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Cyclical Fiscal Policy, Credit Constraints, and Industry Growth*

Philippe Aghion, David Hemous, Enisse Kharroubi

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Abstract

This paper analyzes the impact of cyclical fiscal policy on industry growth. Using Rajan and Zingales' (1998) difference-in-difference methodology on a panel data sample of manufacturing industries across 15 OECD countries over the period 1980-2005, we show that industries with relatively heavier reliance on external finance or lower asset tangibility tend to grow faster (both in terms of value added and of labor productivity growth) in countries which implement more countercyclical fiscal policies.

Keywords: growth, financial dependence, fiscal policy, countercyclicality

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1 Introduction

Standard macroeconomic textbooks generally comprise two largely separate parts: the analysis of long-run growth, which is linked to structural characteristics of the economy (education, R&D, openness to trade, financial development) and short-term analysis, which emphasizes the short-term effects of productivity or demand shocks and the effects of macroeconomic policies (fiscal and/or monetary) aimed at stabilizing the economy. Yet the view that short-run stabilization policies should have no significant impact on long-run growth has been challenged by several empirical papers, notably Ramey and Ramey (1995), who find a negative correlation in cross-country regression between volatility and long-run growth.[1] More recently, using a Schumpeterian growth framework, Aghion et al (2005) have argued that higher macroeconomic volatility affects the composition of firms' investments and in particular pushes towards more procyclical R&D investments in firms that are more credit-constrained.

This paper takes a further step by analyzing the effect of stabilizing fiscal policy on (industry) growth, and how this effect depends upon the financial constraints faced by the industry.

In the first part of the paper we sketch an *illustrative* model to rationalize our empirical strategy and predictions. In our model, which is a toy version of that developed by Aghion et al (2005), firms choose to direct their investments either towards short-run projects that do not increase the stock of knowledge in the economy, or towards productivity-enhancing long-term projects (e.g, R&D investments). The completion of long-term innovative projects is in turn subject to a liquidity risk: namely, such projects can only be implemented if the firm overcomes a liquidity shock that may occur during the interim period. A reduction in aggregate volatility increases profits from short-term projects in the bad state of the world, and reduces them in the good state of the world. Absent credit constraints, this decreases the incentive to invest in long-term growth-enhancing projects in the bad state, whereas it increases long-term investment incentives in the good state (the literature refers to this as the opportunity cost effect of volatility), so that the overall effect on average R&D and growth is ambiguous. However, if credit constraints bind in the low state of

[1] Additional evidence can be found in Bruno (1993) on inflation and growth, Gavin and Hausman (1996) for Latin American countries, or, more recently, Imbs (2007).

the world only, the negative impact of the opportunity cost effect on the amount of investment undertaken in the bad state of the world is compensated by the increase in the likelihood that long-term projects will survive liquidity shocks in the bad state. Moreover, reducing volatility will increase the likelihood that long-term projects will survive liquidity shocks in the bad state. We thus predict that by reducing aggregate volatility a countercyclical fiscal policy should have a positive impact on R&D and on the growth rate of more credit-constrained industries.[2]

In the second part of the paper, we take our prediction to the data. Departing from the existing empirical literature on volatility and growth, which relies mainly on cross-country regressions, we follow here the methodology developed in the seminal paper by Rajan and Zingales (1998). We use cross-industry/cross-country panel data on a sample of 15 OECD countries over the period 1980-2005, to test whether industry growth is significantly affected by the interaction between fiscal policy countercyclicality (computed for each country as the fiscal balance to GDP sensitivity to the output gap) and external financial dependence or asset tangibility (measured for the corresponding industry in the US). Figure 1 summarizes our main findings: it plots value added growth for a set of manufacturing industries as a function of total fiscal balance to GDP countercyclicality, controlling for initial industry size. The left-hand panel in Figure 1 depicts this relationship for industries with below-median levels of financial dependence, whereas the right-hand panel plots this relationship for industries with above-median levels of financial dependence.[3] We see that a more countercyclical fiscal policy has virtually no effect on value added growth for industries with below-median levels of financial dependence, i.e. that face milder credit constraints.

[2] See Aghion et al (2009) for firm-level evidence of an asymmetric effect of credit constraints on R&D over firm's business cycle.

[3] More precisely, the estimated equation is $\mathrm{g}_{i,c} = \alpha + \beta \mathrm{fp}_c - \delta \log \mathrm{y}_{i,c} + \varepsilon_{i,c}$, where $\mathrm{g}_{i,c}$ is the average growth in industry i in country c, fp_c measures fiscal policy countercyclicality (here, the output gap sensitivity of total fiscal balance to GDP), $\mathrm{y}_{i,c}$ is the initial share of industry i in country c in total manufacturing valued added in country c. Parameters for estimation are α, β and δ, while $\varepsilon_{i,c}$ is a residual. This equation is estimated separately for industries with below-median financial dependence and with above-median financial dependence. For the former, the estimated coefficient β is $-.14$ and is insignificant at standard confidence levels. For the latter, the estimated coefficient β is 2.15 and is significant at standard confidence levels (5% level).

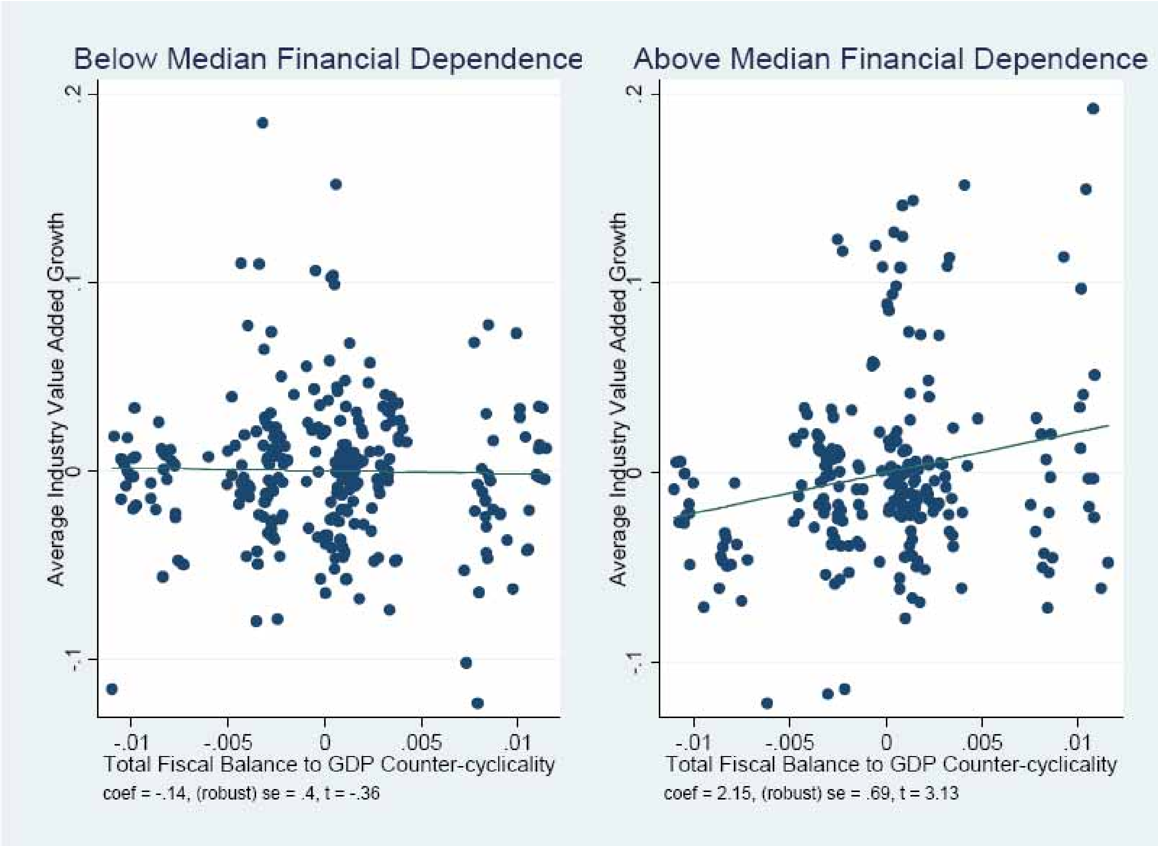


Figure 1

On the contrary, a more countercyclical fiscal policy has a positive and significant impact on real value added growth for industries with above median-levels of financial dependence, i.e. with tighter credit constraints. Using the same methodology, a similar result can be derived decomposing the sample between industries with below-median asset tangibility and with above-median asset tangibility: industry growth and total fiscal balance to GDP countercyclicality are positively ans significantly associated for industries whose assets are relatively intangible (i.e. industries with below-median asset tangibility). However, there is no significant relationship between total fiscal balance to GDP countercyclicality and industry growth for industries whose assets are relatively tangible (i.e. industries with above-median asset tangibility).

The empirical analysis in this paper aims at establishing the robustness of these findings. Our empirical results can be summarized as follows. First, fiscal policy countercyclicality - measured as the sensitivity of a country's total or primary fiscal balance (relative to GDP) to time variations in its output gap - has a disproportionate positive significant and robust impact on industry growth, the higher the extent to which the corresponding industry in the US relies on external finance, or the lower the asset tangibility of the corresponding sector in the US. This result holds whether industry growth is measured by real value added growth or by labour productivity growth. It also holds for industry-level R&D expenditures. Moreover, this interaction between financial dependence and countercyclical fiscal policy is stronger in recessions than in booms, which in turn echoes the asymmetry between good and bad states emphasized in the model. Yet, the ability to tighten fiscal policy in booms remains a significant determinant of growth when interacted with industry external financial dependence. Besides, two factors should be borne in mind when interpreting this last result. First, sustainability issues are not directly addressed and second recent experience shows that credit and asset price booms that precede financial distress tend to flatter fiscal accounts, thereby underestimating the cyclical component. All this puts a premium on the need to be prudent in good times.

Using the regression coefficients, one can assess the magnitude of the corresponding difference-in-difference effect: that is, how much extra growth is generated when fiscal policy countercyclicality and external financial dependence move from the 25th to the 75th percentile? The figures happen to be relatively large, especially when compared to the equivalent figures in Rajan and Zingales (1998). This, in turn, suggests that the effect of a more countercyclical fiscal policy in more financially constrained industries is economically significant. Second, we show that our baseline result is robust to: (i) a whole set of alternative measures of fiscal policy cyclicality; (ii) adding control variables such as financial development, inflation, and average fiscal balance interacted with the industry level variables (external financial dependence or asset tangibility); (iii) taking into account the uncertainty around fiscal policy cyclicality estimates (iv) instrumenting fiscal policy cyclicality with economic, legal and political variables.[4]

What do we gain by moving from cross-country to cross-industry analysis? A pure cross-country analysis raises at least three issues. First, the cyclicality of (fiscal) policy is typically captured by a unique time-invariant parameter which only varies across countries. As a result, standard cross-country panel regression cannot be used to assess the effect of the cyclical pattern of fiscal policy on growth inasmuch as the former is

[4] For the sake of brevity, estimations dealing with issues (i) and (ii) are not presented in the paper, but are available upon request.

perfectly collinear to the fixed effect that is traditionally introduced to control for unobserved cross-country heterogeneity.[5] Second, the causality issue (does a positive correlation between fiscal policy countercyclicality and growth reflect the effect of fiscal policy cyclicality on growth or the effect of growth on the cyclical pattern of fiscal policy) cannot be properly addressed while keeping the analysis at a purely macroeconomic level.[6] A final concern is identification: a cross-country panel regression, particularly one which is restricted to a small cross-country sample, is unlikely to be robust to the inclusion of additional control variables reflecting alternative stories. Thus, even if cross-country panel regressions point to correlations between the cyclical pattern of fiscal policy and growth, the channel through which this correlation works is not likely to be well identified by a pure country-level analysis.

Our industry-level analysis helps us address these concerns. First, even though we estimate the countercyclicality of fiscal policy at the country level with a time-invariant coefficient, which implies that fiscal policy countercyclicality in each country is collinear to that country's fixed effect, the interaction between the country-level measure of countercyclicality and the industry level variable is not. Second, by working at cross-industry level we have enough observations that our results withstand the introduction of country and industry fixed effects plus a whole set of structural variables as additional controls. Finally, to the extent that macroeconomic policy should affect industry level growth whereas the opposite - industry level growth affecting macroeconomic policy- is less likely to hold, finding a positive and significant interaction coefficient in the growth regressions is more likely to reflect a causal impact of the cyclical pattern of fiscal policy on growth.[7] However, there is a downside to the industry-level investigation: namely, our cross-sectoral differences-in-differences analysis has little to say about the aggregate magnitude of the macroeconomic growth gain/loss induced by different patterns of cyclicality in fiscal policy.[8]

[5] To overcome this problem, Aghion and Marinescu (2007) introduce time-varying estimates of fiscal policy cyclicality. While this helps control for unobserved heterogeneity, it comes at the cost of losing precision in the estimates of fiscal policy cyclicality.

[6] One particular reason for this is that fiscal policy cyclicality is used in growth regressions as a right-hand side variable while the estimation of time-varying fiscal policy cyclicality requires using the full data sample. See Aghion and Marinescu (2007).

[7] Fiscal policy cyclicality could be endogenous to the industry-level composition of total output if, for example, industries that benefit more from fiscal policy countercyclicality do lobby more for countercyclical fiscal policy. However, to the extent that there are decreasing returns to scale (which is likely to be the case in the manufacturing industries featured in our empirical analysis), this would rather imply a downward bias in our estimates of the positive impact of fiscal policy countercyclicality on growth. Hence, controlling for this possible source of endogeneity would only reinforce our conclusions by reducing this downward bias.

[8] The fact that we focus on manufacturing industries, and leave out the service sector makes it even harder to use our results to derive more aggregate numerical conclusions.

