Monetary Policy, Liquidity, and Growth*

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Abstract

In this paper, we use cross-industry, cross-country panel data to test whether industry growth is positively affected by the interaction between the reactivity of real short term interest rates to the business cycle and industry-level measures of financial constraints. Financial constraints are measured, either by the extent to which an industry is prone to being "credit constrained", or by the extent to which it is prone to being "liquidity constrained". Our main findings are that: (i) the interaction between credit or liquidity constraints and monetary policy countercyclicality, has a positive, significant, and robust impact on the average annual rate of labor productivity in the domestic industry; (ii) these interaction effects tend to be more significant in downturns than in upturns.

Keywords: growth, financial dependence, liquidity dependence, interest rate, countercyclicality

JEL codes: E32, E43, E52.

1 Introduction

Macroeconomic textbooks usually draw a clear distinction between long run growth and its structural determinants on the one hand, and macroeconomic policies (fiscal and monetary) aimed at achieving short run stabilization on the other. In this paper we argue instead that stabilization policies can affect growth in the long run. Specifically, we provide evidence to the effect that countercyclical monetary policies, whereby real short term interest rates are lower in recessions and higher in booms, have a disproportionately more positive impact on long-run growth in industries that are more prone to being credit-constrained or in industries that are more prone to being liquidity-constrained.

In the first part of the paper, we present a simple model of an economy populated by entrepreneurs who must borrow from outside investors to finance their investments. At the initial investment stage, entrepreneurs may borrow on the credit market if they need to invest more than their initial wealth. Credit

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markets are imperfect due to the limited pledgeability of the returns from the project to outside investors (as in Holmström and Tirole, 1997). Once they are initiated, projects may either turn be "fast" and yield full returns within one period after the initial investment has been sunk, or they may turn out to be "slow" and require some reinvestment in order to yield returns within two periods. The probability $1-\alpha$ of a project being slow, and therefore requiring reinvestment, measures the degree of potential liquidity dependence of the economy in the model. However, the actual degree of liquidity dependence will also depend upon the aggregate state of the economy. More precisely, we assume that if the economy as a whole is in a boom, then short-run profits are sufficient for entrepreneurs to finance the required reinvestment whenever they need to do so (i.e whenever their project turns out to slow); in contrast, if the economy is in a slump, then reinvesting requires that the entrepreneur downsize and delever her project (and therefore reduce her expected end-of-project returns) in order to generate cash to pay for the reinvestment. However, the entrepreneur can somewhat reduce the need for deleveraging in case the project is slow, if she decides ex ante to invest part of her initial funds in liquid assets. Hoarding more liquidity reduces the need for ex post downsizing but this comes at the expense of reducing the initial size of the project.

A more countercyclical interest rate policy enhances ex ante investment by reducing the amount of liquidity entrepreneurs need to hoard to weather liquidity shocks when the economy is in a slump. The model generates two main predictions. First, the lower the fraction of returns that can be pledged to outside investors, the more investment enhancing it is to implement a more countercyclical interest policy. Second, the higher the liquidity risk measured by the probability $(1-\alpha)$, the more investment enhancing it is to conduct a more countercyclical interest rate policy. Third, the differential effect of more countercyclical interest rates across firms with different degrees of liquidity dependence, is stronger in recessions than in expansions.

In the second part of the paper, we take these predictions to the data. Specifically, we build on the methodology developed in the seminal paper by Rajan and Zingales (1998) and use cross-industry, cross-country panel data to test whether industry growth is positively affected by the interaction between monetary policy cyclicality (i.e the sensitivity of short-run real interest rates to the business cycle, computed at the country level) and industry-level measures of financial constraints computed for each corresponding industry using data for U.S industries. This approach provides a clear and net way to address causality issues. Indeed, any positive correlation one might observe between the countercyclicality of macroeconomic policy and average long run growth, might equally reflect the effect of countercyclical policy on growth or the effect of growth on a country's ability to pursue more countercyclical interest rate policies. However, what makes us reasonably confident that our regression results capture a causal link from countercyclical monetary policy to industry growth, is the fact that: (i) we look at the effect of macroeconomic policies implemented at the country level on industry-level growth; (ii) individual industries are small compared to the overall economy so that we can confidently rule out the possibility that growth at the industry level should affect the cyclical pattern of macroeconomic policy at country level; (iii) our financial constraint variables are computed for

US industries and therefore are unlikely to be affected by policies and outcomes in other countries. Financial constraints at the industry level are measured, either by the extent to which the corresponding industry in the US is dependent on external finance or displays low levels of asset tangibility (these two measures capture the extent to which the industry is prone to being credit constrained), or by the extent to which the corresponding industry in the US features high labor costs to sales or high inventories to sales (i.e the extent to which the industry is prone to being liquidity constrained).

Our main empirical finding is that the interaction between credit or liquidity constraints in an industry and monetary policy countercyclicality in the country, has a positive, significant, and robust impact on the average annual rate of labor productivity of such an industry. More specifically, the higher the extent to which the corresponding industry in the United States relies on external finance, or the lower the asset tangibility of the corresponding sector in the United States, the more growth-enhancing it is for an industry, to pursue a countercyclical monetary policy. Likewise, the more liquidity dependent the corresponding US industry is, the more growth-enhancing it is for an industry to pursue a more countercyclical monetary policy. Moreover, the interaction effects between monetary policy countercyclicality and each of these various measures of credit and liquidity constraints, tend to be more significant in downturns than in upturns. These effects are robust to controlling for the interaction between these measures of financial constraints and country-level economic variables such as inflation, financial development, and the size of government which are likely to affect the country's ability to pursue more countercyclical macroeconomic policies.

Finally, we look at how monetary policy cyclicality affects the composition of investment: more specifically, we show that more countercyclical monetary policy shifts the composition of investment towards R&D disproportionately more in industries with tighter borrowing or liquidity constraints.

The paper relates to several strands of literature. First, to the literature on macroeconomic volatility and growth. A benchmark paper in this literature is Ramey and Ramey (1995) who find a negative correlation in cross-country regressions between volatility and long-run growth. A first model to generate the prediction that the correlation between long-run growth and volatility should be negative, is Acemoglu and Zilibotti (1997) who point to low financial development as a factor that could both, reduce long-run growth and increase the volatility of the economy. Acemoglu et al (2003) and Easterly (2005) hold that both, high volatility and low long-run growth do not directly arise from policy decisions but rather from bad institutions. Our paper contributes to this debate by showing a significant growth effect of more countercyclical monetary policies on industries which are all located in OECD countries with similar property rights and political institutions.[1]

Second, we contribute to the literature on monetary policy design. In our model, monetary policy operates through a version of the credit channel (see Bernanke and Gertler 1995 for a review of the credit

[1] See also Aghion et al (2006) who analyze the relationship between long-run growth and the choice of exchange-rate regime; and Aghion, Hemous and Kharroubi (2009) who show that more countercyclical fiscal policies affect growth more significantly in sectors whose US counterparts are more credit constrained.

channel literature).[2] But more specifically, our model builds on the macroeconomic literature on liquidity (e.g Woodford 1990 and Holmström and Tirole 1998). This literature has emphasized the role of governments in providing possibly contingent stores of value that cannot be created by the private sector. Like in Holmström and Tirole, liquidity provision in our paper is modeled as a redistribution from consumers to firms in the bad state of nature; however, here redistribution happens ex post rather than ex ante. As in Holmström and Tirole (1998). This perspective is shared with Farhi and Tirole (2012), however their focus is on time inconsistency and ex ante regulation; also in their model, unlike in ours, there is no liquidity premium and therefore, under full government commitment, there is no role for a countercyclical interest rate policy.

The paper is organized as follows. Section 2 outlays the model. Section 3 develops the empirical analysis. It first details the methodology and the data. Then it presents the main empirical results. Section 4 concludes. Finally, proofs and sample and estimation details are contained in the Appendix.

2 Model

2.1 Model setup

There are three periods, $t = 0, 1, 2$. Entrepreneurs have utility function $U = \mathbb{E}[c_2]$, where c_2 is their date-2 consumption. They are protected by limited liability and their only endowment is their wealth A at date 0. Their technology set exhibits constant returns to scale. At date 0 they choose their investment scale $i > 0$.

At date 1, uncertainty is realized: the aggregate state is either good (G) or bad (B), and the firm is either intact or experiences a liquidity shock. The date-0 probability of the good state is μ, and the date-0 probability of a firm experiencing a liquidity shock is $1 - \alpha$. Both events are independent.

At date 1, a cash flow πi accrues to the entrepreneur where, depending on the aggregate state, $\pi \in \{\pi^G, \pi^B\}$. This cash flow is not pledgeable to outside investors. If the project is intact, the investment delivers at date 1; it then yields, besides the cash flow πi, a payoff of $\rho_1 i$, of which $\rho_0 i$ is pledgeable to investors.[3] If the project is distressed, besides the cash flow πi, it yields a payoff at date 2 if fresh resources $j \leq i$ are reinvested. It then delivers at date 2 a payoff of $\rho_1 j$, of which $\rho_0 j$ is pledgeable to investors. The variable ρ_0 we take as an inverse measure of credit-constraint. In particular a lower ρ_0 is likely to be associated with lower asset tangibility.

The interest rate is a key determinant of the collateral value of a project. It plays an important role in determining the initial investment scale i as well as the reinvestment scale j. The gross rate of interest is equal to R_0 between dates 0 and 1, and R_1 between dates 1 and 2, where $R_1 \in \{R_1^G, R_1^B\}$ depending on the aggregate state.

[2] There are two versions of the credit channel : the "balance sheet channel" and the "bank lending channel". Our model features the balance sheet channel, focusing more on the effect of interest rates on firms' borrowing capacity.

[3] As usual, the "agency wedge" $\rho_1 - \rho_0$ can be motivated in multiple ways, including limited commitment, private benefits or incentives to counter moral hazard (see for example Holmström and Tirole 2010).

The following assumption is necessary to ensure that entrepreneurs are liquidity constrained and must invest at a finite scale.

Assumption 1 *(liquidity constraint)* $\rho_0 < \min\{R_0, R_1^G, R_1^B\}$.

The following assumption will guarantee that: (i) in the good state, date-1 cash flows will be enough to cover liquidity needs and reinvest at full scale in the event of a liquidity shock, even with no hoarded liquidity or issuance of new securities; and (ii) in the bad state, date-1 cash flows will not be enough to cover liquidity needs and reinvest at full scale so that downsizing will take place if no liquidity is hoarded at date 0.

Assumption 2 *(cash-flows)* $\pi^G > 1$ *and* $1 - \rho_0/R_1^B > \pi^B$.

Because cash flows are not enough to cover liquidity shocks in the bad state, entrepreneurs might wish to engage in liquidity policy. They can purchase an asset that pays off xi at date 1 in case of a liquidity shock in the bad state. The date-0 cost of this liquidity is $q(1-\mu)(1-\alpha)xi/R_0$, where $q \geq 1$. When $q > 1$, the date-0 cost of this liquidity is greater than $(1-\mu)(1-\alpha)xi/R_0$. The corresponding liquidity premium is denoted by $q - 1$. This captures a situation where aggregate liquidity is scarce as in Holmström and Tirole (1997). Alternatively, one can imagine that liquidity needs to be hoarded in the form of an instrument with a high degree of market liquidity: the entrepreneur needs to be able to sell it quickly, without it losing much value. Such instruments typically command a liquidity premium, for which $q - 1$ could be a stand in.

Assumption 6 in the Appendix guarantees that the projects are attractive enough that entrepreneurs will always invest all their net worth.

At the core of the model is a maturity mismatch issue, where a long-term project requires occasional reinvestments. The entrepreneur has to compromise between initial investment scale i and reinvestment scale j in the event of a liquidity shock. Maximizing initial scale i requires minimizing hoarded liquidity and exhausting reserves of pledgeable income. This in turn forces the entrepreneur to downsize and delever in the event of a liquidity shock. Conversely, maximizing liquidity to mitigate maturity mismatch requires sacrificing initial scale i.

Besides short term profits πi, liquidity xi represents cash available at date 1 in the event of a liquidity shock (x is the analog of a liquidity ratio). We assume that any potential surplus of cash over liquidity needs for reinvestment is consumed by entrepreneurs. The policy of pledging all cash that is unneeded for reinvestment is always weakly optimal. Pledging less is also optimal (and leads to the same allocation) if the entrepreneur has no alternative use of the unneeded cash to distributing to investors. However, if the entrepreneur can divert (even an arbitrarily small) fraction of the extra cash for her own benefit, then pledging the entire unneeded cash is *strictly* optimal.

At date 1, in the bad state, if a liquidity shock hits, the entrepreneur can dilute initial investors by issuing new securities against the date-2 pledgeable income $\rho_0 j$, and so its continuation $j \in [0, i]$ must satisfy:

$$j \leq (x + \pi^B)i + \frac{\rho_0 j}{R_1^B}$$

yielding continuation scale:

$$j = \min\left\{\frac{x + \pi^B}{1 - \frac{\rho_0}{R_1^B}}, 1\right\} i.$$

This formula captures the fact that lower interest rates facilitate refinancing. An entrepreneur would never choose to have excess liquidity and so we restrict our attention to $x \in [0, 1 - \rho_0/R_1^B - \pi^B]$.

The entrepreneur needs to raise $i - A$ from outside investors at date 0. If no liquidity shock hits, the entrepreneur returns $\rho_0 i$ to these investors at date 1. If a liquidity shock hits in the good state, the entrepreneur returns $\rho_0 i$ to these investors at date 2. If a liquidity shock hits in the bad state, these investors are committed to inject additional funds xi; moreover, they are fully diluted. As a result, its borrowing capacity at date 0 is given by:

$$i - A = \alpha \frac{\rho_0 i}{R_0} + \mu(1-\alpha)\frac{\rho_0}{R_0 R_1^G} i - (1-\mu)(1-\alpha)\frac{qxi}{R_0}$$

i.e.

$$i = \frac{A}{1 - \alpha\frac{\rho_0}{R_0} - \mu(1-\alpha)\frac{\rho_0}{R_0 R_1^G} + (1-\mu)(1-\alpha)\frac{qx}{R_0}}.$$

Assumption 7 in the Appendix guarantees that the entrepreneur optimally chooses to hoard enough liquidity $x = 1 - \rho_0/R_1^B - \pi^B$ to withstand a liquidity shock in the bad state without downsizing.

Our proxy for long-run investment in this model is the firm equilibrium investment, which is equal to $i = sA$, where:

$$s = \frac{1}{1 - \alpha\frac{\rho_0}{R_0} - \mu(1-\alpha)\frac{\rho_0}{R_0 R_1^G} + (1-\mu)(1-\alpha)q\left(\frac{1-\pi_B}{R_0} - \frac{\rho_0}{R_0 R_1^B}\right)}.$$

This variable captures long run growth in this model.

