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Research Report

Monetary policy and the stock market: Insights from a model of endogenous business cycles

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FINMAP –

FINANCIAL DISTORTIONS AND MACROECONOMIC
PERFORMANCE: EXPECTATIONS, CONSTRAINTS AND
INTERACTION OF AGENTS

DATE: 04/03/2016

TITLE

Monetary Policy and the Stock Market: Insights from a Model of Endogenous Business Cycles

by: Boyan Yanovski, Christian-Albrechts-Universität zu Kiel, Institute for Economics

KEY TAKEAWAYS

- Monetary policy might be ineffective in its attempt to influence the borrowing conditions over the business cycle because of the existence of adverse endogenous factors (like an endogenous risk premium, for example) counteracting monetary policy.
- The evolution of the stock market over the business cycle can be considered an indicator of the extent to which monetary policy is able to affect the current borrowing conditions in the economy.
- The pro-cyclical stock market observed in the US during the last 25 years in the presence of a counter-cyclical monetary policy can be considered evidence of monetary policy ineffectiveness and/or weak reactivity.
- Monetary policy might be ineffective in reducing endogenous business cycle fluctuations because of the lags involved in its reactions and in the transmission process.

INTRODUCTION

We investigate issues related to the speed and strength of monetary policy reactions, as well as to its ability to ultimately affect the borrowing conditions in the economy in a context of a dynamic endogenous business cycle model with monetary policy and a financial sector. In particular, we look at the evolution of the stock market over the business cycle in the US during the last 25 years and consider the implications of such an evolution for monetary policy within the context of the model.

Intuitively, the evolution of the stock market should depend on the profits generated by the firms in the economy and on the interest rate by which these profits are discounted. Thus, in theory, monetary policy should be able to affect the stock market by changing the base interest rate in the economy. In reality, however, the base interest rate is only one component of the borrowing conditions, while other components like the risk premium or the amount of credit granted “can have a life of their own”. In this line of thought, if monetary policy fails to control the actual borrowing conditions such that the conditions remain unchanged or are pro-cyclical (become tighter during recessions and relax during booms), then one would observe a stock market dominated by the fluctuations in profits or similar measures of economic activity (like the output gap, for example). This kind of behaviour of the stock market is observed in the US during the last 25 years (see Figure 1). The stock market is strongly pro-cyclical in the presence of a counter-cyclical monetary policy.

A major component of the borrowing conditions that monetary policy is not able to directly affect is the risk premium. The risk premium tends to be counter-cyclical, counteracting the pro-cyclical base interest rate (counter-cyclical monetary policy implies a pro-cyclical base interest rate). Minsky (1986) provides a comprehensive theory on why that may be happening. He argues that the current (and past) economic performance of firms and households strongly affects the borrowing conditions these agents are facing, because this past performance is part of the information set used as a criterion for current lending. Thus, when monetary policy attempts to stabilize the economy, it is confronted with an endogenous relaxation of the borrowing conditions during a boom and with a tightening during a recession.

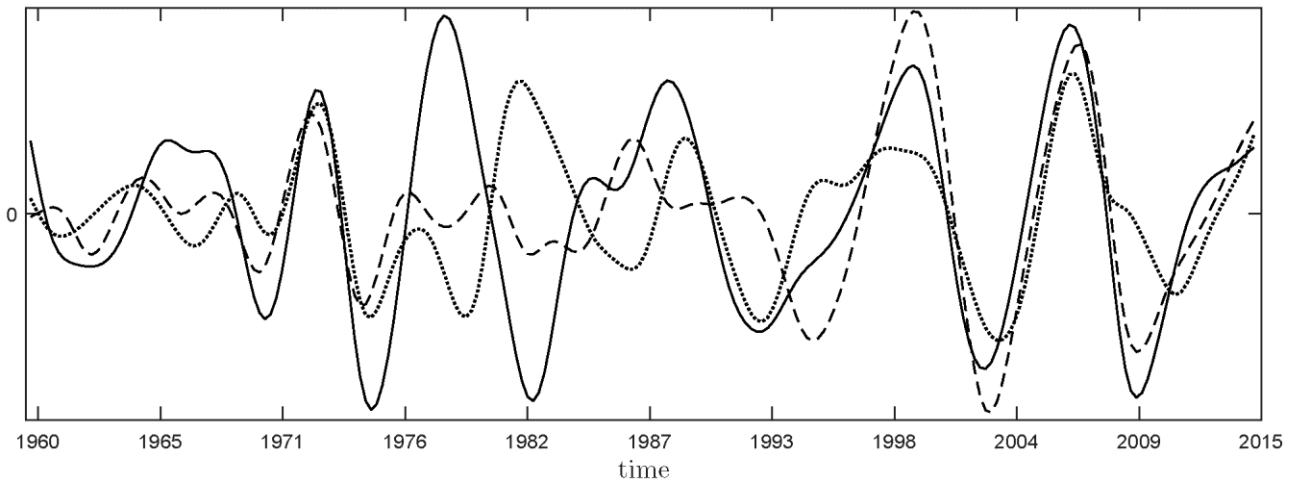


Figure 1: The filtered fluctuations of real gross value added of the non-financial sector as a proxy of the output gap (solid line), real base interest rate (dotted line) and stock price index S&P 500 (dashed line) around their respective long run trends for the US over the period (1960-2014). The fluctuations have been re-scaled to make them comparable by means of visual inspection.

