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Market Power and Fiscal Policy in OECD Countries

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MARKET POWER AND FISCAL POLICY IN OECD COUNTRIES*

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Abstract

We compute average mark-ups as a measure of market power throughout time and study their interaction with fiscal policy and macroeconomic variables in a VAR framework. From impulse-response functions the results, with annual data for a set of 14 OECD countries covering the period 1970-2007, show that the mark-up (i) depicts a pro-cyclical behaviour with productivity shocks and (ii) a mildly counter-cyclical behaviour with fiscal spending shocks. We also use a Panel Vector Auto-Regression analysis, increasing the efficiency in the estimations, which confirms the country-specific results.

JEL Classification: D4, E6, E3, H6.
Keywords: Fiscal Policy, Mark-up, VAR, Panel VAR.

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1. Introduction

The interaction between imperfect competition and fiscal-policy effectiveness has deserved a fair share of attention in economic theory – see Costa and Dixon (2009) for a survey. Most theoretical models tend to associate larger mark-ups with higher fiscal policy effectiveness due to either a (short-run) pure profits multiplier mechanism or to a (long-run) entry effect that increases factor efficiency – increasing returns to entry or endogenous mark-ups. Nonetheless, there is no consensus on the topic, as preferences, technologies, heterogeneity of firms, and types of taxation are crucial for the theoretical outcomes obtained. Thus, taking the theory to the test of data is an important step in order to derive some useful policy implications, both in qualitative and quantitative terms. However, the empirical analysis of the connection between market power and the effects of fiscal shocks is scant.

Imperfect competition has a special role in the transmission mechanism of fiscal policy when mark-ups vary endogenously along the business cycle. New Keynesian synthesis models produce undesired endogenous mark-ups due to nominal rigidity, enhancing the effectiveness of demand-side policy, including fiscal policy – see Linnemann and Schabert (2003) for an example with productive public expenditure. Additionally, recent interest in macroeconomic models where desired mark-ups vary over time make the research topic even more attractive, as they work similarly to productivity shocks in the presence of active fiscal policy – see Barro and Tenreyro (2006), Bilbiie et al. (2007), dos Santos Ferreira and Dufourt (2006), dos Santos Ferreira and Lloyd-Braga (2005), Jaimovich (2007), Jaimovich and Floetotto (2008), amongst others.

One of the reasons why empirical research in this area is not abundant is related to the limited availability of time series for mark-ups as a measure of market power. There are several papers that try to measure mark-ups for different industries and sectors over a period, following the seminal paper of Hall (1988), e.g. Christopoulou and Vermeulen (2008), Martins et al. (1996), and Roeger (1995). Despite the fact these studies do not provide time series for mark-ups, there is some evidence on its mildly counter-cyclical behaviour provided in Martins and Scarpetta (2002). However, the production of time series for mark-ups for the US economy has been done by Rotemberg and Woodford (1991, 1999) (henceforth RW) using macroeconomic data and simple assumptions on both the technology used and the long-run features exhibited by the variables.

We follow the RW approach to generate mark-up time series for OECD countries. We introduce a methodological innovation since we allow for smooth changes in the technological parameters. Furthermore, we also generate a total-factor-productivity measure compatible with the above-mentioned mark-up series.

We produced illustrative results with annual data for a group of 14 OECD countries in the period 1970-2007: Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the UK, and the US. The VAR impulse-response functions show that, in general the mark-up (i) depicts a pro-cyclical behaviour with productivity shocks and (ii) a mildly counter-cyclical behaviour with fiscal spending shocks

Finally, using also a Panel Vector Auto-Regression analysis, which allows increasing the efficiency of the estimations, we are able to essentially confirm the country-specific results regarding the mark-up pro (counter)-cyclicality with productivity (fiscal spending) shocks.

The remainder of this paper is organised as follows. Section two describes the theoretical underpinnings of our mark-up measures. Section three jointly computes the average mark-up and total factor productivity (TFP) throughout time. Section four conducts the VAR analysis and section five estimates a panel VAR. Section six concludes.

2. The mark-up: theoretical framework

In this section we use economic theory to produce time series for average mark-ups, a variable that cannot be directly observed. The “mark-up” is usually defined as a measure of the distance between prices and marginal costs. It expresses the power firms have to set a price above its cost of producing an additional unit of output, i.e. the market power.

In the presence of a positive supply shock, we expect the marginal cost function to shift downwards, i.e. the marginal cost tends to decrease for a given output. Therefore, assuming that the indirect effect on prices via demand is small, mark-ups tend to increase implying a pro-cyclical average mark-up.

When a positive shock originates in the demand side (e.g. a fiscal policy shock), the marginal cost function is only indirectly affected and the main effect depends on how the demand function faced by individual producers responds to the shock. Nominal rigidity (Clarida et al. (1999), Goodfriend and King (1997), Hairault and Portier (1993)), varying composition of aggregate demand (Galí (1994a, 1994b)), deep habits in consumption (Ravn et al. (2006)), variety-specific subsistence levels (Ravn et al. (2008)), non-CES utility functions (Feenstra (2003)), implicit collusion in the supply side (Rotemberg and Woodford (1991, 1992)), Cournot competition (Costa (2004), Portier (1995)), or feedback effects of entry

(Linnemann (2001), Jaimovich (2007)) are just examples of models that produce counter-cyclical mark-ups in the presence of demand shocks.

The combination of both types of shocks with the above-described features is a possible explanation for the existing evidence on mildly counter-cyclical mark-ups that can be found in Martins and Scarpetta (2002) or Rotemberg and Woodford (1999), inter alia.

2.1. Definitions

The measure of market power used here, henceforth the “mark-up,” is the price wedge, usually preferred by macroeconomics authors

$$\mu_{it} = \frac{P_{it}}{MC_{it}} \ , \qquad (1)$$

where P_{it} represents the price of the good produced by firm i and MC_{it} stands for its marginal cost, both measured for period t. This measure is increasing with market power and ranges between 1, the perfectly competitive case where $P_{it} = MC_{it}$, and $+\infty$, the degenerate-monopoly case where the firm can set an infinite price when compared to its marginal cost.

The basic problem in determining mark-up measures lies in the fact that marginal costs are not directly observable. Thus, the usual approach consists of using economic relationships to estimate marginal costs. For a cost-minimising and profit-maximising firm, we know that its marginal cost is equal to the ratio between the price of an input and its marginal productivity. Thus, considering that labour is more easily measured than other inputs, we can estimate the marginal cost using the relationship $MC_{it} = W_t/MPL_{it}$, where W_t represents the nominal wage per unit of labour[1] and MPL_{it} stands for the marginal product of labour.

However, once again, the latter is not directly observable and we have to postulate a specific production function such that $MPL_{it} = \partial Y_{it}/\partial L_{it}$, where L_{it} is the labour input used in the production of firm i, here represented by Y_{it}. A general production function can be represented by $Y_{it} = F(L_{it},\cdot)$ and we can assume it has the usual properties, namely a positive but decreasing MPL_{it}.

[1] Here, for the sake of simplicity, we assume that all firms use a homogeneous labour input.

2.2. Average mark-ups

Following Rotemberg and Woodford (1991) let us assume the representative firm in the economy uses a technology that can be represented by the following production function:

$$Y_t = A_t \cdot \left(K_t^{\alpha_t} . L_t^{1-\alpha_t} - \Phi_t \right) \;, \tag{2}$$

where Y_t stands for the output, K_t is the capital stock used, and L_t represents the labour input used by the representative firm. A_t is a (non-observable) measure of TFP, $0 < \alpha_t < 1$, and $\Phi_t > 0$. Notice that if we had $\Phi_t = 0$, we would obtain a constant-returns-to-scale Cobb-Douglas production function. However, without a fixed cost it would be impossible to sustain imperfect competition in the long run for this economy.

Real pure profits of this representative firm, considering that there are only costs of hiring labour and capital services, are given by

$$\pi_t = Y_t - \frac{W_t . L_t + R_t . K_t}{P_t} \;, \tag{3}$$

where R_t is the nominal rental price of capital and P_t is the aggregate price index relevant for producers.

Given the existence of imperfect competition in product markets, real factor prices are not equal to their marginal products:

$$\frac{W_t}{P_t} = \frac{MPL_t}{\mu_t} \quad , \quad \frac{R_t}{P_t} = \frac{MPK_t}{\mu_t} \;, \tag{4}$$

where *MPK* stands for the marginal product of capital.

Thus, if we substitute (2), and (4) in (3) we obtain the following expression for profits:

$$\pi_t = A_t \cdot \left(\frac{\mu_t - 1}{\mu_t} . K_t^{\alpha_t} . L_t^{1-\alpha_t} - \Phi_t \right) \;. \tag{5}$$

2.3. Aggregate variables' long-run constraints

Considering the average labour share in aggregate income is given by $s_t = W_t.L_t/(P_t.Y_t)$ and using both (2) and (4), we obtain the following short-run expression for the mark-up as a function of the labour share:

$$\mu_t = \frac{1-\alpha_t}{s_t}.\frac{1}{1-\phi_t} \ , \tag{6}$$

where ϕ_t is a measure of increasing returns given by $\phi_t = \Phi_t / \left(K_t^{\alpha_t}.L_t^{1-\alpha_t} \right)$.

In the long run, entry and exit eliminate pure profits. Thus, the following equalities must hold in order to obtain $\pi_t^* = 0$ from (5) and where asterisks identify the balanced-growth-path values for variables:

$$\Phi_t = \frac{\mu_t^* - 1}{\mu_t^*}.K_t^{*\alpha_t}.L_t^{*1-\alpha_t} \ . \tag{7}$$

Therefore, using (7) in (6), we can obtain the long-run share of wages in aggregate income that is given by $s_t^* = 1 - \alpha_t$.

In a previous version we analysed the effect of considering the representative firm as the average firm in the economy. However, to do this we need a long time series for the total number of firms or establishments in the economy. We succeeded to obtain data for the Netherlands (1983-2007), Sweden (1971-2007), and the US (1964-2007). However, we concluded that the results were virtually identical, as our benchmark mark-up measure was very similar considering or not the effect of changes in the number of firms.[2] Therefore, we considered that the benefit of enlarging the country sample was greater than the cost of ignoring the effects of entry and exit on the benchmark mark-up measures.