2.2 Illiquidity, pledgeability, and countercyclical interest rate policy

We want to derive comparative static results with respect to the cyclicality of interest rate policy. For this purpose, it will prove useful to adopt the following parametrization: $R_B = R\gamma$, $R_G = R/\gamma$, and $R_0 = R$. We take $\gamma \leq 1$ to be our measure of the cyclicality of interest rate policy: a low γ indicates a countercyclical interest rate policy. We can then compute size

$$s = \frac{1}{1 - \alpha\frac{\rho_0}{R} - \mu(1-\alpha)\frac{\rho_0\gamma}{R^2} + (1-\mu)(1-\alpha)q\left(\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}\right)}. \tag{1}$$

First, we look at the interaction between countercyclical interest rate policy and firms' vulnerability to liquidity shocks. Countercyclical interest policy helps the refinancing of firms that experience a liquidity shock in the bad state. It also hurts the refinancing of firms that experience a liquidity shock in the good state. However, it helps the former more than it hurts the later, since firms do not need to hoard costly liquidity for the good state but do for the bad state. Indeed, in the good state, they can finance their liquidity needs with their short term cash flows. It is then natural to expect more liquidity dependent firms (with a higher probability $1-\alpha$ of a liquidity shock) to benefit disproportionately from a more countercyclical interest rate policy if the probability of the bad state $1-\mu$ is high enough, and if the liquidity premium $q-1$ is high enough. The following proposition formalizes this insight.

Proposition 1 *Suppose that $\mu < \hat{\mu} \equiv q/(q+\gamma^2)$. Then $\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma} < 0$.*

Proof. We start again from:

$$\frac{\partial \log s}{\partial \gamma} = -\frac{(1-\alpha)\left[-\mu\frac{\rho_0}{R^2} + (1-\mu)q\frac{\rho_0}{R^2\gamma^2}\right]}{1-\frac{\rho_0}{R} + (1-\alpha)\left[\frac{\rho_0}{R} - \mu\frac{\rho_0\gamma}{R^2} + (1-\mu)q\left(\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}\right)\right]}.$$

This implies that

$$\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma} = -\frac{\left(1-\frac{\rho_0}{R}\right)\frac{\rho_0}{R^2}\left[-\mu + (1-\mu)q\frac{1}{\gamma^2}\right]}{\left\{1-\frac{\rho_0}{R} + (1-\alpha)\left[\frac{\rho_0}{R} - \mu\frac{\rho_0\gamma}{R^2} + (1-\mu)q\left(\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}\right)\right]\right\}^2}.$$

The result immediately follows. ■

A more countercyclical interest rate policy reduces the amount of liquidity $\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}$ that entrepreneurs need to hoard to weather liquidity shocks in the bad state. This releases more pledgeable income for more liquidity dependent firms (with a higher $1-\alpha$) as long as the probability of the bad state $1-\mu$ and the liquidity premium $q-1$ are both sufficiently high. As a result, those firms can expand in size more.

We now want to investigate how this comparative static result is affected by the state of the business cycle. We view expansions and recessions as corresponding to different values of μ: in an expansion, the probability μ of the good state is high and it is low in a recession. The next proposition establishes that the differential effect of countercyclical interest rate policy across firms with different degrees of liquidity dependence is stronger in recessions than in expansions.

Proposition 2 *There exists $\tilde{\mu} < \hat{\mu}$ such that for all $\mu \in (\tilde{\mu}, \hat{\mu})$, $\frac{\partial^3 \log s}{\partial\mu\partial(1-\alpha)\partial\gamma} > 0$.*

Proof. We have

$$\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma} = -\frac{\left(1-\frac{\rho_0}{R}\right)\frac{\rho_0}{R^2}\left[\frac{q}{\gamma^2} - \mu\left(1+\frac{q}{\gamma^2}\right)\right]}{\left\{1-\alpha\frac{\rho_0}{R} + (1-\alpha)q\left(\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}\right) - \mu(1-\alpha)\left[\frac{\rho_0\gamma}{R^2} + q\left(\frac{1-\pi_B}{R} - \frac{\rho_0}{R^2\gamma}\right)\right]\right\}^2}.$$

This expression is first decreasing in μ and then increasing in μ. The minimum occurs at $\mu = \tilde{\mu}$ where

$$\tilde{\mu} = \frac{-\left(1+\frac{q}{\gamma^2}\right)\left[1-\alpha\frac{\rho_0}{R}+(1-\alpha)q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)\right]+2\frac{q}{\gamma^2}(1-\alpha)\left[\frac{\rho_0\gamma}{R^2}+q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)\right]}{\left(1+\frac{q}{\gamma^2}\right)(1-\alpha)\left[\frac{\rho_0\gamma}{R^2}+q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)\right]}.$$

It is easily verified that $\tilde{\mu} < \hat{\mu}$. ■

Next, we look at the interaction between countercyclical interest rate policy and firms' income pledgeability. One can first show:

Proposition 3 *Suppose that* $\mu < \hat{\mu} \equiv q/(q+\gamma^2)$. *Then* $\frac{\partial^2 \log s}{\partial\rho_0\partial\gamma} > 0$.

Proof. It is easy to see that

$$\frac{\partial \log s}{\partial\gamma} = -\frac{(1-\alpha)\left[-\mu\frac{\rho_0}{R^2}+(1-\mu)q\frac{\rho_0}{R^2\gamma^2}\right]}{1-\frac{\rho_0}{R}+(1-\alpha)\left[\frac{\rho_0}{R}-\mu\frac{\rho_0\gamma}{R^2}+(1-\mu)q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)\right]}.$$

Dividing the numerator and denominator of this expression by ρ_0, we have

$$\frac{\partial \log s}{\partial\gamma} = -\frac{(1-\alpha)\left[-\mu\frac{1}{R^2}+(1-\mu)q\frac{1}{R^2\gamma^2}\right]}{\frac{1}{\rho_0}-\frac{1}{R}+(1-\alpha)\left[\frac{1}{R}-\mu\frac{\gamma}{R^2}+(1-\mu)q\left(\frac{1-\pi_B}{R\rho_0}-\frac{1}{R^2\gamma}\right)\right]}.$$

But then

$$\frac{\partial^2 \log s}{\partial\rho_0\partial\gamma} = \frac{\frac{1}{R^2}[1+(1-\alpha)(1-\mu)q(\frac{1-\pi_B}{R})]\left[\frac{q}{\gamma^2}-\mu\left(1+\frac{q}{\gamma^2}\right)\right]}{\left\{1-\alpha\frac{\rho_0}{R}+(1-\alpha)q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)-\mu(1-\alpha)\left[\frac{\rho_0\gamma}{R^2}+q\left(\frac{1-\pi_B}{R}-\frac{\rho_0}{R^2\gamma}\right)\right]\right\}^2}.,$$

which is positive whenever $\mu < \hat{\mu} \equiv q/(q+\gamma^2)$. This establishes the proposition. ■

Thus countercyclical interest rate policy encourages investment more for firms with lower fractions of pledgeable income ρ_0. As discussed above, these fractions are an inverse measure of the extent to which firms are credit-constrained, and they may also reflect the nature of firms' activities.

We now investigate how this comparative static result is affected by the state of the business cycle, again viewing expansions and recessions as corresponding to different values of μ: in an expansion, the probability μ of the good state is high and it is low in a recession.

Proposition 4 *There exists* $\tilde{\mu} < \hat{\mu}$ *such that for all* $\mu \in (\tilde{\mu}, \hat{\mu})$, $\frac{\partial^3 \log s}{\partial\mu\partial\rho_0\partial\gamma} > 0$.

Proof. From the proofs of Proposition 1 and 2, note that

$$\frac{\partial^2 \log s}{\partial\rho_0\partial\gamma} = -\kappa[1+(1-\alpha)(1-\mu)q(\frac{1-\pi_B}{R})]\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma},$$

where κ is a positive constant. Thus

$$\begin{aligned}\frac{\partial^3 \log s}{\partial\mu\partial\rho_0\partial\gamma} &= \kappa q(\frac{1-\pi_B}{R})\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma} \\ &\quad -\kappa[1+(1-\alpha)(1-\mu)q(\frac{1-\pi_B}{R})]\frac{\partial^3 \log s}{\partial\mu\partial(1-\alpha)\partial\gamma}.\end{aligned}$$

The proposition then immediately follows from the fact that $\frac{\partial^2 \log s}{\partial(1-\alpha)\partial\gamma} < 0$ and that $\frac{\partial^3 \log s}{\partial\mu\partial(1-\alpha)\partial\gamma} > 0$ for all $\mu \in (\tilde{\mu}, \hat{\mu})$. ■

One implication from this latter result is that projects with lower asset tangibility, should benefit more from more countercyclical monetary policy in expansions than projects with higher degree of asset tangibility.

Propositions 1,2, 3 and 4 summarize the key comparative statics of the model that we wish to confirm in the data. But before we turn to the empirical analysis, let us briefly look at sufficient conditions under which countercyclical monetary policy is welfare improving.

2.3 Welfare analysis

So far, we have maintained a positive focus. This allowed us to keep some aspects of the economy in the background. In order to explore the normative implications of our model, those aspects now need be fleshed out.

Closing the model. Suppose that the economy involves a continuum of firms which may differ in their probability of facing a liquidity shock or in their level of income pledgeability , i.e with respect to α and ρ_0. Firms might also differ with respect to the share of income that accrues to owners-consumers. We denote by F the corresponding cumulative distribution function.

We introduce investors in the following way. There are overlapping generations of consumers: generation 0 lives between dates 0 and 1, and generation 1 lives between dates 1 and 2. We model those two generations slightly differently. There are also two short-term storage technologies between dates 0 and 1, and between dates 1 and 2. We explain in turn how we specify consumers and storage technologies between dates 0 and 1, and between dates 1 and 2.

We assume that consumers born at date 0 have linear utility $c_0 + \delta\mathbb{E}_0[c_1]$. They are endowed with a large amount of resources S when born. There are also short-term storage technologies corresponding to different sets of states of the world at date 1. For a set of date-1 states of probability p, these technologies are such that $q \geq 1$ units of goods invested at date 0 yield δ/p units of goods at date 1. The interest rate between dates 0 and 1 is pinned down by the preferences of consumers at $R_0 = 1/\delta$. However this interest rate is not available to firms. The reason is that, following Holmström and Tirole (1997), we assume that consumers lack commitment. In particular, they cannot commit to pay back at date 1 a firm that would try to lend them resources at date 0. As a result, firms which desire to save have to use a costly storage technology with rate of return $R_0/q < R_0$.

We assume that consumers born at date 1 have utility $\mathbb{E}_1[c_2]$. They are endowed with a large amount or resources S when born. We introduce a short-term *storage technology* between dates 1 and 2 that yields R_1 at date 2 for 1 unit of good invested at date 1. For the date-1 interest rate to be $\tilde{R}_1 \neq R_1$, the storage technology must be taxed at rate $1-\tilde{R}_1/R_1$ (see below for an interpretation). The proceeds are rebated lump sum to consumers at date 2. We assume that S is large enough to finance all the necessary investments in the projects of entrepreneurs at each date t. As a result, consumers always invest a fraction of their savings in the short-term storage technology.[4]

Assumption 3 *(interest rate distortion): The set of feasible interest rates is* $[\underline{R}_1, \overline{R}_1]$ *where* $\underline{R}_1 > \rho_0$ *for all* ρ_0 *in the support of* F *and* $\overline{R}_1 \leq R_1$*. Furthermore, there exists a fixed distortion or deadweight loss* $L(\tilde{R}_1) \geq 0$ *when the interest rate* $\tilde{R}_1$ *diverges from its natural rate* R_1 *defined by:* $L(R_1) = L'(R_1) = 0$*, and* L *is decreasing on* $[\underline{R}_1, \overline{R}_1]$*.*

The upper bound $\overline{R}_1$ for the interest rate $\tilde{R}_1$ is not crucial but simplifies the analysis. One can justify this assumption by positing arbitrage (foreigners or some long-lived consumers would take advantage of $\tilde{R}_1 > \overline{R}_1$) or by assuming that marginal distortions $L'(\tilde{R}_1)$ are very high beyond R_1. But again, we want to emphasize that this particular assumption only simplifies the exposition and plays no economically substantive role in the analysis. The lower bound at $\underline{R}_1$ for the interest rate $\tilde{R}_1$ also simplifies the analysis at little economic cost.

Assumption 4 *(consumers): Suppose that date-*0 *investment is equal to* i*, that firms hoard liquidity* x *and thus can salvage* $j = xi/(1-\rho_0/R)$ *in case of crisis. Up to a normalizing constant, date-*1 *consumer welfare is* $V = -L(\tilde{R}_1) - (R_1 - \tilde{R}_1)\rho_0 j/\tilde{R}_1$*.*

The second term in V stands for the implicit subsidy from savers to borrowing firms. Indeed date-1 consumers' return on their savings $\widetilde{S}$ is $R\widetilde{S} + (1-R)\left(\widetilde{S} - \rho_0 j/R\right)$ (the last term representing the lump-sum rebate on the amount $\widetilde{S} - (\rho_0 j/R)$ invested in the storage technology), or $\widetilde{S} - (1-R)\rho_0 j/R$.[5] Finally, we ignore the welfare of date-0 consumers as they have constant utility $u_0 = s$.

Comments. The deadweight loss function L can also be interpreted as a reduced form of a more standard distortion associated with conventional monetary policy, as emphasized in the New-Keynesian literature. Here we have in mind not a short-term intervention, but a prolonged reduction of interest rates (a year to several years, for example thinking of Japan). Even though our model is entirely without money balances, sticky prices or imperfect competition, it captures a key feature of monetary policy in New-Keynesian models routinely used to discuss and model monetary policy. In New-Keynesian models, the nominal interest rate is

[4] Although we think of this as roughly capturing interest rate policy, this modelling device could more generally be thought of as a way of capturing a range of policy interventions that reduce borrowing costs for firms. For instance, taxing the short-term storage technology and rebating the proceeds lump-sum to consumers is essentially equivalent to subsidizing investment in the firms and financing this subsidy by a lump-sum tax on consumers. We do not introduce any other instrument.

[5] Note that we use the notation $\widetilde{S}$ instead of S for the savings of date-1 consumers. This is because under our Interpretation 1 below, some of the savings s of date-1 consumers are invested in alternative wasteful investment projects. As a result, only a part $\widetilde{S}$ of their savings are split between reinvestment in banks and the short-term storage technology.

controlled by the central bank. Prices adjust only gradually according to the New-Keynesian Phillips Curve, and the central bank can therefore control the real interest rate. The real interest rate regulates aggregate demand through a version of the consumer Euler equation—the dynamic IS curve. Without additional frictions, the central bank can achieve the allocation of the flexible price economy by setting nominal interest rates so that the real interest rate equals to the "natural" interest rate. Deviating from this rule introduces variations in the output gap together with distortions by generating dispersion in relative prices. To the extent that these effects enter welfare separately and additively from the effects of interest rates on banks' balance sheets—arguably a strong assumption—our loss function $L(R)$ can be interpreted as a reduced form of the loss function associated with a real interest rate below the natural interest rate in the New-Keynesian model.[6][7] Under this interpretation, monetary policy works both through the usual New-Keynesian channel and through its effects on firms via a version of the "credit channel".[8]

The asymmetric treatment of the first and second periods is meant to build the simplest possible model that allows us to capture the following features. First we want a model embodying the key friction in Holmström and Tirole (1997), namely, that consumers cannot commit to reinvest funds in the firm in subsequent periods generates a liquidity premium $q-1$. Second, we need the interest rate $\tilde{R}_1$ between dates 1 and 2 to be a policy variable. Because our focus is not on the interest rate between dates 0 and 1, this interest rate is exogenous in our model.

