (1991) and Censolo and Colombo (2008), in an imperfect competition framework, focus on the effect of fiscal multipliers, i.e. how market power influences the way output is affected by fiscal policy.

Market power or the degree of competition is approximated by the price-cost margin. It is obvious, at least intuitively, that the price variable (i.e. the first of the two components that constitute the PCM) is affected by changes in taxes (e.g. value added tax). On the other hand, public spending can affect equilibrium prices through the aggregate demand mechanism.[1] Additionally, the marginal cost (i.e. the other component of the PCM) is not independent of taxes, since both labor and capital are affected by taxes. The above argument makes it clear that both variables which determine fiscal balance (i.e. public spending, *G*, and taxes, *T*) influence the markup of price over marginal cost.

In this paper the focus is on the effects of fiscal policy, that is changes in government spending and taxes, on the profit margins at the industry level. We thus deviate from the existing literature which focuses mainly on the effects of fiscal policy on the profit margin of the economy as a whole as this is calculated, for

[1] It is worth remembering that in the relevant literature the formal analysis, which results in the PCM or the markup relationship (e.g. Cowling and Waterson (1976)) uses the aggregate demand function.

instance, by the ratio of the difference between GDP and labour compensation as a proportion of GDP[2]. Our approach allows us to consider the effects of other market variables such as industry share and price, which are absent from a macro analysis environment. In effect, we examine a fiscal policy transmission mechanism based on a microfoundation framework which relates sectoral profit margins to fiscal policy.

2. Analytical framework

We consider an economy which consists of households, firms and government.

2.1 Households

The representative household maximizes a Cobb – Douglas utility function over consumption and leisure (for more details, see Mankiw (1988)). The first-order conditions for this maximization problem combined with the government budget constraint show that total expenditure (Y) is composed of private consumption and government consumption, i.e.

$$Y = b(W + \Pi - T) + G \tag{1}$$

where W is labor income, while Π and T stand for profits and the lump-sum tax, respectively, with b being the marginal propensity to consume.

2.2 Firms

In the industrial economics literature on PCM, the typical economy consists of N firms producing a homogeneous product.[3] Firm i chooses the level of its production (q_i) in order to maximize its profit (Π_i) subject to the inverse demand function $P = f(Q)$ of the industry, where $Q = \sum_{i=1}^{N} q_i$. The solution of this profit maximization problem leads to the following PCM equation (see Appendix 1):

[2] See for example Katsimi and Sarantides (2011).
[3] The analysis is still valid if the N firms produce a differentiated product as noted in Mankiw (1988). In this case the PCM will depend on each firm's elasticity of demand, which could be plausibly assumed to be constant.

$$\frac{P - MC_i}{P} = -\gamma a_i \frac{1}{P} S_i Q$$

(2)

where $S_i = \frac{q_i}{Q}$ α_i = 1+conjectural variation of firm *i* and $\gamma = f'_Q = \frac{df(Q)}{dQ}$ is the slope of the inverse demand function assumed to be constant.

2.3 The government

The government chooses its fiscal policy, taxes and public spending, aiming at reducing unemployment, or equivalently at increasing output, while maintaining sound public finances, in the sense of low fiscal deficits.[4] The implied objective of the fiscal authority is to solve the following maximization problem,

$$\max_{T,G} U^G = \max_{T,G} \left\{ \mu Y^2 + \delta (FB)^2 \right\} with\, \mu, \gamma \in (0,1] \tag{3}$$

subject to constraint (1) derived from the household's optimization problem, where U^G stands for the government's utility function and *FB* stands for the government's fiscal balance which is assumed to be a function of taxes *(T)* and government spending *(G).*

The first- order conditions require:

$$\frac{\partial U^G}{\partial T} = \mu Y \frac{\partial Y}{\partial T} + \delta FB \frac{\partial FB}{\partial T} = 0 \tag{4}$$

$$\frac{\partial U^G}{\partial G} = \mu Y \frac{\partial Y}{\partial G} + \delta FB \frac{\partial FB}{\partial G} = 0 \tag{5}$$

[4] In fact this assumption is consistent with any optimization problem that is subject to the government's budget constraint which equalises revenue and expenditure. This allows the public debt to be written as a function of the government's fiscal balance and vice versa. As a result, the deficit, or equivalently the debt, could appear as an argument in the government's objective function. Additionally, this setting is consistent with the structure of an economic union, like EMU, where there is an upper limit for the fiscal deficit It also is consistent with the literature related to politically motivated fiscal deficits. Similar reasoning can be found in many theoretical and empirical works (see for example, Chari and Kehoe (2007), van Aarle et al (1997) etc).