Our analysis contributes to at least three ongoing debates among macroeconomists: 1) is there a (causal) link between volatility and growth?; 2) what is the optimal design of intertemporal fiscal policy?; and 3) what are the effects of a countercyclical fiscal stimulus on aggregate output? Acemoglu and Zilibotti (1997) stress that the correlation between long-term growth and volatility is not entirely causal pointing to low financial development as a factor that could both reduce long-run growth and increase the volatility of the economy. More recently, Acemoglu et al (2003) and Easterly (2005) hold that both high volatility and low long-run growth arise not directly from policy decisions but rather from bad institutions. However, fiscal policy cyclicality varies significantly even among OECD countries (Lane, 2003) which share similar institutions. And our own finding of significant correlations between growth and countercyclical fiscal policy in a sample of OECD countries also speaks to the importance of cyclical fiscal policy, over and above the effect of more structural variables. As mentioned previously, Aghion et al (2005) defend the view that higher volatility should induce lower growth by discouraging long-term growth-enhancing investments, particularly in more credit-constrained firms. Aghion et al (2009) build on that insight when analyzing the relationship between long-run growth and the choice of exchange-rate regime.[9]

The case for a countercyclical fiscal policy was most forcefully made by Barro (1979): it helps smooth out intertemporal consumption when production is affected by exogenous shocks, thereby improving welfare. Another justification for countercyclical fiscal policy stems from a more Keynesian view of the cycle: namely, to the extent that a recession corresponds to an increase in the inefficiency of the economy, appropriate fiscal or monetary policy that raises aggregate demand can bring the economy closer to the efficient level of production (see Galí, Gertler, López-Salido, 2007).[10] The effect of fiscal policy in our model is different: fiscal policy affects growth through a market-size effect: e.g. by increasing expenditures, the government can induce firms to devote more investment to long-term projects, as innovations will then pay out more.[11]

Finally, an extended literature looks at the - short-run - output response to an exogenous increase in

[9] See Aghion and Banerjee (2005) and Aghion and Howitt (2009, ch14) for more complete literature reviews on the link between volatility and long-run growth.

[10] Consequently, government purchases need to remain above the level implied by the optimal provision of public good, as their role is dual: providing a public good, and increasing the efficiency in the economy (Galí, 2005).

[11] In Barro (1990)'s AK model, however, growth decreases with utility-type government expenditures and increases only initially with productive government expenditures.

government spending or to a tax cut. Importantly in these papers, GDP is usually detrended, so that all long-run effects are shut down. Although most economists would agree that a fiscal shock should increase short-run output, there is no consensus on the magnitude of the effect.[12] In particular, papers that introduce rational expectations and long-run wealth effects will typically predict a lower value of the multiplier (based on the idea that consumers anticipate that an increase in government spending today is likely to result in an increase in taxes tomorrow).[13] We move beyond this debate by looking only at the long-run effect of a more countercyclical fiscal policy: even if the short-run effect of a more countercyclical policy were more in line with the prediction of low multipliers, our results point to economically significant long-run effects.

The remaining part of the paper is organized as follows. Section 2 presents the model which helps us organize our thoughts and formulate our main prediction. Section 3 describes the econometric methodology and the data sources used in our estimations. Section 4 presents our empirical results and discusses their robustness. Section 5 concludes.

2 Cyclical fiscal policy and growth: an illustrative model

In this section we develop a simple model to rationalize our following empirical findings, namely that countercyclical fiscal policy is more growth- and R&D-enhancing in sectors that are more credit-constrained, the effect being driven by what happens in the low states of the world where credit constraints are more binding.

[12]Skeptical views on the importance of the effect of fiscal shocks include Andrew Mountford and Harald Uhlig (2008) or Roberto Perotti (2005). On the other hand, Antonio Fatás and Ilian Mihov (2001b) find that an increase in government spending (especially government wage expenditures increase) induces increases in consumption and employment. All the above mentioned papers use VAR analysis, and Olivier Blanchard and Roberto Perotti (2002) use a mixed VAR - event study approach to show that both, increases in government spending and tax cuts have a positive effect on GDP; they also find - like Alberto Alesina et al (2002) - that fiscal policy shocks have a negative effect on investment; note that this does not contradict our theory which points at investments being directed towards more productivity enhancing projects as the channel whereby long-run growth is enhanced by a more countercyclical fiscal policy.

Somewhat closer to the analysis in this paper, Athanasios Tagkalakis (2008) shows on a panel of 19 OECD countries from 1970 to 2002 that the effects of fiscal policy changes on private consumption is higher in recessions than in expansions. Interestingly, they explain this phenomenon by the presence of more liquidity constrained consumers in recessions, and show that the effect is more pronounced in countries characterized by less developed consumer credit markets.

[13]For example John F. Cogan et al (2009) use the Frank Smets and Rafael Wouters (2007) model and compute the effect of a permanent increase by 1% of GDP of government expenditures as of 2009: by 2011 Q4, they find that the increase in GDP is only equal to 0.44%, whereas Christina D. Romer and Jared Bernstein (2009) find a 1.57% increase. Finally, based on narrative records, Christina D. Romer and David H. Romer (2007) find that - exogenous - tax increases are highly contractionary.

2.1 Basic setup

The environment The model builds on Aghion et al (2005). We consider a discrete time model of an economy populated by a continuum of two-periods lived risk neutral entrepreneurs (firms).

Each firm starts out with a positive amount of wealth $W^t = wT^t$, where T^t denotes the accumulated knowledge at the beginning of the current period t, and w denotes the firm's knowledge adjusted wealth. Initial wealth can be invested in two types of projects: a short term investment project which generates output in the current period and a long term innovation project which, when successful, generates production with higher productivity next period. The short term investment project may involve maintaining existing equipment, expanding a business using the same kind of technology and equipment, or increasing marketing expenses. The long term project may consist in learning a new skill, learning about a new technology, or investing in R&D. Investing in the long term project increases the stock of knowledge available in the economy next period, whereas investing in the short term project does not contribute to knowledge growth. Both, short term and long term profits are proportional to market demand (see Daron Acemoglu and Joshua Linn, 2004).[14]

More specifically, by investing capital $K^t = k^t T^t$ in the short term project at time t, where k^t denotes the knowledge adjusted short-run capital investment, a firm generates short-run profits

$$\Pi_1(K^t, P^t) = T^t P^t \pi_1(k^t)$$

where P^t is an aggregate shock at time t and $\pi_1(k^t)$ is the normalized short-run profit, π_1 being increasing and weakly concave. P^t follows a Markovian process. We assume that $P^t \in \{P_L, P_H\}$ with $P_H > P_L$, and $\Pr\left(P^{t+1} = P_X \middle| P^t = P_X\right) = 1/2$ for $X \in \{L, H\}$.[15]

Now, consider firms' long term investments. Following Aghion et al (2005), we shall assume that after the

[14] In this set-up, short- and long-term investments may increase the mark-ups that firms can charge, but they have no effect on total production which is pinned down by the market size variable $\overline{P^t}$ detailed below.

[15] We can easily extend our analysis to the case of a persistent aggregate shock, with

$$\Pr\left(P^{t+1} = P_X \middle| P^t = P_X\right) = p \geq 1/2.$$

.

R&D investment $Z^t = z^t T^t$ has been incurred, where z^t denotes the knowledge-adjusted long-term innovative investment, the firm faces an idiosyncratic liquidity shock $C^t = cT^t$ drawn in a uniform distribution over $[0; \overline{c}]$. The firm reaps the profits of its long-term investments (and the liquidity shock including the interest payment) if and only if it is able to pay for the liquidity cost C^t, such long term profits write as

$$\Pi_2 \left(Z^t, P^{t+1} \right) = T^t P^{t+1} \pi_2(z^t)$$

where $\pi_2(z^t)$ is the normalized long-term profit in present value terms, π_2 being increasing and concave. Thus here we implicitly assume that the liquidity shock is either paid and then recouped ex post including interest payments on it, or not paid at all.

While liquidity shocks are private information and hence cannot be diversified, firms can still borrow once the liquidity shock is realized. Following Aghion et al (2005), a firm cannot borrow more than $\mu - 1$ times their current cash flow in order to overcome the liquidity shock.[16][17] Long-term investments survive the liquidity shock with probability

$$\delta(P^t, k^t) = \Pr(cT^t \leq \mu T^t P^t \pi_1(k^t)),$$

The parameter μ can be interpreted as a proxy for the tangibility of the firm' assets: more tangible assets being typically associated with lower monitoring costs for potential creditors, and therefore to a higher value of the credit multiplier μ. Similarly the parameter $\overline{c}$ can be interpreted as the extent to which the firm depends upon external finance: the higher $\overline{c}$, the less likely the firm will be able to cover its liquidity shock using only its retained earnings $T^t P^t \pi_1(k^t)$.

Knowledge growth results from investments in long-term projects that overcome the liquidity shock.

[16] This type of borrowing constraint can be based on ex post moral hazard considerations. See Philippe Aghion, Abhijit Banerjee and Thomas Piketty (1999). Note that the existence of borrowing constraints also prevents firms from achieving insurance against idiosyncratic liquidity shocks.

[17] Following Aghion, Banerjee and Piketty (1999) or Aghion et al (2005), we take μ to be constant over time. Alternative formulations, for example Bengt Holmstrom and Jean Tirole (1995) based on ex ante moral hazard, would generate a credit multiplier which is negatively correlated with the interest rate, and therefore typically procyclical. A procyclical μ would only reinforce the optimality of countercyclical fiscal policy established later in this section.

More formally, the growth rate q_{t+1} between period t and period $t+1$, is given by:[18]

$$q_{t+1} = \frac{T^{t+1} - T^t}{T^t} = \delta(P^t, k^t) z^t. \tag{1}$$

Timing of events The overall timing of events is as follows:

(i) The state of nature in period t happens; new firms make their investment decisions based on current government policy and the policy they anticipate in the following period,

(ii) Short-term investments and liquidity shocks are realized. A capital market opens. Firms that have accumulated enough wealth to overcome their liquidity shock lend to those that have not,

(iii) Firms that have overcome their idiosyncratic liquidity shocks in period t realize their long term investment at the beginning of period $t+1$.

2.2 A firm's maximization problem

In this subsection we analyze firms' optimal investment decisions. Given that firms are ex ante identical, there exists a symmetric equilibrium where all firms make the same investment decisions, and we focus our attention on this particular equilibrium.[19] Once the state of nature at time t is realized, a representative firm chooses investments to maximize its expected present value, that is the sum of its current profits and of its expected future revenues; more formally it chooses investments (K^t, Z^t) to

$$\max_{K^t; Z^t} \Pi_1(K^t, P^t) + E_t \left(\Pi_2 \left(Z^t, P^{t+1} \right) | P^t \right)$$
$$\text{subject to: } K^t + Z^t \leq W^t$$

[18] Alternatively, the growth rate could be proportional to the profits realized from long-term investments π_2 instead of being proportional to long-term investments z (note that if π_2 were to represent the probability of discovering a new technology, this would be a natural assumption to make).

[19] Given that all firms start out with same initial wealth $W^t = wT^t$, there is no borrowing and lending in equilibrium at the beginning of a period. However, once the idiosyncratic liquidity shocks are realized, firms with low liquidity shocks will typically lend to firms facing higher liquidity shocks.

which simplifies to:

$$\max_{k^t;z^t} P^t\pi_1(k^t) + \Pr\left(c \leq \mu P^t\pi_1(k^t)\right) m^t\pi_2(z^t)$$

$$\text{subject to: } k^t + z^t \leq w$$

where $m^t = E\left(P^{t+1}|P^t\right) = m = \frac{1}{2}P_L + \frac{1}{2}P_H$.

We will consider the effects on the expected growth rate of reducing the variance of P^{t+1} conditional on $m^t = m$.

The first term $P^t\pi_1(k^t)$ corresponds to knowledge adjusted profits derived from short term investments. The second term which represents the expected profits derived from long term investments is the product of three items. The first item $\Pr\left(c \leq \mu P^t\pi_1(k^t)\right)$ is the probability that long term investments go through the liquidity shock. m represents the expected aggregate shock at time $t+1$. The last term $\pi_2(z^t)$ represents the normalized long-term profit.

2.3 Analysis

Assume that credit constraint does not bind in the good state, $P^t = P_H$. Then the entrepreneur's problem writes as

$$\max_{z_H} P_H\pi_1(w - z_H) + m\pi_2(z_H).$$

Assuming an interior solution, the optimal long term investment $z_H = z_H^*$ satisfies

$$m\pi_2'(z_H^*) = P_H\pi_1'(w - z_H^*) \tag{2}$$

In particular, a reduction in the variance of P^{t+1} keeping m constant, decreases P_H and therefore increases optimal long term investment z_H^*. This is commonly referred to as the *opportunity cost* effect.

Now we turn to the low state $P^t = P_L$. First, if the credit constraint *does not bind* in that state, then the optimal R&D investment $z_L = z_L^{*,nb}$ is subject to the same opportunity cost effect, with

$$m\pi_2'(z_L^{*,nb}) = P_L\pi_1'(w - z_L^{*,nb}) \tag{3}$$

and therefore a reduction in aggregate volatility which amounts to increasing P_L, results in decreasing $z_L^{*,nb}$.[20]

Now, if the credit constraint *binds* in the low state, the entrepreneurs's problem writes as

$$\max_{z_L} P_L \pi_1(w - z_L) + \left[\frac{\mu}{\overline{c}} P_L \pi_1(w - z_L)\right] m\pi_2(z_L).$$

Assuming an interior solution,[21] the optimal long term investment $z_L = z_L^{*,b}$ satisfies

$$m\pi_2'(z_L^{*,b}) = \left[m\pi_2(z_L^{*,b}) + \frac{\overline{c}}{\mu}\right] \frac{\pi_1'\left(w - z_L^{*,b}\right)}{\pi_1\left(w - z_L^{*,b}\right)}. \tag{4}$$

In particular, a reduction in volatility has no effect on $z_L^{*,b}$: what happens here is that the opportunity cost effect is exactly offset by a *liquidity* effect, namely the fact that increasing P_L increases the probability that the long-term project survives; that these two effects exactly compensate each other is an artifact of the uniform distribution assumption on c.[22]

Moreover, note that in this case the optimal long-term investment $z_L^{*,b}$ in the low state is larger the lower the $\overline{c}$ and/or the higher the μ. In other words, when credit constraints are relaxed, the profitability of long-term investments increases which in turn encourages more long-term investment.

2.4 Growth effect of government spending countercyclicality

Recall that the growth rate q_{t+1} between period t and period $t+1$, is given by (1). Therefore, when the credit constraint never binds, the expected growth rate Eq^{t+1} writes as

$$Eq^{t+1} = \frac{1}{2} z_L^{*,nb} + \frac{1}{2} z_H^*. \tag{5}$$

[20] Logically, because of the opportunity cost effect, $z_L^{*,nb} > z_H^{*,nb}$, so that the credit constraint is more likely to bind in the low state of the world than in the high state.

[21] We deal with the non-interior solution case in the Appendix A.

[22] If the distribution of shocks is not uniformly distributed then current aggregate shock will typically affect the investment in long-term projects also in the low state of the world. In particular, one can show that in the case of a Pareto distribution with parameter smaller than 1, an increase in P_L will increase investment in long-term projects.