Optimality of countercyclical interest rate policy. Before moving on to computing welfare, we make one more assumption:

Assumption 5 *(short-term profits and reinvestment): Short-term profits generated at date* 1 *by firms can only be used to reinvest in the firm. If they are not reinvested in the firm, these profits are dissipated.*

Welfare is then given by

$$W(R_1^G, R_1^B) = w(R_1^G, R_1^B) - \mu L(R_1^G) - (1-\mu)L(R_1^B),$$

where

$$w(R_1^G, R_1^B) = \int \frac{\beta(\rho_1 - \rho_0) - (1-\alpha)(1-\mu)(\frac{R_1}{R_1^B} - 1)\rho_0}{1 - \alpha\frac{\rho_0}{R_0} - \mu(1-\alpha)\frac{\rho_0}{R_0 R_1^G} + (1-\mu)(1-\alpha)q\left(\frac{1-\pi_B}{R_0} - \frac{\rho_0}{R_0 R_1^B}\right)} dF$$

and β is the relative welfare weight on the utility of entrepreneurs.

[6] Yet another cost, absent in cashless New Keynesian models, is the so called inflation tax which arises when money demand is elastic.

[7] Because they are not our focus, we imagine here that the traditional time-inconsistency problems associated with monetary policy in the New-Keynesian model have been resolved. As is well known, this is the case if a sales subsidy is available to eliminate the monopoly price distortion.

[8] There are two versions of the credit channel (see Bernanke-Gertler 1995 for a review): the "balance sheet channel" and the "bank lending channel". Our model is consistent with the former in its emphasis on the effect of interest rates on collateral value.

Proposition 5 *There exists* $\overline{\mu}$ *and* $\overline{q}$ *such that for* $\mu \geq \overline{\mu}$ *and* $q \geq \overline{q}$*, we have* $\frac{1}{1-\mu}\frac{\partial w}{\partial R_1^B} < \frac{1}{\mu}\frac{\partial w}{\partial R_1^B} < 0$*, so that it is optimal to have a countercyclical monetary policy, i.e* $R_1^B < R_1^G$*.*

Proof. Let N and D be the numerator and denominator on the right-hand side of:

$$w(R_1^G, R_1^B) = \int \frac{\beta(\rho_1 - \rho_0) - (1-\alpha)(1-\mu)(\frac{R_1}{R_1^B} - 1)\rho_0}{1 - \alpha\frac{\rho_0}{R_0} - \mu(1-\alpha)\frac{\rho_0}{R_0 R_1^G} + (1-\mu)(1-\alpha)\, q\left(\frac{1-\pi_B}{R_0} - \frac{\rho_0}{R_0 R_1^B}\right)} dF.$$

The partial derivatives $w_{R_1^G}$ and $w_{R_1^B}$ can be expressed as:

$$w_{R_1^G} = -\int \mu(1-\alpha)\frac{\rho_0}{R_0 (R_1^G)^2}\frac{N}{D^2} dF,$$

and

$$w_{R_1^B} = \int (1-\mu)(1-\alpha)\frac{\rho_0 q}{R_0 (R_1^B)^2 D^2} X dF,$$

where

$$X = (1-\mu)(1-\alpha)(2 - \pi_B - \frac{\rho_0}{R_1^B} - \frac{R_0}{R_1^B}) + \frac{1}{q}(R_0 - \alpha\rho_0 - \mu(1-\alpha)\frac{\rho_0}{R_1^G}) - \beta(\rho_1 - \rho_0).$$

If μ is sufficiently large so that for all α, β and ρ_0 in the support of F

$$(1-\mu)(1-\alpha)(2-\pi_B) < \beta(\rho_1 - \rho_0),$$

then for q sufficiently large, we immediately obtain that:

$$\frac{1}{1-\mu}\frac{\partial w}{\partial R_1^B} < \frac{1}{\mu}\frac{\partial w}{\partial R_1^B} < 0.$$

This establishes the proposition. ■

The intuition for this proposition is simple. Firms need to hoard liquidity in order to weather liquidity shocks if the aggregate state is bad. This liquidity hoarding is costly (the rate of return on hoarded liquidity is equal to $R_0/q < R_0$) because of the lack of commitment of consumers. Reducing interest rates in bad times lowers the amount of hoarded liquidity, by increasing the ability of firms to leverage their net worth. This effect is weaker when the aggregate state is good because in that state, short-term profits are enough to cover reinvestment needs so that no liquidity needs to be hoarded to weather liquidity shocks that occur in that aggregate state of the world. Hence a higher marginal benefit of reducing interest rates in bad times relative to good times. This effect is strong enough to overcome a countervailing effect arising from the fact that lowering interest rates in bad times leads to an implicit subsidy from consumers to entrepreneurs, explaining that optimal interest rate policy is countercyclical.

3 Empirical analysis

3.1 Methodology and data

The model in the previous section predicts that a more countercyclical monetary policy should foster growth disproportionately more in industries which face either tighter financial constraints or tighter liquidity constraints. To test these predictions, we adopt the following empirical framework. Our dependent variable is the average annual growth rate in labor productivity in industry j in country k for the period 1995-2005.[9] On the right hand side, we introduce industry and country fixed effects $\{\alpha_j, \beta_k\}$ to control for unobserved heterogeneity across industries and across countries. The variable of interest, $(ic)_j \times (mpc)_k$, is the interaction between industry j's intrinsic characteristic and the degree of (counter) cyclicality of monetary policy in country k over the same time period of time over which industry growth rates are computed, here 1995-2005. Finally, we control for initial conditions by including the ratio of labor productivity in industry j in country k to labor productivity in the overall manufacturing sector in country k at the beginning of the period, i.e. in 1995. Denoting y_{jk}^t (resp. y_k^t) labor productivity in industry j (resp. in total manufacturing) in country k at time t, and letting ε_{jk} denote the error term, our baseline estimation equation is expressed as follows:

$$\frac{\ln(y_{jk}^{2005}) - \ln(y_{jk}^{1995})}{10} = \alpha_j + \beta_k + \gamma(ic)_j \times (mpc)_k - \delta \ln\left(\frac{y_{jk}^{1995}}{y_k^{1995}}\right) + \varepsilon_{jk}. \qquad (2)$$

Now, turning to the stabilization policy cyclicality measure, $(mpc)_k$, in country k, it is estimated as the sensitivity of the real short term interest rate to the domestic output gap. We therefore use country-level data to estimate the following country-by-country "auxiliary" equation over the time period 1995-2005:

$$rsir_{kt} = \eta_k + (mpc)_k.z_{kt} + u_{kt}, \qquad (3)$$

where $rsir_{kt}$ is the real short term interest rate in country k at time t –defined as the difference between the three months policy interest rate set by the central bank and the 3-months annualized inflation rate- ; z_{kt} measures the output gap in country k at time t (that is, the percentage difference between actual and potential GDP).[10] It therefore represents the country's current position in the cycle; η_k is a constant; and u_{kt} is an error term. For example, a positive (resp. negative) regression coefficient $(mpc)_k$ reflects a countercyclical (pro-cyclical) monetary policy as the short term cost of capital tends to increase (resp. decrease) when the economy's outlook improves (resp. deteriorates).

It has become standard in the literature to estimate Taylor rules where the nominal short term interest

[9] Two measures of labor productivity, either per worker or per hour worked are available. We will use the latter in order to take into account the possible procyclicality of hours worked per worker. Some results where the dependent variable is the growth rate in real value added will also be presented.

[10] The output gap is estimated as the difference between the log of real GDP and the HP filtered series of the log of real GDP, using the standard smoothing parameter for quarterly data. Moreover the time span 1995-2005 is such that we can avoid beginning- and end-of-sample problems in the estimated of trend GDP and output gap. We have enough data both at the before the beginning and after the end of our sample to estimate properly the cycle for all the period we use.

rate ($nsir$) is a function of inflation π and the output gap z.

$$nsir_{kt} = \eta_k + \theta\pi_{kt} + (mpc^{tr})_k.z_{kt} + u_{kt} \tag{4}$$

We have made the choice of using Taylor rules as auxiliary -robustness- equations, our reason being that for most countries, interest rates and inflation rates are not stationary variables, while the difference between the interest rate and the inflation rate is stationary. Hence, the cyclicality estimates obtained from our procedure are less likely to be biased than those we would obtain from using Taylor rules as auxiliary equations. This also explains why we focused on a relatively recent period, namely 1995-2005. Had we extended the sample period to the early nineties, even the real short term interest rate would become non-stationary. We also choose to concentrate on the most recent period 1995-2005, during which monetary policy was essentially conducted through short term interest rates to make sure that our auxiliary regression does capture the bulk of monetary policy decisions.[11] In addition to Taylor rules, we also estimate a standard Philips curves for each country. This will be helpful to determine whether the effect of countercyclical monetary policy on growth, if any, comes either from the cyclical pattern of nominal interest rates or from the cyclical pattern of inflation or from both. For example, a countercyclical monetary policy should translate into a higher value for the parameter mpc^{tr} and/or a lower value for the parameter mpc^{pc}.

$$\pi_{kt} = \eta_k + \theta\pi_{kt-1} + (mpc^{pc})_k.z_{kt} + u_{kt} \tag{5}$$

Yet, as alternative robustness checks, we introduce two different alternative auxiliary regressions designed to take into account either past or future persistence. In the first variant (4), we control for the one-quarter-lagged real short term interest rate:

$$rsir_{kt} = \eta_k + \theta rsir_{kt-1} + (mpc)_k.z_{kt} + u_{kt}. \tag{6}$$

In the second variant, we control for the one-quarter-forward real short term interest rate:

$$rsir_{kt} = \eta_k + \theta rsir_{kt+1} + (mpc)_k.z_{kt} + u_{kt}. \tag{7}$$

Last, when two countries differ in their monetary policy cyclicality estimates, it is worth knowing whether this difference comes mainly from what happens in upturns versus downturns. To this end, we shall estimate the following third variant of the auxiliary equation:

$$rsir_{kt} = \eta_k + (mpc^+)_k.z^+_{kt} + (mpc^-)_k.z^-_{kt} + u_{kt}. \tag{8}$$

[11] Yet, it is fair to say that even during this period, some countries like Japan did conduct monetary policy mainly though other means than short term interest rates as the country went through a long period of "unconventional" monetary policy during which the central bank was massively buying government bonds. In that particular case, equations (3) and (4) may provide a wrong assessment of monetary policy cyclicality. For this reason, we have chosen to keep Japan out of our sample.

Here, z_{ktq}^{+} is the output gap if it is higher than its historical median and zero otherwise. Similarly, z_{ktq}^{-} is the output gap if it is lower than its historical median and zero otherwise. The estimated coefficient mpc^{+} (resp. mpc^{-}) measures how strongly the real interest rate reacts to variations in the output gap during an expansion (resp. a recession). This will help determine whether the growth effect of monetary policy cyclicality, if any, comes from what happens during expansions versus recessions.

Turning now to industry-specific characteristics, we follow Rajan and Zingales (1998) in using firm-level data pertaining to the United States. We concentrate on two set of financial constraints affecting firms, borrowing constraints and liquidity constraints. We consider two different proxies for borrowing constraints, namely external financial dependence and asset tangibility. External financial dependence is measured as the median ratio across firms belonging to the corresponding industry in the US of capital expenditures minus current cash flow to total capital expenditures. Asset tangibility is measured as the median ratio across firms in the corresponding industry in the US of the value of net property, plant, and equipment to total assets. To measure liquidity constraints, we consider two alternative indicators. First, the median ratio across firms belonging to the corresponding industry in the US of inventories to total sales.[12] Second, the median ratio across firms in the corresponding industry in the US of labor costs to total sales. The first two measures (financial dependence and asset tangibility) give an indication about an industry need or difficulty to raise external finance and as such can be considered as proxies for an industry's borrowing constraints. The last two measures (inventories to sales and labor costs to sales) give an indication about an industry's need for short term financing. For example, industries with a larger ratio of labor costs to sales have larger payments to make on a monthly basis and should therefore face larger needs for short term refinancing. Similarly, industries have higher needs for liquidity when they need to maintain larger inventories since these are the most liquid physical assets firms can hold. Confirming that view, the data shows a very high correlation across industries between the inventories to sales ratio and the cash conversion cycle variable which measures the average time between a firm pay for its inputs and the moment it is paid for its output.

Using US industry-level data to compute industry characteristics, is valid as long as (a) differences across industries are driven largely by differences in technology and therefore industries with higher levels of credit or liquidity constraints in one country are also industries with higher level levels of credit or liquidity constraints in another country within our country sample; (b) technological differences persist over time across countries; and (c) countries are relatively similar in terms of the overall institutional environment faced by firms. Under those three assumptions, our US-based industry-specific measures are likely to be valid measures for the corresponding industries in countries other than the United States. We believe that these assumptions are satisfied for industries within our OECD country sample. For example, if pharmaceuticals require proportionally more external finance or have lower labor costs than textiles in the United States,

[12] Liquidity dependence can also be proxied with a cash conversion cycle variable which measures the median time elapsed between the moment a firm pays for its inputs and the moment its is paid its output across firms in the corresponding industry in the US. Results available upon request are very similar to those obtained with the inventories to sales ratio, which is not surprising since the correlation coefficent between the two variables is around 0.9.

this is likely to be the case in other OECD countries as well. Finally, to the extent that the United States is more financially developed than other countries worldwide, US-based measures are likely to provide the least noisy measures of industry-level credit or liquidity constraints.

Turning now to the estimation method, we follow Rajan and Zingales (1998) in using a simple ordinary least squares (OLS) procedure to estimate our baseline equation (2) with a correction for heteroskedasticity bias. In particular, the interaction term between industry-specific characteristics and country-specific monetary countercyclicality is likely to be largely exogenous to the dependent variable for three reasons. First, industry specific characteristics are measured on a period -the eighties- prior to the period on which industry growth is computed -1995-2005-. Second industry specific characteristics pertains to industries in the United States, while the dependent variable involves countries other than the United States. It is hence quite implausible that industry growth outside the United States could affect industry specific characteristics in the United States. Last, monetary policy cyclicality is measured at a macroeconomic level, whereas the dependent variable is measured at the 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.