[2] The correlations between both benchmark mark-up measures for the common periods are respectively 0.978, 0.889, and 0.933.

3. Computing the average mark-up throughout time

3.1. The data

We consider the following OECD countries for which there was data on average mark-ups for a long recent period (broadly for the period 1970-2007): Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the UK, and the US.

The macroeconomic variables were taken from the European Commission AMECO database (codes in brackets) and correspond to:

- Y_t represents real GDP (1.1.0.0.OVGD) per capita, i.e. per head between 15 and 64 years old (1.0.0.0.NPAN), measured in 2000 Purchasing Power Standards (PPS).

- K_t stands for real capital stock (1.0.0.0.OKND) per capita, measured in 2000 PPS.

- L_t is total hours worked, i.e. the product of average hours per employee (1.0.0.0.NLHA) and total employment (1.0.0.0.NETN).

- s_t represents the adjusted wage share in total income (1.0.0.0.ALCD0).[3]

For the data on μ^*_t, i.e. the long-run mark-up ratios for the economy, we used two different sources of information. We used the information in Martins et al. (1996), Table 3, and calculated the gross-production-weighted average mark-ups for the period 1980-92 for 14 OECD countries.

3.2. Mark-up time series

To obtain the benchmark measures of mark-up, we assume the long-run mark-up level is constant (μ^*) along the sample period and it is given by the average mark-up obtained using the information in Martins et al. (1996), reported in Table 1.

[3] This share is adjusted using the ratio between the concepts of employment and number of employees (in full-time equivalents when available) that exist in the national accounts for domestic industries.

Table 1 – Production-weighted average mark-ups 1980-1992

Country	Average mark-up
Australia	1.293
Belgium	1.269
Canada	1.279
Denmark	1.265
Finland	1.252
France	1.263
Germany [$]	1.248
Italy	1.376
Japan	1.271
Netherlands	1.262
Norway	1.201
Sweden	1.199
UK	1.232
US	1.203

Source: Martins et al. (1996).
NOTE: Sectors considered: Manufacturing; Electricity, Gas, and Water; Construction; Wholesale, Retail Trade, Restaurants, and Hotels (Wholesale and Retail Trade for Australia and Japan); and Transport, Storage, and Communication. Gross-production weights obtained using 1990 data, except for Australia (1989), Belgium, Finland, and Sweden (1995), Italy (1985), and Netherlands (1986).
$ - West Germany.

Next, we allow the long-run parameters (α_t, Φ_t) to change smoothly over time. We obtain the balanced-growth-path series for the pair of parameters using the Hoddrick-Prescott (HP) filter with λ = 100. The series for α_t is simply given by HP(1 - s_t,100). The series for Φ_t is obtained by applying the HP filter to the right-hand side of (7).

Finally, we obtain our mark-up measure by substituting the above-mentioned values in (6), i.e. the mark-up is then given by

$$\mu_t = \frac{1-\alpha_t}{s_t} \cdot \frac{\mu^*}{\mu^* - \left(\mu^* - 1\right).x_t} \quad . \tag{8}$$

where $x_t \equiv \dfrac{\mathrm{HP}\left(K_t^{\alpha_t}.L_t^{1-\alpha_t}\right)}{K_t^{\alpha_t}.L_t^{1-\alpha_t}}$ is a measure of the cyclical position of the input combination.

When inputs are being used above (below) its long-run value, then we have x less (greater) than one. Thus, there are two effects pushing μ_t away from its long-run value (μ^*): (i) when the labour share deviates from its trend; and (ii) when the input combination also deviates from its long-run value. When the labour share overshoots its trend, the mark-up is lower than its average value, while x_t has the opposite effect.

Table 2 shows us that the mark-up measure depicts no contemporaneous cyclical pattern, as it is acyclical for most countries, but it tends to be mildly counter-cyclical with lagged output and mildly pro-cyclical with leaded output.

Table 2 – Cyclical properties of the mark-up (1970-2007)

Country	Corr(μ_t, Y_t)	Corr(μ_t, Y_{t-1})	Corr(μ_t, Y_{t+1})
Australia	0.396**	-0.072	0.406**
Belgium	0.011	-0.437***	0.266
Canada	0.347**	-0.099	0.425***
Denmark	0.379**	-0.282*	0.555***
Finland	0.110	-0.439***	0.417***
France	0.269	-0.291*	0.486***
Germany	0.224	-0.149	0.330**
Italy	0.199	-0.418***	0.207
Japan	0.390**	0.011	0.422***
Netherlands	-0.179	-0.546***	0.067
Norway	-0.130	-0.376**	0.115
Sweden	0.041	-0.380**	0.330**
UK	-0.069	-0.561***	0.194
US	-0.112	-0.598***	0.230

NOTE: Correlations between the ratios of each variable and its trend component given by a HP filter. Asterisks indicate if the correlation coefficient is statistically different from zero at 1 (***), 5 (**), and 10 (*) per cent significance levels.

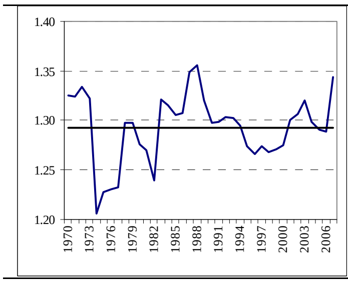
Appendix 1 presents some alternative mark-up measures using another specification for the production function, using Christopoulou and Vermeulen (2008) as a different source for the long-run mark-ups, dividing the period in sub-periods, and also alternative ways of computing the deep parameters, including a measure based on the Monacelli and Perotti (2008) approach of using the labour share.

Figure 1 plots for the six countries the benchmark mark-up and respective total factor productivity measures. It is possible to observe a non-stationary behaviour of TFP (in logs), indicating that the series are I(1), and a stationary pattern for the mark-up, I(0) series, which was afterwards confirmed by formal ADF unit root tests.