In particular a reduction in aggregate volatility can either raise or reduce average growth: on the one hand a lower P_H decreases the opportunity cost effect which increases R&D investment; on the other hand a higher P_L increases the opportunity cost effect which reduces R&D investment.

When the credit constraint binds only in the low state of the world, the expected growth rate Eq^{t+1} between periods t and $t+1$ is simply equal to:

$$Eq^{t+1} = \frac{1}{2}\frac{\mu P_L \pi_1 \left(w - z_L^{*,b}\right)}{\bar{c}} z_L^{*,b} + \frac{1}{2} z_H^{*}. \tag{6}$$

It then follows that a reduction in aggregate volatility increases average growth: first, a lower P_H decreases the opportunity cost effect which increases R&D investment; second, a higher P_L raises the number of R&D projects that survive the liquidity shock without affecting the aggregate R&D effort.

This establishes:

Proposition 1 *A small reduction in aggregate volatility has an ambiguous effect on the average growth rate if the credit constraint never binds, whereas it has a positive effect on the aggregate growth rate if it binds only in the low state.*

An important implication of this proposition is that a countercyclical fiscal policy which would reduce the volatility of the aggregate shocks faced by firms, will be more growth-enhancing for firms that face tighter credit constraints, when credit constraints are (more) binding in the low states of the world.[23] This is because, in the low state of nature, a more counter-cyclical fiscal policy tends to raise successful R&D investment for firms whose credit constraint is binding while it tends to reduce R&D investment for firms whose credit constraint is not binding.

To conclude this section, note that if credit constraints were to bind in both states of the world, then a reduction in aggregate volatility would not affect expected growth in this set-up with $p = 1/2$. Yet, it might

[23] The difference between the expected growth rate of a sector where the credit constraint binds in the low state, and one where it never binds writes simply as:

$$\frac{1}{2}\frac{\mu P_L \pi_1 \left(w - z_L^{*,b}\right)}{\bar{c}} z_L^{*,b} - \frac{1}{2} z_L^{*,nb}.$$

As $z_L^{*,b}$ is independent of P_L and $z_L^{*,nb}$ decreases in P_L, this term is unambiguously positive.

actually result in a higher expected number of surviving long-term projects, i.e. in higher growth, as more long term investment would be undertaken in the high state, if there is positive persistence in the aggregate shock. However, our empirical analysis suggests that this "gambling for resurrection" effect is dominated in the data.

3 Econometric methodology and data

We investigate whether differences in fiscal policy cyclicality across countries and in financial constraints across industries can account for cross-country cross industry growth differences. To do so, we consider an empirical specification in which our dependent variable is the average annual growth rate of labour productivity or real value added in industry i in country c for a given period of time, say $[t; t+n]$. Labour productivity is defined as the ratio of real value added to total employment.[24] On the right hand side (henceforth, RHS), we introduce our variable of interest $(\mathrm{sc}_i) \times (\mathrm{fp}_c)$, namely the interaction between industry i's specific characteristic (sc_i) (external financial dependence or asset tangibility), and the degree of (counter-) cyclicality of fiscal policy (fp_c) in country c over the period $[t, t+n]$. Moreover, we control for initial conditions by including the term $\log \mathrm{y}_{i,c}^t$ as an additional regressor on the RHS of the estimation equation. When labour productivity (resp. value added) growth is the dependent variable, $\mathrm{y}_{i,c}^t$ represents the beginning of period ratio of labour productivity (resp. value added) in industry i in country c to total manufacturing labor productivity (resp. total manufacturing real value added) in country c. Finally, we introduce a full set of industry and country fixed effects $\{\alpha_i; \beta_c\}$ to control for unobserved heterogeneity across industries and across countries. Letting $\varepsilon_{i,c}$ denote the error term, our main estimation equation -which we will also refer to as the second stage regression- can then be expressed as:

$$\mathrm{g}_{i,c} = \alpha_i + \beta_c + \gamma\,(\mathrm{sc}_i) \times (\mathrm{fp}_c) - \delta \log \mathrm{y}_{i,c}^t + \varepsilon_{i,c} \tag{7}$$

[24] Although we also have access to industry level data on hours worked, we prefer to focus on productivity per worker and not productivity per hour as measurement error is more likely to affect the latter than the former.

Following Rajan and Zingales (1998) we measure industry specific characteristics using firm level data in the US. External financial dependence is measured as the average across all firms in a given industry of the ratio of capital expenditures minus current cash flow to total capital expenditures. Asset tangibility is measured as the average across all firms in a given industry of the ratio of the value of net property, plant and equipment to total assets. This methodology is predicated on the assumptions that: (i) differences in financial dependence/asset tangibility across industries are largely driven by differences in technology; (ii) technological differences persist over time across countries; (iii) countries are relatively similar in terms of the overall institutional environment faced by firms. Under those three assumptions, the US based industry-specific measure is likely to be a valid interactor for industries in countries other than the US.[25] Now, there are good reasons to believe that these assumptions are satisfied particularly if we restrict the empirical analysis to a sample of OECD countries. For example, if pharmaceuticals require proportionally more external finance than textiles in the US, this is likely to be the case in other OECD countries. Moreover, since little convergence has occurred among OECD countries over the past twenty years, cross-country differences are likely to persist over time. Finally, to the extent that the US are more financially developed than other countries worldwide, US based measures of financial dependence as well as asset tangibility are likely to provide the least noisy measures of industry level financial dependence or asset tangibility.

We next focus attention on how to measure fiscal policy cyclicality over the time interval $[t, t+n]$, i.e. how to construct the RHS variable (fp_c). Given that fiscal policy cyclicality cannot be observed, we need an "auxiliary" equation -which we will also refer to as the first stage regression- to infer fiscal policy cyclicality for each country of the sample. Our approach is to estimate fiscal policy cyclicality as the marginal change in fiscal policy stemming from a given change in the domestic output gap. Thus we use country-level data over the period $[t; t+n]$ to estimate the following country-by-country "auxiliary" equation:

$$\mathrm{fb}_{c,\tau} = \eta_c + \mathrm{fp}_c \mathrm{z}_{c,\tau} + u_{c,\tau}, \tag{8}$$

[25] Note however that this measure is unlikely to be valid for the US as it likely reflects the equilibrium of supply and demand for capital in the US and therefore is endogenous.

where: (i) $\tau \in [t; t+n]$; (ii) $\mathrm{fb}_{c,\tau}$ is a measure of fiscal policy in country c in year τ: for example total fiscal balance to GDP; (iii) $\mathrm{z}_{c,\tau}$ measures the output gap in country c in year τ, that is the percentage difference between actual and potential GDP, and therefore represents the country's current position in the cycle; (iv) η_c is a constant and $u_{c,\tau}$ is an error term. Equation (8) is estimated separately for each country c in our sample. For example, if the LHS of (8) is the ratio of fiscal balance to GDP, a positive (resp. negative) regression coefficient (fp_c) reflects a countercyclical (resp. pro-cyclical) fiscal policy as the country's fiscal balance improves (resp. deteriorates) in upturns. Moreover, as a robustness check, we consider the case where fiscal policy indicators in regression (8) are measured as a ratio to potential and not current GDP. This alternative specification helps make sure that the cyclicality parameter (fp_c) captures changes in the numerator of the LHS variable -related to fiscal policy- rather than in the denominator -related to cyclical variations in output-.[26] Furthermore more elaborated fiscal policy specifications can also be considered. In particular, following Jordi Galí et al (2003), a debt stabilization motive as well as a control for fiscal policy persistence can be included on the RHS. Thus, letting $\mathrm{b}_{c,\tau}$ denote the ratio of public debt to potential GDP in country c in year τ, we could estimate fiscal policy cyclicality $\left(\mathrm{fp}_{2,c}\right)$ over the period $[t; t+n]$ using the modified "auxiliary" equation:

$$\mathrm{fb}_{c,\tau} = \eta_c + \theta_c \mathrm{fb}_{c,\tau-1} + \mathrm{fp}_{2,c} \mathrm{z}_{c,\tau} + \lambda_c \mathrm{b}_{c,\tau-1} + v_{c,\tau} \tag{9}$$

where $\mathbf{z}_{c,\tau}$ is as previously the output gap in country c in year τ, $\mathrm{fb}_{c,\tau-1}$ is the fiscal policy indicator in country c in year $\tau - 1$ and $v_{c,\tau}$ is an error term.

Following Rajan and Zingales (1998), when estimating our second stage regression (7) we rely on a simple OLS procedure, correcting for heteroskedasticity bias whenever needed, without worrying much further about endogeneity issues. In particular, the interaction term between industry specific characteristics and fiscal policy cyclicality is likely to be largely exogenous to the LHS variable, be it industry labour productivity

[26] When data is available, we also measure fiscal policy using cyclically adjusted variables. In this case, the cyclicality of fiscal policy results more directly from discretionary policy. Put differently, cyclicality stemming from automatic stabilizers is purged out. Unreported results -available upon request- are very similar to the case where fiscal policy indicators are not cyclically adjusted.

or value added growth. First, our external financial dependence variable pertains to industries in the US while the growth variables on the LHS involves other countries than the US. Hence reverse causality whereby industry growth outside the US could affect external financial dependence or asset tangibility of industries in the US, seems quite implausible. Second, fiscal policy cyclicality is measured at a macro level whereas the LHS growth variable is measured at industry level, which again reduces the scope for reverse causality as long as each individual industry represents a small share of total output in the domestic economy. Yet, as an additional test that our results are not driven by endogeneity considerations, we produce additional regressions where we instrument for fiscal policy cyclicality.[27]

Our data sample focuses on 15 industrialized OECD countries plus the US. In particular, we do not include Central and Eastern European countries and other emerging market economies. Industry-level data for this country sample are available for the period 1980-2005 while R&D data are only available for the period 1988-2005.[28] Our data come from four different sources. Industry level real value added and labour productivity data are drawn from the EU KLEMS dataset while Industry level R&D data is drawn from OECD STAN database.[29] The primary source of data for measuring industry financial dependence, is Compustat which gathers balance sheets and income statements for US listed firms. We draw on Rajan and Zingales (1998) and Claudio Raddatz (2006) to compute the industry level indicators for financial dependence.[30] We draw on Matías Braun and Borja Larrain (2005) to compute industry level indicators for asset tangibility. Finally, macroeconomic fiscal and other control variables are drawn from the OECD Economic Outlook dataset and from the World Bank Financial Development and Structure database.[31]

[27] Our IV tables below show a large degree of similarity between OLS and IV estimations, thereby confirming that our basic empirical strategy properly addresses the endogeneity issue, even though it uses OLS estimations.

[28] We present here the empirical results related to the 1980-2005 period. Estimations on sub-samples with shorter time span are available upon request. Cf. Appendix B for more details on the data and country sample.

[29] These data are available respectively from: http://www.euklems.net/data/08i/all_countries_08I.txt and http://stats.oecd.org/Index.aspx

[30] Rajan and Zingales data is accessible at: http://faculty.chicagogsb.edu/luigi.zingales/research/financing.htm

[31] The OECD Economic Outlook dataset is accessible at: http://titania.sourceoecd.org. The World Bank Financial Development and Structure database is accessible at: http://siteresources.worldbank.org

4 Results

4.1 The first stage estimation

We first focus on first stage regressions which deliver estimates for fiscal policy cyclicality. The first histogram (figure 2) provides the country by country estimates for fiscal policy cyclicality when the dependent variable in equation (8) is total fiscal balance to potential GDP as well as the estimated confidence interval at the 10 percent level for each country.[32] According to these estimates, the most counter-cyclical countries of our sample are Sweden and Denmark. In Sweden, total fiscal balance to potential GDP tends to increase by 1.7 percentage point in response to a 1 percentage point increase in the domestic output gap. In Denmark, the corresponding increase is of almost 1.5 percentage point. In these two countries, the government is more likely to run a surplus when the economy experiences a boom (i.e. a positive output gap) and is more likely to run a deficit when the economy experiences a bust (i.e. a negative output gap). Conversely, the least counter-cyclical countries -put differently, the most pro-cyclical countries- of our sample are Greece and Italy. In these two countries, the sensitivity to the domestic output gap of the ratio of total fiscal balance to potential GDP is negative: the government runs a larger surplus or a lower deficit, when the output gap decreases, i.e. when the economy deteriorates. Note however that for both countries (Greece and Italy), the estimated coefficient is not significant since the hypothesis that it is equal to zero cannot be rejected at the 10 percent level given the confidence bands. The second histogram (figure 3) provides the country by country estimates for fiscal policy cyclicality when the dependent variable in equation (8) is primary fiscal balance to potential GDP. The difference between total and primary fiscal balance is that the latter excludes interest payments to or from the government. This histogram is similar to the first one. In particular, Denmark and Sweden remain the most counter-cyclical countries of our sample while Greece and Italy are still the most pro-cyclical countries. A key difference between the two histograms however is that primary fiscal balance to potential GDP ratio is significantly pro-cyclical in Greece and Italy for the two latter countries whereas the ratio of total fiscal balance to GDP is not.

[32] The confidence interval at the 10% level is built as $[m - 1.65\sigma; m + 1.65\sigma]$ where m and σ respectively denote the estimated coefficient and standard error for fiscal policy cyclicality using equation (8).

Next we look at bivariate correlations between fiscal policy cyclicality and macroeconomic variables. Empirical evidence first shows that fiscal policy countercyclicality is positively associated with the size of the government (figure 4). Indeed the correlation between total fiscal balance to GDP countercyclicality and average total fiscal expenditures to GDP is positive and significant. However this correlation is only marginally significant. When government size is captured by the ratio of average primary -rather than total- fiscal expenditures to GDP, the correlation remains positive, and with much larger significance. Next we investigate the correlation between fiscal countercyclicality and fiscal discipline (figure 5). Here, there is a strong positive association between total fiscal balance to GDP countercyclicality and average total fiscal balance to GDP. This means that countries which have run the largest average deficits have also run the least counter-cyclical or the most pro-cyclical fiscal policies. Note however that this result does not hold in the case of primary fiscal balance since then the correlation between primary fiscal balance to GDP countercyclicality and average primary fiscal balance to GDP while still positive is not significant. Finally, we look at the relationship between fiscal cyclicality and macroeconomic volatility (figure 6). Figure 6 shows that there is a significantly negative correlation between fiscal countercyclicality and the volatility in labour productivity growth. This result is not too surprising: a more counter-cyclical fiscal policy should have a more dampening effect on aggregate volatility.