From (1) we obtain $\frac{\partial Y}{\partial T} = -b$ and $\frac{\partial Y}{\partial G} = 1$. Substituting these values into (4) and (5) we obtain:

$$b = \frac{\delta}{\mu} \frac{FB}{Y} \frac{\partial FB}{\partial T} \tag{6}$$

$$Y = -\frac{\delta}{\mu} FB \frac{\partial FB}{\partial G} \tag{7}$$

Combining equations (2) and (7) and using the definitional relationship $Y = P \cdot Q$, we can derive the following relationship between PCM and the fiscal variable (deficit or surplus):

$$\frac{P - MC_i}{P} = \gamma a_i \frac{1}{P^2} S_i \left(\frac{\delta}{\mu} FB \frac{\partial FB}{\partial G}\right) \tag{8}$$

Equation (8) is the functional relationship between market power *(PCM)* and the fiscal balance (*FB*). Its nature is further explored below before an attempt is made to investigate it econometrically.

The effect of fiscal policy on the PCM is not expected to be straight forward; changes in fiscal policy are transmitted to the private sector and hence affect the price cost margin in an indirect way[5]. Increases, for example, in public spending as a result of higher wages in the public sector would induce higher wages in the private sector by increasing the reservation utility of the workers, assuming the existence of strong trade unions. The reservation utility of the trade union members would also go up if taxes to individuals and subsidies to unemployment increase. In this case, there would be strong pressures for wage increases by the trade unions.

Based on the above argument, one would expect that increasing deficits, which induce higher wages in the private sector, would have a negative impact on the price cost margin and hence the expected regression coefficient of the fiscal balance variable will be positive.

[5] See for example Alessina, (2002), Ardagna (2001), Baxter and King (1993), Katsimi and Sarantides (2011).

In imperfectly competitive labor markets[6], increases in wages associated with relatively higher increases in labor productivity will not lead to a decrease in the profit margin. In this case, increasing deficits would not lead to decreases in the price-cost margin and therefore the expected regression coefficient of the fiscal balance variable will be negative.

The effect of a wage increase on a firm's profits depends also on the elasticity of substitution between labor and capital. For an elasticity of substitution less than unity, wage increases would lower profits and the opposite if the elasticity of substitution is greater than one[7]. In other words, the direction of the results regarding the effect of fiscal policy on profits depends on-among other things-the size of the elasticity of substitution between labor and capital. Krusell et al. (2000) reports estimated elasticities[8], both greater and lower than one, depending on whether the labor force is skilled (with elasticity less than one) or unskilled (with elasticity greater than one). This, in terms of our model, would imply that increased wages, for example, of the unskilled labor force induced by the fiscal policy, will not necessarily result in profit margin reductions and the opposite for an elasticity of substitution less than one. Therefore, increasing deficits could have a differential impact on price cost margins depending on whether they affect the wages of the skilled or the unskilled workers.

3. Fiscal Variables and Market Power

As noted in the introduction, one way the fiscal balance could be related to the degree of competition, comes via the two components of the PCM, i.e. the price variable (P) and the marginal cost (MC). A simple way to formally show this relationship is to follow the relevant literature and express output as a function of the fiscal variables (G and T), that is

$$Q=\zeta(Z) \quad , \quad Z = G \text{ or } T \tag{9}$$

From the definition of output Q :

[6] This assumption deviates from the Cobb-Douglas production function and the constant elasticity of substitution between labor and capital framework. See, for example, Booth (1995), Rowthorn (1999), and Katsimi (2012).
[7] For the proof, see Appendix 2.
[8] An elasticity of substitution greater/lower than one implies that the growth of the stock of equipment decreases/increases the marginal product of unskilled/skilled labor.

$$\frac{dQ}{dZ} = \frac{\partial q_1}{\partial Z} + \frac{\partial q_2}{\partial Z} + \ldots + \frac{\partial q_N}{\partial Z} \tag{10}$$

while from the inverse demand function $P = f(Q)$:

$$\frac{dP}{dZ} = f'_Q \frac{dQ}{dZ} \tag{11}$$

and $f'_Q = df(Q)/dQ$.

Substituting $\frac{dQ}{dZ}$ from (10) into (11) we have

$$\frac{dP}{dZ} = f'_Q \cdot \frac{dQ}{dZ} = f'_Q \cdot \left(\frac{\partial q_1}{\partial Z} + \ldots + \frac{\partial q_N}{\partial Z} \right) \tag{12}$$

Integrating (12) with respect to *Z* we get:

$$\int \frac{dP}{dZ} dZ = \int f'_Q \left(\frac{\partial q_1}{\partial Z} + \ldots + \frac{\partial q_N}{\partial Z} \right) dZ$$

or

$$P = \int f'_Q \left(\frac{\partial q_1}{\partial Z} + \ldots + \frac{\partial q_N}{\partial Z} \right) dZ \tag{13}$$

The above relationship indicates that the fiscal variable denoted by *Z* is related to the price variable, assuming that *Q* is related to *Z*.

Let us see now how the other component of the PCM, that is the marginal cost, is related to the fiscal variables.