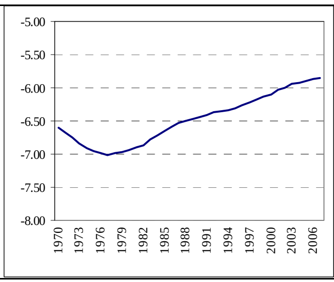
Figure 1 – Mark-up and TFP

Australia

1.1 – Average mark-up

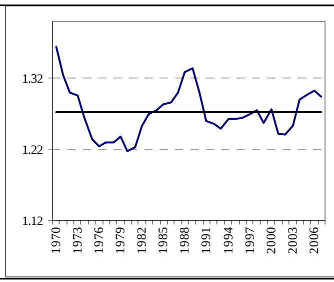


1.2 – Log of TFP

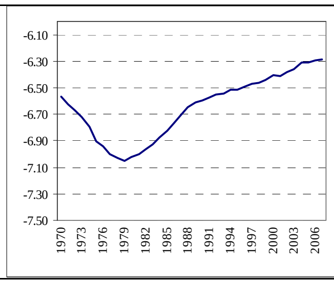


Belgium

1.3 – Average mark-up

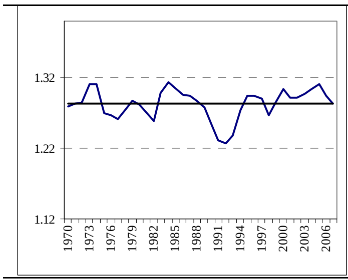


1.4 – Log of TFP

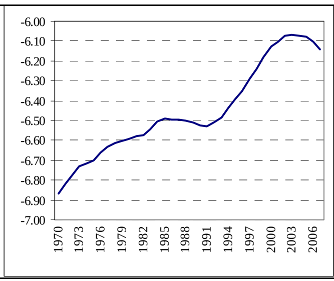


Canada

1.5 – Average mark-up

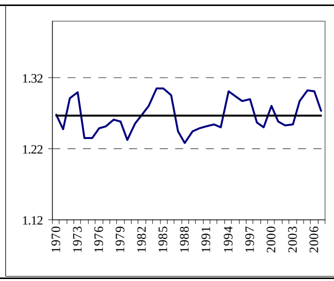


1.6 – Log of TFP

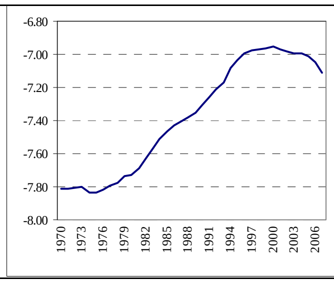


Denmark

1.7 – Average mark-up

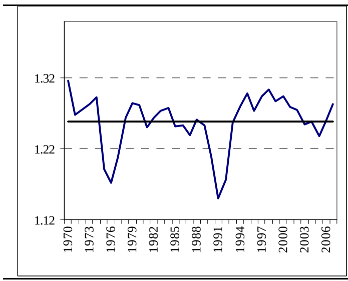


1.8 – Log of TFP

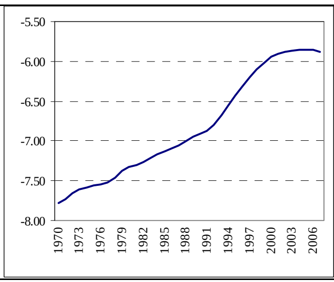


Finland

1.9 – Average mark-up

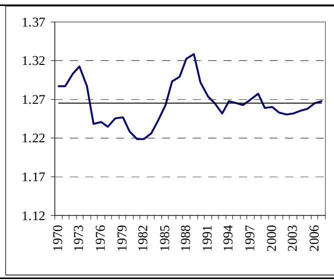


1.10 – Log of TFP

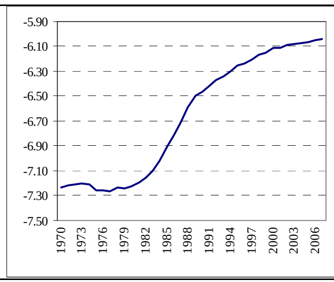


France

1.11 – Average mark-up

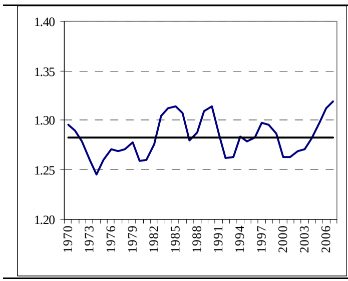


1.12 – Log of TFP

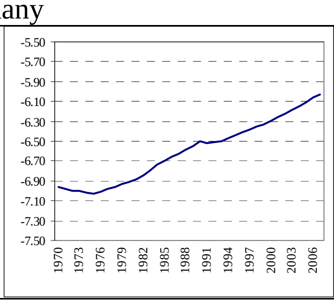


Germany

1.13 – Average mark-up

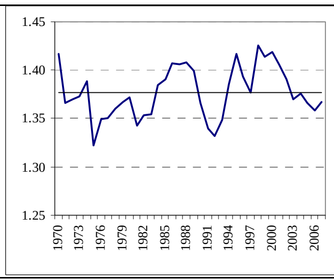


1.14 – Log of TFP

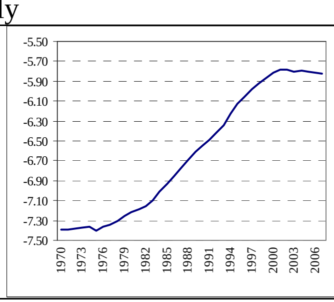


Italy

1.15 – Average mark-up

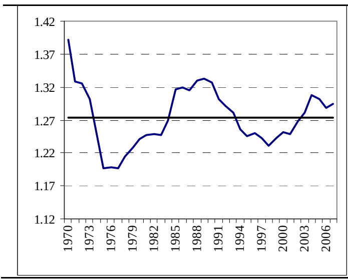


1.16 – Log of TFP

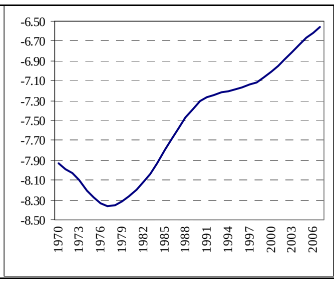


Japan

1.17 – Average mark-up

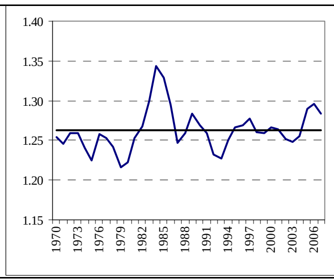


1.18 – Log of TFP

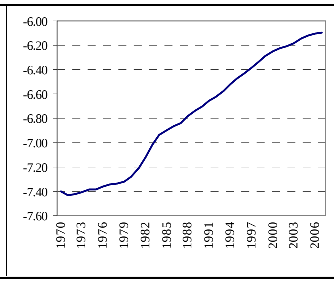


Netherlands

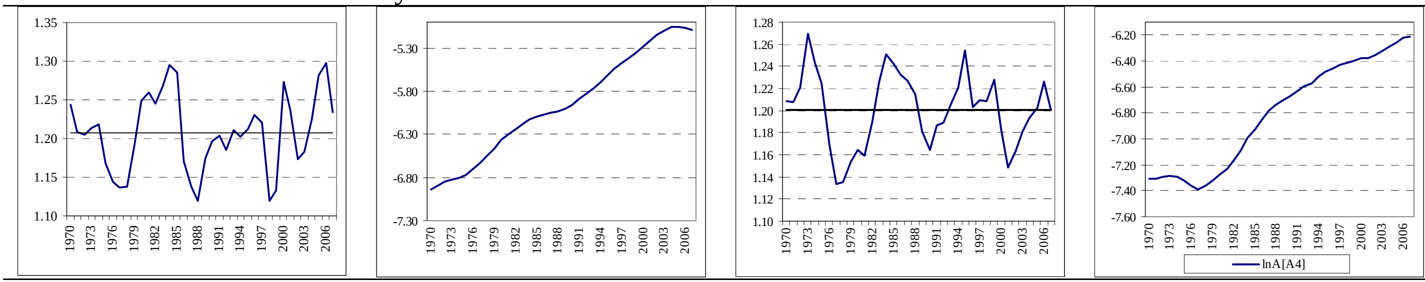
1.19 – Average mark-up



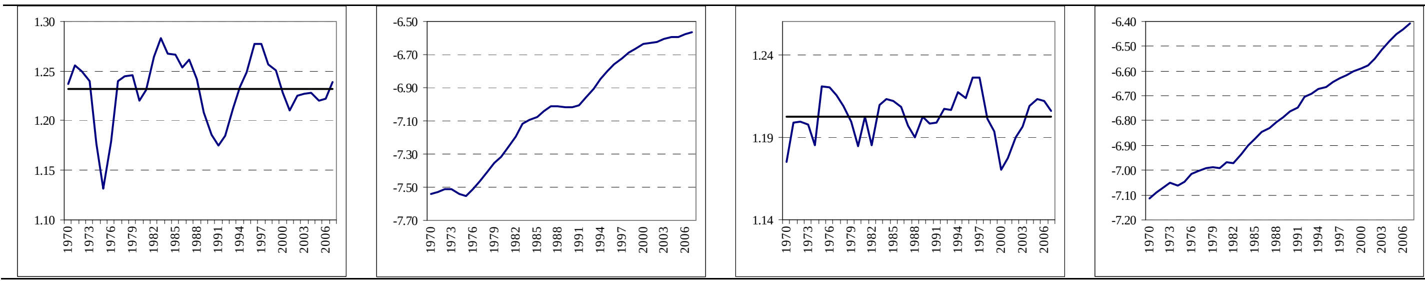
1.20 – Log of TFP



1.21 – Average mark-up	1.22 – Log of TFP	1.23 – Average mark-up	1.24 – Log of TFP
Norway		Sweden	



1.25 – Average mark-up	1.26 – Log of TFP	1.27 – Average mark-up	1.28 – Log of TFP
UK		US	



The period-averages for the mark-ups plotted in Figure 1 are 1.293 (Australia), 1.272 (Belgium), 1.283 (Canada), 1.267 (Denmark), 1.259 (Finland), 1.265 (France), 1.247 (Germany), 1.377 (Italy), 1.274 (Japan), 1.263 (Netherlands), 1.208 (Norway), 1.201 (Sweden), 1.232 (UK), and 1.202 (US), virtually the same as in Table 1, as one should expect. These values compare with the mark-up of 1.23 reported for the US in Bayoumi et al. (2004).

4. VAR analysis

4.1. Setting up the VAR

We estimate a five-variable VAR model for the period 1970-2007 for the above-mentioned set of OECD countries. The variables in the VAR are real total final government consumption expenditure plus real government investment, G, real output, Y, real taxes T, all in logarithms, the mark-up, μ, and the logarithm of the level of productivity, A (the corresponding measure of TFP). The macro variables are per head of working-age population (between 15 and 64 years old). Moreover, productivity, A, real output, real total final government expenditure and real taxes will usually enter in first differences, and the mark-up, μ, enters in levels, in order that all variables in the VAR are I(0).

The VAR model in standard form can be written as

$$\mathbf{X}_t = \mathbf{c} + \sum_{i=1}^{p} \mathbf{V}_i \mathbf{X}_{t-i} + \boldsymbol{\varepsilon}_t \quad . \tag{9}$$

where $\mathbf{X}_t$ denotes the (5×1) vector of the five endogenous variables given by $\mathbf{X}_t \equiv \left[\Delta\ln A_t \quad \Delta\ln G_t \quad \Delta\ln T_t \quad \Delta\ln Y_t \quad \mu_t\right]'$, **c** is a (5×1) vector of intercept terms, **V** is the matrix of autoregressive coefficients of order (5×5), and the vector of random disturbances $\boldsymbol{\varepsilon}_t \equiv \left[\varepsilon_t^A \quad \varepsilon_t^G \quad \varepsilon_t^T \quad \varepsilon_t^Y \quad \varepsilon_t^\mu\right]'$. The lag length of the endogeneous variables, *p*, will be determined by the usual information criteria.

The VAR is ordered from the most exogenous variable to the least exogenous one, with the log of TFP in the first position. As a result, a shock to productivity may have an instantaneous effect on all the other variables. However, TFP does not respond contemporaneously to any structural disturbances to the remaining variables. In the same way, total final government expenditure also does not react contemporaneously to taxes, to GDP or to the mark-up, due for instance, to lags in government decision-making. In other words, the mark-up, GDP, taxes, and final government spending, may affect productivity with a one-period lag. For instance, a shock in taxes, the third variable, does not have an instantaneous impact on consumption expenditure of general government or in techonology, but it affects contemporaneously real output and the mark-up.

In addition to the data used in section three, to compute the average mark-up throughout time, we now used for the VAR also the following series: total final government consumption expenditure (1.1.0.0.OCTG), government gross fixed capital formation (1.0.0.0.UIGG), while government revenues are the sum of direct taxes (1.0.0.0.UTYG), indirect taxes (1.0.0.0.UTVG), and social security contributions (1.0.0.0.UTSG), divided by the GDP deflator, which is computed as the ratio between nominal GDP (1.0.0.0.UVGD) and real GDP.

4.2. Estimation and results

Since real output, real total final government consumption expenditure, real output, real taxes and TFP are I(1) variables, they enter in the VAR in first differences. On the other hand, the mark-up is a I(0) variable entering therefore in levels in the VAR. The unit root tests provide similar stationarity results for all countries (see Table 3).

Table 3 – Unit-root tests: Augmented Dickey-Fuller test statistics

	$\Delta\ln A$		μ		$\Delta\ln Y$		$\Delta\ln T$		$\Delta\ln G$	
	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value
Australia	-2.61	-2.36#	-2.61	-2.92#	-5.15	-3.32	-3.92	-3.63	-4.93	-2.61
Belgium	-2.31	-2.61#	-2.87	-2.61#	-5.75	-3.62	-3.89	-3.63	-4.30	-4.23&
Canada	-1.89	-2.61#	-1.60	-1.60#	-4.64	-3.63	-5.35	-3.63	-3.76	-3.63
Denmark	-1.22	-1.61#	-3.99	-3.63	-53.4	-3.63	-3.50	-2.94 $	-7.95	-4.23&
Finland	-1.13	-1.61 #	-3.82	-3.63	-4.47	-3.63	-5.07	-3.63	-3.53	-2.94 $
France	-1.79	-2.61#	-2.85	-2.61#	-4.43	-2.62	-4.40	-3.63	-5.36	-4.23&
Germany	-4.35	-3.63	-3.67	-3.63	-5.72	-3.63	-4.66	-3.63	-3.49	-2.95$
Italy	-1.24	-1.61#	-3.13	-2.92 $	-3.87	-3.63	-5.59	-3.63	-3.79	-3.62
Japan	-4.91	-3.65	-2.21	-2.61#	-4.09	-3.62	-4.03	-3.63	-5.63	-3.63
Netherlands	-2.60	-2.60#	-3.40	-2.95$	-3.66	-3.62	-4.52	-3.63	-5.20	-3.63
Norway	-0.87	-1.61#	-4.42	-3.63	-3.80	-3.63	-5.25	-3.63	-4.28	-3.63
Sweden	-1.91	-2.61	-4.69	3.65	-3.75	-3.63	-3.70	-3.63	-4.56	-3.63
UK	-2.54	-2.61#	-4.32	-3.63	-4.50	-4.24	-4.28	-3.63	-5.64	-4.23
US	-5.04	-3.63	-4.17	-3.63	-5.10	-3.58	-4.81	-3.63	-3.15	-2.92$

Notes: critical values are for 1% level unless otherwise mentioned.
– 10% level; $ – 5% level; & – with time trend.