Our data sample focuses on 15 industrial OECD countries. In particular, we do not include the United States, as this would be a source of reverse causality problems.[13]. Industry-level labor productivity data are drawn from the European Union (EU) KLEMS data set and is restricted to manufacturing industries.[14] These industry level data are available on a yearly frequency. The primary source of data for measuring industry-specific characteristics is Compustat, which gathers balance sheets and income statements for US. listed firms. We draw on Rajan and Zingales (1998), Braun (2003) and Braun and Larrain (2005), and Raddatz (2006) to compute industry-level indicators for borrowing and liquidity constraints. Finally, macroeconomic variables -such as those used to compute monetary policy cyclicality estimates- are drawn from the OECD Economic Outlook data set (2010).

3.2 Results

3.2.1 First stage estimates

The histogram depicted in Figure 1 shows the results from the auxiliary regression (3). In particular it shows that Great Britain and Sweden are the OECD countries with the most countercyclical real short term interest rates over the period we consider. A natural explanation for this, is that both countries conduct their own monetary policies, and through independent central banks. The least countercyclical among the countries in our sample are Spain, Portugal and Finland. These three countries are all part of the Euro area; moreover, all three are "small economies" in GDP terms compared to the Euro area as a whole, therefore they are unlikely to have much influence on the European Central Bank's policy; finally, inflation is notoriously

[13]The sample consists of the following countries: Australia, Austria, Belgium, Canada, Denmark, Spain, Finland, France, Germany, Italy, Netherlands, Portugal, Sweden, and United Kingdom.
[14]See the Appendix for the list of industries in the sample.

pro-cyclical in these countries, which in turn results in a real short term interest rate which is higher in recessions than in booms.

FIGURE 1 *HERE*

Alternatively we consider the results of the auxiliary regression (4) which provide the country-by-country estimate for the output gap coefficient in the Taylor rule (see figure 2). The results are fairly comparable to those from the previous estimation exercise. In particular, Great Britain and Sweden are still the most counter-cyclical countries while Spain and Portugal are still (the most) procyclical countries.

FIGURE 2 *HERE*

Next we investigate variables that may correlate with the estimate for monetary policy countercyclicality. First, the cross country evidence shows that countries that have run a more countercyclical monetary policy have also experienced a higher cost of capital, both in the short and in the long run. This means that the real short term interest rate as well as the real long term interest rate were higher in countries where monetary policy was more countercyclical.

FIGURE 3 *HERE*

Then splitting the real cost of capital between the nominal interest rate and the inflation rate, the cross country evidence shows that they have played a similar role in terms of magnitude. This means that the positive cross-country correlation between monetary policy countercyclicality and the average real cost of capital is due, in equal terms, to a positive correlation between monetary policy countercyclicality and the average nominal interest rate on the one hand and to a negative correlation between monetary policy countercyclicality and the average inflation rate on the other hand. Countries that maintain high inflation rates and/or low interest rates tend to run procyclical monetary policies.

FIGURE 4 *AND* 5 *HERE*

Second, we investigate the correlation between monetary policy countercyclicality and macroeconomic volatility. In theory, a country which runs a more counter-cyclical monetary policy should experience a lower volatility since monetary policy would then help dampen cyclical fluctuations. Yet, the counter-cyclical pattern of monetary policy is only one possible determinant of macroeconomic volatility. It hence could be that a country runs a more countercyclical monetary policy because its "natural" volatility is higher, so that overall it would still be more volatile than a country that runs a procyclical monetary policy. The empirical evidence shows that even in the absence of such a control for the "natural" volatility, there is a negative correlation between macroeconomic volatility and monetary policy countercyclicality.

FIGURE 6 *HERE*

Last, we look at the evidence on the correlation between monetary policy countercyclicality and fiscal policy. If anything, the data shows that there is no significant correlation between the cyclical pattern of monetary policy and fiscal discipline understood as the average fiscal balance to GDP. Similarly, there is no significant correlation with government size: countries where fiscal expenditures represent a larger fraction of GDP do not show significantly more or less countercyclical monetary policies..

FIGURE 7 HERE

3.2.2 Baseline regressions

The subsequent tables show the results from the main (second-stage) regressions. Table 1 shows the results of estimating the baseline equation (2) with the average annual growth rate in real value added over the period 1995-2005, as the left hand side variable, using financial dependence or asset tangibility as measures of financial constraints, and the countercyclicality measure $(mpc)_k$ being derived first from (3), then (6), and finally (7). The first three columns show that growth in industry real value added growth is significantly and positively correlated with the interaction of financial dependence and monetary countercyclicality: a larger sensitivity of the real short term interest rate to the output gap tends to raise industry real value added disproportionately for industries with higher financial dependence. A similar type of result holds for the interaction between monetary policy cyclicality and industry asset tangibility: a larger sensitivity of the real short term interest rate to the output gap raises industry real value added growth disproportionately more for industries with lower asset tangibility.

TABLE 1 HERE

We now repeat the same estimation exercise, but moving the focus to measures of industry liquidity constraints. As noted above, a counter-cyclical monetary policy should contribute to raise growth in the sectors that are most liquidity dependent by easing the process of refinancing. Indeed the empirical evidence in Table 2 shows that for each of our two measures of liquidity constraints, the interaction of counter-cyclical monetary policy and liquidity constraints does have a positive effect on industry real value added growth. Moreover, as in the case of borrowing constraints, these results do not depend on the specific measure for monetary policy countercyclicality. At this point it is worth making two remarks. First the correlations between the two different measures of liquidity constraints is around 0.6, which means these two variables are not simply replicating a unique result. Moreover, the correlation between indicators of borrowing constraint and liquidity constraint is also far from being one. It ranges actually between 0.4 and 0.7 (when borrowing constraints are measured with external financial dependence, correlations being the same but negative when using asset tangibility). Liquidity and borrowing constraints are therefore two distinct channels through which monetary policy countercyclicality can affect industry growth.

TABLE 2 HERE

Tables 3 and 4 below, replicate the same regression exercises as Table 1 and 2 respectively, but with average annual growth in labor productivity *per hour* as the left hand side variable. We therefore aim at understanding whether the positive effect of countercyclical monetary policy on real value added growth for financially/liquidity dependent industries comes from a true enhancement in productivity growth or if it is simply reflecting an increase in employment growth in which case, the growth effect would simply be related to factor accumulation.[15] What Tables 3 and 4 show is that the interactions between financial or liquidity constraints on the one hand and the countercyclicality of monetary policy on the other hand has a significantly positive effect on labor productivity per hour growth. The factor accumulation hypothesis can hence be dismissed to the benefit of a true improvement of productivity.

TABLES 3 *AND* 4 *HERE*

Next, we provide estimations for labor productivity growth where we focus on the 1999-2005 period during which EuroZone countries effectively had a unique nominal short term interest rate. Indeed our original estimation time span covered two different periods. In the first period from 1995 to 1998, future EuroZone countries still had national monetary policies, although these countries were already in the convergence process aiming at closing cross-country gaps in nominal short term interest rates. By contrast, in the second period 1999-2005, EuroZone countries had a unique monetary policy determined by the European Central Bank, with a unique nominal short term interest rates. To make sure that our above results are not driven by the mix of these two different regimes, we reestimate our main regression equation (2) focusing on the period 1999-2005. During this period, differences in monetary policy cyclicality across EuroZone countries were either related to differences in cyclical positions or differences in the cyclical pattern of inflation.

Table 5 and 6 show that focusing on the 1999-2005 period yields very similar results to those in our previous tables. In particular labor productivity growth is still positively and significantly correlated to the interaction of monetary policy cyclicality and industry financial constraints, be they borrowing or liquidity constraints. Moreover, the estimated coefficients are very similar to those obtained using the longer time span 1995-2005.

TABLES 5 *AND* 6 *HERE*

3.2.3 Disentangling interest rate and inflation cyclicality

So far we have focused on the cyclicality in the real short term interest rate. However, the cyclical pattern of the real short term interest rate may either reflect the cyclical movement of the nominal interest rate or that of inflation. Here we separate these two components of real interest rate cyclicality. Columns (i) and

[15] Looking moreover at productivity *per hour* is important to filter out fact that the number of hours per worker tends to be procyclical in upturns while acyclical in downturns. Looking just at the effect of the interaction of financial constraints with monetary policy countercyclicality on average growth in productivity per worker may therefore simply reflect the (asymmetric) effect of that interaction on the number of hours per worker.

(ii) in Table 7 show that the effect of the interaction between inflation procyclicality and industry financial dependence is at best weakly significant once controlling for the interaction between financial development and the cyclicality of the real short term interest rate. In other words the cyclicality of inflation does not have an effect beyond that already embedded in the real short term interest rate countercyclicality. Columns (iv) and (v) in Table 7 confirm this result for the interaction of inflation procyclicality and industry level asset tangibility. In other words, what matters for labor productivity growth is the cyclical pattern of the real short term interest rate, no matter whether it relates to the nominal interest rate or to the inflation rate. Column (iii) and (vi) in Table 7 propose another way to answer this question by running a horse race between the cyclicality of nominal interest rates, for given inflation (based upon estimating a standard Taylor rule as in (4)) and the cyclicality of inflation (based on estimating a standard Phillips curve as in (5)). If the estimated coefficient is larger -in absolute value- for inflation procyclicality than for nominal interest rate countercyclicality, the estimation shows that these two effects are of similar magnitude: in other words, there are not statistically different from each other, which is indeed consistent with the view that what matters is the extent to which the real short term interest rate is countercyclical, not the source for its countercyclicality.

Next, Table 8 performs the same analysis but focusing now on industry measures of liquidity dependence. Looking first at columns (i)-(iii), the results are somewhat different from those obtained in Table 7 as inflation countercyclicality appears to be the main force behind the effect of real short term interest rate countercyclicality on labor productivity growth. Yet, nominal short term interest rate countercyclicality does still play a role; however the corresponding effect is either small (less than one fourth of the effect of inflation countercyclicality, according to column (i) & (ii)) or not significantly different from zero (column (iii)). This result is not so surprising: to the extent that firms use their inventories as collateral or as guarantee for credit, a more procyclical inflation will tend to reduce the value of inventories during downturns, that is when firms' borrowing needs are highest. This may explain the effect of inflation cyclicality on the growth performance of industries that maintain a high level of inventories.

TABLES 7 AND 8 HERE

3.2.4 Dealing with the uncertainty around the monetary policy cyclicality index

An important limitation of the empirical analysis carried out so far, is that monetary policy cyclicality cannot be directly observed, it can only be estimated. Yet, in our analysis so far, the index for monetary policy cyclicality -obtained from first stage regressions- has been treated as an observed variable whereas in reality all we know are the first and second moments of the distribution of monetary policy cyclicality for each country. Because monetary policy cyclicality is a generated regressor, it might well be that taking the uncertainty around our monetary policy cyclicality coefficients into account could make the interaction between monetary policy countercyclicality and financial constraints become insignificant. To deal with this problem, we adopt the following three-stage procedure:

First, instead of considering the average coefficient $(mpc)_k$ estimated in the first stage regression as an explanatory variable in our second stage regression, we draw for each country k a monetary policy cyclicality index $(mpc)_{k,i}$ from a normal distribution with mean $(mpc)_k$ and standard deviation $\sigma_{(mpc)_k}$, where $\sigma_{(mpc)_k}$ is the standard error for the coefficient $(mpc)_k$ estimated in the first stage regression. Each draw yields a different vector of monetary policy cyclicality indexes.

Typically the larger the estimated standard deviations $\sigma_{(mpc)_k}$ the more likely the vector of monetary policy cyclicality indexes $(mpc)_{k,i}$ will be different from the vector used in previous estimations where we abstracted from the standard deviations in monetary policy cyclicality.

Second, for each draw of the monetary policy cyclicality index $(mpc)_{k,i}$ we run a separate second stage regression:

$$\frac{\ln(y_{jk}^{2005}) - \ln(y_{jk}^{1995})}{10} = \alpha_{j,i} + \beta_{k,i} + \gamma_i (ic)_j \times (mpc)_{k,i} - \delta_i \ln\left(\frac{y_{jk}^{1995}}{y_k^{1995}}\right) + \varepsilon_{jk,i} \tag{9}$$

Running this regression yields an estimated coefficient γ_i and an estimated standard deviation σ_{γ_i}. We repeat this same procedure 2000 times, and thereby end up with a series of 2000 estimated coefficients γ_i and standard errors σ_{γ_i}.

Third and last, we average across all draws to obtain an average $\overline{\gamma}$ of the estimated coefficients γ_i and $\overline{\sigma_\gamma}$ of estimated standard errors σ_{γ_i}. The statistical significance can eventually be tested on the basis of the averages $\overline{\gamma}$ and $\overline{\sigma_\gamma}$. The results of this estimation procedure are provided in Table 9 (for interactions with credit constraints) and Table 10 (for interactions with liquidity constraints). The interaction of monetary policy cyclicality and industry financial constraints still has a significant effect on industry growth. Yet, the estimated parameters are somewhat smaller -in absolute value- than their counterpart in the simple OLS regressions in Tables 3 and 4. Note however that the difference is by no means statistically significant. Thus the interaction of industry financial constraints and monetary policy cyclicality has a genuine significant effect on industry growth which is unlikely to reflect a bias related to the use of a generated regressor. The simple OLS regressions therefore do not seem to provide significantly biased results.

TABLE 9 AND 10 HERE

3.2.5 Competing stories and omitted variables

We have established that monetary policy cyclicality does enhance disproportionately the growth rate of sectors that face tighter financial or liquidity constraints. Yet a concern is to which extent are not we picking up other factors or stories when looking at the correlation between industry growth and the cyclicality of fiscal policy? The next four tables address this issue. First, it could be that differences in monetary policy countercyclicality reflect differences in average monetary policies. For example we have seen that countries which run countercyclical policies maintain higher real interest rates. The question is therefore worth asking whether the effect of countercyclical monetary policy on labor productivity growth may not be simply capturing the effect of high real interest rates. Second, it could be that a more countercyclical monetary policy reflects a higher degree of financial development in the country, 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). Last, monetary policy countercyclicality may also be related to fiscal policy. We hence need to investigate whether the effect of countercyclical monetary policy does not capture the effect of government size or fiscal discipline on labor productivity growth.

Table 11 performs horse-races between the effect of the interaction between asset tangibility and the countercyclicality of monetary policy and the interaction of asset tangibility with measures of financial development, average monetary policy and average fiscal policy, on average growth in labor productivity per hour.

The first three columns control for asset tangibility interacted with three different measures of financial development, namely the ratio of bank credit to bank deposits, the ratio of private bond market capitalization to GDP and the real long term interest rate, which measures the cost of capital . These three interaction terms have negative coefficients, meaning that industries with less tangible assets benefit more from higher bank credit to bank deposits or higher private bond market capitalization to GDP. Similarly, industries with more tangible assets benefit more from lower cost of capital. Yet only the estimated coefficient for the interaction term with bank credit to bank deposits is significant while the interaction of asset tangibility and monetary policy countercyclicality is always negative and significant. Monetary policy cyclicality hence does not capture the effect of financial development on labour productivity growth. Last it is worth noting that the estimated coefficient for the interaction between asset tangibility and monetary policy countercyclicality is very similar to those estimated in Table 3, where there are no control variable. Controlling for financial development has therefore very negligible implications for the magnitude of estimated coefficients.