Since the cost of the inputs of a firm or an industry is affected by the government's fiscal policy, we can write the cost of an industry or a firm in an implicit form as:

$$C = c[Q(T)] \tag{14}$$

Differentiating the above with respect to taxes we get:

$$\frac{dC}{dT} = \frac{dc[Q(T)]}{dQ} \frac{dQ}{dT} = MC \frac{dQ}{dT}$$

$$\text{or} \qquad \frac{dC}{dT} = MC \frac{dQ}{dT}\frac{T}{Q}\frac{Q}{T}$$

$$\text{or} \qquad \frac{dC}{dT}\frac{1}{\frac{dQ}{dT}\frac{T}{Q}} = MC\frac{Q}{T}$$

$$\text{or} \qquad P\frac{dC}{dT}\varepsilon_{T,Q}\,\tau = MC \tag{15}$$

where $\varepsilon_{T,Q}$ is the elasticity tax revenue with respect to output and τ = *T/PQ* the tax rate. The derivative $\frac{dC}{dT}$ reflects the way total cost is related to the government's tax policy.

4. The econometric model and the data

The functional relationship between the price-cost margin (PCM) and the other variables, that is, fiscal balance (FB), industry share (S), price (P) and conjectural variation for estimation purposes, can take various forms depending on the kind of data to be utilized. In this work, we will use panel data for which the standard model is the following:

$$Yit = Xit\,\beta + \gamma i + uit \qquad i = 1,2,\ldots,N, \quad t = 1,2,\ldots,T \tag{16}$$

where Xit is the 1x(K+1) vector of the regressors, β is the (K+1)x1 vector of the coefficients, γi is the time invariant unobserved individual effect, and uit is the error term.

We estimate the above model for the member countries of the European Union (EU), using panel data for the 2-digit breakdown of the manufacturing sector contained in EU KLEMS Data Base[9]. The KLEMS Data Base contains yearly data for twenty three subsectors of manufacturing, given in table (1), for all member countries of the EU, for the period 1970-2005. We will use the KLEMS data to obtain the relevant series for PCM, P and S. Specifically, the PCM of industry i (PCMi) is the

[9] The EU KLEMS Data base is part of a research project financed by the European Commission to analyze productivity in the Union at the industry level. KLEMS means capital (K), labor (L), energy (E), material (M) and service (S) inputs. See, EU KLEMS GROWTH AND PRODUCTIVITY ACCOUNTS Version 10, March 2007.

ratio of its capital compensation to its value added. Capital compensation is defined as the difference between the value added and the labor compensation. That is:

$$PCM_i = \frac{(\text{Value Added})_i - (\text{Labor Compensation})_i}{(\text{Value Added})_i} = \frac{(\text{Capital Compensation})_i}{(\text{Value Added})_i}$$

Labor compensation includes imputed compensation of self employment, which is assumed to equal compensation of employees, and as a result it might exceed value added. In such cases PCM becomes negative. The value added price index in the KLEMS database is used as a proxy for the industry's i price level (Pi). The industry's i share (Si) is simply the ratio of its value added to the total value added of the manufacturing sector. For the fiscal variable (FB), we will use the current fiscal deficit (minus sign) or surplus (positive sign) as a percentage of GDP and designate it as (FBP).The relevant data for the fiscal variable come from AMECO[10]. Of course, there are no available data to be used for the conjectural variation. However, we can plausibly assume that in our model the unobserved effect γ_i refers mainly to the conjectural variation, assumed to be constant over time.

The model then to be estimated is the following:

$$PCM_{i,t} = \beta_0 + \beta_1 FBP_{i,t} + \beta_2 S_{i,t} + \beta_3 P_{i,t} + \gamma_i + u_{i,t} \qquad (17)$$

$$i=1,2,\ldots,N, \quad t=1,2,\ldots,T$$

Complete sets of the data are available only for the following ten EU member countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, The Netherlands, Spain and the United Kingdom. The time span, however, is not the same for all countries. Specifically: for Austria, Belgium, France and Greece the time period is 1988-2005, for Finland, 1988-2004, for The Netherlands and Spain, 1995-2005, for Denmark, to 1993-2005, for Germany to 1991-2005 and for the United Kingdom, 1992-2005.

As noted earlier, the PCM might also take on negative values and that is true for all countries except Spain, for which it is always positive. The fiscal variable (FBP) is negative (indicating a deficit) for the entire sample period for Austria, France, and Greece. For Spain it is also negative for all years except for the last one (2005). For

[10]Annual Macroeconomic Database of the European Commission.

Germany the fiscal balance is also negative for the entire period with the exception for the year 2000. For the rest of the countries there is more than one year for which the fiscal balance was positive (indicating a surplus). Specifically, two years for Belgium, seven for Denmark, three for U.K., while for Finland the fiscal balance was negative only for the period 1992-1998.

5. Econometric results

We estimated the panel model first by pooling the ten countries together for the 23 industry breakdown of the manufacturing sector and then for each country separately. The results are summarized in tables (3)-(5).

5.1 Ten country panel

Pooling together the ten countries we formed an unbalanced panel for the eighteen year period 1988-2005.The cross-sectional unit for this panel is the country-industry of the manufacturing sector which means that there are 23x10 =230 cross-sectional units for a series of 18 years and a total of 3426 observations. In estimating this panel model we added as a control variable for the country characteristics the openness of the economy defined as the ratio of the sum of exports plus imports to gross domestic product[11]. Before proceeding with the estimation of the model we checked for stationarity by applying three well known unit roots tests for panel data, namely the Levin, Lin and Chin t test, the Im, Pesaran and Shin w-statistic and the ADF Fisher chi-square test. The results are summarized in table (2). As it can be seen from the table, all five variables are stationary by at least one criterion.