In the case of Sweden, there is a break around 1991 in the series for real GDP and real taxes, linked to the banking crisis and economic downturn in the beginning of the 1990’s. Therefore, in the VAR for Sweden we also include a dummy variable that assumes the value one for 1991 (zero otherwise) and that turns out to be statistically significant in the regressions for real GDP, real taxes and TFP. A similar situation occurred for the case of Finland, where a dummy varible for 1991 was also used. In addition, for Germany a dummy variable was also needed, and was strongly statiscally significant, for 1991, when the series reflect the German reunification effect.[4]

The VAR order used in the estimation of each model was selected with the Akaike and the Schwarz information criteria. Those tests led us to choose a parsimonious model with one lag for ten countries, two lags for three countries, and three lags for one country, which helped avoid the use of too many degrees of freedom. With such specifications we also could not reject the null hypothesis of no serial residual correlation. In addition, we did not reject the null hypothesis of normality of the VAR residuals (see Table 4).

[4] We used Zivot and Andrews (1992) recursive approach to test the null of unit root against the alternative of stationarity with structural change at some unknown break date. The results allow the rejection of the unit root hypothesis in particular for the logarithmic growth rate of real taxes and GDP in Sweden, and for GDP and the mark-up for Finland. A similar result occurs for Germany.

Table 4 – Diagnostic tests, dynamic feedback VAR

	Autocorrelation test (p-value)[1]	Normality test (p-value)[2]	Number of lags	Number of observations
Australia	0.376	0.130	2	35
Belgium	0.540	0.289	1	36
Canada	0.309	0.155	1	36
Denmark	0.770	0.087	2	35
Finland	0.442	0.364	1	36
France	0.152	0.521	1	36
Germany	0.636	0.100	2	35
Italy	0.938	0.382	1	36
Japan	0.121	0.186	1	36
Netherlands	0.186	0.197	1	36
Norway	0.478	0.454	1	36
Sweden	0.857	0.499	1	36
UK	0.440	0.423	1	36
US	0.391	0.212	1	36

NOTE: We considered the maximum VAR order to be three.

1 – Multivariate residual serial correlation LM test. For the null hypothesis of no serial autocorrelation (of order one) the test statistic as an asymptotic chi-square distribution with k^2 degrees of freedom.

2 – Multivariate Jarque-Bera residual normality test. For the null hypothesis of normality, the test statistic has an asymptotic chi-square.

In Figure 2 we plot simultaneously the average responses of real output and of the mark-up to a one standard deviation shock to real final government spending, and to a one standard deviation technological shock, for the countries covered in this study. Figure A1 in Appendix 2 reports the impulse-response functions to shocks in TFP and real government final spending. Impulse-response functions to shocks in the remaining three variables are not shown due to length constraints and in order to concentrate in the main topic of the paper.

First, let us analyse the reaction of output to unexpected productivity shocks. In general, there is strong evidence of a positive impact effect on output, despite the fact that Finland and the UK present very small positive effects. When we consider the cummulated effect after two, five, and ten periods, we observe a similar overall pattern with only negative reactions in Belgium and occasional negative values for either Finland or the UK.

Second, there is also strong evidence of an increase in average mark-ups following a positive TFP shock. Australia, Belgium, and Finland are the notable exceptions for the impact period. When we consider the cummulated effects Norway occasionally joins the group with either a small negative or a very small positive effect. We only observe positive cummulated effects after ten periods.

Therefore, we can conclude that, in general, mark-ups present a pro-cyclical behaviour after a productivity shock. This is observed for 12 countries in our sample in either the impact period and also considering the cummulated effects after two, five, and ten periods This outcome is consistent with most endogenous mark-ups hypothesis in the literature, either of the undesired or of the desired kinds: a productivity shock has a strong direct effect in shifting the marginal-cost schedule downnwards and a smaller effect moving rightwards along both the marginal-cost and demand curves when output increases.[5]

Third, let us observe the effect of an unexpected shock in government final spending on output. A group of six countries show a considerable short-run (i.e. impact) Keynesian effect: Belgium, Canada, Finland, Germany, Japan, and Sweden. Italy and the UK present very small positive reactions of output to a positive fiscal schock of this kind. Australia and Denmark join the group when we consider the cummulated effects after two, five, and ten periods, but Germany, Sweden, and the UK leave it. Canada shows a long-run (i.e. considering the first ten periods cummulated) non-Keynesian effect. France, Netherlands, Norway, and the US also present evidence consistent with the so-called non-Keynesian effects.[6]

Fourth, there is strong evidence of a decrease in average mark-ups following a positive government-spending shock. Sweden and the US are the notable exceptions to this pattern in the impact period. France, Japan, and the UK occasionaly join the group for larger time windows, but no more than four countries present simultaneously a positive cummulated effect on mark-ups.

Thus, we can conclude that, for most countries, mark-ups present a counter-cyclical behaviour following a government spending shock. This is observed at least for seven countries in our sample in either the impact period and also considering the cummulated effects after two, five, and ten periods. Australia, Denmark, France, Netherlands, Norway, and Sweden are the exceptions in the short run. We can only find evidence of consistent pro-cyclical behaviour of mark-ups for the Netherlands and Norway. Germany also presents a similar pattern from period two onwards. Canada, Japan, and the UK also present occasionally less expected combinations. Again, the results obtained are consistent with existing theoretical endogenous mark-up models: a government spending shock, or a similar aggregate demand shock, implies a shift to the right in the demand curve and a rightward movement along the marginal-cost curve when output increases, with a smaller increase in prices than the one observed in marginal costs.[7]

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[5] Nominal rigidity provides a good example of a constant or sluggish marginal-revenue curve faced by each producer.

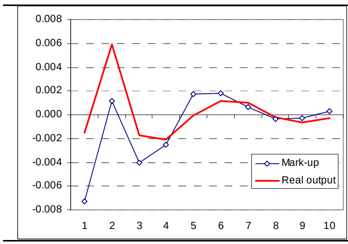
[6] Notice that nothing can be said for higher frequencies, especially for quarterly data.

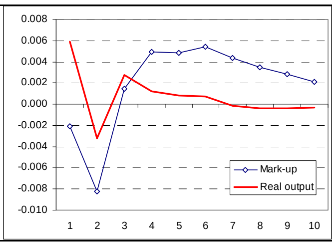
[7] Once again, the nominal rigidity example illustrates how the (undesired) mark-up reduction (increase) arises simultaneously with an output increase (reduction).

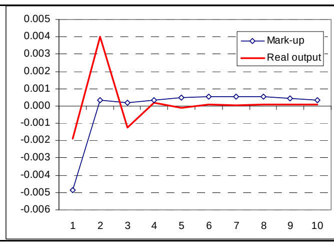
Figure 2 – Responses to a one standard deviation shock

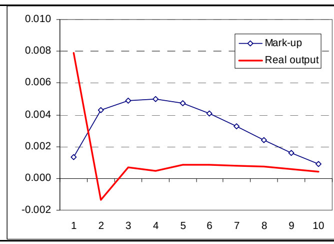
2.1 – Shock in *G* | 2.2 – Shock in *A* | 2.3 – Shock in *G* | 2.4 – Shock in *A*

Australia | Belgium



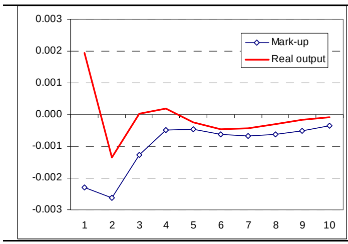


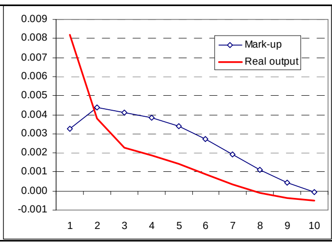


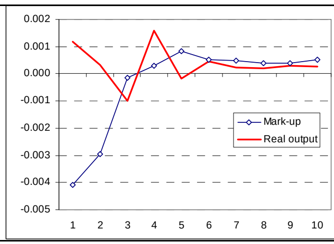


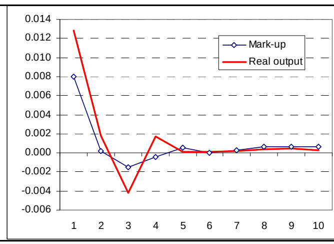
2.5 – Shock in *G* | 2.6 – Shock in *A* | 2.7 – Shock in *G* | 2.8 – Shock in *A*

Canada | Denmark



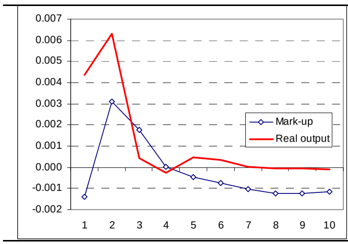


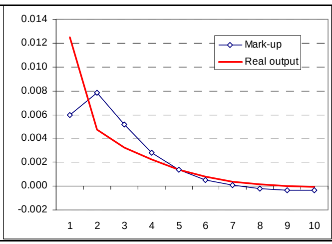


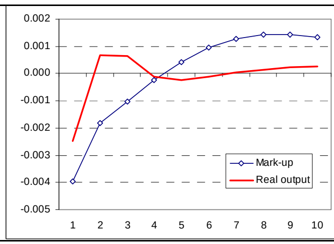


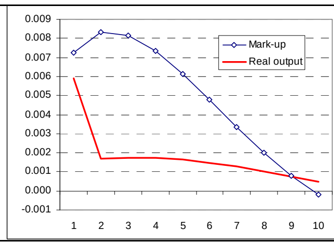
2.9 – Shock in *G* | 2.10 – Shock in *A* | 2.11 – Shock in *G* | 2.12 – Shock in *A*