The next two columns focus on average monetary policy to check if the cyclical pattern of monetary policy may not reflect tighter or slacker monetary policy on average. Column (iv) shows that monetary policy countercyclicality fosters labor productivity growth disproportionately more for industries with less tangible assets, independently of the level for the real short term interest rate or the inflation rate. In other words differences in average monetary policies do not explain differences in productivity growth. Moreover, as is the case for financial development, the estimated coefficient for the interaction of asset tangibility and countercyclical monetary policy is very similar to our previous estimates.

The last three columns control for the interaction between asset tangibility and average government primary surplus, average government debt and average government expenditure to GDP ratios. The first column controls for fiscal discipline, the latter two control for government size. Again, controlling for the corresponding interactions does not affect the magnitude nor the significance of the interaction coefficient between asset tangibility and monetary countercyclicality.

TABLE 11 *HERE*

Table 12 repeats the same exercise, but using external financial dependence as the measure of financial constraint. The basic conclusions are the same as in the previous table, namely that controlling for the interaction between financial dependence and financial development, or for the interaction with average monetary policy or average fiscal policy does not modify the conclusion that the interaction between financial dependence and monetary countercyclicality has a significant effect on labor productivity growth. Yet the estimations in column (iii) and (v) show that adding controls can affect the significance and magnitude of the estimated coefficients. Control variables like average inflation provide a complementary but not an alternative story to the one highlighted in this paper.

TABLE 12 *HERE*

Tables 13 and 14 perform the same horse race exercises as the previous two tables, but using liquidity constraint measures -labor costs to sales and inventories to sales ratios respectively- as industry characteristics. As one can see in these two tables, the interaction between these two measures of liquidity constraints and the countercyclicality of monetary policy overwhelms the interaction of the same liquidity constraints measures with inflation, financial development and government size/budgetary discipline in the sense that none of these other interactions ever comes out significant. This in turn suggests that monetary policy countercyclicality is of paramount importance especially for those sectors that are more prone to be liquidity constrained.

TABLES 13 *AND* 14 *HERE*

Note finally that these results do not imply that the control variables we consider do not matter for industry growth in industries that are more liquidity constrained. It rather means that if they matter, it is primarily through their effects on the central banks's ability to implement a countercyclical monetary policy.

3.2.6 Magnitude of the effects

How large are the effects implied by the above regressions? This question can be answered by computing the predicted difference in labor productivity between on the one hand an industry at the first quartile of the distribution for borrowing (liquidity) constraints located in a country at the first quartile of the distribution for monetary policy countercyclicality and on the other hand, an industry at the third quartile of the distribution for borrowing (liquidity) constraints located in a country at the third quartile of the distribution for monetary policy countercyclicality.[16]

This difference ranges between 0.7 and 2 percentage points per year for borrowing constraints (financial dependence and asset tangibility) and between 2.7 and 3.7 percentage points per year for liquidity constraints (labor cost to sales and inventories to sales). These magnitudes are fairly large. As a matter of comparison, the corresponding figures in Rajan and Zingales (1998) –the difference in value added growth from

[16] The presence of industry and country fixed effects prevents any evaluation of the impact of a change in monetary policy cyclicality for a given industry or conversely the effect of a change in industry characteristics in a country with a given cyclical pattern of monetary policy.

moving from the first to the third quartile in the level of financial dependence and financial development simultaneously- IS roughly equal to 1 percentage point per year.

However, it is important to note that these are difference-in-difference (cross-country/cross-industry) effects, which are not interpretable as country-wide effects.[17] Second, the relatively small sample of countries implies that moving from the first to the third quartile in the distribution of monetary policy countercyclicality corresponds to a dramatic change in the design of monetary policy over the cycle. Third, this simple computation does not take into account the possible costs associated with the transition from a situation with low monetary policy countercyclicality to one with high monetary policy countercyclicality. Yet, this quantification exercise still suggests that differences in the cyclicality of monetary policy are an important driver of the observed cross-country/cross-industry differences in value added and productivity growth.

3.2.7 Upturns versus downturns

Table 15 runs the second stage regression (2), separating monetary policy cyclicality in upturns from monetary policy cyclicality in downturns. Our main purpose here is to check whether the positive effect of monetary policy countercyclicality on labor productivity growth comes from maintaining high real short term interest rates during booms or keeping low real short term interest rates during slumps. This table shows one important result, namely that the interaction between financial constraints and monetary countercyclicality is always significant in downturns, no matter if we use financial dependence, asset tangibility, labor cost to sales or inventories to sales ratio as the industry characteristic. However, the interaction between financial constraints and monetary countercyclicality tends to be more significant in downturns than in upturns. In particular, the interaction of industry financial constraints and monetary policy countercyclicality in upturns is never significant at the 5% level. This in turn is consistent with the idea that labor productivity growth of more financially constrained industries is more significantly affected by countercyclical real short term interest rates when countercyclicality relates to downturns periods where financial constraints are more likely to bind.

TABLE 15 *HERE*

3.2.8 Instrumenting monetary policy cyclicality

The empirical methodology used in this paper is essentially designed to address the reverse causality problem. As already stressed above, to the extent that monetary policy cyclicality is estimated at the country level while growth is measured at the industry level, and to the extent that each individual industry is too small to affect the design of monetary policy in the overall economy-, causality should in principle run from monetary policy cyclicality to industry growth. Yet, this does not rule out the possibility of a reverse causality. For

[17] It could be that adopting a monetary policy with more countercyclical real short term interest rates simply redistributes productivity growth across sectors leaving aggregate productivity growth unchanged.

example, monetary policy makers could choose to run more countercyclical policies in economies where industries who contribute more to macroeconomic growth face tighter financial or liquidity constraints. To overcome this problem, we can rely on instrumental variable estimations. Basically by taking variables that are known to be exogenous -in the sense that they can affect monetary policy cyclicality while monetary policy cyclicality cannot affect them- we can get rid of the possible endogeneity problem and the uncertainty around the estimate for monetary policy cyclicality. To this end, we restrict the set of instruments to variables such as the legal origin of the country (French, English, Scandinavian, and German), the population's religious characteristics (share of Catholics in total population in 1980, share of Protestants in total population in 1980) and the number of years since the country's independence.[18] Running the regressions with (a subset of) these instruments -Tables 16 and 17 below- shows a significant effect of the interaction between monetary policy countercyclicality and industry financial or liquidity constraints on industry labor productivity growth. In other words, previous results are not related to the existence of a reverse causality bias. Actually a striking feature of the IV regressions is the similarity in the estimated coefficients when compared with those obtained in the OLS estimations, which actually confirms the prior that the cyclical pattern of monetary policy is likely to be exogenous to industry labor productivity growth. Finally, the test for the validity of instruments is passed in the case of industry financial constraints as well as in the case of liquidity constraints.[19]

TABLES 16 *AND* 17 *HERE*

3.2.9 R&D investment

In the model developed above, monetary policy cyclicality affects growth through the composition of investment. Specifically, entrepreneurs reduce the amount of liquidity they need to hoard to weather liquidity shocks when monetary policy is more countercyclical. Moreover, this reduction is larger in more financially constrained industries. To test this prediction, we now consider the composition of investment between R&D and capital expenditures at the industry level as our left-hand side variable in the main regression, and we investigate whether the share of R&D expenditures in total (R&D plus capital) investment is significantly affected by the interaction between monetary policy countercyclicality and industry financial constraints. To the extent that R&D expenditures are longer term investments relative to capital expenditures, our prediction is that a more countercyclical monetary policy should raise the share of R&D expenditures in total investment disproportionately more for industries with tighter financial constraints.

To test this prediction, we run the equivalent of our baseline regressions using average R&D intensity of investment -defined as the ratio between R&D expenditures and the sum of R&D and capital expenditures for each industry- as the dependent variable instead. The dependent variable is measured for each industry

[18] Following Persson, Tabellini and Trebbi (2003), the independence year is set at 1748 for countries that have never been colonized.

[19] Note that in the regressions incorporating liquidity constraints, there may a weak instruments problem, which can solved by restricting the set of instruments used for estimation. The point here is to show that a unique set of instrument can go a long way to dealing with potential endogeneity and measurement error issues with a set of relatively different industry characteristics.

j and country k for the period 1995-2005.

In these regressions we control for the initial relative R&D intensity of investment (defined as the ratio of the industry's R&D intensity of investment to total manufacturing R&D investment intensity in 1995). As previously, we introduce industry and country fixed effects $\{\alpha_j, \beta_k\}$ to control for unobserved heterogeneity across industries and across countries, and again we include the variable of interest, $(ic)_j \times (mpc)_k$, namely the interaction between industry j's intrinsic characteristic and the degree of (counter) cyclicality of monetary policy in country k over the same time period 1995-2005. Denoting RD_{jk}^t (resp. RD_k^t) the ratio of R&D expenditures to R&D and capital expenditures in industry j (resp. in total manufacturing) in country k at time t, and letting ε_{jk} denote the error term, we thus estimate:

$$\overline{RD_{jk}} = \alpha_j + \beta_k + \gamma (ic)_j \times (mpc)_k + \delta \frac{RD_{jk}^{1995}}{RD_k^{1995}} + \varepsilon_{jk}$$

where $\overline{RD_{jk}}$ represents the average ratio of R&D expenditures to R&D plus capital expenditures in industry j (resp. in total manufacturing) in country k over the period 1995-2005. The data for R&D and capital expenditures are drawn from the OECD database on structural analysis. The sample covers the same countries as those included in the analysis for productivity growth. Yet, the coverage for industries is much MORE narrow: the sample size is about 50% smaller compared with the previous analysis.

Table 18 shows the effects on average R&D intensity of the interaction between monetary policy countercyclicality and credit constraints (external financial dependence and asset tangibility) whereas Table 18 shows the effects on average R&D intensity of interacting monetary countercyclicality with our two measures of liquidity constraints. We see that A more countercyclical real short term interest rate tilts the composition of investment more towards R&D in more credit constrained or liquidity constrained sectors. The interaction effects are always significant, especially when monetary policy cyclicality is interacted with financial dependence or asset tangibility.

TABLES 18 *AND* 19 *HERE*

Thus the empirical results vindicate our view that the positive effect of monetary policy cyclicality on growth relates to the composition of investment being tilted towards longer term growth-enhancing investments like those in R&D.

4 Conclusion

In this paper we have developed a simple framework to look at how the interaction between the cyclicality of (short-term-) interest rate policy and firms' credit or liquidity constraints, affects firms' long-term growth-enhancing investments. Three main predictions came out of our mode, namely: (i) the more credit-constrained an industry, the more growth in that industry benefits from more countercyclical interest rates;

(ii) the more liquidity-constrained an industry, the more growth in that industry benefits from more countercyclical interest rates; (iii) the growth enhancing effect of countercyclical interest rate policies in more credit- or liquidity-constrained sectors, is more significant in downturns than in upturns. Then, we have successfully confronted these predictions to cross-industry, cross-country OECD data over the period 1995-2005.

The approach and analysis in this paper could be extended in several interesting directions. First, one could revisit the costs and benefits of monetary unions, i.e the potential gains from joining the union in terms of credibility versus the potential costs in terms of the reduced ability to pursue countercyclical monetary policies. Here, we think for example of countries like Portugal or Spain where interest rates went down after these countries joined the Eurozone but which at the same time were becoming subject to cyclical monetary policies which were no longer set with the primary objective of stabilizing the domestic business cycle or domestic inflation.

Second, one could look at the interplay between cyclical monetary policy and cyclical fiscal policy: are those substitutes or complements?

Third, one could embed our analysis in this paper into a broader framework where interest rate policy would also affect the extent of collective moral hazard among banks as in Farhi and Tirole (2010). There a countercyclical monetary policy would have ambiguous effects since lowering interest rates during downturns would encourage short-term debt borrowing by banks while raising interest rates in booms would rather curb such incentives.

Finally, we would like to test the same predictions on firm-level panel data. However, such data are nor available cross-country. The strategy there would be to focus on particular countries, using firm-level measures of credit and liquidity constraints. We are currently exploring such data for France.

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5 Appendix

Assumption 6 *(high return)*

$$\frac{\mu\left[\alpha\left(\rho_1-\rho_0\right)R_1^G+(1-\alpha)\left(\rho_1-\rho_0\right)+\pi^G R_1^G+(1-\alpha)\left(\pi^G-1\right)R_1^G\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)q\left(\frac{1-\pi_B}{R_0}-\frac{\rho_0}{R_0R_1^B}\right)} + \frac{(1-\mu)\left[\alpha\left(\rho_1-\rho_0\right)R_1^B+(1-\alpha)\left(\rho_1-\rho_0\right)+\alpha\pi^B R_1^B\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)q\left(\frac{1-\pi_B}{R_0}-\frac{\rho_0}{R_0R_1^B}\right)} > R_0(\mu R_1^G+(1-\mu)R_1^B).$$

Assumption 7 *(demand for liquidity):*

$$\frac{(\rho_1-\rho_0)}{1-\frac{\rho_0}{R_1^B}}\frac{R_0}{q} \geq \frac{\mu\left[\alpha\left(\rho_1-\rho_0\right)R_1^G+(1-\alpha)\left(\rho_1-\rho_0\right)+\pi^G R_1^G+(1-\alpha)\left(\pi^G-1\right)R_1^G\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}} + \frac{(1-\mu)\left[\alpha\left(\rho_1-\rho_0\right)R_1^B+(1-\alpha)\left(\rho_1-\rho_0\right)\frac{x+\pi^B}{1-\frac{\rho_0}{R_1^B}}+\alpha\pi^B R_1^B\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}}.$$

Proof that Assumption 7 implies that entrepreneurs hoard enough liquidity to weather liquidity shocks. The entrepreneur therefore maximizes over $x \in [0, 1-\rho_0/R_1^B-\pi^B]$:

$$A\frac{\mu\left[\alpha\left(\rho_1-\rho_0\right)R_1^G+(1-\alpha)\left(\rho_1-\rho_0\right)+\pi^G R_1^G+(1-\alpha)\left(\pi^G-1\right)R_1^G\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)\frac{qx}{R_0}} + \frac{(1-\mu)\left[\alpha\left(\rho_1-\rho_0\right)R_1^B+(1-\alpha)\left(\rho_1-\rho_0\right)\frac{x+\pi^B}{1-\frac{\rho_0}{R_1^B}}+\alpha\pi^B R_1^B\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)\frac{qx}{R_0}}.$$