4.2 The second stage estimation

We first estimate our main regression equation (7), with real value added growth as LHS variable, using financial dependence or asset tangibility as industry-specific interactors (table 1). Fiscal policy cyclicality is estimated using alternatively the ratio of total or primary fiscal balance to actual or potential GDP as LHS fiscal policy indicator in regression (8). The difference between these total and primary fiscal balance is that the latter does not include net interest repayments to/from the government. The empirical results show that real value added growth is significantly and positively (resp. negatively) correlated with the interaction of external financial dependence (resp. asset tangibility) and fiscal policy countercyclicality: a larger sensitivity to the output gap of total fiscal balance to GDP (actual or potential) raises industry real valued added growth the more so for industries with higher financial dependence or for industries with lower asset tangibility.

The results are qualitatively similar when using primary fiscal balance: industries with larger financial dependence or lower asset tangibility tend to benefit more from a more countercyclical fiscal policy in the sense of a larger sensitivity of the primary fiscal balance to variations in the output gap. Estimated coefficients are however smaller in absolute value when fiscal policy is measured through primary fiscal balance. This is related to the fact that the cross-country dispersion in the cyclicality of primary fiscal balance is larger than the cross-country dispersion in the cyclicality of total fiscal balance.

Three remarks are worth making at this point. First, the estimated coefficients are highly significant -in spite of the relatively conservative standard errors estimates which we cluster at the country level-. Second, the pairwise correlation between industry financial dependence and industry asset tangibility is around -0.6 which is significantly below -1. In other words, these two variables are far from being perfectly negatively correlated, which in turn implies that the regressions with financial dependence as the industry specific characteristic are not just mirroring regressions where asset tangibility is the industry specific characteristic. Instead these two set of regressions convey complementary information. Finally, the estimated coefficients remain essentially the same whether the LHS variable in equation (8) is taken as a ratio of actual or potential GDP, so that the correlations between (fp_c) and industry growth indeed capture the effect of fiscal policy rather than just the effect of changes in actual GDP.

We now repeat the same estimation exercise, but taking labour productivity as the LHS variable in our main estimation equation (7). Comparing the results from this new set of regressions with the previous tables, in turn will allow us to decompose the overall effect of fiscal policy countercyclicality on industry value added growth into employment growth and productivity growth. As is shown in table 2, labour productivity growth is significantly affected by the interaction between financial dependence/asset tangibility and fiscal policy cyclicality: a larger sensitivity to the output gap of -total or primary- fiscal balance to -actual or potential- GDP raises industry labour productivity growth the more so for industries with higher financial dependence or lower asset tangibility. Decomposing real value added growth into labour productivity growth and employment growth, regressions with external financial dependence as the industry interactor show that about 75 percent of the effect of fiscal countercyclicality on value added growth is driven by productivity growth, the remaining 25 percent corresponding to employment growth.

How robust is the effect of countercyclical fiscal policy on industry growth? In particular, to what extent are our results driven by the choice of econometric methodology, or by sample selection or by the existence of omitted variables? For the sake of presentation we will focus in the remainder of the paper on labor productivity growth as the LHS variable in our regressions. Results are similar when considering real value added growth instead.[33,34]

4.3 Alternative first stage regression

Here we check the robustness of our results to replacing our auxiliary equation (8) by the alternative specification (9) where, on the RHS of the equation, we add the one-period lagged fiscal policy indicator to control for possible auto-correlation as well as the ratio of government liabilities to potential GDP on the RHS to control for debt stabilization motives, either considered on gross or net bases. On the LHS of (9), we consider both total and primary fiscal balance as a ratio of potential GDP. Finally in the main specification (7), as mentioned above we consider labor productivity growth as our dependent variable. Results in table 3 show that in spite of relatively lower levels of statistical significance -which we attribute to the smaller data sample for estimating this alternative specification-, the estimated coefficients are quite close to those obtained when using the benchmark auxiliary equation (8). Also interestingly, we find no significant difference between the estimated coefficients for total and primary fiscal balance countercyclicality.

[33] And the results are available upon request from the authors.

[34] For the sake of brevity, two additional robustness checks are not presented. First, we do not show regressions which check the robustness of our interaction coefficient to removing countries from the data sample one by one. Evidence available upon request shows that interaction coefficients remain relatively unchanged both in terms of statistical significance and economic magnitude across all regressions. Second we do not show the regressions which investigate the possibility of quadratic effects, i.e. whether the estimated coefficient for the interaction term is larger for industries with low or high financial dependence. Empirical evidence available upon request shows that the estimated coefficient for the interaction term is significantly larger for industries above median financial dependence compared to industries with below median financial dependence.

4.4 Competing stories and omitted variables

To what extent aren't we picking up other factors or stories when looking at the correlation between industry growth and the cyclicality of fiscal policy? In this subsection, we focus on just a few alternative explanations.

4.4.1 Financial development

A more countercyclical fiscal policy could reflect a higher degree of financial development in the country.[35] And financial development in turn is known to have a positive effect on growth, particularly for industries that are more dependent on external finance (Rajan and Zingales, 1998). To disentangle the effects of countercyclical fiscal policy from the effects of financial development, in the RHS of the main estimation equation (7) we control for financial development and its interaction with external financial dependence. Columns 1-3 in Tables 4 and 5 below show that controlling for financial development and its interaction with financial dependence or asset tangibility - where financial development is measured either by the ratio of private credit to GDP, or by the ratio of financial system deposits to GDP, or by the real long term interest rate[36]- does not affect nor the significance nor the magnitude of the interaction coefficients between financial dependence/asset tangibility and the cyclicality of fiscal policy. In other words, the effect of fiscal policy cyclicality on industry growth, remains unaffected both qualitatively and quantitatively once financial development is controlled for. Moreover, our measures of financial development interacted with financial dependence or asset tangibility do not appear to have a significant and robust effect on labour productivity growth once we control for the cyclicality of fiscal policy and its interaction with financial dependence or asset tangibility.

4.4.2 Inflation

Inflation may also impact on the effect of fiscal policy particularly in more financially dependent sectors. In particular, inflation is widely perceived as having a negative impact on the allocative efficiency of capital

[35] For example Aghion and Marisnecu (2007) point to a positive correlation between fiscal policy counter-cyclicality and financial development.
[36] The first two indicators measure the availability of external capital, the third one measures its cost.

across sectors, the idea being that higher inflation makes it more difficult for outside investors to identify high productivity projects: then, the higher the inflation rate, the less efficiently should the financial system allocate capital across sectors. And to the extent that those sectors that suffer more from capital misallocation are the more financially dependent sectors, inflation is more likely to have a negative effect on value added/productivity growth for industries with more reliance on external finance. In contrast, in industries with no or low financial dependence, this negative effect of inflation is less likely to hold.[37] Column 4 in Tables 4 and 5 indeed shows that the interaction of inflation and financial dependence is never a significant determinant of labour productivity growth at industry level. The same applies to the interaction between inflation and industry asset tangibility. Finally, we investigate whether this absence of any significant effect of inflation could be related to the level of central bank policy rates, given that central banks tend to determine their policy rates depending on inflation (see column 5 in Tables 4 and 5). However, we find that even after controlling for central bank policy rates the interaction between fiscal policy cyclicality and industry financial dependence remains significant. This suggests that the positive growth effect of stabilizing fiscal policies in more financially constrained industries, is largely unrelated to average inflation in a country: for given inflation rate, raising the counter-cyclical pattern of fiscal policy raises growth more in industries with higher financial dependence or with lower asset tangibility. These results however do not imply that high average inflation is not costly: in particular, a higher level of inflation is likely to affect the local government's ability to carry out a stabilizing fiscal policy.

4.4.3 Fiscal discipline and size of government

If the cyclical component of fiscal policy does significantly affect industry value added growth or labour productivity growth, it is also likely that the structural component of fiscal policy should play a similar role. In fact it could be the case that countercyclical fiscal policy is positively correlated with industry growth not so much because countercyclicality per se is growth-enhancing but rather because a more countercyclical

[37] A reinforcing consideration is that increases in short term interest rates by central banks in response to higher inflation or higher expected inflation, should also have a negative effect on industry value added and productivity growth that is larger for industries with higher financial dependence or lower asset tangibility.

fiscal policy simply reflects better designed fiscal policy or higher fiscal discipline over the cycle. In the same vein, the cyclicality of fiscal policy might be a proxy for the relative size of government. To address this potential objection, we consider four controls for different fiscal institutional characteristics: average fiscal balance, average government expenditures, average government revenues and average gross government debt. The first measure captures fiscal discipline, the second and third measures capture the relative size of government, the fourth measure represents both the relative size of the government as well as the debt burden that can hinder fiscal policy countercyclicality. Columns 6 to 9 in Tables 4 and 5 show that in the horse race between the cyclicality of fiscal policy and those four measures of structural fiscal policy, countercyclicality in primary fiscal balance is a significant determinant of industry growth irrespective of the control considered. Moreover, none of these controls shows a significant effect in the interaction with financial depedence or asset tangibility. This does not imply that fiscal discipline, for example as reflected through a moderate average fiscal deficit, does not matter for industry growth: tighter fiscal discipline should actually make it easier for a government to implement a more countercyclical fiscal policy whereas large average fiscal deficits should make it harder for any government to stabilize the economy in downturns, particularly if the government, as any other agent in the economy, also faces a borrowing constraint.

4.5 Dealing with the variability in fiscal cyclicality estimates.

An important limitation to the empirical analysis carried out so far, is that fiscal policy countercyclicality cannot be directly observed: instead, it can only be inferred through an auxiliary regression. This in turn raises a number of issues. Among those lies the fact that countercyclicality is measured with a standard error. Hence our estimates only provide a "noisy" signal of the "true" value of fiscal policy countercyclicality for each country. This problem can be dealt in at least two possible ways.

A first approach is to reproduce the uncertainty surrounding our fiscal policy estimates and checking whether it affects the results of our second stage regression. More precisely, we adopt the following three step procedure. First, instead of taking the average coefficient fp_c estimated in the first stage regression as an explanatory variable in our second stage regression, for each country c we draw a fiscal policy cyclicality index fpi_c from a normal distribution with mean fp_c and standard deviation σ_{fp_c}, where σ_{fp_c} is the standard error for the coefficient fp_c estimated in the first stage regression. Typically the larger the estimated standard deviation σ_{fp_c} the more likely it is that the fiscal policy cyclicality index fpi_c for country c will be different from the average coefficient fp_c. Then we run our second stage regression using the randomly drawn fiscal policy cyclicality indexes fpi_c:

$$\text{g}_{i,c} = \alpha_i + \beta_c + \gamma\,(\text{sc}_i) \times (\text{fpi}_c) - \delta \log \text{y}_{i,c}^t + \varepsilon_{i,c} \tag{10}$$

Running this regression yields an estimated coefficient γ and an estimated standard deviation σ_γ. We repeat this same procedure 2000 times, and thereby end up with a series of (2000) estimated coefficients γ and standard errors σ_γ which we then average across all draws $\overline{\gamma}$ and $\overline{\sigma_\gamma}$. The statistical significance of our coefficient can eventually be tested on the basis of the average values of $\overline{\gamma}$ and $\overline{\sigma_\gamma}$.

Table 6 shows the results from this estimation procedure when fiscal policy cyclicality is drawn randomly from a normal distribution whose parameters have been estimated in the first stage regression. In particular we first see that the interaction of fiscal policy cyclicality and industry financial dependence still has a significant effect on industry growth when the uncertainty surrounding fiscal policy cyclicality estimates is taken into account. Second the estimated parameter is usually slightly smaller than its counterpart in the simple OLS regression in Table 2. However the difference is by no means statistically significant. Hence neither the significance nor the magnitude of our main effect, appear to be related to a possible bias stemming from our generated regressors. In other words, the simple OLS regression does not seem to provide significantly biased results.

4.5.1 Instrumental variable estimation

A second approach to deal with the uncertainty surrounding our fiscal policy estimates is to perform instrumental variable estimations considering our second stage regression as a model with errors-in-variables in which we only observe a noisy signal of the explanatory variable(s).[38] Here we instrument fiscal policy countercyclicality using a set of instrumental variables which share two basic characteristics. First, these variables are directly observed, none of them is inferred from another model or regression. Second, these variables are all predetermined: that is, the period over which the instrumental variables are observed, is prior to the time interval over which the auxiliary regressions that determine our countercyclicality measure, are being run.

More precisely, we perform two alternative sets of IV estimations. In the first set of IV estimations we use "economic variables" as instruments, for example GDP per worker, the ratio of imports to GDP, CPI inflation, nominal long term interest rate, nominal short term interest rate, private credit to GDP, financial system deposits to GDP. In the second set of IV estimations, we use legal and political variables as instruments: legal origin (English, French, German, Scandinavian), district magnitudes and an index for government centralization (ratio of central to general government expenditures).

Table 7 shows our IV estimations results when fiscal policy countercyclicality is instrumented using economic variables. Three main results emerge from this exercise. First, no matter which underlying fiscal policy indicator we consider, a more countercyclical fiscal policy has a more significantly positive effect on industry growth the larger the degree of industry external financial dependence or the lower industry asset tangibility, in the IV regressions. Second, the effects implied by the IV estimations, are of comparable magnitude to those implied by the above OLS regressions: the interaction coefficients are at least as large and often larger (in absolute value) in the IV estimations than in the OLS estimations.[39] Finally, the Hansen test for instrument validity is always accepted at the 10 percent level.

Next, we consider the case where fiscal policy cyclicality is instrumented using legal and political variables. Table 8 shows the corresponding IV estimations results. Again, we find that the instrumentation does not

[38] In other words, the instrumental variable estimations we perform in this subsection are meant to rule out the possibility that our above findings about the interaction between financial dependence and fiscal policy counter-cyclicality being a significant determinant of industry level growth, might simply reflect the fact that the standard errors around the estimates of fiscal policy counter-cyclicality have not been properly taken into account in the estimations.

[39] Note that R-squared are much lower for IV than for OLS regressions. The reason has to do with the country and industry dummies which are included incomputing the R-squared in the OLS regressions but not in the IV regressions.

affect the significance or the magnitude of the interaction coefficients between external dependence (or asset tangibility) and fiscal policy countercyclicality in the growth regressions. Moreover, as it was already the case when looking at "economic" instruments, legal and political instruments always pass the Hansen test, confirming the validity of our instruments. Also, note that instrumentation with "economic" or "legal and political " variables tend to provide similar magnitudes for the effect of fiscal policy countercyclicality on industry growth. Finally, as we already obtained when using economic variables as instruments, interaction coefficients here happen to be as large or larger than those estimated in the OLS regressions especially when fiscal policy is captured through primary fiscal balance.