Finland | France



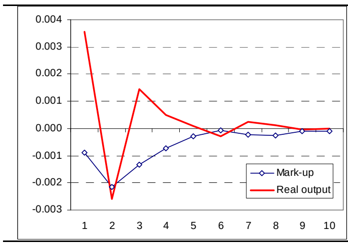


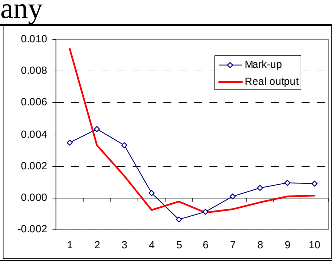


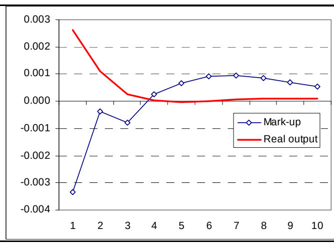


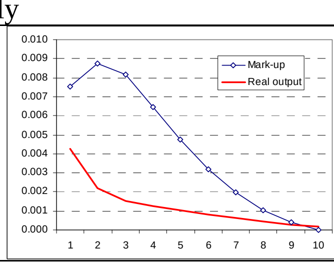
2.13 – Shock in *G* | 2.14 – Shock in *A* | 2.15 – Shock in *G* | 2.16 – Shock in *A*

Germany | Italy



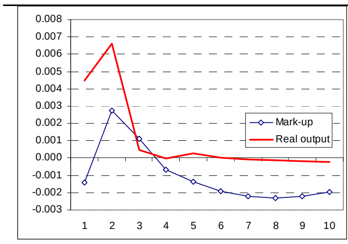


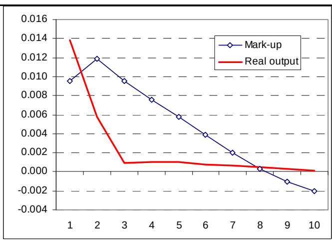


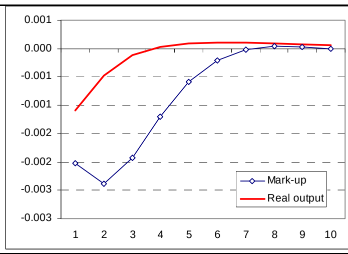


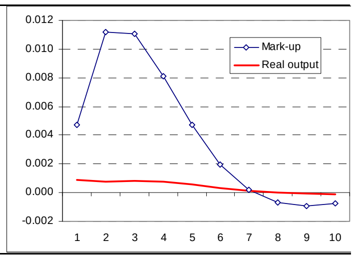
2.17 – Shock in *G* | 2.18 – Shock in *A* | 2.19 – Shock in *G* | 2.20 – Shock in *A*

Japan | Netherlands

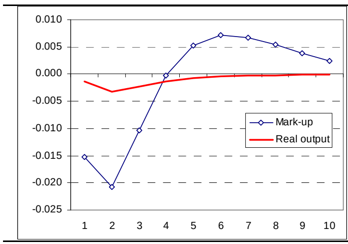


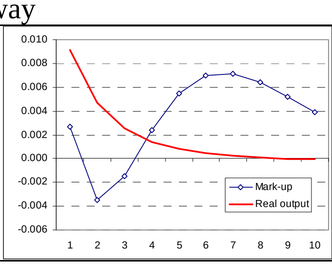


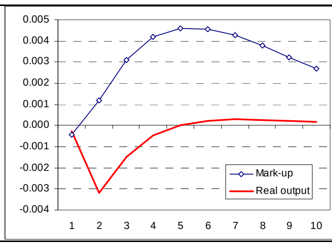


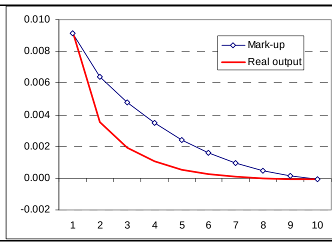


2.21 – Shock in *G*	2.22 – Shock in *A*	2.23 – Shock in *G*	2.24 – Shock in *A*
Norway		Sweden	

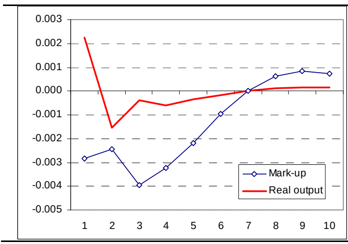


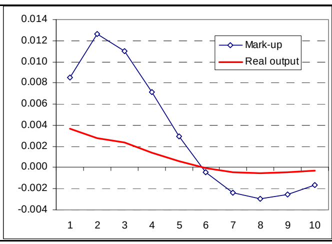


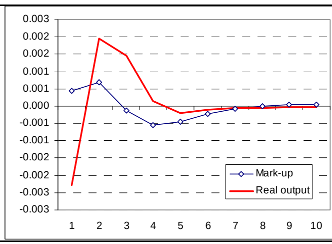


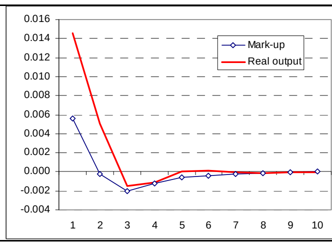


2.25 – Shock in *G*	2.26 – Shock in *A*	2.27 – Shock in *G*	2.28 – Shock in *A*
UK		US	









However, most theoretical models with endogenous mark-ups, either of the undesired or the desired types, predict that we should expect counter-cyclical mark-ups when shocks originate on the demand side of the economy and pro-cyclical mark-ups when shocks are of technological nature (on the supply side). The evidence here produced points precisely in this direction. On the other hand, the relative strength of Keynesian and non-Keynesian effects of fiscal policy is also rather controversial in the empirical literature.

To our knowledge, the closest article to our approach is Monacelli and Perotti (2008) that also employ a VAR technology to study the interaction between mark-ups and fiscal policy for the US Using quarterly data, and alternative measures of government spending and different methods for identifying shocks and measuring mark-ups, their results also indicate a counter-cyclical behaviour of the mark-up with fiscal shocks.

Recently, Hall (2009) surveys the literature on fiscal policy effectiveness, especially on the VAR estimates of short-run multipliers, and relates it to mark-up measures using a counter-cyclical mark-up model.

4.3. Robustness

Using alternative mark-up measures and the corresponding TFP measures in the VAR analysis provided similar results. This should not be a surprise if one takes into account the high correlations between the alternative and the benchmark measures, once we de-trend them (see Table A2 in Appendix 1).

Despite the fact that most qualitative results hold for most countries, there are some quantitative differences and some indications that using one type of mark-up and TFP measures may be crucial to the outcomes. Further investigation is needed in this front.

In addition, we also estimated the VAR models using first differences of the level of the variables, instead of logarithmic differences, but the results were broadly similar.

Finally, and in order to allow for the interaction of interest rates, we replicated as an example the VAR analysis for the US, using either short-term or long-term interest rates. The results did not change.

4.4. Multipliers and mark-ups in the long run

One of the central issues in the early New Keynesian literature is the relationship between fiscal-policy effectiveness and market power in the long run – see, inter alia, Costa (2007). We can use the VAR estimates to obtain long-run elasticities of output to government final spending:

$$\hat{\eta}_i = \frac{\sum_{t=1}^{10} \Delta \ln X_{it}\left(\varepsilon_{it}^{G}\right)}{\sum_{t=1}^{10} \Delta \ln G_{it}\left(\varepsilon_{it}^{G}\right)}, \qquad (10)$$

where $\Delta \ln X_{it}\left(\varepsilon_{it}^{G}\right)$ represents the effect, given by the impulse-response function, of an unexpected shock to government final spending on variable *X* for country *i* in period *t*.

The long-run multiplier is obtained dividing $\hat{\eta}_i$ by the share of government final spending in GDP. The estimates for the multiplier are presented in Table 5.

Table 5 – Long-run multipliers 1970-2007

Country	Multipliers
Australia	1.609
Belgium	0.822
Canada	-0.303
Denmark	0.743
Finland	0.645
France	-1.644
Germany	-3.839
Italy	0.264
Japan	2.365
Netherlands	-0.247
Norway	-4.296
Sweden	-0.733
UK	-3.291
US	-0.051

The correlation with the long-run mark-up measures presented in Table 1 is 0.34 in levels and 0.42 in ranks. This positive correlation is robust to using the government-spending share in GDP as an instrument to control for mark-up endogeneity, since both variables present a correlation of -0.24.

Therefore, there is some evidence that fiscal policy tends to be more effective in countries where product markets are more imperfectly competitive. Costa (2007) suggests that larger correlations should be observed if we took into account the effect of capital depreciation on output, i.e. had we used a net- instead of a gross-output measure in the VAR.

5. Panel VAR

In this section we estimate the VAR model in a panel format in order to pool together the time and cross-section dimensions and profit from the gains of efficiency in the estimation procedure.[8] The panel VAR (PVAR) specification draws on the country-specific case, equation (9), and can be written as follows:

$$\mathbf{X}_{it} = \mathbf{c}_0 + \sum_{j=1}^{p} \mathbf{V}_j \mathbf{X}_{it-j} + \mathbf{v}_i + \boldsymbol{\varepsilon}_{it} . \qquad (11)$$

In (16) the index i (i=1,…,N) denotes the country, the index t (t=1,…,T) indicates the period, $\mathbf{X}_{it}$ is the vector of the endogenous variables given by $\mathbf{X}_{it} \equiv \left[\Delta \ln A_{it} \quad \Delta \ln G_{it} \quad \Delta \ln T_{it} \quad \Delta \ln Y_{it} \quad \mu_{it} \right]'$, $\mathbf{c_0}$ is a vector of intercept terms, $\mathbf{V}$ is the matrix of autoregressive coefficients, $\mathbf{v}_i$ is the matrix of country-specific fixed effects, and the vector of random disturbances $\boldsymbol{\varepsilon}_{it} \equiv \left[\varepsilon_{it}^{A} \quad \varepsilon_{it}^{G} \quad \varepsilon_{it}^{T} \quad \varepsilon_{it}^{Y} \quad \varepsilon_{it}^{\mu} \right]'$. The lag length of the endogeneous variables, p, will be set in this case to one, based also on the previously uncovered country-specific VAR evidence. Since our time dimension is not that small, the use of time dummies would imply a loss of efficency.