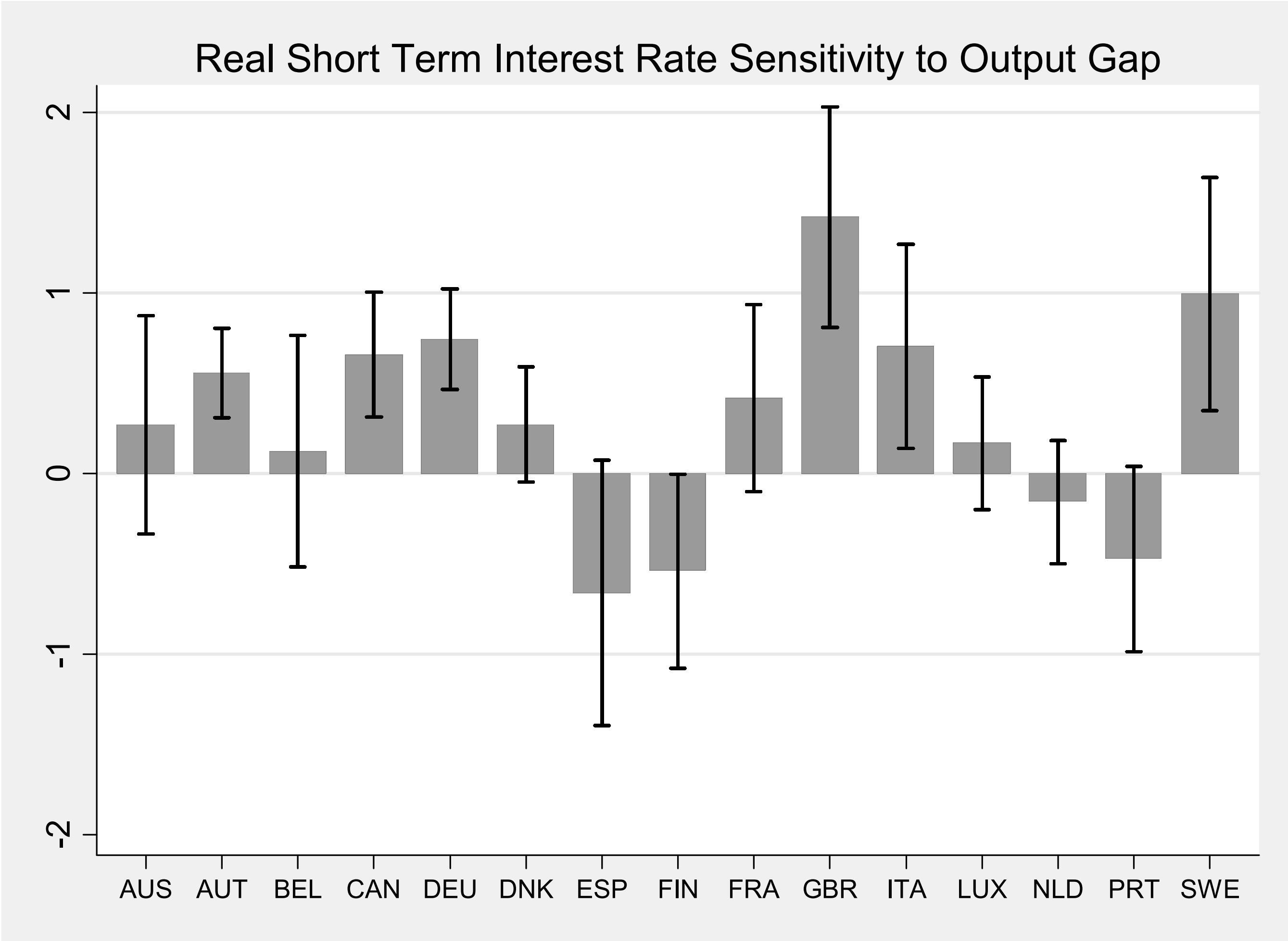
This expression is increasing in x if and only if Assumption 7 holds.

Proof that Assumption 6 implies that entrepreneurs invest all their net worth in their project. By investing in his own project, the entrepreneur gets an expected return of:

$$\frac{\mu\left[\alpha\left(\rho_1-\rho_0\right)R_1^G+(1-\alpha)\left(\rho_1-\rho_0\right)+\pi^G R_1^G+(1-\alpha)\left(\pi^G-1\right)R_1^G\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)q\left(\frac{1-\pi_B}{R_0}-\frac{\rho_0}{R_0R_1^B}\right)} + \frac{(1-\mu)\left[\alpha\left(\rho_1-\rho_0\right)R_1^B+(1-\alpha)\left(\rho_1-\rho_0\right)+\alpha\pi^B R_1^B\right]}{1-\alpha\frac{\rho_0}{R_0}-\mu(1-\alpha)\frac{\rho_0}{R_0R_1^G}+(1-\mu)\left(1-\alpha\right)q\left(\frac{1-\pi_B}{R_0}-\frac{\rho_0}{R_0R_1^B}\right)}$$

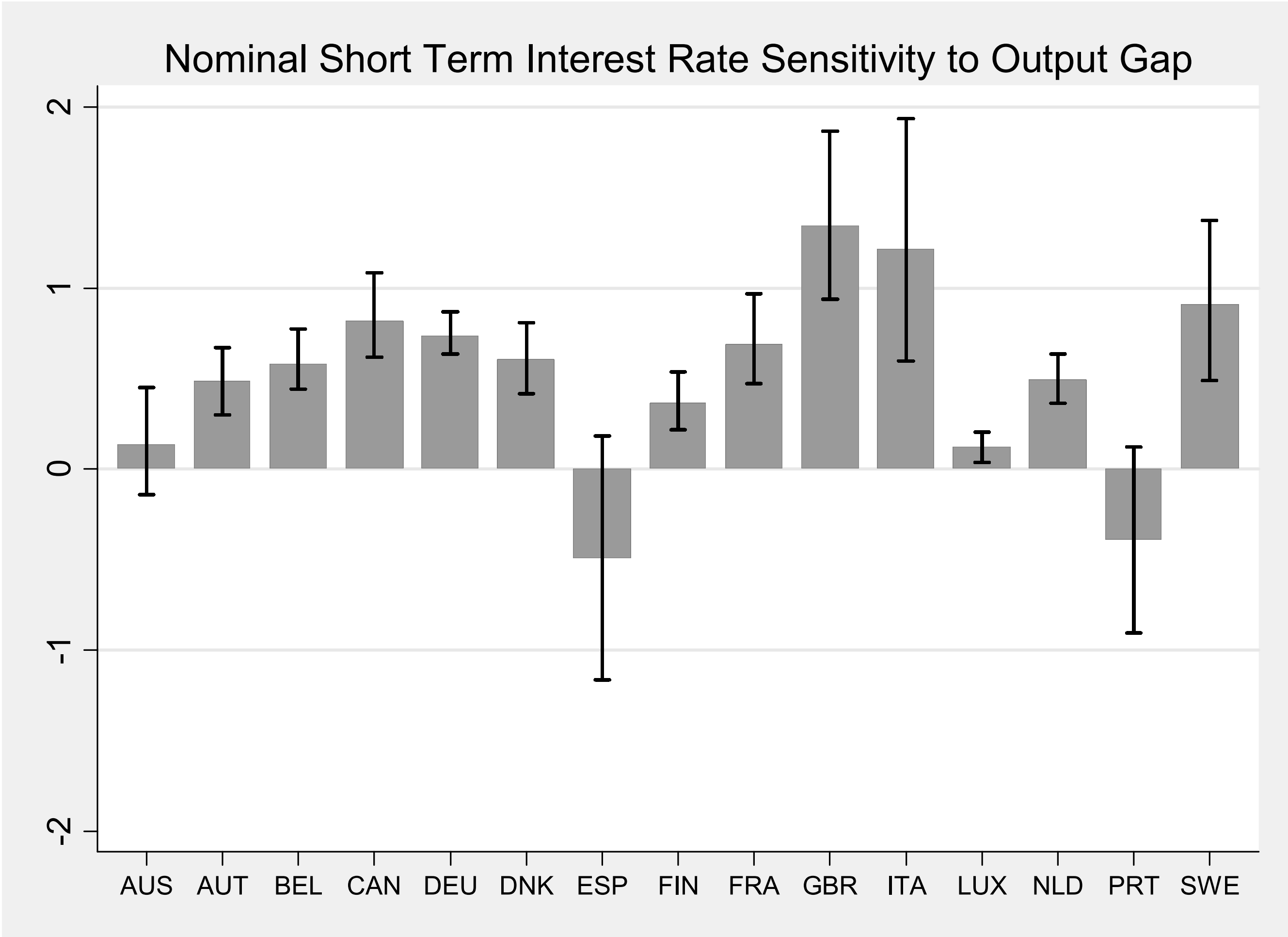
which Assumption guarantees is greater than the return he gets by investing his net worth at the risk-free rate and rolling it over.

Figure 1



Real Short Term Interest Rate Sensitivity to Output Gap
2
1
0
-1
-2
AUS
AUT
BEL
CAN
DEU
DNK
ESP
FIN
FRA
GBR
ITA
LUX
NLD
PRT
SWE

Figure 2


Nominal Short Term Interest Rate Sensitivity to Output Gap
2
1
0
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-2
AUS
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LUX
NLD
PRT
SWE