4.6 Magnitude of the effects

How large are the effects implied by the above regressions? To get a sense of the magnitudes involved in these regressions, we compute the difference in (labor) productivity growth gains Δ between an industry in the top quartile (75^{th} percentile) and an industry in the bottom quartile (25^{th} percentile) with regard to financial dependence when the country increases the countercycliclality of its fiscal policy from the 25^{th} to the 75^{th} percentile. Then, we repeat the same exercise, but replacing financial dependence by asset tangibility (which moves from the 75^{th} to the 25^{th} percentile of the corresponding distribution).[40] As shown in the table below, Δ lies between a 1.1 and a 2.1 percentage points per year. These magnitudes are fairly large especially when compared to the corresponding figures in Rajan and Zingales (1998). According to their results, the difference Δ from moving from the 25^{th} to the 75^{th} percentile in the level of financial development, is roughly equal to 1 percentage point per year.

[40] The presence of industry and country fixed effects prevents us from evaluating the impact of a change in fiscal policy cyclical pattern for a given industry or conversely from evaluating the effect of a change in industry characteristics (financial dependence or asset tangibility) in a country with a given cyclical pattern of fiscal policy.

Labour productivity growth gain (in %) from a change in fiscal policy counter-cyclicality and industry characteristics	Financial Dependence	Asset Tangibility
Total Fiscal Balance to potential GDP	**1.45**	**2.14**
Primary Fiscal Balance to potential GDP	**1.15**	**1.77**

Table 9: Magnitudes

However, the following considerations are worth pointing out. First, these are diff-and-diff (cross-country/cross industry) effects, which are not interpretable as country-wide effects.[41] Second, we are just looking at manufacturing sectors, which represent less than 40 percent of total GDP of countries in our sample. Third, given the relatively small set of countries in our sample, there is a fairly large degree of dispersion in fiscal policy cyclicality across countries in our sample. Hence moving from the 25^{th} to the 75^{th} percentile in the countercyclicality of total or primary fiscal balance relative to GDP, corresponds to a dramatic change in the design of fiscal policy over the cycle, which in turn is unlikely to take place in any individual country over a short period of time. Fourth, this simple computation does not take into account the possible costs associated with the transition from a steady state with low fiscal countercyclicality to a steady state with high fiscal countercyclicality. Yet, the above exercise suggests that differences in the cyclicality of fiscal policy are an important driver of the observed cross-country/cross-industry differences in value added and productivity growth.[42]

[41] It could be in particular that a more counter-cyclical fiscal policy simply redistributes growth accross sectors without any impact at the macro level, because the gains for some industries -here the most financially dependent industries- would be compensated by the loss for some others -here the least financially dependent industries.

[42] Yet another limit is related to the relatively small number of countries in our sample. Because we focus exclusively on developed countries and abstract from emerging and developing countries, the sample on which we estimate the distribution quantiles for fiscal policy counter-cyclicality is relatively small. Hence quantiles of the cross-country are relatively unprecisely estimated.

4.7 Asymmetry between booms and slumps

The model predicts that the interaction between firms' credit constraints and the fiscal countercyclicality should play more in downturns than in upturns. Tables 10a and 10b run the second stage regression, separately for country-years where the output gap is respectively below and above its median value over the whole period for the corresponding country. As we can see by comparing the interaction coefficients between these two tables: (i) when credit constraints are (inversely) measured by asset tangibility of the corresponding sector in the US (columns 5 to 8), the interaction coefficients are significant only when the output gap is below median; (ii) when credit constraints are measured by external financial dependence of the corresponding sector in the US (columns 1 to 4), then the interaction coefficients are higher and more significant when the output gap is below median. That they remain positive and somewhat significant when the output gap is above median, may reflect anticipatory effects which we do not capture in our model with one-period-lived firms: for example, with higher taxes in booms firms may anticipate higher subsidies or lower taxes in subsequent slumps, which in turn should have a more positive effect on their growth-enhancing investments, particularly for firms that are more credit-constrained.

4.8 R&D spending and fiscal policy countercyclicality

A natural explanation for why a more countercyclical fiscal policy has a positive growth effect on more financially constrained industries, is that it provides incentives to pursue long-term innovative investments. In this subsection we look at whether a more counter-cyclical fiscal policy has a positive impact on R&D spending at industry level over the estimation period 1988-2005. To this end we run the regression:

$$\ln\left(\frac{1}{n}\sum_{1\leq h\leq n}\mathrm{RD}_{i,c}^{t+h}\right)=\alpha_i+\beta_c+\gamma\left(\mathrm{sc}_i\right)\times\left(\mathrm{fp}_c\right)+\delta\ln\left(\mathrm{RD}_{i,c}^{t}\right)+\varepsilon_{i,c} \tag{11}$$

where $\mathrm{RD}_{i,c}^{t}$ is the volume of R&D spending at time t in country c and industry i, other variables being similar to specification (7). We first look at the impact of a more counter-cyclical fiscal balance on the average industry R&D spending; and then decompose fiscal policy into fiscal revenues and expenditures.

We obtain two main findings. First, columns 1-4 in table 11 show that the interaction of countercyclicality in fiscal balance and industry financial dependence has a significant effect on the average R&D spending. This conclusion holds irrespective of whether we look at total or primary fiscal balance and wether we consider it as ratio to actual or to potential GDP. Second, when decomposing fiscal balance between expenditures and revenues (columns 5-8 in table 10), we find that the positive effect of a more countercyclical fiscal balance on industry R&D is mostly driven by the countercyclical pattern of government expenditures, not so much by that of government revenues whose estimated coefficient is not significantly different from zero when considering primary government revenues. This we see as further evidence of a market size channel lying behind the positive impact of countercyclical fiscal policy on industry R&D and thereby on industry growth.

5 Conclusions

In this paper, we have analyzed the extent to which macroeconomic policy over the business cycle can affect industry growth, focusing on fiscal policy. Following the Rajan-Zingales (1998) methodology, we have interacted credit constraints (measured either by external financial dependence or by the negative of asset tangibility in US industries) and the cyclicality of fiscal policy at the country level, and assessed the impact of this interaction on value added or productivity growth at the industry level. Using this methodology which helps address potential endogeneity issues, we provided evidence that a more countercyclical fiscal policy enhances output and productivity growth more in more financially constrained industries, i.e. in industries whose US counterparts are more dependent on external finance or display lower asset tangibility. This result appears to survive a number of robustness tests, in particular the inclusion of structural macroeconomic variables such as financial development, inflation and average fiscal deficits, to which one could also add openness to trade or the net current account position.[43] This, in turn, suggests either that the growth impact of the cyclical pattern of fiscal policy is of comparable (or even greater) importance to that of more structural features, or that the effect of these structural features operates at least partly through their own effects on the cyclicality of fiscal policy.

[43] The corresponding regressions can be provided by the authors upon request.

Our analysis suggests at least three avenues for future research. A first is to open the black box of fiscal policy and investigate which component of government budget drives the relationship between industry growth and the cyclicality of fiscal policy. Appendix A below makes a first step in this direction by distinguishing between government expenditure and government revenues. A second question is whether the above analysis of the effects of fiscal policy countercyclicality on industry growth can be transposed from the fiscal to the monetary sphere of the economy. A positive answer to this question would be all the more important as presumably monetary policy can be more easily modified over time than fiscal policy, although transmission lags may be larger for monetary than for fiscal policy. Finally comes the question of the determinants of countercyclical fiscal policy, and especially the institutional features or arrangements that foster or prevent countercyclicality. Answering this question will shed new light on the ongoing debate about the relationship between growth and institutions.

References

[1] Acemoglu, Daron, Johnson, Simon, Robinson, James, and Yunyong Thaicharoen. 2003. "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises, and Growth." *Journal of Monetary Economics*, 50: 49-123.

[2] Acemoglu, Daron and Joshua Linn. 2004. "Market Size in Innovation: Theory and Evidence from the Pharmaceutical Industry." *The Quarterly Journal of Economics*, 119(3): 1049–1090.

[3] Acemoglu, Daron and Fabrizio Zilibotti. 1997. "Was Prometheus Unbound by Chance? Risk, Diversification and Growth." *Journal of Political Economy*, 105(4): 709-751.

[4] Aghion, Philippe, George-Marios Angeletos, Abhijit V. Banerjee and Kalina Manova. 2005. "Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment." NBER Working Paper 11349.

[5] Aghion, Philippe, Philippe Bacchetta, Romain Ranciere, and Kenneth Rogoff. 2009. "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development." *Journal of Monetary Economics*, 56(4): 494-513.

[6] Aghion, Philippe and Abhijit Barnerjee. 2005. *Volatility and Growth.* Clarendon Lectures in Economics. Oxford, UK: Oxford University Press.

[7] Aghion, Philippe, Abhijit Banerjee and Thomas Piketty. 1999. "Dualism and Macroeconomic Volatility." *The Quaterly Journal of Economics,* 114(4): 1359-1397.

[8] Aghion, Philippe, and Peter Howitt. 2009. *The Economics of Growth.* Cambridge, MA: MIT Press.

[9] Aghion, Philippe and Ioana Marinescu. 2007. "Cyclical Budgetary Policy and Economic Growth: What Do We Learn from OECD Panel Data." *NBER Macroeconomics Annual*, 22: 251-293.

[10] Alesina, Alberto, Ardagna, Sivlia, Perotti, Roberto and Fabio Schiantarelli. 2002. "Fiscal Policy, Profits and Investment." *The American Economic Review*, 92(3): 571-589

[11] Alesina, Alberto and Roberto Perotti. 1996. "Fiscal Adjustments in OECD Countries: Composition and Macroeconomic Effects." NBER Working Paper 5730.

[12] Andrés, Javier, Rafael Domenech and Antonio Fatas. 2008. "The stabilizing role of government size." *Journal of Economic Dynamics and Control*, 32(2): 571-593.

[13] Barro, Robert J. 1979. "On the Determination of Public Debt". *Journal of Political Economy*, 87: 940-971.

[14] Barro, Robert J. 1981. "Output Effects of Government Purchases." *Journal of Political Economy*, 89(6): 1086-1121.

[15] Barro, Robert J. 1990. "Government Spending in a Simple Model of Endogeneous Growth." *Journal of Political Economy,* 98(5): 103-126.

[16] Beck, Thorsten, Asli Demirgüç-Kunta and Ross Levine. 2000. "A New Database on Financial Development and Structure." *World Bank Economic Review,* 14: 597-605.

[17] Blanchard, Olivier and Roberto Perotti. 2002. "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *The Quarterly Journal of Economics,* 117(4): 1329-1368.

[18] Braun, Matías and Borja Larrain. 2005. "Finance and the Business Cycle: International, Inter-Industry Evidence." *The Journal of Finance,* 60(3): 1097-1128.

[19] Bruno, Michael. 1993. *Crisis, Stabilization, and Reform: Therapy by Consensus*. Oxford, UK: Oxford University Press.

[20] Cogan, John F., Cwik, Tobias, Taylor, John B., and Volker Wieland. 2009. "New Keynesian versus Old Keynesian Government Spending Multipliers." Rock Center for Corporate Governance at Stanford University Working Paper 47.

[21] Darby, Julia and Jacques Melitz. 2007. "Labour Market Adjustment, Social Spending and the Automatic Stabilizers in the OECD." CEPR Discussion Paper 6230.

[22] DeLong, J. Bradford and Lawrence H. Summers. 1986. "The Changing Cyclical Variability of Economic Activity in the United States." NBER Working Paper 1450.

[23] Easterly, William. 2005. "National Policies and Economic Growth: A Reappraisal." In *Handbook of Economic Growth*, ed. Philippe Aghion and Steven Durlauf, chapter 15.

[24] Fatás, Antonio and Ilian Mihov. 2001. "Government Size and Automatic Stabilizers." *Journal of International Economics*, 55: 3-28.

[25] Fatás, Antonio and Ilian Mihov. 2001. "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence." CEPR Discussion Paper 2760.

[26] Fatás, Antonio and Ilian Mihov. 2003. "The Case For Restricting Fiscal Policy Discretion." *The Quarterly Journal of Economics*, 118(4): 1419-1447.

[27] Galí, Jordi. 1994. "Government Size and Macroeconomic Stability." *European Economic Review*, 38 (1): 117-32.

[28] Galí, Jordi. 2005. "Modern perspective of fiscal stabilization policies." *CESifo Economic Studies*, 51(4): 587-599.

[29] Galí, Jordi, Gertler, Mark and J. David López-Salido. 2007. "Markups, Gaps, and the Welfare Costs of Business Fluctuations." *The Review of Economics and Statistics*, 89(1): 44-59.

[30] Galí, Jordi, Roberto Perotti, Philip R. Lane and Wolfram F. Richter. 2003. "Fiscal Policy and Monetary Integration in Europe." *Economic Policy*, 18(37): 533-572.

[31] Gavin, Michael, and Ricardo Hausman. 1996. "The Roots Banking Crises: The Macroeconomic Context." InterAmerican Development Bank Working Paper 318.

[32] Holmstrom, Bengt and Jean Tirole. 1998. "Private and Public Supply of liquidity." *Journal of Political Economy*, 106(1): 1-40.

[33] Imbs, Jean. 2007. "Growth and volatility." *Journal of Monetary Economics*, 54 (7): 1848-1862.

[34] Lane, Philip R.. 2003. "The Cyclical Behavior of Fiscal Policy: Evidence from the OECD." *Journal of Public Economics*, 87: 2661-2675.

[35] La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny. 1998. "The Quality of Government." *Journal of Law, Economics and Organization*, 15 (1): 222-279.

[36] La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny. 1998. "Law and Finance." *Journal of Political Economy*, 106: 1113-1155.

[37] Lucas, Robert E. 1987. *Models of business cycles*. Yrjo Jahnsson Lectures. Oxford, UK: Basil Blackwell.

[38] Mountford, Andrew and Harald Uhlig. 2008. "What are the Effects of Fiscal Policy Shocks?" NBER Working Paper 14551.

[39] Perotti, Roberto. 1999. "Fiscal Policy in Good Times and Bad." *The Quarterly Journal of Economics*, 114 (4): 1399–1436.

[40] Perotti, Roberto. 2005. "Estimating the effects of fiscal policy in OECD countries." CEPR Discussion paper 4842.