The PVAR allows treating all variables as jointly endogenously, with each variable depending on its past information and on the realizations of the other variables. In addition the use of the panel VAR approach increases the degrees of freedom for the estimation. On the other hand, the PVAR set-up imposes a similar lag structure across all the countries.

[8] For instance, Beetsma et al. (2008) also use a panel VAR approach in a related context for fiscal and external imbalances.

Nevertheless, cross-section heterogeneity can be accounted for via the fixed effects, an the bias due to the existence of lagged endogenous variables can be overcome by using GMM.[9]

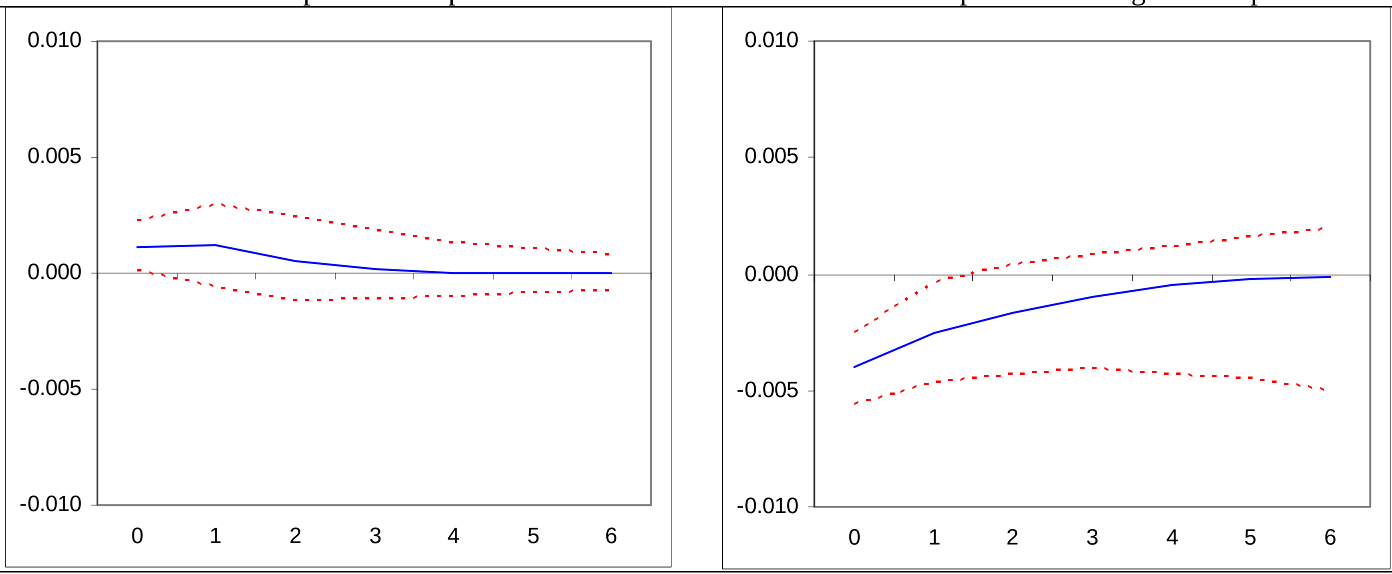
We also checked for the existence of unit roots in the panel using the panel data integration tests of Im et al. (2003) and Levin et al. (2002), which assume cross-sectional independence among panel units (except for common time effects). Concerning the first difference of TFP, government spending, revenues, and GDP, the results given by the panel data unit root tests (reported in Appendix 3) essentially reveal that the null unit root hypothesis can be rejected. The same is true for the level of the mark-up, which overall confirms the same integration order for the variables in the panel as well as in the country-specific analysis.

The results of the PVAR impulse response functions are presented in Figure 3. Accordingly, we can observe a pro-cyclical behaviour of the mark-up with total factor productivity shocks, and a counter-cyclical behaviour of the mark-up with fiscal spending shocks. Such results confirm the overall picture that was uncovered with the country-specific VAR evidence.

Figure 3 – Panel VAR impulse-response functions

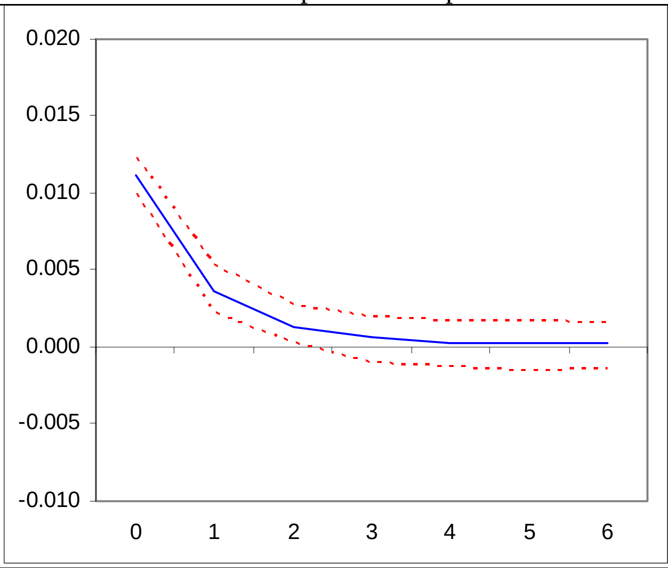
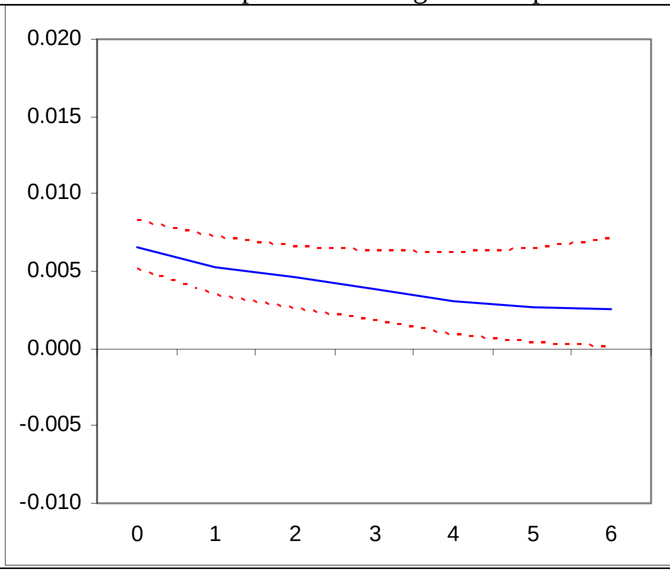
Shock in *G*

3.1 – Response of output | 3.2 – Response of average mark-up



[9] In our computations we use the programs from Love and Zicchino (2006), which include a routine for the removal of the fixed effects via the Helmert transformation and uses GMM to estimate the system OLS.

Shock in A

3.3 – Response of output	3.4 – Response of average mark-up
	

Note: Errors are 5 per cent on each side generated by Monte Carlo with 1000 replications.

6. Conclusions

In this paper we have computed the average mark-up throughout time as a market-power measure, and studied its interaction with fiscal policy and other macroeconomic variables, using a five-variable annual VAR for OECD countries. The mark-up measure is calculated in a standard fashion, but we allowed for smooth changes in the long-run technological parameters.

We produced illustrative results with annual data for the period 1970-2007, for a group of 14 OECD countries: Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the UK, and the US. The VAR impulse response functions show that, in general the mark-up (i) depicts a pro-cyclical behaviour with productivity shocks and (ii) a mildly counter-cyclical behaviour with fiscal spending shocks. Furthermore, we also obtain non-Keynesian impacts of real final government spending on output in some cases.

Finally, we also used a Panel Vector Auto-Regression analysis, increasing the efficiency in the estimations, which overall confirmed the country-specific results regarding the behaviour of the mark-up.

From a policy point of view, positive productivity shocks imply, by its nature, a rightward shift in labour demand, but an increased mark-up weakens the initial expansive effect on both employment (and output) and real wages. On the other hand, positive fiscal shocks show, besides their usual wealth effect via future taxes expanding the labour supply, an additional effect due to a decrease in the mark-up that shifts the labour demand rightwards, stimulating further employment (and output) and also real wages. Our results, illustrating the counter-cyclical behaviour of the mark-up with fiscal spending shocks, imply a stronger effectiveness of fiscal policy on output and this is especially relevant when the fiscal multiplier is positive.

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Appendix 1 – Alternative mark-up measures

In order to generate alternative mark-up measures to assess the robustness of our results, we used five types of variations to the benchmark measure:

1. We also used the following form instead of (2),

$$Y_t = A_t . K_t^{\alpha_t} . \left(L_t - \Lambda_t\right)^{1-\alpha_t} \quad , \tag{A1}$$

where $\Lambda_t > 0$. Notice that if we had $\Lambda_t = 0$, we would also obtain a constant-returns-to-scale Cobb-Douglas production function.

2. In addition we used a different source for the long-run mark-up measures as well. In this case we considered Christopoulou and Vermeulen (2008), Table 1, that present average mark-ups for 9 countries for the period 1981-2004.

3. We also divided the period into three sub-periods, using information available in Christopoulou and Vermeulen (2008), Table 2, to test for time-varying long-run mark-ups, using the periods 1970-79, 1981-92, and 1993-2004. Unfortunately, the data is only available for the manufacturing sector.

4. We also assumed that deep parameters (α_t, and Φ_t or Λ_t) could exhibit a fixed value over the period or for each sub-period considered, instead of changing smoothly.

5. Finally, we also considered an approach inspired by Monacelli and Perotti (2008), by assuming that $\phi_t = 0$. Notice that, in this case, the mark-up measure is given by $(1 - \alpha_t)/s_t$, according to (6).