Figure 3

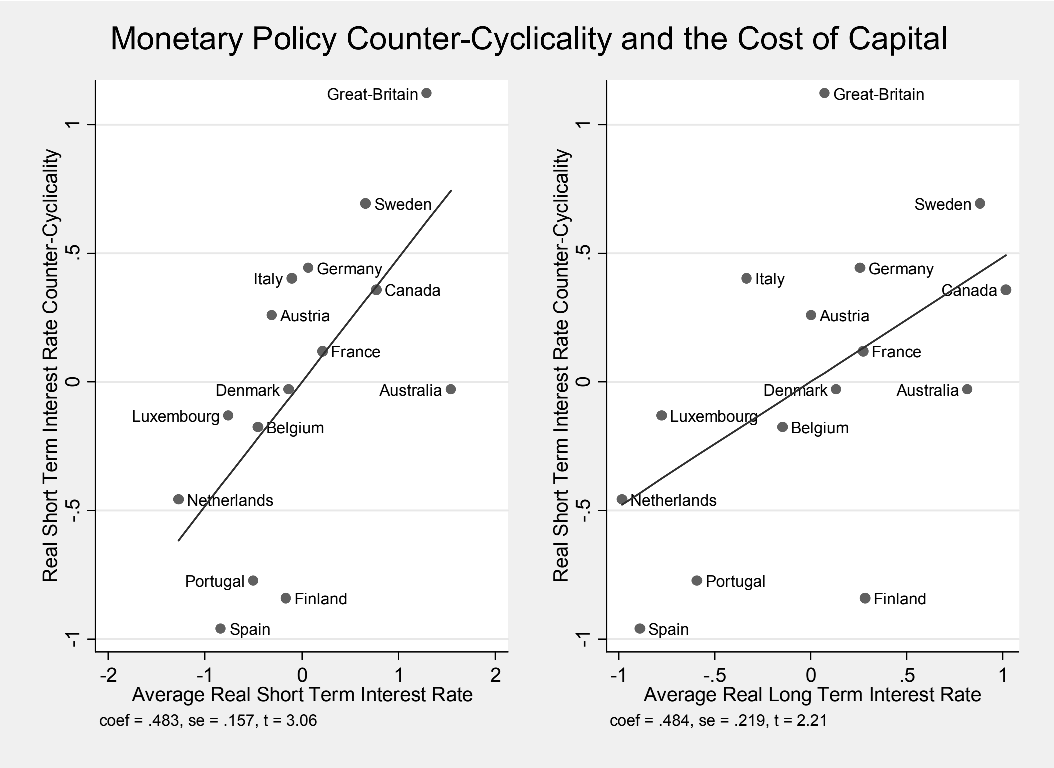


Figure 4

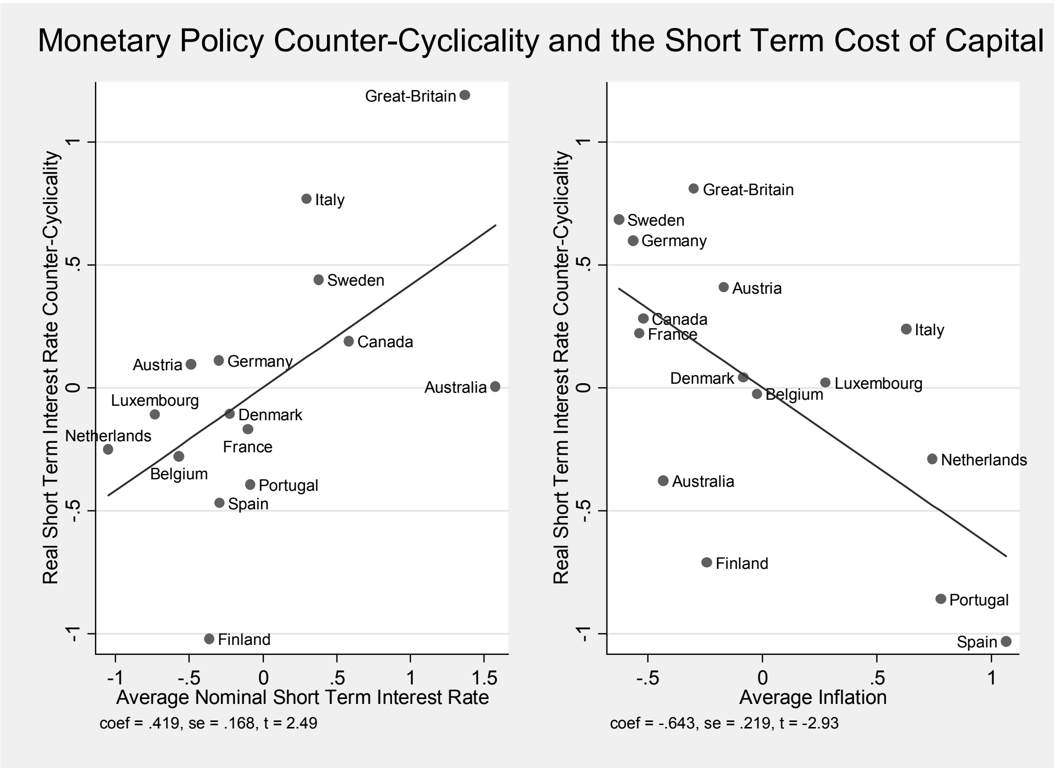


Figure 5

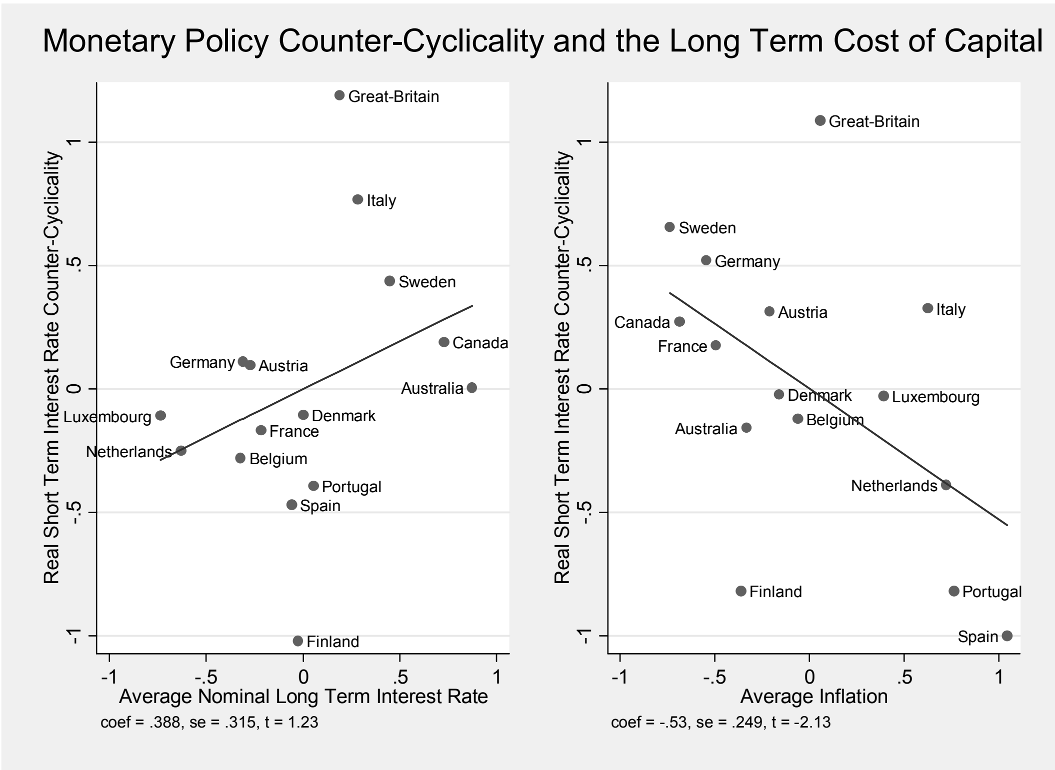


Figure 6

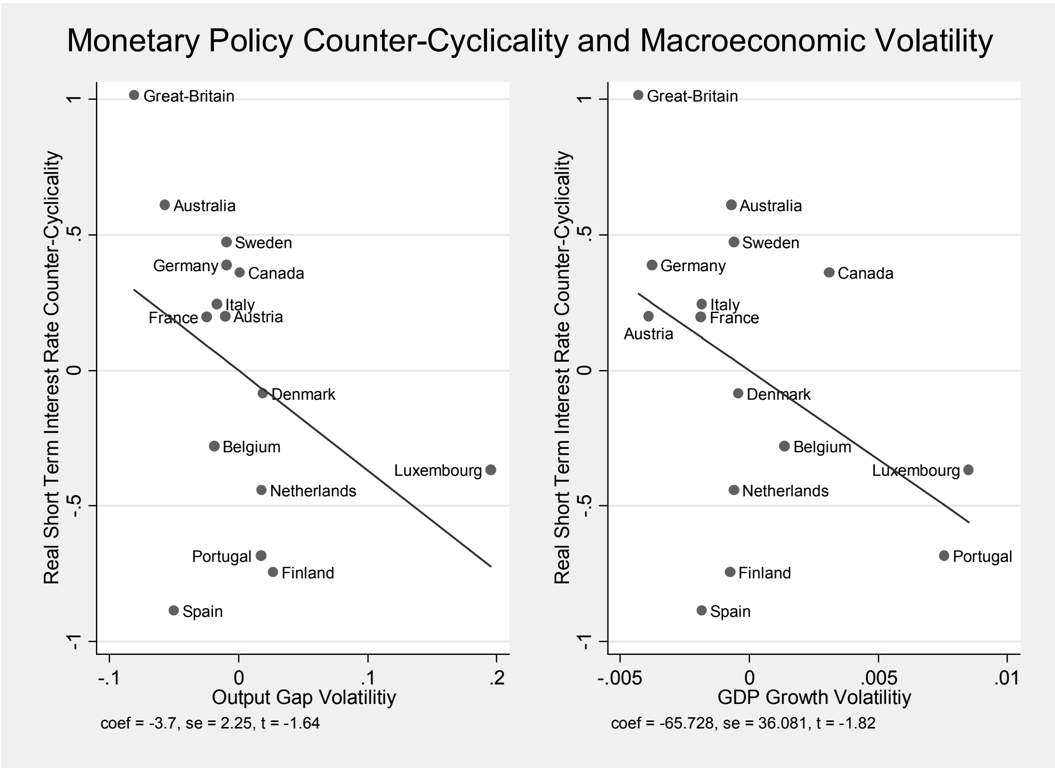
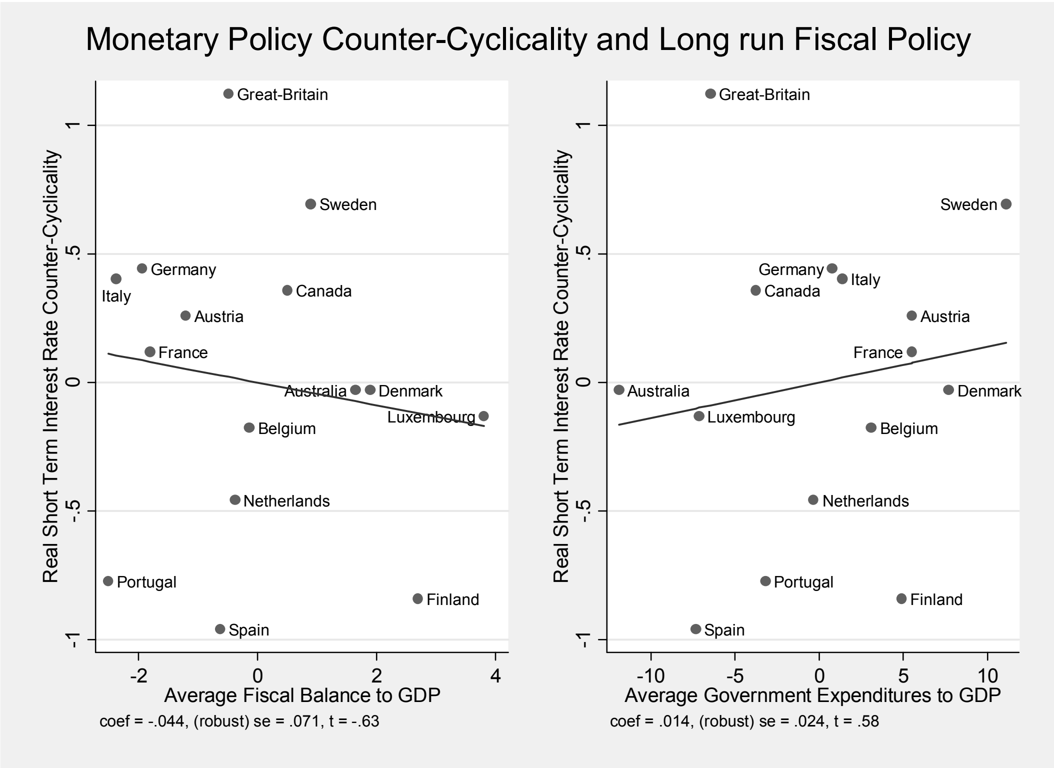


Figure 7



Monetary Policy Counter-Cyclicality and Long run Fiscal Policy
Real Short Term Interest Rate Counter-Cyclicality
Average Fiscal Balance to GDP
coef = -.044, (robust) se = .071, t = -.63
Great-Britain
Sweden
Germany
Italy
Canada
Austria
France
Australia
Denmark
Luxembourg
Belgium
Netherlands
Portugal
Finland
Spain
Average Government Expenditures to GDP
coef = .014, (robust) se = .024, t = .58

Table 1

Dependent variable: Real Value Added Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Share in Manufacturing Value Added	**-1.271**** *(0.628)*	**-1.270*** *(0.632)*	**-1.293*** *(0.648)*	**-1.244*** *(0.626)*	**-1.251*** *(0.627)*	**-1.243*** *(0.633)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**5.061***** *(1.311)*					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**7.716***** *(2.051)*				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**8.303***** *(2.776)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-16.00***** *(4.851)*		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-24.15***** *(6.974)*	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-24.17***** *(8.439)*
Observations	611	611	611	611	611	611
R-squared	0.399	0.401	0.404	0.394	0.395	0.396

Note: The dependent variable is the average annual growth rate in real value added for the period 1995-2005 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 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry 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

Dependent variable: Real Value Added Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Share in Manufacturing Value Added	**-1.227***	**-1.240***	**-1.231***	**-1.220***	**-1.217***	**-1.214***
	(0.634)	*(0.637)*	*(0.643)*	*(0.629)*	*(0.631)*	*(0.641)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**26.11****					
	(10.78)					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**40.52****				
		(16.02)				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**46.01****			
			(17.77)			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**16.71*****		
				(5.449)		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**25.24*****	
					(8.180)	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**21.89***
						(11.20)
Observations	611	611	611	611	611	611
R-squared	0.392	0.393	0.395	0.393	0.394	0.392

Note: The dependent variable is the average annual growth rate in real value added for the period 1995-2005 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 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry 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

Dependent variable: Labor Productivity per hour Growth						
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.494*****	**-3.566*****	**-3.526*****	**-3.537*****	**-3.568*****	**-3.572*****
	(0.898)	*(0.933)*	*(0.939)*	*(0.907)*	*(0.931)*	*(0.928)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**4.396*****					
	(1.288)					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**6.955*****				
		(2.391)				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**7.437****			
			(2.796)			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-13.61*****		
				(4.392)		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-21.53*****	
					(7.347)	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-22.69*****
						(7.364)
Observations	611	611	611	611	611	611
R-squared	0.364	0.367	0.370	0.359	0.361	0.363

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry 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

Dependent variable: Labor Productivity per hour Growth						
	(i)	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
Log of Initial Relative Labor Productivity	**-3.684*****	**-3.727*****	**-3.748*****	**-3.593*****	**-3.596*****	**-3.588*****
	(0.901)	*(0.923)*	*(0.926)*	*(0.881)*	*(0.897)*	*(0.882)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**29.63*****					
	(8.893)					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**47.90*****				
		(14.06)				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**53.45*****			
			(14.74)			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**17.53*****		
				(4.323)		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**28.37*****	
					(7.267)	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**25.61*****
						(9.279)
Observations	611	611	611	611	611	611
R-squared	0.361	0.364	0.367	0.361	0.364	0.362

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry 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

Dependent variable: Labor Productivity per hour Growth						
	(i)	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
Log of Initial Relative Labor Productivity	**-2.144*** *(1.181)*	**-2.232*** *(1.234)*	**-2.171*** *(1.220)*	**-2.061*** *(1.181)*	**-2.075*** *(1.228)*	**-2.053** *(1.234)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**3.545**** *(1.570)*					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**7.240***** *(2.538)*				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**7.015**** *(2.879)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-13.32*** *(7.812)*		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-23.10**** *(10.40)*	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-23.50**** *(10.32)*
Observations	611	611	611	611	611	611
R-squared	0.265	0.274	0.273	0.265	0.270	0.270

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1999-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1999. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry 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

Dependent variable: Labor Productivity per hour Growth						
	(i)	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
Log of Initial Relative Labor Productivity	**-2.160*** *(1.188)*	**-2.232*** *(1.225)*	**-2.230*** *(1.222)*	**-2.139*** *(1.163)*	**-2.205*** *(1.186)*	**-2.192*** *(1.182)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**31.46**** *(13.93)*					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**55.38***** *(17.96)*				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**57.37***** *(17.22)*			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**13.47**** *(6.582)*		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**26.88***** *(8.824)*	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**28.65***** *(9.350)*
Observations	611	611	611	611	611	611
R-squared	0.266	0.273	0.274	0.264	0.270	0.271

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1999-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1999. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 7

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.531***** *(0.917)*	**-3.561***** *(0.921)*	**-3.547***** *(0.924)*	**-3.521***** *(0.903)*	**-3.525***** *(0.913)*	**-3.542***** *(0.914)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality)	**3.466***** *(1.195)*	**3.184**** *(1.188)*				
Interaction (Financial Dependence and Inflation Pro-Cyclicality I)	**-4.041** *(2.787)*					
Interaction (Financial Dependence and Inflation Pro-Cyclicality II)		**-3.760*** *(2.058)*	**-6.362***** *(2.159)*			
Interaction (Financial Dependence and Taylor Rule Counter-Cyclicality)			**3.663***** *(1.266)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality)				**-11.85**** *(4.518)*	**-10.97**** *(4.253)*	
Interaction (Asset Tangibility and Inflation Counter-Cyclicality I)				**7.050** *(10.16)*		
Interaction (Asset Tangibility and Inflation Counter-Cyclicality II)					**7.633** *(9.308)*	**16.58*** *(8.699)*
Interaction (Asset Tangibility and Taylor Rule Counter-Cyclicality)						**-12.27***** *(4.249)*
Observations	611	611	611	611	611	611
R-squared	0.367	0.367	0.369	0.360	0.360	0.361

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Taylor Rule Counter-Cyclicality is the coefficient of the output gap when the Nominal Short Term Interest Rate is regressed on a constant, the output gap and inflation for each country. Inflation Pro-Cyclicality I (resp. II) is the coefficient of the output gap when Inflation is regressed on a constant, the output gap (resp. and lagged Inflation). The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 8

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.632*****	**-3.634*****	**-3.650*****	**-3.597*****	**-3.603*****	**-3.602*****
	(0.900)	*(0.907)*	*(0.911)*	*(0.885)*	*(0.891)*	*(0.892)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality)	**19.27***	**16.81***				
	(10.02)	*(9.825)*				
Interaction (Inventories to Sales and Inflation Pro-Cyclicality I)	**-42.88****					
	(20.52)					
Interaction (Inventories to Sales and Inflation Pro-Cyclicality II)		**-37.97****	**-51.89*****			
		(16.29)	*(14.23)*			
Interaction (Inventories to Sales and Taylor Rule Counter-Cyclicality)			**17.27**			
			(10.56)			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality)				**15.22*****	**12.15****	
				(4.976)	*(4.874)*	
Interaction (Labor Costs to Sales and Inflation Pro-Cyclicality I)				**-9.673**		
				(15.33)		
Interaction (Labor Costs to Sales and Inflation Pro-Cyclicality II)					**-16.19**	**-26.18*****
					(10.57)	*(9.180)*
Interaction (Labor Costs to Sales and Taylor Rule Counter-Cyclicality)						**13.15****
						(5.108)
Observations	611	611	611	611	611	611
R-squared	0.365	0.365	0.365	0.362	0.363	0.364

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Taylor Rule Counter-Cyclicality is the coefficient of the output gap when the Nominal Short Term Interest Rate is regressed on a constant, the output gap and inflation for each country. Inflation Pro-Cyclicality I (resp. II) is the coefficient of the output gap when Inflation is regressed on a constant, the output gap (resp. and lagged Inflation). The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 9