Based on this finding we proceeded with the estimation of the panel model described earlier. To avoid some possible endogeneity problems, the model was estimated with the fiscal variable lagged one period. The results are summarized in table (3). As can be seen from column (1) of the table, the cross-section fixed effects model is well specified with a high value for the adjusted coefficient of determination (R^2 = 0.93) and highly significant regression coefficients. All coefficients are positive except for the fiscal variable for which is negative. That is an increase in surplus/reduction in the deficit reduces the price-cost margin. Furthermore, there are

[11] The relevant data were obtained by BIS, see Cecchetti et al. (2011).

significant cross-section effects as this is indicated by the (Likelihood ratio) F test. The presence of random effects is rejected by the Hausman chi-square test. The fixed time effects are insignificant. As it was pointed out earlier, in the panel model of table (3), the cross-sectional unit is the country-industry. To check for country effects we estimated a pooled model by adding dummies for the ten countries, while to check for industry effects we added dummies for the twenty three industries. The results are given in table (3) in columns (2) and (3), respectively. The relevant F tests show that there are significant differences across countries and industries.

The results reported in table (3) are based on the assumption that the coefficients on the explanatory variables are the same across industries, which might not be the case. To further explore the effect of the fiscal variable on the profit margin we ran separate panel regressions for each industry. The results, summarized in table (4), show that for seventeen of the 2 digit sectors the coefficient of the fiscal variable is negative, but for only ten of them is statistically significant at the 5% level of significance or less. Of the subsectors with a positive regression coefficient for the fiscal balance, only for one subsector is the coefficient statistically significant.

5.2. Each country separately

The results of estimating the panel model for each country are summarized in table (5). For all countries we observe high values for the coefficient of determination and significant cross-section effects, as shown by the fixed effects tests (not shown in the table, but available on request). There are, however, some notable differences concerning the sign and the statistical significance of the estimated coefficients of the explanatory variables. The coefficient on the price in the subsector is positive for six countries (Belgium, Finland, Germany, Greece, Spain and the United Kingdom) and negative for the rest (Austria, Denmark, France and the Netherlands). It is significant for all countries except for Germany, Denmark, and the Netherlands. The impact of the subsector share on the price-cost margin is positive for all countries[12]. The impact of the fiscal balance is negative for all countries except for Germany, Denmark and France for which it is positive. All fiscal balance regression coefficients are

[12] In this instance, it is apt to recall that in a Nash - Cournot environment, the PCM of a firm is positively related to the market share of a firm, given the elasticities of market demand (Hay and Derek (1991), Church and Ware pp239 (1999)).

significant at the 5% level of significance or less except for Germany, Belgium and Denmark. The latter two are significant at the 6% level[13].

5.3. The impact of fiscal policy on the price-cost margin

In our model the impact of fiscal policy changes on the price cost margin is measured by the coefficient on the fiscal balance variable. In most cases, the coefficient is negative indicating that an increase in the surplus/decrease in the deficit causes the price-cost margin to fall.

The statistical results obtained in this study point to the existence of a non trivial relationship between price cost margins and fiscal policy in manufacturing. The overall picture that emerges from the study supports the hypothesis that changes in the price-cost margins in the manufacturing sector, in general, move to the opposite direction to changes in the fiscal balance. Testing the hypothesis across the EU countries, a rising fiscal surplus/falling deficit is associated with the fall in price-cost margins. However, only in one case was the relationship significant at the 5% level. Across subsectors of manufacturing, the results obtained are similar in the sense that for the vast majority of subsectors changes in the fiscal balance have a negative impact on the price-cost margin, although not statistically significant for all of them. Further research is needed to explain the differential impact of fiscal policy on specific sectors of an economy, by explicitly examining, for example, factors such as the elasticity of substitution. The results of this work are only indicative and they point to the need for more analytical research and certainly better data.

6. Summary and conclusion

In this work, an attempt was made to present a macroeconomic framework relating profit margins to fiscal policy. For this purpose, starting with a standard New Keynesian framework consistent with households and firms maximizing utility and profits respectively, we add as a third agent the government which conducts fiscal policy. This allows us to investigate the effect of fiscal policy on sector specific profit margins in manufacturing, rather than on the profit margin for the economy as whole,

[13] It should be mentioned that the use of the cyclically adjusted fiscal balance did not have any appreciable effect on the regression coefficient.

which is the usual approach followed in the literature. This effect depends on production and labor market conditions of the particular industry concerned. The econometric results, based on a ten EC member countries sample and presented in this work, in general, point to the existence of a long-run relationship between fiscal policy and the price-cost margin in most sectors of manufacturing. Changes in the fiscal balance are expected, by and large, to affect negatively the price-cost margins of the manufacturing. There are, however, differences between countries as well as across industries.