Table A1 – Alternative mark-up measures (1970-2007)

Measure	Production Function	Source for μ^*	Period	Deep parameters (α, and Φ or Λ)	α_t
Benchmark	Equation (2)	Martins et al. (1996)	Whole	Smooth changes (HP)	$1 - s_t^*$
1	Equation (A1)	Martins et al. (1996)	Whole	Smooth changes (HP)	$(1 - s_t^*).\mu_t^*$
2	Eq. (2)/(A1) and $\phi = 0$	Martins et al. (1996)	Whole	Fixed (average)	$1 - s_t^*.\mu_t^*$
3	Equation (2)	Martins et al. (1996)	Whole	Fixed (average)	$1 - s_t^*$
4	Equation (2)	Christopoulou and Vermeulen (2008), Table 1	Whole	Fixed (average)	$1 - s_t^*$
5	Equation (2)	Christopoulou and Vermeulen (2008), Table 2.	1970-1979, 1980-1992, 1993-2007	3 step changes (average)	$1 - s_t^*$
6	Equation (2)	Christopoulou and Vermeulen (2008), Table 1	Whole	Smooth changes (HP)	$1 - s_t^*$
7	Equation (2)	Christopoulou and Vermeulen (2008), Table 2.	1970-1979, 1980-1992, 1993-2007	Smooth changes (HP)	$1 - s_t^*$
8	Equation (A1)	Martins et al. (1996)	Whole	Fixed (average)	$(1 - s_t^*).\mu_t^*$
9	Equation (A1)	Christopoulou and Vermeulen (2008), Table 1	Whole	Fixed (average)	$(1 - s_t^*).\mu_t^*$
10	Equation (A1)	Christopoulou and Vermeulen (2008), Table 2	1970-1979, 1980-1992, 1993-2007	3 step changes (average)	$(1 - s_t^*).\mu_t^*$
11	Equation (A1)	Christopoulou and Vermeulen (2008), Table 1	Whole	Smooth changes (HP)	$(1 - s_t^*).\mu_t^*$
12	Equation (A1)	Christopoulou and Vermeulen (2008), Table 2	1970-1979, 1980-1992, 1993-2007	Smooth changes (HP)	$(1 - s_t^*).\mu_t^*$

NOTE: All mark-up and TFP series available on request from the authors.

Table A2 – Correlations between the cyclical components of benchmark and alternative mark-up measures (1970-2007)

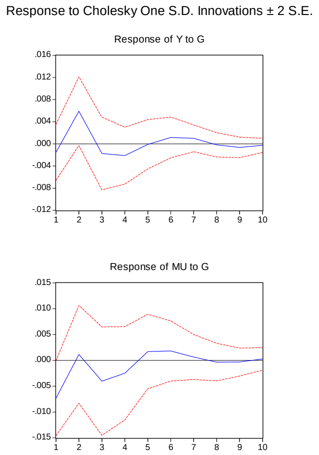
	1	2	3	4	5	6	7	8	9	10	11	12
Australia	0.973	-	0.991	-	-	-	-	0.924	-	-	-	-
Belgium	0.960	0.999	0.988	0.988	0.709	0.999	0.993	0.888	0.934	0.831	0.891	0.913
Canada	0.949	-	0.995	-	-	-	-	0.850	-	-	-	-
Denmark	0.862	-	0.992	-	-	-	-	0.928	-	-	-	-
Finland	0.933	1.000	0.983	0.982	0.637	1.000	0.992	0.909	0.884	0.585	0.882	0.884
France	0.935	0.999	0.976	0.975	0.840	0.999	0.997	0.934	0.956	0.798	0.945	0.960
Germany	0.892	0.999	0.992	0.992	0.820	0.999	0.993	0.952	0.938	0.946	0.939	0.946
Italy	0.878	0.992	0.974	0.962	0.889	0.992	0.974	0.872	0.700	0.822	0.780	0.815
Japan	0.966	-	0.984	-	-	-	-	0.976	-	-	-	-
Netherlands	0.919	0.999	0.991	0.988	0.718	0.999	0.988	0.948	0.968	0.758	0.941	0.887
Norway	0.974	-	0.997	-	-	-	-	0.981	-	-	-	-
Sweden	0.945	-	0.993	-	-	-	-	0.985	-	-	-	-
UK	0.954	-	0.998	-	-	-	-	0.944	-	-	-	-
US	0.972	0.991	0.993	0.975	0.577	0.991	0.923	0.918	0.781	0.533	0.777	0.524

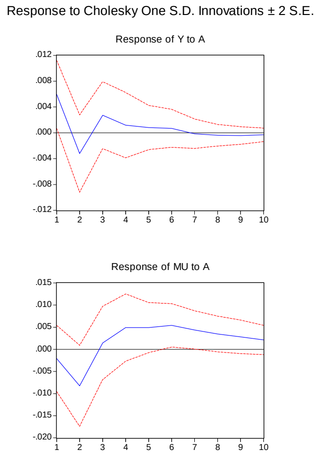
Note: Correlations between the ratio of each measure to its trend component given by a HP filter. All correlation coefficients are statistically different from zero at the 1 per cent significance level.

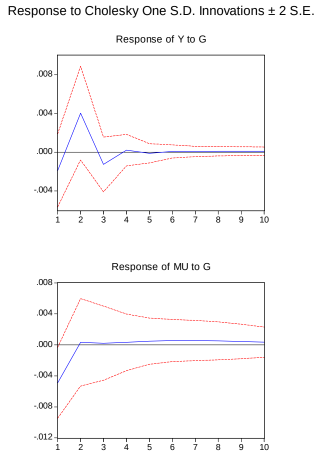
Appendix 2 – Impulse-response functions

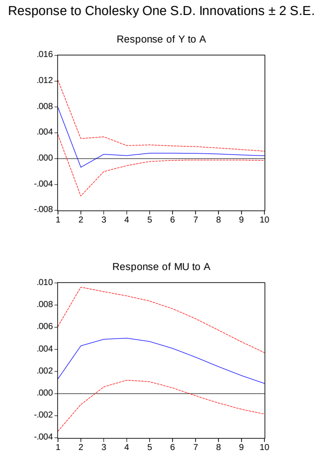
Figure A1 – Impulse-response functions, shocks to spending (*G*) and productivity (*A*)

A1.1 – Shock in *G*	A1.2 – Shock in *A*	A1.3 – Shock in *G*	A1.4 – Shock in *A*
Australia		Belgium	

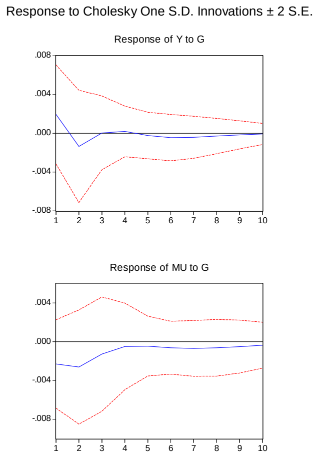


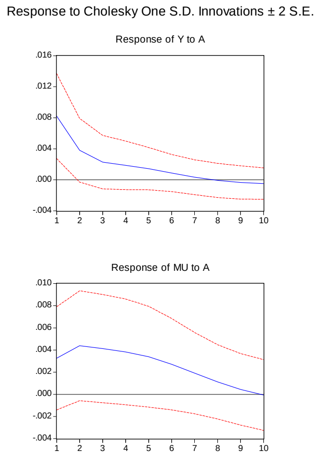


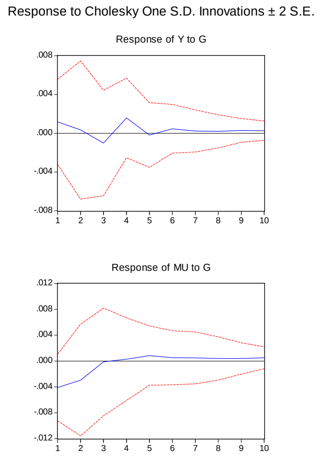


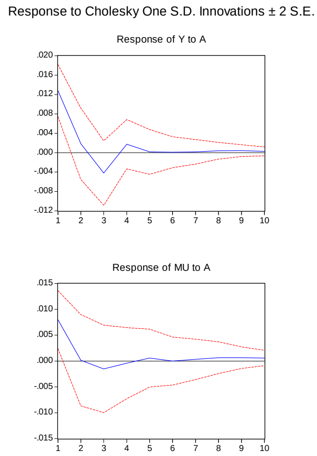


A1.5 – Shock in *G*	A1.6 – Shock in *A*	A1.7 – Shock in *G*	A1.8 – Shock in *A*
Canada		Denmark	