[41] Raddatz, Claudio. 2006. "Liquidity needs and vulnerability to financial underdevelopment." *Journal of Financial Economics,* 80, 677-722.

[42] Rajan, Raghuram G. and Luigi Zingales. 1998. "Financial dependence and Growth." *American Economic Review*, 88: 559-586.

[43] Ramey, Garey and Valerie A. Ramey. 1995. "Cross-Country Evidence on the Link between Volatility and Growth." *American Economic Review,* 85 (5): 1138-51

[44] Ramey, Valery A. 2009. "Identifying Government Spending Shocks: It's All in the Timing." NBER Working Paper 15464.

[45] Romer, Christina D. and Jared Bernstein. 2009. "The job impact of the American recovery and reinvestment plan."

[46] Romer, Christina D. and David H. Romer. 2007. "The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks." NBER Working Paper 13264.

[47] Shleifer, Andrei. 1986. "Implementation Cycles." *Journal of Political Economy*, 94(6): 1163-1190.

[48] Smets, Frank and Rafael Wouters. 2007. "Shocks and Frictions in U.S. Business Cycles: A Bayesian DSGE Approach." *American Economic Review,* 97(3): 506–606.

[49] Persson, Torsten and Guido Tabellini. 2002. "Do Constitution Cause Large Governments? Quasi-experimental evidence." *European Economic Review*, 46(4): 908-918.

[50] Tagkalakis, Athanasios. 2008. "The Effects of Fiscal Policy on Consumption in Recessions and Expansions." *Journal of Public Economics*, 92 (5-6): 1486–1508

Appendix A: Resolution of the other possible cases in the model

In Section 2 we focused on the case where credit constraints bind only in the low state of the world and where equilibrium long-term investments are always interior solutions of the firm's maximization problem. In this Appendix we investigate other possible cases.

For clarity we relabel the amount of long-term investment undertaken when the firm is not constrained in the high state of the world as $z_H^{*,nb}$ (defined by (2)). Now if the firm were to be constrained in the high state of the world, the optimal amount of long-term investment $z_H^{*,b}$m, assuming an interior solution, would also satisfy, (4), hence we have, $z_H^{*,b} = z_L^{*,b} = z^{*,b}$. However if $\frac{\mu}{c} P_X \pi_1 \left(w - z_X^{*,nb} \right) < 1$, and, if at the same time $\frac{\mu}{c} P_X \pi_1 \left(w - z^{*,b} \right) > 1$ the equilibrium long-term investment in the state X is a corner solution defined by

$$\frac{\mu}{c} P_X \pi_1 \left(w - z_X^{*,c} \right) = 1, \tag{12}$$

for $X = H, L$. This investment is increasing in P_X while the probability of survival is constant equal to 1.

As a consequence, if the credit constraint does not bind in the high state of the world and binds in the low state of the world, but not too tightly such that the solution to the maximization problem is the corner solution, a reduction in aggregate volatility also increases the expected growth rate.

We are left to study what happens when credit constraint binds in both states of the world. This case itself can be subdivided in three subcases: (a) when credit constraints are so tight that they bind in both state of the world and investments are at the interior solution, (b) when credit constraint binds in the low state of the world and are at the interior solution but are at the corner solution in the high state of the world, and (c) when equilibrium long-term investments are at the corner solution in both states of the world.

Case (a): Investment is then given by $z^{*,b}$ in both states of the world, so that one can express the expected growth rate as

$$Eq^{t+1} = m \frac{\mu}{c} \pi_1 \left(w - z^{*,b} \right) z^{*,b},$$

and a reduction of volatility has no effect on expected growth.[44]

[44] This effect is not robust to the introduction of positive persistence in the aggregate shock. With a persistent aggregate shock ($p > 1/2$) we would have $z_H^{*,b} > z_L^{*,b}$, so that R&D efforts would be pro-cyclical. As a consequence a reduction in

Case (b): In this case a reduction in aggregate volatility boosts the probability that long-term projects survive in the low state of the world - without affecting the number of projects undertaken -, but reduces the number of projects undertaken in the high state of the world -without affecting the probability of survival-. The overall effect on growth is ambiguous.

Case (c): In this case $\frac{\mu}{c} P_X \pi_1 \left(w - z_X^{*,c}\right) = 1$ both for $X = H$ and $X = L$, so that the expected growth rate writes as:

$$E\left(q^{t+1}\right) = \frac{1}{2}\left(z_L^{*,c} + z_H^{*,c}\right). \tag{13}$$

We can rewrite $P_H = m + \sigma$ and $P_L = m - \sigma$ where σ is the standard deviation of P. We then get:

$$\frac{dE\left(q^{t+1}\right)}{d\sigma} = \frac{\sigma}{m+\sigma} \frac{\pi_1\left(w - z_H^{*,c}\right)}{\pi_1'\left(w - z_H^{*,c}\right)} - \frac{\sigma}{m-\sigma} \frac{\pi_1\left(w - z_L^{*,c}\right)}{\pi_1'\left(w - z_L^{*,c}\right)}$$

which is negative as $z_L^{*,c} < z_H^{*,c}$ and $\frac{\pi_1(w-z)}{\pi_1'(w-z)}$ is decreasing. Thus in this case a (small) reduction is aggregate volatility is growth enhancing.

aggregate volatility, would increase the probability of survival of long-term projects when there are less of them, which would be growth reducing as long as $\lim_{z \to 0} \pi_2(z) - z\pi_2'(z) \geq 0$.

Appendix B: Details on the sample composition and data sources

Sample Countries

Countries in the sample used for value added and labor productivity estimations	Countries in the sample used for R&D estimations
Australia	Australia
Austria	Belgium
Belgium	Canada
Denmark	Denmark
Spain	Spain
Finland	Finland
France	France
Great Britain	Great Britain
Greece	Greece
Ireland	Ireland
Italy	Iceland
Japan	Japan
Netherlands	Netherlands
Portugal	Norway
Sweden	New-Zealand
	Portugal
	Sweden

Data Sources

Variable	Source
Industry Real Value Added	EU KLEMS
Industry Labour Productivity	EU KLEMS
Industry R&D spending	OECD STAN
External Financial Dependence	Compustat
Asset Tangibility	Compustat
GDP	OECD Economic Outlook
Potential GDP	OECD Economic Outlook
Output Gap	OECD Economic Outlook
Total Fiscal Balance	OECD Economic Outlook
Primary Fiscal Balance	OECD Economic Outlook
Total Government Expenditures	OECD Economic Outlook
Total Government Revenues	OECD Economic Outlook
Primary Government Expenditures	OECD Economic Outlook
Primary Government Revenues	OECD Economic Outlook
Gross Public Liabilities	OECD Economic Outlook
Net Public Liabilities	OECD Economic Outlook
CPI Inflation	OECD Economic Outlook
Nominal Long Term Interest Rate	OECD Economic Outlook
Nominal Short Term Interest Rate	OECD Economic Outlook
Real GDP per capita	OECD Economic Outlook
Imports to GDP	OECD Economic Outlook
Private Credit	WB Financial Structure and Development
Financial System Deposits	WB Financial Structure and Development
Legal Origin	La Porta et al. (1998)
Average district magnitude	Persson and Tabellini (1999)
Federal Political System	Persson and Tabellini (2002)
Index for civil liberties	Persson and Tabellini (2002)

Appendix C: Opening the fiscal policy box: expenditures and revenues

In this appendix, we investigate the relative importance of the government expenditure and the government revenue components of fiscal policy in the overall effect of a more countercyclical fiscal policy on industry growth. For this purpose, we replace the baseline equation (7) by one in which, on the RHS, we interact industry financial dependence or asset tangibility with both, the countercyclicality in government revenues and the countercyclicality in government expenditures.[45][46] More precisely, we focus separately on total and primary government revenues and expenditures. Columns 1 and 3 in table A1 show that there is hardly any difference both in the significance and the magnitude of the interaction coefficients when fiscal policy is decomposed into total government expenditures and total government revenues. The result is different when fiscal policy is decomposed into on primary government expenditures and primary government revenues, i.e. when we abstract from government interest payments and government interest revenues: Indeed columns 2 and 4 in table A1 show that the interactions of financial dependence or asset tangibility with both, primary expenditures and primary revenues, come out as significant. However, the impact of countercyclicality in primary government expenditures is on average larger than that of countercyclicality in primary government revenues. When interacted with financial dependence, the impact of countercyclicality in primary government expenditures is around 35 percent larger than the impact of countercyclicality in primary government revenues while when interacted with asset tangibility, the impact of countercyclicality in primary government expenditures is approximately two times the impact of countercyclicality in primary government revenues.

Insert table C1 here

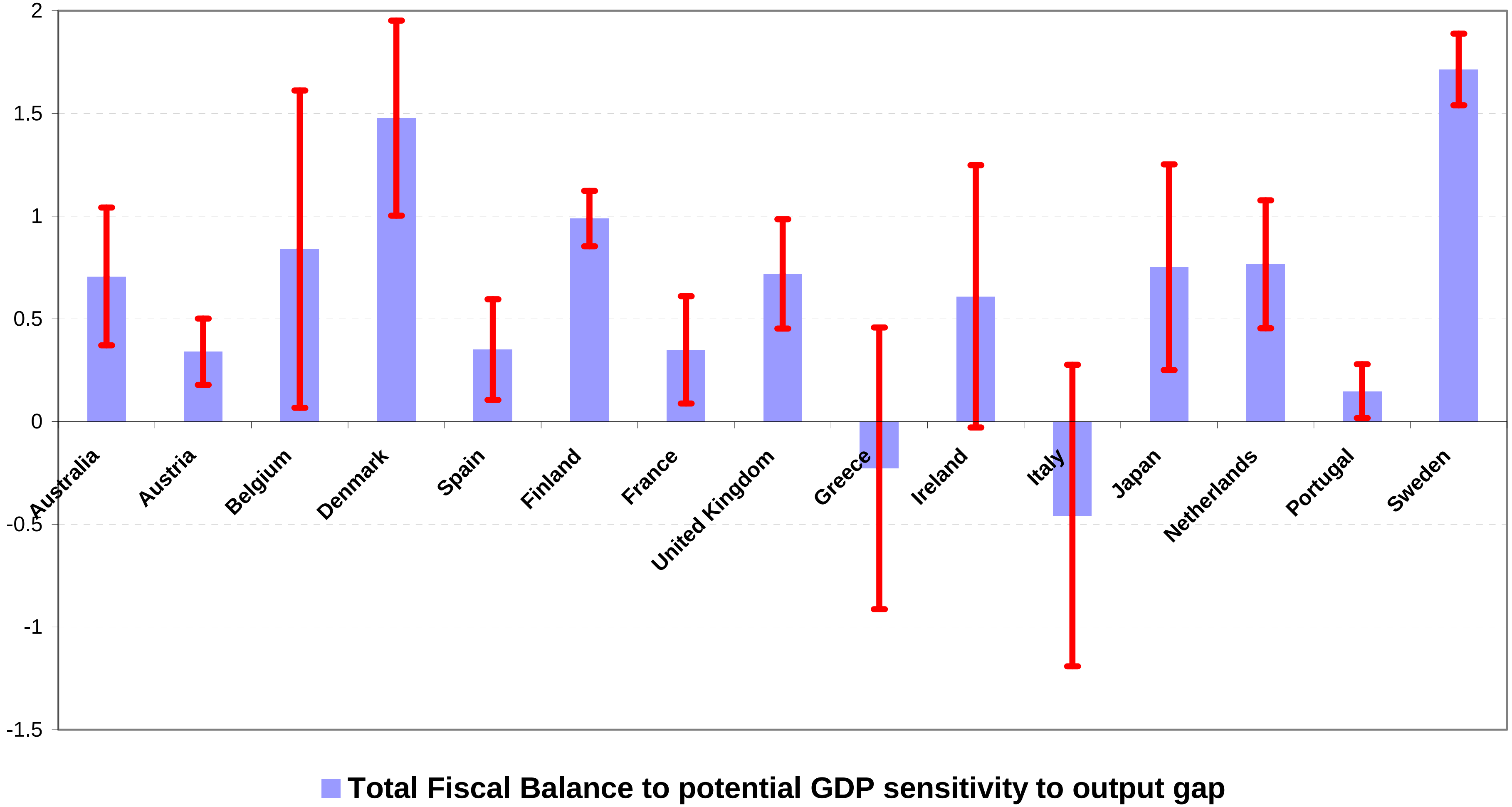
Overall, these findings suggest that the positive effect on industry growth of fiscal balance countercyclicality, involves both the expenditure and the revenue sides of fiscal policy. That the estimated interaction

[45] From a statistical point of view, this decomposition boils down to relaxing the assumption that estimated coefficients for expenditures and revenues should be equal in absolute value since fiscal balance is simply the difference between revenues and expenditures.

[46] Following the OECD decomposition for government accounts, government expenditures are the sum of government consumption, government investment, net capital transfers, property income, government subsidies, social security expenditures and other expenditures. Government revenues are the sum of total direct taxes, indirect taxes, social security revenues, property income and other current revenues.