References

Alesina, A., Ardagna S., Perotti R., and Schiantarelli F. (2002). "Fiscal policy, profits and investment", The American Economic Review, 92(3), pp. 571-589.

Ardagna, S. (2007). "Fiscal policy in unionized Labor Markets", Journal of Economic Dynamics and Control, 31(5), pp. 498-534.

Aschauer, D. (1989). "Is Public Expenditure Productive?" Journal of Monetary Economics, 23(2), pp. 177-200.

Azariadis, C. (1993). Intertemporal Macroeconomics. Cambridge, MA: Blackwell.

Azariadis, C. (1996). "The Economics of Poverty Traps Part One: Complete Markets", Journal of Economic Growth 1, pp. 449–486.

Barro, R.J. (1989). "The Neoclassical Approach to Fiscal Policy". In: Barro, R.J. (Eds.), *Modern Business Cycle Theory*. Harvard University Press, Cambridge, MA, pp. 178-235.

Baxter, M., and King, R., M. (1993). "Fiscal Policy in General Equilibrium", American Economic Review, 83(3), pp. 315-334.

Censolo, R., and Colombo C. (2008). "Mixed industrial Structure and the Short run Fmultiplier", Australian Economic Papers 47(2).

Cecchetti et al. (2011). "The real effect of debt", BIS Working Papers 352, September.

Cowling, K. and Waterson, M. (1976). "Price-Cost Margins and Market Structure", Economica, New Series, 43(171).`

Chari, V. V. and Kehoe, P. J. (2007). "On the Need of Fiscal Constraints in a Monetary Union", Journal of Monetary Economics, Vol. 54, pp. 2399-2408.

Church, J. and Roger Ware (1999). *Industrial Organization: a strategic approach*. Irwin McGraw-Hill, Boston, pp. 239.

Dixon, H. (1987). "A Simple Model of Imperfect Competition with Walrasian Features", Oxford Economic Papers, Vol. 39(1), pp. 134-160.

Dixon, H. D., and Ranking, N. (1995). Imperfect Competition and Macroeconomics: a survey. In: Dixon, H. D. and Rankin, N. (Eds.), *The New Macroeconomics: Imperfect Markets and policy effectiveness*, Cambridge University Press, Cambridge, UK, pp. 34-62.

Dixit, A. K. and Stiglitz, J. E. (1977)."Monopolistic Competition and optimum Product Diversity", American Economic Review, Vol. 67, pp. 297-308.

Duffy, J. and Papageorgiou, C. (2000). “A cross country empirical investigation of the aggregate production function specification”, Journal of Economic Growth, Vol. 5(1), pp. 87–120.

Hay, D. A. and Morris, D. J. (1991). *Industrial Economics and Organization*, 2nd Ed., Oxford University Press, Oxford, pp. 172.

Wu Yangru and Zhang Junxi (2000). “Endogenous Markups and the Effects of Income Taxation: Theory and Evidence from the OECD Countries”, Journal of Public Economics, Vol. 77, pp. 383-406.

Katsimi, M. and Sarantides, V. (2011). “The impact of Fiscal Policy on Profits”, Economic Inquiry.

Katsimi, M., Kalivitis, S., and Moutos T. (2012). “Excesive wages and the return on capital”, Cambrige Journal of Economics, Vol. 36, pp. 435-461.

Krusell, P., Ohanian, L., E., Rios-Rull, J.-V., and Violante, G. L. (2000). “Capital–skill complementarity and inequality: a macroeconomic analysis”, Econometrica, Vol. 68(5), pp. 1029–54.

Mankiw, N. G. (1988). “Imperfect Competition and the Keynesian Cross”, Economics Letters, VOL. 26, pp. 7-13.

Martinez, J. C. and Dixon, H. (2003). “Profits Markups and Entry: Fiscal Policy in an Open Economy”, Journal of Economic Dynamics and Control, Vol. 27, pp. 573-597.

Molana, H. and Moutos, T. (1992). “Imperfect Competition and the Balanced Budget Multiplier”, Oxford Economic Papers, Vol. 44(1), pp. 68-74.

Spence, M. A. (1976). “Product Selection, Fixed Costs, and Monopolistic Competition”, Review of Economic Studies, Vol. 43, pp. 217-235.

Summers L. H. (1988). “Relative Wages, Efficiency Wages and Keynesian Unemployment”, American Economic Review, Vol. 78, No 2, pp. 383-388.

Van Aarle, A., Lans Bovemberg and Matthias G. Raith (1997). “Is There Tragedy of a Common Central Bank? A Dynamic Analysis”, Journal of Economic Dynamics and Control, Vol. 21.