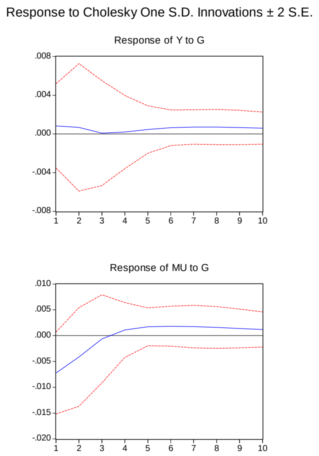


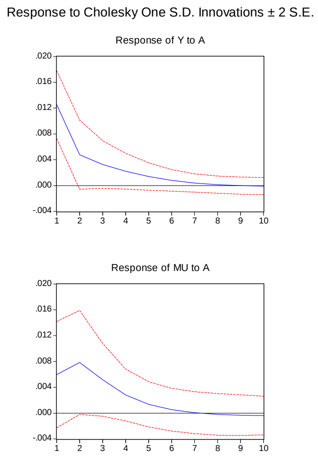


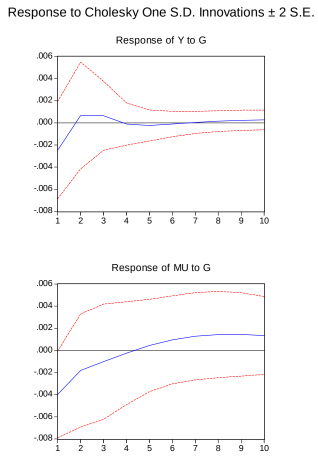


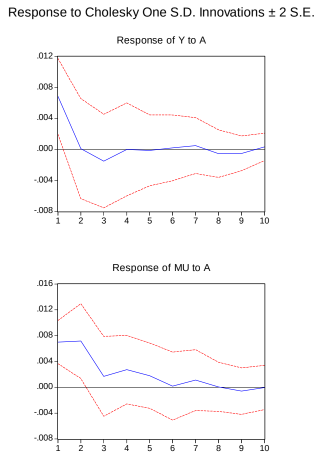


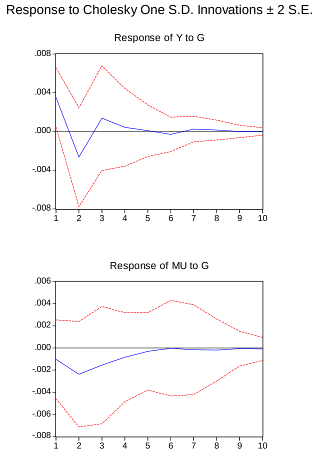
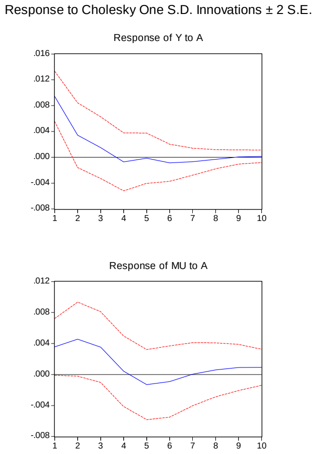
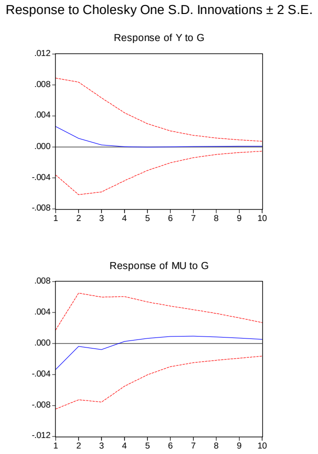
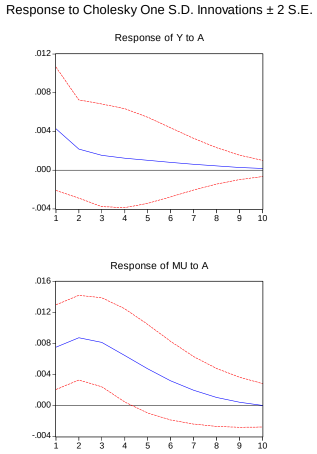
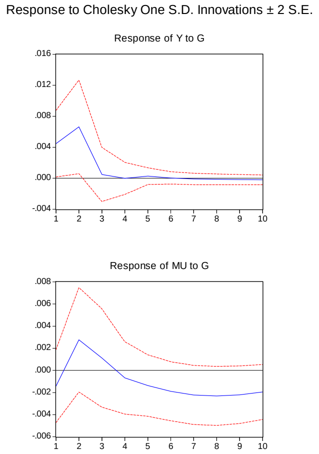
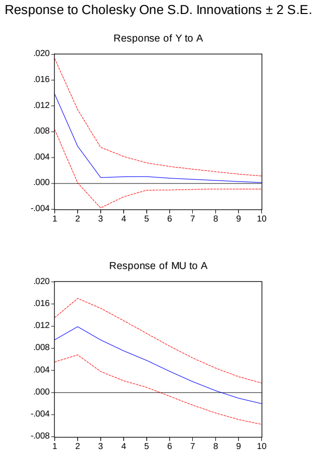
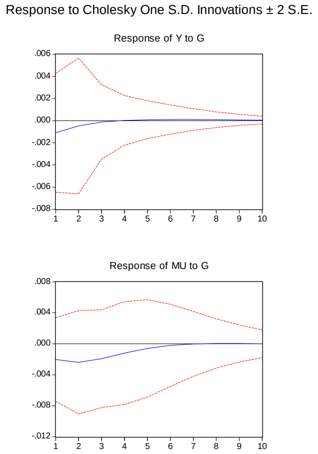
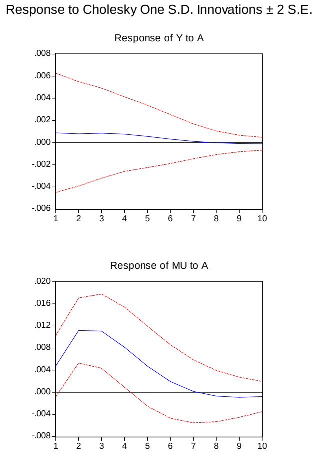
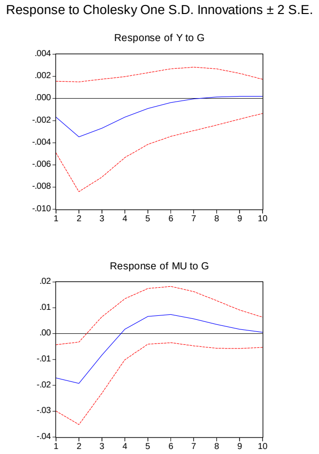
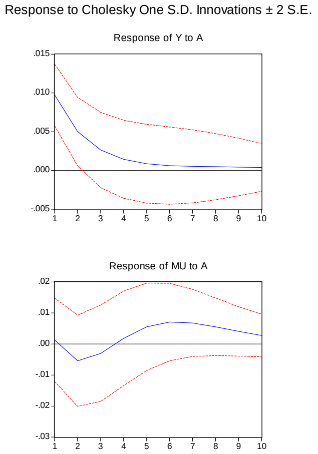
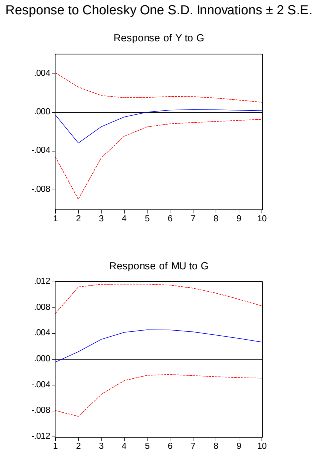
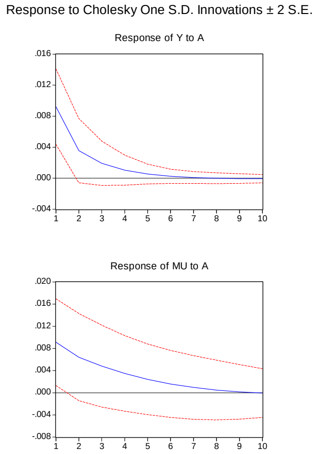
A1.9 – Shock in *G*	A1.10 – Shock in *A*	A1.11 – Shock in *G*	A1.12 – Shock in *A*
Finland		France	



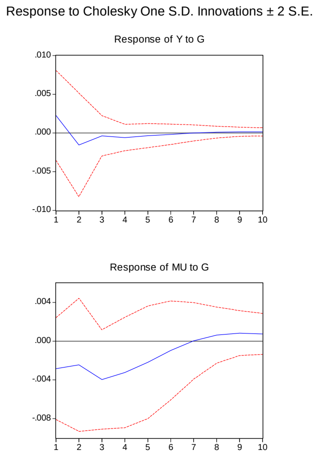


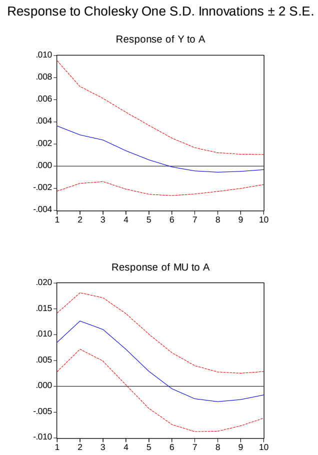


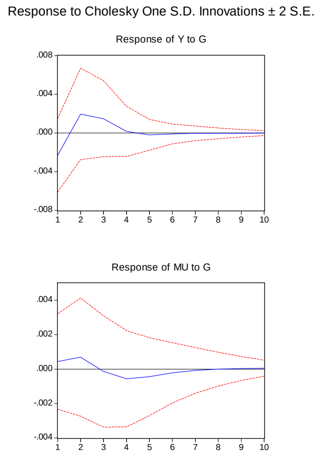


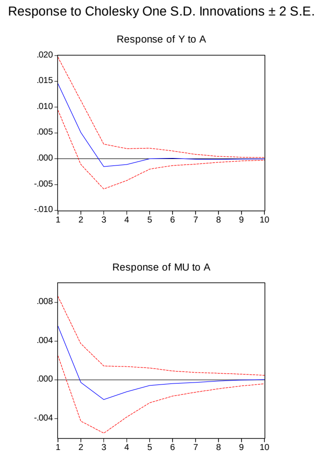
A1.13 – Shock in *G*	A1.14 – Shock in *A*	A1.15 – Shock in *G*	A1.16 – Shock in *A*
Germany		Italy	
			
A1.17 – Shock in *G*	A1.18 – Shock in *A*	A1.19 – Shock in *G*	A1.20 – Shock in *A*
Japan		Netherlands	
			
A1.21 – Shock in *G*	A1.22 – Shock in *A*	A1.23 – Shock in *G*	A1.24 – Shock in *A*
Norway		Sweden	
			

A1.25 – Shock in *G*	A1.26 – Shock in *A*	A1.27 – Shock in *G*	A1.28 – Shock in *A*
UK		US	









Note: Y- axis, percent deviations from the un-shocked path; X- axis, years.

Appendix 3 – Panel unit-root results

Table A3 – Summary of panel-data unit-root tests (1970-2007)

	Statistic	P-value*	Cross-sections	Observa-tions
Levin et al. (2002) t stat 1/				
$\Delta \ln A_{it}$	-0.7078	0.2395	14	490
$\Delta \ln G_{it}$	-6.5523	0.0000	14	490
$\Delta \ln T_{it}$	-4.2789	0.0000	14	490
$\Delta \ln Y_{it}$	-12.0364	0.0000	14	490
μ_{it}	-5.8392	0.0000	14	504
Im et al. (2003) W-stat 2/				
$\Delta \ln A_{it}$	-1.7167	0.0430	14	490
$\Delta \ln G_{it}$	-8.9425	0.0000	14	490
$\Delta \ln T_{it}$	-3.3877	0.0004	14	490
$\Delta \ln Y_{it}$	-10.807	0.0000	14	490
μ_{it}	-6.7250	0.0000	14	504

* The tests assume asymptotic normality.
Automatic selection of lags based on SIC. Newey-West bandwidth selection using a Bartlett kernel.
1/ Null: Unit root (assumes common unit root process).
2/ Null: Unit root (assumes individual unit root process).