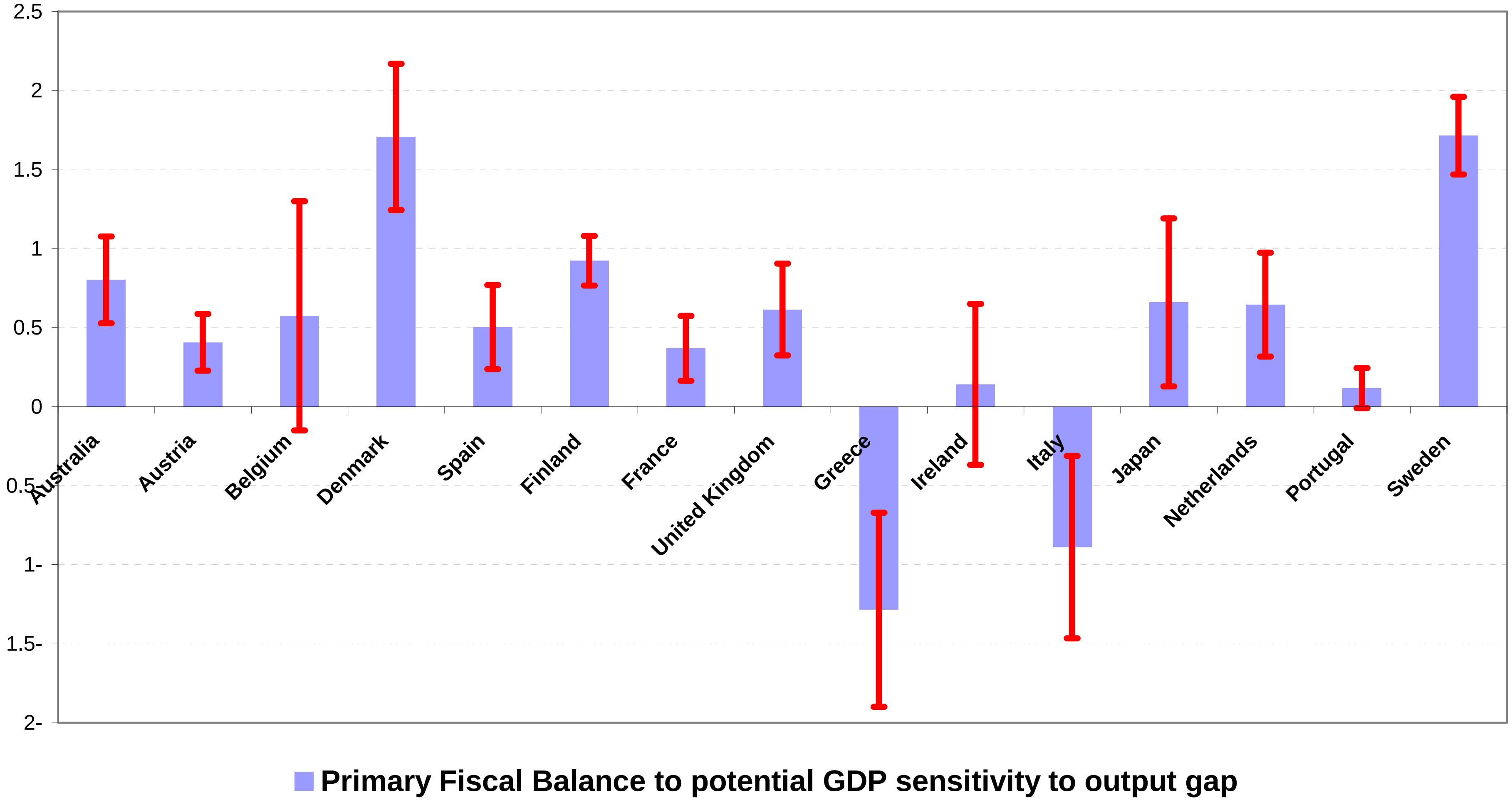
coefficient for primary expenditures be larger than the interaction coefficient for primary revenues, is consistent with the notion that fiscal policy over the cycle affects industry growth at least partly through a market size effect: indeed, the cyclicality in government expenditures is likely to have a more direct effect on the demand for firms' products than the cyclicality in government revenues which affects demand only indirectly through its impact on agents' budget constraints, as long as crowding out of private expenditures by public expenditures remains small. This intuition is reinforced by our finding of more significant interaction coefficients between financial dependence and the countercyclicality of government expenditures when looking at primary expenditures instead of total expenditures. Total expenditures embed interest payments from the government, which have no direct impact on aggregate demand.

Figure 2
Fiscal Policy Counter-Cyclicality Estimates



Note: Each bar represents the coefficient fp_c in the OLS regression: $\mathrm{fb}_{c,t} = \eta_c + \mathrm{fp}_c \mathrm{z}_{c,t} + u_{c,t}$ where $\mathrm{fb}_{c,t}$ is total fiscal balance to potential GDP in country *c* at time *t*, $\mathrm{z}_{c,t}$ is the output gap in country *c* at time *t*. Each line represents the confidence interval at the 10% level around the mean estimate.

Figure 3
Fiscal Policy Counter-Cyclicality Estimates



Note: Each bar represents the coefficient fp_c in the OLS regression: $\mathrm{fb}_{c,t} = \eta_c + \mathrm{fp}_c \mathrm{z}_{c,t} + u_{c,t}$ where $\mathrm{fb}_{c,t}$ is primary fiscal balance to potential GDP in country *c* at time *t*, $\mathrm{z}_{c,t}$ is the output gap in country *c* at time *t*. Each line represents the confidence interval at the 10% level around the mean estimate.

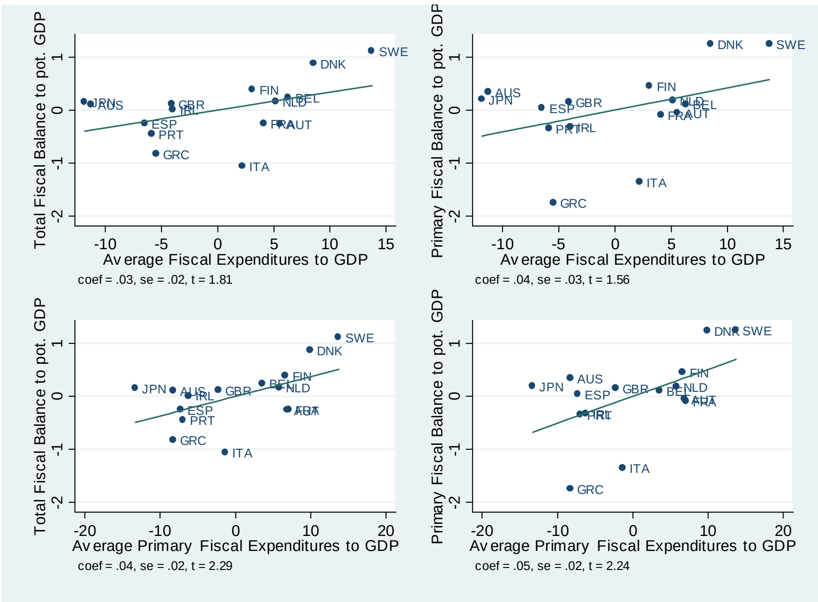


Figure 4

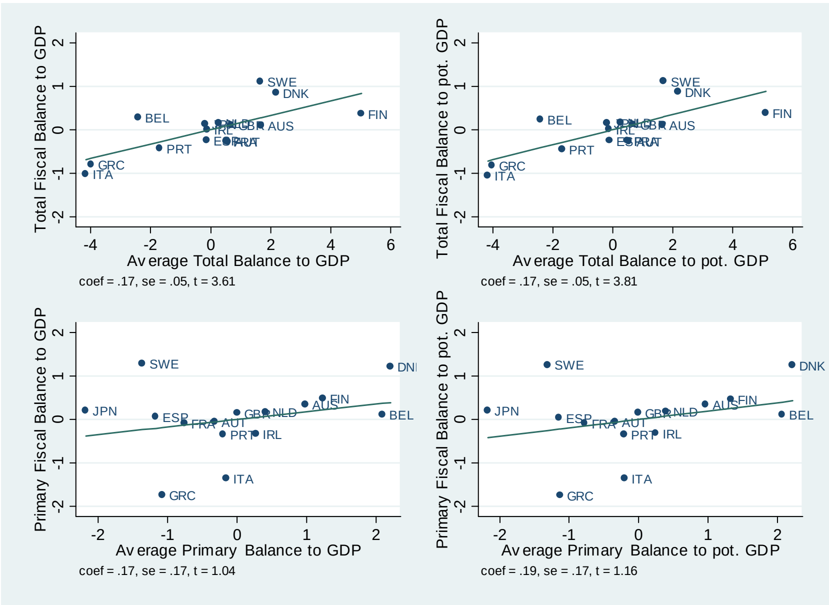


Figure 5

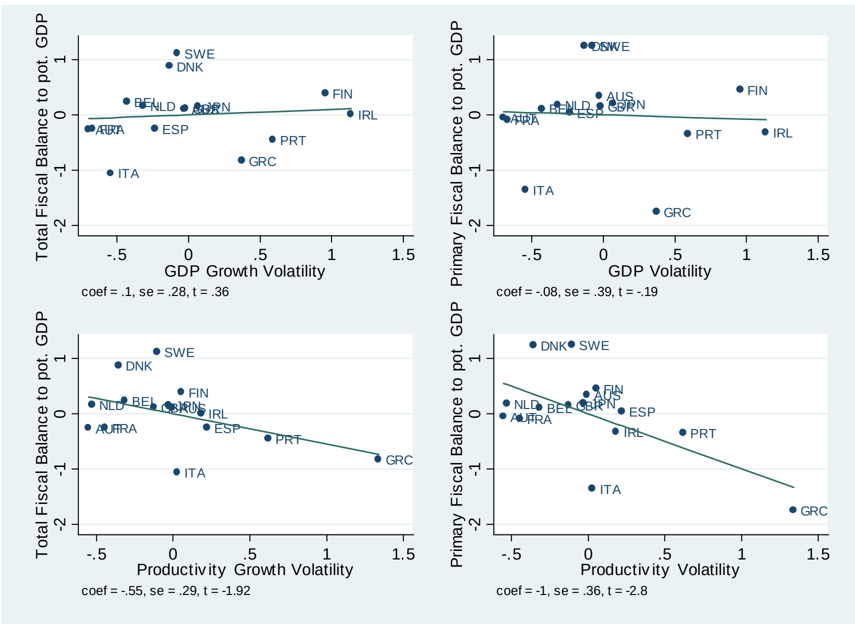


Figure 6

Table 1: Baseline Regressions

Dependent variable: Real Value Added Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Share in Manufacturing Value Added	**-0.797****	**-0.808****	**-0.809*****	**-0.811*****	**-0.528**	**-0.530**	**-0.508**	**-0.510**
	(0.280)	*(0.278)*	*(0.246)*	*(0.247)*	*(0.350)*	*(0.350)*	*(0.351)*	*(0.352)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**6.687*****							
	(1.510)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**6.701*****						
		(1.419)						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**4.661*****					
			(0.878)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**4.680*****				
				(0.860)				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-13.30*****			
					(4.406)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-13.24*****		
						(4.251)		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-8.942*****	
							(2.895)	
Interaction (Asset Tangibility and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-9.039*****
								(2.830)
Observations	528	528	528	528	528	528	528	528
R-squared	0.579	0.581	0.579	0.579	0.560	0.561	0.560	0.560

Note: The dependent variable is the average annual growth rate in real value added for the period 1980-2005 for each industry in each country. Initial Share in Manufacturing Value Added is the ratio of industry real value added to total manufacturing real value added in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 2: Baseline Regressions

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-2.549***** *(0.512)*	**-2.541***** *(0.513)*	**-2.539***** *(0.557)*	**-2.537***** *(0.556)*	**-2.512***** *(0.503)*	**-2.510***** *(0.503)*	**-2.505***** *(0.533)*	**-2.502***** *(0.533)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**5.005***** *(0.773)*							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**4.957***** *(0.718)*						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**3.403***** *(0.498)*					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**3.408***** *(0.496)*				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-13.03***** *(4.011)*			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-12.81***** *(3.971)*		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-8.118***** *(2.656)*	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-8.220***** *(2.642)*
Observations	523	523	523	523	523	523	523	523
R-squared	0.548	0.548	0.546	0.547	0.538	0.538	0.535	0.535

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 3: Alternative estimates of fiscal policy countercyclicality

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-1.957***	**-1.952***	**-1.980****	**-1.977****	**-1.865***	**-1.855***	**-1.864***	**-1.859***
	(0.880)	*(0.877)*	*(0.873)*	*(0.866)*	*(0.866)*	*(0.866)*	*(0.867)*	*(0.860)*
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality (gross liabilities))	**5.338****							
	(1.709)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality (net liabilities))		**5.494****						
		(1.725)						
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality (gross liabilities))			**5.541****					
			(1.849)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality (net liabilities))				**5.452****				
				(2.071)				
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality (gross liabilities))					**-15.18****			
					(4.778)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality (net liabilities))						**-15.22****		
						(4.979)		
Interaction (Asset Tangibility and Primary Fiscal Balance to potential GDP Counter-Cyclicality (gross liabilities))							**-14.41****	
							(5.105)	
Interaction (Asset Tangibility and Primary Fiscal Balance to potential GDP Counter-Cyclicality (net liabilities))								**-14.83****
								(5.359)
Observations	347	347	347	347	347	347	347	347
R-squared	0.459	0.460	0.460	0.458	0.454	0.454	0.453	0.453

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each country in each industry. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total (resp. Primary) Fiscal Balance to GDP Counter-Cyclicality (gross liabilities) is the regression coefficient of the output gap when total (resp. primary) fiscal balance to GDP is regressed for each country on a constant and the output gap, controlling for lagged total (resp. primary) fiscal balance to GDP and lagged gross government liabilities to GDP for each country. Total (resp. Primary) Fiscal Balance to GDP Counter-Cyclicality (net liabilities) is the regression coefficient of the output gap when total (resp. primary) fiscal balance to GDP is regressed for each country on a constant and the output gap, controlling for lagged total (resp. primary) fiscal balance to GDP and lagged net government liabilities to GDP for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors - clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 4: Controlling for alternative effects

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Log of Initial Relative Labor Productivity	**-2.533*****	**-2.524*****	**-2.621*****	**-2.549*****	**-2.016*****	**-2.543*****	**-2.546*****	**-2.554*****	**-2.007***
	(0.572)	*(0.577)*	*(0.654)*	*(0.583)*	*(0.610)*	*(0.573)*	*(0.569)*	*(0.565)*	(0.910)
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)	**3.370*****	**3.426*****	**3.698*****	**3.578*****	**3.728*****	**3.350*****	**3.225*****	**3.637*****	**3.851*****
	(0.536)	*(0.530)*	*(0.716)*	*(0.851)*	*(0.606)*	*(0.597)*	*(0.766)*	*(0.552)*	(0.727)
Interaction (Financial Dependence and Average Private Credit to GDP)	**0.337**								
	(2.483)								
Interaction (Financial Dependence and Average Financial System Deposits to GDP)		**0.949**							
		(1.360)							
Interaction (Financial Dependence and Average Real long term interest rate)			**-0.427**						
			(0.836)						
Interaction (Financial Dependence and Average CPI Inflation)				**0.0779**					
				(0.315)					
Interaction (Financial Dependence and Average Short term Nominal Policy interest rate)					**-0.0302**				
					(0.327)				
Interaction (Financial Dependence and Average Total Fiscal Expenditures to GDP)						**0.0147**			
						(0.0953)			
Interaction (Financial Dependence Average and Total Fiscal Revenues to GDP)							**0.0292**		
							(0.0942)		
Interaction (Financial Dependence and Average Primary Fiscal Balance to potential GDP)								**-0.450**	
								(0.422)	
Interaction (Financial Dependence and Average Gross Government Debt to GDP)									**-2.360**
									(3.200)
Observations	523	523	490	523	482	523	523	523	347
R-squared	0.547	0.547	0.533	0.547	0.475	0.547	0.547	0.548	0.468