Tables and Figures

Table 1. Industry Classification	
1	Food and beverages
2	Tobacco
3	Textiles
4	Wearing apparel, dressing and dying of fur
5	Leather and footwear
6	Wooden products and products of wood and cork
7	Pulp, paper and paper products
8	Printing, publishing and reproduction
9	Coke, refined petroleum and nuclear fuel
10	Chemicals and chemical products
11	Rubber and plastics
12	Other non- metallic mineral
13	Basic metals
14	Fabricated metals
15	Machinery, NEC
16	Office accounting and computing machinery
17	Electrical machinery and apparatus, NEC
18	Radio TV and communications equipment
19	Medical, precision and optical instruments
20	Motor vehicles, trailers and semi-trailers
21	Other transport equipment
22	Manufacturing NEC
23	Recycling

Table 2. Unit Root Tests for the Ten Country Pooled Series, 1988-2005

Variables	Test Criteria					
	Levin, Lin and Chut		Im, Pesaran and Shim W-Statistic		ADF Fisher Chi Square	
	Constant	Constant and Trend	Constant	Constant and Trend	Constant	Constant and Trend
Price-Cost Margin	-8.0	-16.1	-4.5	-6.8	667.3	714.9
	0.0	0.0	0.0	0.0	0.0	0.0
Fiscal Balance	-25.4	-7.9	-15.9	-10.0	1037.0	900.0
	0.0	0.0	0.0	0.0	0.0	0.0
Industry Share	-7.6	-15.4	-0.6	-4.4	548.8	819.0
	0.0	0.0	0.0	0.0	0.0	0.0
Industry Price	-13.6	-8.7	0.6	-0.6	573.1	531.7
	0.0	0.0	0.7	0.3	0.0	0.0
Openness of the economy	5.8	-11.8	8.4	-1.5	342.5	480.0
	1.0	0.0	1.0	0.0	1.0	0.2

Note:

First row, value of test statistic

Second row, P-value

Table 3. Estimation Results for The Ten Country Panel Model, 1988-2005

Columns	Cross-section Fixed Effects (1)	Country Dummies (2)	Industry Dummies (3)
Constant	-0.077 -4.3	0.080 6.6	0.094 8.9
Fiscal Balance Lagged	-0.004 -10.5	-0.003 -6.6	-0.000 -0.3
Industry Share	2.794 10.5	0.508 19.5	1.430 42.0
Industry Price	0.022 2.8	0.044 7.5	0.023 3.8
Openness of the economy	0.003 13.6	0.001 13.1	0.001 18.9
Adjusted R^2	0.93	0.41	0.70
Number of Observations	3426	3426	3426
Likelihood Ratio test for cross section effects	F=172.1 P= 0.0		
Hausman chi- square test for random effect	X^2=68.4, P=0.0		
Fixed time effects:	F=1.23 P=0.23		
Country effects:		F=123.1 P=0.0	
Industry effects:			F=277.0 P=0.0

Note:

First row, regression coefficient (cross section weights)

Second row, t statistic (white cross-section)

Country Dummies, zero for Austria

Industry Dummies, zero for Industry 1 (Food and beverages)

Table 4. Estimation Results By Industry For The Ten Countries Panel. 1988-2005

Industry	Constant	Fiscal Balance Lagged	Industry Share	Industry Price	Openness of the economy	Adjusted R^2	No of obs
1	0.2938 8.82	-0.021 -2.49	0.17 1.04	-0.004 0.32	7.56E-05 0.22	0.80	140
2	0.519 12.2	0.001 1.16	0.30 1.14	0.02 3.42	0.00 0.23	0.87	139
3	-0.346 -4.25	-0.008 -7.29	5.11 4.72	0.138 5.030	0.003 7.69	0.78	140
4	-0.448 -5.49	-0.015 -8.41	0.661 1.53	0.106 2.98	0.006 10.02	0.63	140
5	-0.000 -0.007	-0.000 -0.68	0.219 0.07	0.004 0.19	0.003 5.22	0.58	140
6	-0.407 -7.86	0.001 1.83	10.94 6.79	0.016 0.76	0.004 14.96	0.82	140
7	0.076 1.34	-0.000 -1.34	2.467 6.18	0.036 0.72	0.001 4.27	0.89	140
8	-0.369 -7.09	-0.003 -4.32	2.818 5.68	0.127 3.90	0.004 7.34	0.75	140
9	-0.063 -0.71	0.001 0.70	6.500 7.65	-0.022 -7.76	0.005 4.86	0.86	140
10	0.039 1.14	-0.004 -5.27	0.486 2.31	0.079 4.40	0.003 8.66	0.93	140
11	0.078 2.66	-0.006 -9.33	2.234 2.70	0.060 6.09	0.000 3.74	0.55	140
12	-0.16 -5.30	-0.004 -9.09	4.33 9.27	0.125 5.77	0.001 5.76	0.85	140
13	-0.474 -7.25	-0.007 -3.97	4.038 3.06	0.11 2.55	0.006 8.62	0.84	140
14	-0.144 -3.16	-0.004 -4.92	1.234 2.18	0.090 3.29	0.001 4.26	0.86	140
15	-0.107 -2.00	-0.002 -3.74	1.62 2.61	0.001 0.05	0.002 4.90	0.82	140
16	0.032 0.17	-0.004 -0.99	69.27 5.86	-0.131 -3.91	-0.002 -1.18	0.80	140
17	-0.304 -3.80	-0.000 -0.65	10.423 7.96	0.040 2.41	0.001 3.19	0.68	140
18	-0.353 -3.96	-0.012 -4.55	3.760 5.91	0.109 6.49	0.004 4.53	0.77	140
19	-0.357 -9.58	-0.009 -6.30	5.150 3.57	0.025 1.28	0.005 9.07	0.78	140
20	-0.154 -3.55	0.000 0.46	3.719 4.98	0.172 5.13	0.000 1.16	0.82	140
21	-0.566 -4.98	0.003 1.68	6.720 3.63	0.269 6.15	0.003 2.69	0.69	140
22	-0.333 6.73	-0.003 -2.87	3.885 7.00	0.086 3.10	0.003 5.48	0.83	140
23	0.022 0.32	0.005 2.42	0.969 0.74	0.067 5.59	0.004 5.48	0.69	140