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.528***** *(0.896)*	**-3.587***** *(0.915)*	**-3.535***** *(0.911)*	**-3.552***** *(0.902)*	**-3.578***** *(0.913)*	**-3.577***** *(0.906)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**3.389**** *(1.356)*					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**4.774**** *(2.204)*				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**5.506**** *(2.13)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-10.92**** *(4.756)*		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-15.42**** *(7.194)*	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-16.25**** *(6.438)*
Observations	611	611	611	611	611	611
R-squared	0.292	0.294	0.298	0.288	0.289	0.290

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. Estimation results are based on the average for parameters, standard errors and statistics, computed over 2000 OLS regressions using real short term interest rate cyclicality index randomly drawn from the empirical distribution estimated in the first stage regression. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 10

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.671***** *(0.896)*	**-3.692***** *(0.908)*	**-3.695***** *(0.906)*	**-3.609***** *(0.878)*	**-3.618***** *(0.888)*	**-3.588***** *(0.876)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**25.17***** *(8.822)*					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**36.37**** *(13.131)*				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**37.28***** *(13.041)*			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**14.57***** *(4.761)*		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**21.19***** *(7.31)*	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**18.28**** *(7.799)*
Observations	611	611	611	611	611	611
R-squared	0.29	0.292	0.29	0.29	0.292	0.293

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. Estimation results are based on the average for parameters, standard errors and statistics, computed over 2000 OLS regressions using real short term interest rate cyclicality index randomly drawn from the empirical distribution estimated in the first stage regression. The interaction variable is the product of variables in parentheses. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 11

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-3.570*** **	**-3.431*** **	**-3.482*** **	**-3.532*** **	**-3.542*** **	**-3.558*** **	**-3.537*** **	**-3.556*** **
	(0.888)	*(1.036)*	*(0.906)*	*(0.912)*	*(0.898)*	*(0.916)*	*(0.910)*	*(0.883)*
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality)	**-11.91*** **	**-12.67*** **	**-10.07** **	**-13.22** **	**-10.39* **	**-12.98*** **	**-13.61*** **	**-11.90*** **
	(4.246)	*(4.264)*	*(4.696)*	*(5.015)*	*(5.207)*	*(4.455)*	*(4.386)*	*(4.221)*
Interaction (Asset Tangibility and Average Bank Credit to Bank deposits)	**-18.14** **							
	(8.772)							
Interaction (Asset Tangibility and Average Private Bond Market to GDP)		**-17.90**						
		(15.34)						
Interaction (Asset Tangibility and Average Real Long term Interest Rate)			**-7.030**					
			(7.955)					
Interaction (Asset Tangibility and Average Real Short term Interest Rate)				**-0.469**				
				(4.740)				
Interaction (Asset Tangibility and Average Inflation rate)					**7.277**			
					(7.497)			
Interaction (Asset Tangibility and Average Government Primary Surplus to GDP)						**2.700**		
						(2.975)		
Interaction (Asset Tangibility and Average Government Debt to GDP)							**-0.00169**	
							(0.112)	
Interaction (Asset Tangibility and Average Government Expenditures to GDP)								**-0.952**
								(0.596)
Observations	611	578	611	611	611	611	611	611
R-squared	0.363	0.361	0.361	0.359	0.361	0.361	0.359	0.364

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 12

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-3.438*** **	**-3.292*** **	**-3.406*** **	**-3.481*** **	**-3.431*** **	**-3.499*** **	**-3.490*** **	**-3.389*** **
	(0.893)	*(1.011)*	*(0.878)*	*(0.897)*	*(0.854)*	*(0.900)*	*(0.881)*	*(0.840)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality)	**4.018*** **	**4.165*** **	**1.911* **	**3.730*** **	**2.484* **	**4.218*** **	**4.400*** **	**3.532*** **
	(1.154)	*(1.270)*	*(1.124)*	*(1.330)*	*(1.335)*	*(1.315)*	*(1.285)*	*(1.067)*
Interaction (Financial Dependence and Average Bank Credit to Bank Deposits)	**4.226**							
	(2.517)							
Interaction (Financial Dependence and Average Private Bond Market to GDP)		**5.014*** **						
		(1.556)						
Interaction (Financial Dependence and Average Real Long term Interest Rate)			**5.052**					
			(3.131)					
Interaction (Financial Dependence and Average Real Short term Interest Rate)				**0.797**				
				(1.704)				
Interaction (Financial Dependence and Average Inflation rate)					**-4.142** **			
					(1.898)			
Interaction (Financial Dependence and Average Government Primary Surplus to GDP)						**-0.774**		
						(0.569)		
Interaction (Financial Dependence and Average Government Debt to GDP)							**-0.386**	
							(3.410)	
Interaction (Financial Dependence and Average Government Expenditures to GDP)								**0.492** **
								(0.207)
Observations	611	578	611	611	611	611	611	611
R-squared	0.368	0.367	0.376	0.365	0.375	0.367	0.364	0.382

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 13

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-3.736*** **	**-3.585*** **	**-3.676*** **	**-3.678*** **	**-3.698*** **	**-3.694*** **	**-3.688*** **	**-3.691*** **
	(0.894)	*(1.033)*	*(0.901)*	*(0.907)*	*(0.904)*	*(0.906)*	*(0.899)*	*(0.896)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality)	**27.85*** **	**28.58*** **	**22.38** **	**24.42** **	**26.07*** **	**28.68*** **	**29.92*** **	**28.48*** **
	(8.393)	*(8.491)*	*(9.548)*	*(11.16)*	*(8.304)*	*(8.939)*	*(8.830)*	*(7.619)*
Interaction (Inventories to Sales and Average Bank Credit to Bank deposits)	**20.01**							
	(19.46)							
Interaction (Inventories to Sales and Average Private Bond Market to GDP)		**25.79**						
		(28.45)						
Interaction (Inventories to Sales and Average Real Long term Interest Rate)			**14.68**					
			(17.93)					
Interaction (Inventories to Sales and Average Real Short term Interest Rate)				**6.225**				
				(9.002)				
Interaction (Inventories to Sales and Average Inflation rate)					**-8.015**			
					(13.48)			
Interaction (Inventories to Sales and Average Government Primary Surplus to GDP)						**-4.007**		
						(4.992)		
Interaction (Inventories to Sales and Average Government Debt to GDP)							**-0.198**	
							(0.211)	
Interaction (Inventories to Sales and Average Government Expenditures to GDP)								**0.655**
								(1.398)
Observations	611	578	611	611	611	611	611	611
R-squared	0.362	0.362	0.363	0.361	0.362	0.362	0.362	0.361

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 14

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Log of Initial Relative Labor Productivity	**-3.612*** **	**-3.430*** **	**-3.655*** **	**-3.592*** **	**-3.623*** **	**-3.594*** **	**-3.609*** **	**-3.624*** **
	(0.877)	*(1.001)*	*(0.893)*	*(0.887)*	*(0.891)*	*(0.874)*	*(0.879)*	*(0.869)*
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality)	**16.36*** **	**17.71*** **	**13.53*** **	**17.88*** **	**15.38*** **	**17.57*** **	**17.42*** **	**15.94*** **
	(3.910)	*(4.285)*	*(3.885)*	*(4.601)*	*(4.211)*	*(4.373)*	*(4.333)*	*(3.756)*
Interaction (Labor Costs to Sales and Average Bank Credit to Bank deposits)	**13.58**							
	(11.83)							
Interaction (Labor Costs to Sales and Average Private Bond Market to GDP)		**14.90**						
		(20.77)						
Interaction (Labor Costs to Sales and Average Real Long term Interest Rate)			**8.191**					
			(10.14)					
Interaction (Labor Costs to Sales and Average Real Short term Interest Rate)				**-0.422**				
				(5.190)				
Interaction (Labor Costs to Sales and Average Inflation rate)					**-4.797**			
					(7.623)			
Interaction (Labor Costs to Sales and Average Government Primary Surplus to GDP)						**0.140**		
						(3.115)		
Interaction (Labor Costs to Sales and Average Government Debt to GDP)							**0.103**	
							(0.128)	
Interaction (Labor Costs to Sales and Average Government Expenditures to GDP)								**0.992**
								(0.792)
Observations	611	578	611	611	611	611	611	611
R-squared	0.363	0.362	0.363	0.361	0.362	0.361	0.362	0.365

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 15

Dependent variable: Labor Productivity per hour Growth					
		(i)	(ii)	(iii)	(iv)
Log of Initial Relative Labor Productivity		**-3.480*** *(0.913)*	**-3.540*** *(0.917)*	**-3.682*** *(0.899)*	**-3.601*** *(0.883)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality)	Upturn	**2.664*** *(1.455)*			
	Downturn	**1.745**** *(0.680)*			
Interaction (Asst Tangibility and Real Short term Interest Rate Counter-Cyclicality)	Upturn		**-6.964*** *(3.583)*		
	Downturn		**-6.807**** *(3.075)*		
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality)	Upturn			**15.37*** *(7.648)*	
	Downturn			**14.89**** *(6.437)*	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality)	Upturn				**8.328*** *(4.406)*
	Downturn				**9.391***** *(2.705)*
Observations		611	611	611	611
R-squared		0.364	0.359	0.361	0.361

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I upturn (resp. downturn) is the output gap sensitivity of the Real Short Term Interest Rate when the output gap is above (below) median. Real Short term Interest Rate Counter-Cyclicality II upturn (resp. downturn) is the output gap sensitivity of the Real Short Term Interest Rate when the output gap is above (below) median, controlling for lagged Real Short Term Interest Rate. Real Short term Interest Rate Counter-Cyclicality III upturn (resp. downturn) is the output gap sensitivity of the Real Short Term Interest Rate when the output gap is above (below) median, controlling for forward Real Short Term Interest Rate. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 16

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.469***** *(0.730)*	**-3.563***** *(0.756)*	**-3.533***** *(0.749)*	**-3.527***** *(0.738)*	**-3.564***** *(0.762)*	**-3.572***** *(0.755)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**5.555***** *(2.139)*					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**7.921***** *(3.018)*				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**6.616**** *(2.586)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-16.28***** *(5.758)*		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-25.00***** *(8.518)*	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-21.75***** *(7.480)*
Hansen J. Stat	**7.830**	**7.697**	**8.237**	**6.086**	**4.569**	**6.129**
p. value	*0.166*	*0.174*	*0.144*	*0.298*	*0.471*	*0.294*
Observations	611	611	611	611	611	611
R-squared	0.071	0.076	0.080	0.064	0.067	0.069

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. Instruments for monetary policy cyclicality: share of Catholics in total population in 1980, share of Protestants in total population in 1980, number of years since independence, legal origin. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 17

Dependent variable: Labor Productivity per hour Growth	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Log of Initial Relative Labor Productivity	**-3.701***** *(0.760)*	**-3.729***** *(0.776)*	**-3.732***** *(0.771)*	**-3.592***** *(0.736)*	**-3.594***** *(0.739)*	**-3.588***** *(0.743)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**34.91***** *(11.85)*					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**48.82***** *(16.64)*				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**47.96***** *(16.28)*			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**13.81**** *(6.661)*		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**21.60**** *(9.148)*	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**18.78**** *(9.222)*
Hansen J. Stat	**1.353**	**0.674**	**1.456**	**2.533**	**1.406**	**2.650**
p. value	*0.508*	*0.714*	*0.483*	*0.282*	*0.495*	*0.266*
Observations	611	611	611	611	611	611
R-squared	0.067	0.071	0.076	0.067	0.071	0.068

Note: The dependent variable is the average annual growth rate in labor productivity per hour for the period 1995-2005 for each industry in each country. Initial Relative Labor Productivity is the ratio of industry labor productivity per hour to total manufacturing labor productivity per hour in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. Instruments for monetary policy cyclicality: share of Catholics in total population in 1980, share of Protestants in total population in 1980, number of years since independence. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 18

Dependent variable: Average R&D intensity	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
Initial relative R&D intensity	**0.0504***** *(0.0110)*	**0.0476***** *(0.0105)*	**0.0536***** *(0.0100)*	**0.0494***** *(0.0110)*	**0.0478***** *(0.0111)*	**0.0511***** *(0.0105)*
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality I)	**0.139***** *(0.0478)*					
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality II)		**0.187***** *(0.0583)*				
Interaction (Financial Dependence and Real Short term Interest Rate Counter-Cyclicality III)			**0.230***** *(0.0518)*			
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality I)				**-0.409***** *(0.118)*		
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality II)					**-0.477***** *(0.157)*	
Interaction (Asset Tangibility and Real Short term Interest Rate Counter-Cyclicality III)						**-0.701***** *(0.171)*
Observations	309	309	309	309	309	309
R-squared	0.841	0.840	0.846	0.837	0.835	0.841

Note: The dependent variable average R&D intensity is the average ratio of R&D expenditures to R&D and capital expenditures for the period 1995-2005 for each industry in each country. Initial Relative R&D intensity is the ratio of industry R&D intensity to total manufacturing R&D intensity in 1995. Financial Dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980-1989. Asset Tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).

Table 19

Dependent variable: Average R&D intensity	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Initial relative R&D intensity	**0.0496***** *(0.0112)*	**0.0471***** *(0.0108)*	**0.0513***** *(0.0108)*	**0.0499***** *(0.0115)*	**0.0468***** *(0.0108)*	**0.0507***** *(0.0111)*
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality I)	**0.880**** *(0.359)*					
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality II)		**1.162**** *(0.457)*				
Interaction (Inventories to Sales and Real Short term Interest Rate Counter-Cyclicality III)			**1.419***** *(0.462)*			
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality I)				**0.507**** *(0.238)*		
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality II)					**0.680**** *(0.321)*	
Interaction (Labor Costs to Sales and Real Short term Interest Rate Counter-Cyclicality III)						**0.732**** *(0.312)*
Observations	309	309	309	309	309	309
R-squared	0.837	0.837	0.840	0.837	0.837	0.838

Note: The dependent variable average R&D intensity is the average ratio of R&D expenditures to R&D and capital expenditures for the period 1995-2005 for each industry in each country. Initial Relative R&D intensity is the ratio of industry R&D intensity to total manufacturing R&D intensity in 1995. Inventories to Sales is the median ratio of total inventories over annual sales for US firms in the same industry for the period 1980-1989. Labor Costs to Sales is the median ratio of labor costs to shipments for US firms in the same industry for the period 1980-1989. Real Short term Interest Rate Counter-Cyclicality I is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant and the output gap for each country. Real Short term Interest Rate Counter-Cyclicality II is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the lagged Real Short Term Interest Rate for each country. Real Short term Interest Rate Counter-Cyclicality III is the coefficient of the output gap when Real Short Term Interest Rate is regressed on a constant, the output gap and the forward Real Short Term Interest Rate for each country. The interaction variable is the product of variables in parentheses. Standard errors -clustered at the industry level- are in parentheses. All estimations include country and industry dummies. Significance at the 1% (resp. 5%; 10%) level is indicated by *** (resp. **; *).