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Primary Fiscal Balance to potential GDP Counter-Cyclicality is the regression coefficient of the output gap when primary fiscal balance to potential GDP is regressed on a constant and the output gap for each country. Averages of control variables are computed over the estimation period 1980-2005. Interaction variables are the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 5: Controlling for alternative effects

Dependent variable: Labor Productivity Growth

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Log of Initial Relative Labor Productivity	**-2.503*** **	**-2.501*** **	**-2.544*** **	**-2.501*** **	**-2.009*** **	**-2.500*** **	**-2.499*** **	**-2.492*** **	**-1.884***
	(0.533)	*(0.533)*	*(0.603)*	*(0.538)*	*(0.540)*	*(0.537)*	*(0.536)*	*(0.525)*	*(0.902)*
Interaction (Asset Tangibility and Primary Fiscal Balance to potential GDP Counter-Cyclicality)	**-7.834** **	**-8.278*** **	**-8.441***	**-8.085** **	**-9.772*** **	**-8.321** **	**-8.639** **	**-7.986*** **	**-10.32** **
	(2.905)	*(2.735)*	*(3.963)*	*(3.259)*	*(2.960)*	*(3.133)*	*(3.579)*	*(2.673)*	*(4.337)*
Interaction (Asset Tangibility and Average Private Credit to GDP)	**-3.356**								
	(4.317)								
Interaction (Asset Tangibility and Average Financial System Deposits to GDP)		**-2.673**							
		(2.653)							
Interaction (Asset Tangibility and Average Real long term interest rate)			**2.388**						
			(3.783)						
Interaction (Asset Tangibility and Average CPI Inflation)				**0.0639**					
				(0.709)					
Interaction (Asset Tangibility and Average Short term Policy interest rate)					**-0.00838**				
					(0.704)				
Interaction (Asset Tangibility and Average Fiscal Expenditures to GDP)						**0.0253**			
						(0.268)			
Interaction (Asset Tangibility and Average Fiscal Revenues to GDP)							**0.0663**		
							(0.269)		
Interaction (Asset Tangibility and Average Primary Fiscal Balance to potential GDP)								**-0.488**	
								(1.477)	
Interaction (Financial Dependence and Average Gross Government Debt to GDP)									**-6.650**
									(13.30)
Observations	523	523	490	523	482	523	523	523	347
R-squared	0.535	0.535	0.524	0.535	0.460	0.535	0.535	0.535	0.454

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Primary Fiscal Balance to potential GDP Counter-Cyclicality is the regression coefficient of the output gap when primary fiscal balance to potential GDP is regressed on a constant and the output gap for each country. Averages of control variables are computed over the estimation period 1980-2005. Interaction variables are the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 6: Taking into account the standard error of fiscal policy cyclicality estimates

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-2.559*** **	**-2.553*** **	**-2.548*** **	**-2.546*** **	**-2.531*** **	**-2.530*** **	**-2.517*** **	**-2.514*** **
	(0.513)	*(0.513)*	*(0.550)*	*(0.548)*	*(0.503)*	*(0.503)*	*(0.528)*	*(0.528)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**4.111*** **							
	(1.026)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**4.062*** **						
		(0.991)						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**3.127*** **					
			(0.63)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**3.131*** **				
				(0.631)				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-10.90** **			
					(3.667)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-10.66** **		
						(3.652)		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-7.451** **	
							(2.701)	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-7.567** **
								(2.703)
Observations	523	523	523	523	523	523	523	523
R-squared	0.575	0.576	0.559	0.559	0.577	0.577	0.559	0.559

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors are in parentheses. All estimations include country and industry dummies. Standard errors clustered at the country level. Estimations are based on the average for parameters and standard errors estimates, computed over 2000 OLS regressions using a fiscal policy cyclicality index randomly drawn from the empirical distribution estimated in the first stage regression. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 7: Instrumenting fiscal policy cyclicality with economic variables

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-2.024*** **	**-2.017*** **	**-1.980*** **	**-1.984*** **	**-1.957*** **	**-1.957*** **	**-1.942*** **	**-1.942*** **
	(0.568)	*(0.568)*	*(0.559)*	*(0.559)*	*(0.525)*	*(0.525)*	*(0.527)*	*(0.526)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**4.237** **							
	(1.927)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**4.312** **						
		(1.852)						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**4.027*** **					
			(1.495)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**4.019*** **				
				(1.484)				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-16.09** **			
					(6.888)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-15.73** **		
						(6.662)		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-12.26** **	
							(5.837)	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-12.34** **
								(5.782)
Hansen J. Stat	**6.177**	**5.968**	**5.236**	**5.127**	**7.337**	**7.116**	**8.259**	**7.923**
p. value	*0.404*	*0.427*	*0.514*	*0.528*	*0.395*	*0.417*	*0.310*	*0.339*
Observations	417	417	417	417	417	417	417	417
R-squared	0.091	0.093	0.096	0.097	0.085	0.086	0.081	0.082

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Set of instruments for estimations (i)-(iv): GDP per capita, Total Government Expenditures to GDP, Imports to GDP, CPI inflation, nominal long term interest rate, nominal short term interest rate, private credit to GDP. Set of instruments for estimations (v)-(viii): GDP per capita, Total Fiscal Balance to GDP, Primary Fiscal Balance to GDP, Imports to GDP, CPI inflation, real long term interest rate, real short term interest rate, private credit to GDP, financial system deposits to GDP. All instruments are averages over the period 1976-1980 except GDP per capita for which the 1980 value is considered. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and sector dummies. Significance at the 1% (resp. 5%; 10%) level is by *** (resp. **; *).

Table 8: Instrumenting fiscal policy cyclicality with legal and political variables

Dependent variable: Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-2.529*****	**-2.523*****	**-2.503*****	**-2.500*****	**-2.499*****	**-2.498*****	**-2.474*****	**-2.472*****
	(0.365)	*(0.364)*	*(0.368)*	*(0.368)*	*(0.341)*	*(0.340)*	*(0.343)*	*(0.343)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**6.006*****							
	(2.022)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**5.829*****						
		(1.948)						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**4.527*****					
			(1.558)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**4.534*****				
				(1.554)				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-14.29****			
					(6.146)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-13.96****		
						(6.025)		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-9.880****	
							(4.282)	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-9.913****
								(4.288)
Hansen J. Stat	**2.443**	**2.405**	**4.637**	**4.559**	**1.739**	**1.853**	**2.799**	**2.787**
p. value	*0.655*	*0.662*	*0.327*	*0.336*	*0.784*	*0.763*	*0.592*	*0.594*
Observations	523	523	523	523	523	523	523	523
R-squared	0.185	0.186	0.180	0.180	0.168	0.169	0.162	0.163

Note: The dependent variable is the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Set of instruments for estimations (i)-(iv): Legal origin (English, French, German, Scandinavian), District Magnitude, dummy for federal government. Set of instruments for estimations (v)-(viii): Legal origin (German, Scandinavian), District Magnitude, dummy for federal government, index for civil liberties. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and sector dummies. Significance at the 1% (resp. 5%; 10%) level is by *** (resp. **; *).

Table 10a: Testing for asymmetric effects

Dependent variable: Below Median Output Gap, Industry Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-3.372***** *(0.526)*	**-3.365***** *(0.526)*	**-3.349***** *(0.579)*	**-3.348***** *(0.578)*	**-3.145***** *(0.636)*	**-3.142***** *(0.636)*	**-3.135***** *(0.677)*	**-3.132***** *(0.677)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**8.134***** *(2.363)*							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**8.027***** *(2.317)*						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**5.428***** *(1.609)*					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**5.407***** *(1.628)*				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-19.70***** *(5.322)*			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-19.34***** *(5.335)*		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-11.70***** *(3.700)*	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-11.74***** *(3.685)*
Observations	476	476	476	476	531	531	531	531
R-squared	0.485	0.485	0.481	0.481	0.473	0.473	0.467	0.467

Note: The dependent variable is the average annual growth rate in labor productivity for each industry in each country for the period 1980-2005 when the output gap has been below historical median. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is by *** (resp. **; *).

Table 10b: Testing for asymmetric effects

Dependent variable: Above Median Output Gap, Industry Labor Productivity Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-2.174*** **	**-2.167*** **	**-2.158*** **	**-2.155*** **	**-1.695*** **	**-1.691*** **	**-1.682*** **	**-1.678*** **
	(0.457)	*(0.457)*	*(0.485)*	*(0.486)*	*(0.530)*	*(0.529)*	*(0.528)*	*(0.529)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality)	**6.068***							
	(3.002)							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**6.133***						
		(2.935)						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**4.181****					
			(1.570)					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**4.246****				
				(1.544)				
Interaction (Asset Tangibility and Total Fiscal Balance to GDP Counter-Cyclicality)					**-8.197**			
					(5.679)			
Interaction (Asset Tangibility and Total Fiscal Balance to potential GDP Counter-Cyclicality)						**-8.246**		
						(5.581)		
Interaction (Asset Tangibility and Primary Fiscal Balance to GDP Counter-Cyclicality)							**-5.470**	
							(3.411)	
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)								**-5.646**
								(3.382)
Observations	475	475	475	475	530	530	530	530
R-squared	0.469	0.470	0.468	0.469	0.426	0.427	0.426	0.426

Note: The dependent variable is the average annual growth rate in labor productivity for each industry in each country for the period 1980-2005 when the output gap has been above historical median. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Primary Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when primary fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is by *** (resp. **; *).

Table 11: The effect of fiscal policy countercyclicality on R&D spending

Dependent Variable: Log of Average R&D Spending								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of initial R&D spending	**0.53*** ** *(0.0611)*	**0.53***** *(0.0610)*	**0.53***** *(0.0601)*	**0.53***** *(0.0602)*	**0.52***** *(0.0677)*	**0.53***** *(0.0671)*	**0.52***** *(0.0700)*	**0.52***** *(0.0691)*
Interaction (Financial Dependence and Total Fiscal Balance to GDP Counter-Cyclicality))	**0.78***** *(0.192)*							
Interaction (Financial Dependence and Total Fiscal Balance to potential GDP Counter-Cyclicality)		**0.75***** *(0.189)*						
Interaction (Financial Dependence and Primary Fiscal Balance to GDP Counter-Cyclicality)			**0.53***** *(0.121)*					
Interaction (Financial Dependence and Primary Fiscal Balance to potential GDP Counter-Cyclicality)				**0.53***** *(0.121)*				
Interaction (Financial Dependence and Fiscal Expenditures to GDP Pro-Cyclicality)					**-1.51***** *(0.337)*			
Interaction (Financial Dependence and Fiscal Revenues to GDP Counter-Cyclicality)					**0.56**** *(0.236)*			
Interaction (Financial Dependence and Fiscal Expenditures to potential GDP Pro-Cyclicality)						**-1.49***** *(0.345)*		
Interaction (Financial Dependence and Fiscal Revenues to potential GDP Counter-Cyclicality)						**0.54**** *(0.248)*		
Interaction (Financial Dependence and Primary Fiscal Expenditures to GDP Pro-Cyclicality)							**-1.44***** *(0.240)*	
Interaction (Financial Dependence and Fiscal Revenues to GDP Counter-Cyclicality)							**-0.21** *(0.203)*	
Interaction (Financial Dependence and Primary Fiscal Expenditures to potential GDP Pro-Cyclicality)								**-1.43***** *(0.256)*
Interaction (Financial Dependence and Fiscal Revenues to potential GDP Counter-Cyclicality)								**-0.13** *(0.224)*
Observations	395	395	395	395	395	395	395	395

Note: The dependent variable is the log of average annual R&D spending for the period 1988-2005 for each industry in each country. Initial R&D spending is the value of R&D spending in 1988. Financial Dependence is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total (resp. Primary) Fiscal Balance to (resp. potential) GDP Counter-Cyclicality is the coefficient of the output gap when total (resp. primary) fiscal balance to (resp. potential) GDP is regressed on a constant and the output gap for each country. Total (resp. Primary) Government Revenues (resp. Expenditures) to (resp. potential) GDP Counter-Cyclicality (resp. Pro-cyclicality) is the coefficient of the output gap when total (resp. primary) government revenues (resp. expenditures) to (resp. potential) GDP are regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table C1: Investigating the effect of fiscal expenditures vs. fiscal revenues counter-cyclicality

Dependent variable: Labor Productivity Growth				
	(i)	(ii)	(iii)	(iv)
Log of Initial Relative Labor Productivity	**-2.540***** (0.528)	**-2.441***** (0.536)	**-2.524***** (0.507)	**-2.488***** (0.497)
Interaction (Financial Dependence and Total Fiscal Revenues to potential GDP Counter-Cyclicality)	**5.152***** (0.592)			
Interaction (Financial Dependence and Total Fiscal Expenditures to potential GDP Counter-Cyclicality)	**-4.361***** (1.100)			
Interaction (Financial Dependence and Primary Fiscal Revenues to potential GDP Counter-Cyclicality)		**4.036***** (0.633)		
Interaction (Financial Dependence and Primary Fiscal Expenditures to potential GDP Counter-Cyclicality)		**-5.404***** (1.326)		
Interaction (Asset Tangibility and Total Fiscal Revenues to potential GDP Counter-Cyclicality)			**-12.37**** (4.359)	
Interaction (Asset Tangibility and Total Fiscal Expenditures to potential GDP Counter-Cyclicality)			**14.36***** (4.174)	
Interaction (Asset Tangibility and Primary Fiscal Revenues to potential GDP Counter-Cyclicality)				**-8.188**** (3.109)
Interaction (Asset Tangibility and Primary Fiscal Expenditures to potential GDP Counter-Cyclicality)				**16.46***** (3.948)
Observations	523	523	523	523
R-squared	0.549	0.550	0.538	0.538

Note: The dependent variable is alternatively the average annual growth rate in labor productivity for the period 1980-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity to total manufacturing labor productivity in 1980. Financial Dependence is the fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1990. Asset Tangibility is the fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1990. Total/Primary Government Revenues to potential GDP Counter-Cyclicality (resp. Total/Primary Government Expenditures to potential GDP Pro-cyclicality) is the coefficient of the output gap when total/primary government revenues to potential GDP (resp. total/primary expenditures to potential GDP) is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Estimated coefficients are in percentage. Standard errors -clustered at the country level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).