Note:

First row, regression coefficient (cross-section weights)

Second row, t statistic (white cross-section)

Table 5. Estimation Results For Each Country. Fixed Effects Model. 1988-2005							
COUNTRY	Constant	Fiscal Balance Lagged	Industry Share	Industry Price	Openness of the economy	Adjusted R^2	No of obs
AUSTRIA	-0.277 -3.65	-0.0003 -0.06	5.930 16.57	-0.153 -2.91	0.006 7.56	0.77	391
BELGIUM	-0.007 -0.31	-0.003 -1.9	1.351 3.8	0.049 7.7	0.002 3.8	0.86	391
DENMARK	0.447 6.76	0.005 1.88	0.377 1.33	-0.001 -0.10	-0.002 -2.63	0.86	276
FINLAND	0.83 1.46	-0.002 -2.81	2.118 8.83	0.207 5.88	-0.001 -1.38	0.85	298
FRANCE	-0.088 -2.21	0.006 4.25	8.289 17.89	-0.022 -9.52	0.001 3.21	0.86	391
GERMANY	-0.184 -6.13	0.000 0.04	5.16 7.56	0.012 1.42	0.003 16.47	0.86	322
GREECE	-0.281 -3.41	-0.008 -3.31	3.189 9.75	0.098 7.34	0.004 3.67	0.91	391
NETHERLANDS	-0.579 -8.97	-0.001 -2.28	14.983 17.17	-0.006 -0.37	0.001 5.87	0.95	230
SPAIN	-0.048 -1.17	-0.006 -5.05	3.700 17.17	0.109 10.41	0.001 3.47	0.97	230
UK	-0.580 -4.28	-0.008 -6.25	4.981 9.94	0.094 2.95	0.009 3.71	0.90	299

Note:
First row, regression coefficient (cross-section weights)
Second row, t statistic (white cross-section)

Appendices

APPENDIX 1: The firm's profit maximization problem

Let Π_i be the firm's *i* profit and q_i and TC_i its output and total cost, respectively. Under the assumption that the *N* firms produce a homogenous product, the total industry's output could be written as:

$$Q = q_1 + q_2 + ... + q_N$$

Letting *P* stand for the price of the product, the firm's profit maximization problem is the following:

$$\max_{q_i} \Pi_i = P\,q_i - TC_i \tag{1}$$

subject to:

$$P = f\left(Q\right) = f\,(q_1 + q_2 + ... + q_i + ... + q_n) \tag{2}$$

The first order conditions for the above maximization problem require:

$$\frac{d\Pi_i}{dq_i} = \frac{dP}{dq_i} q_i + P - MC_i = 0$$

or

$$P - MC_i = -\frac{dP}{dq_i}\, q_i \tag{3}$$

From (2) we have

$$\frac{dP}{dq_i} = \frac{df\,(Q)}{dQ}\frac{dQ}{dq_i} = f'_Q \frac{dQ}{dq_i} = f'_Q \alpha_i \tag{4}$$

where $\frac{dQ}{dq_i} = \alpha_i$ and $f'_Q = \frac{df\,(Q)}{dQ}$

Combining (3) and (4) we derive

$$P - MC_i = -f'_Q\, \alpha_i\, q_i$$

and dividing both parts by *P* we get:

$$\frac{P - MC_i}{P} = -\frac{1}{P}\, f'_Q\, \alpha_i\, q_i \tag{5}$$

Multiplying (5) by $^{Q}/_{Q}$ and after the appropriate rearrangements we can write the mark up as

$$\frac{P-MC_i}{P} = -\frac{1}{P} f'_Q \alpha_i \frac{q_i}{Q} Q$$

or

$$\frac{P-MC_i}{P} = -\frac{1}{P} f'_Q \alpha_i S_i Q \tag{6}$$

Assuming a linear inverse demand function, the slope $f'_Q = \frac{df(Q)}{dQ}$ is constant. Thus we write equation (6) as,

$$\frac{P-MC_i}{P} = -\gamma \alpha_i S_i Q \frac{1}{P} \tag{7}$$

Where

$$\gamma = f'_Q$$

Alternatively,

$$\frac{P-MC_i}{P} = -\gamma (1+CV_i) S_i Q \frac{1}{P} \tag{8}$$

where

CV_i = firm's i conjectural variation $= \frac{d(Q-q_i)}{dq_i}$

APPENDIX 2

The elasticity of substitution and its relation between wages and profit.

From Summers (1988), Katsimi et al. (2012), the maximum profit Π* of a representative firm is given by the following expression:

$$\Pi^* = \alpha^{\left(\frac{-1}{\alpha-1}\right)} \left(1-\alpha\right) \Delta^{\frac{\alpha}{\rho}\left(\frac{\rho-1}{\alpha-1}\right)}$$

Where $\Delta = \left(\frac{b}{1-\theta}\right)^{\left(\frac{\rho-1}{a-1}\right)} \left(\frac{\theta}{1-\theta}\right)^{-\rho\frac{\theta}{\rho-1}} + r^{\frac{\rho}{\rho-1}}$

Note that $\frac{b}{1-\theta} = w$ stands for the wage chosen by the firm and $\left(\frac{\theta}{1-\theta}\right)^{\theta}$ stands for the optimal level of effort with (θ) denoting the productivity enhancing effect. Also notice that, $0 \leq \alpha \leq 1$, and $\rho \leq 1$ determines the size of the elasticity of substitution between labor and capital.

Since we are interested to find how changes in the wage cost (possibly following the changes in fiscal policy) affect the profit a firm, we differentiate the profit function with respect to wage cost and we obtain:

$$\frac{\partial \Pi^*}{\partial w} = \alpha^{\frac{1}{1+a}} (1+a) \left[w^{(1-\theta)\rho\sigma} \left(\frac{\theta}{b}\right) + r^{-\rho\sigma} \right]^{\frac{\rho-a}{\rho(a-1)}} (1+\theta) \left(\frac{\theta}{b}\right)^{\theta\rho\sigma} \rho\sigma w^{\sigma(\rho(\theta+2)+1)}$$

From the above expression it can be seen that, when the elasticity of substitution σ= $\left(\frac{1}{1-\rho}\right)$ between labor and capital is less than unity (i.e. $\rho<0$), an increase in wages is consistent with lower profits. The opposite holds for (σ>1) (i.e $\rho \geq 0$).

BANK OF GREECE WORKING PAPERS

202. Papadopoulos, S., P. Stavroulias and T. Sager, "Systemic Early Warning Systems for EU15 Based on the 2008 Crisis", January 2016.
203. Papadopoulos, G., S. Papadopoulos and T. Sager, "Credit Risk Stress Testing for EU15 Banks: a Model Combination Approach", January 2016.
204. Louzis, P. D., "Macroeconomic Forecasting and Structural Changes in Steady States", March 2016.
205. Christodoulakis, N. and C. Axioglou, "Underinvestment and Unemployment: the Double Hazard in the Euro Area", April 2016.
206. Bardaka, C. I., "Structural and Cyclical Factors of Greece's Current Account Balances: A Note", May 2016.
207. Lothian, J. R., and G. S. Tavlas, "How Friedman and Schwartz Became Monetarists", May 2016.
208. Balfoussia, H. and H. D. Gibson, "Firm Investment and Financial Conditions in the Euro Area: Evidence from Firm-Level Data", June 2016.
209. Samantas, G.I., "On the Optimality of Bank Competition Policy", July 2016.
210. Malliaropulos, D., and P.M. Migiakis, "The Re-Pricing of Sovereign Risks Following the Global Financial Crisis", July 2016.
211. Asimakopoulos, I., P.K. Avramidis, D. Malliaropulos, N. G. Travlos, "Moral Hazard and Strategic Default: Evidence from Greek Corporate Loans", July 2016.
212. Tavlas, S.G., "New Perspectives on the Great Depression: a Review Essay", September 2016.
213. Papapetrou, E. and P. Tsalaporta, "Inter-Industry Wage Differentials in Greece: Rent-Sharing and Unobserved Heterogeneity Hypotheses", November 2016.
214. Gibson, D.H, S.G. Hall, and G.S. Tavlas, "Self-Fulfilling Dynamics: the Interactions of Sovereign Spreads, Sovereign Ratings and Bank Ratings during the Euro Financial Crisis", November 2016.
215. Baumann, U. and M. Vasardani, "The Slowdown in US Productivity Growth - What Explains it and Will it Persist?", November 2016.
216. Tsionas. G.M., "Alternative Bayesian Compression in Vector Autoregressions and Related Models", November 2016.
217. Tsionas. G.M., "Alternatives to Large VAR, VARMA and Multivariate Stochastic Volatility Models", December 2016.
218. Balfoussia, H. and D. Papageorgiou, "Insights on the Greek Economy from the 3D Macro Model", December 2016.
219. Anastasiou, D., H. Louri and M. Tsionas, "Non-Performing Loans in the Euro Area: are Core-Periphery Banking Markets Fragmented?," December 2016.
220. Charalambakis, E., Y. Dendramis, and E. Tzavalis, "On the Determinants of NPLS: Lessons from Greece", March 2017.