In the paper associated with this policy brief we investigate the conditions under which (in the model developed for this purpose) we can observe a pro-cyclical stock market under a countercyclical monetary policy.

The model is calibrated to fit key properties of the data. In particular, it matches well the magnitude of the fluctuations of the variables involved and their evolution over time relative to the business cycle.

RESEARCH PARAMETERS

The general philosophy of the model underlying this research is that the agents in the economy react primarily to observed imbalances in their immediate environment because of limited available information about the true data generating process for the whole economy and because of limited processing capabilities. Thus, in the mathematical sense, our model has no forward looking components and is thus purely backwards looking. Next, we will discuss shortly some of the key features of the model.

For the real economy, we assume that the steady state growth path of the economy is locally unstable (but globally stable) or at least that a convergence to the steady state growth path takes place in an oscillatory manner.

$$g = g^0 + \phi_r(r^n - i - \xi + \pi^c) + \phi_x x$$

r^n – profitability - the profit rate in the economy under normal utilization

g – the overall investment rate in the economy

i – central bank base rate

ξ – risk premium, now a function of firm performance (r)

π^c – the expected inflation

x – the structure of the expectations about the output gap in the economy

g^0 – exogenous benchmark investment rate (due to labor augmenting technical progress for example)

Equation 1: The determinants of the investment rate, which is the driving force of the real sector in the model.

In terms of intuition, this assumption reflects the idea that the business cycle comes about as a result of an asynchronous interplay of destabilizing and stabilizing economic forces over time. The main destabilizing force in the model are the self-fulfilling expectations. This force has a longstanding tradition in economics at least since Harrod (1939) and is often also referred to as Harrodian instability. Expectations about high demand lead to high

investment, and this investment (as a component of aggregate demand) makes sure that the demand expectations are met or even exceeded, this leads to more investment and so on. Our formalisation of such endogenous expectations follows the agent-based process of sentiment formation that has been proposed first within the framework of speculative trading in financial markets by Lux (1995). A similar approach has first been used as an alternative to rational expectations by Franke (2012). An empirical validation using business survey data can be found in Lux (2009). Ghonghadze (2016) has applied a related sentiment model to survey data on lending standards of U.S. banks. The other two destabilizing forces in the model are inflation (because of its effect on the real interest rate) and the endogenous risk premium. There are two stabilizing forces in the model. The first is related to the variations in profitability due to changes in the scarcity of factor labor. The more general idea of profitability as a global stabilizer of the economy is popular in economics, for example, in terms of the decreasing returns to capital in the Solow-Swan-Model (see Solow (1956)), while the implementation of this idea in terms of the relationship between labor market conditions and profitability has been explored, for example, in Stockhammer (2004). This force is stabilizing since a positive (negative) output gap is associated with high (low) employment, which in turn leads to higher (lower) wages and decreases (increases) in profitability. Because investment is positively affected by profitability, the above effects tend to stabilize the economy. The second stabilizing force in the model is monetary policy which manipulates the base interest rate and tries to counteract output gaps and inflation. The model of the real sector is investment driven, meaning that decisions to increase the stock of real capital determine the fluctuations of the business cycle. Thus, Equation 1 shows how all the forces discussed above affect the real sector in the model.

The concept used for modelling the stock market reflects the philosophy of our general modelling approach in that the agents adjust their behaviour (they buy or sell stocks) based on currently observed imbalances (a discrepancy between the borrowing conditions and the return on equity). This modelling technique was introduced in Franke and Ghonghadze (2014). The agents trade against discrepancies between the risk adjusted interest rate and the return on equity and thereby push stock prices in the direction which closes the discrepancy. Equation 2 represents the firm value

$$q^f = \frac{r(y, \dots) + \dots}{i + \bar{\xi} + \dots}$$

q^f – stock market proxy
 r – the profit rate in the economy, which is a function of the output gap
 y – economic performance proxy (output gap)
 i – central bank base rate
 $\bar{\xi}$ – risk premium, fixed

for which there is no discrepancy between the risk adjusted interest rate and the return on equity. The stock returns depend on the profit rate in the economy (via dividend payments or reinvestment of profits) which in turn depends on the output gap, this is why we see the profit rate in the numerator of the right-hand side of Equation 2. The denominator contains the risk adjusted interest rate in the economy. To better

understand Equation 2 consider the following example. If the profit rate in the economy is higher than the risk adjusted interest rate, the measure of the value of the firms in the economy (left-hand side of Equation 2) would have to be larger than one in order for the discrepancy between the return on equity and the risk adjusted interest rate to close. This is the case because for given profits the equity return decreases as the value of equity increases. In other words, because profits are high, the demand for stocks increases, which increases the value of equity until the return on equity equals the risk adjusted interest rate. The measure of the value of the firms is Tobin's Q (see the last section for more details). In the next section we are going to use Equation 2 in conjunction with some graphical illustrations to better understand the behaviour of the stock market over the business cycle in the model.

First, consider the case in which the risk premium is fixed. The base interest rate set by the central bank for the purposes of a counter-cyclical monetary policy is always (at least slightly) lagging behind measures of economic performance (like the output gap, for example), since the central bank can only react to the observed (past) performance. In that case, the stock market, which depends on the firm performance and on the base rate, can be pro-cyclical, acyclical or even counter-cyclical depending on the relative strength of the fluctuations in profits and borrowing conditions (see Equation 1 and Figures 2 and 3). In this setting, a pro-cyclical stock market is only possible if monetary policy is inactive.

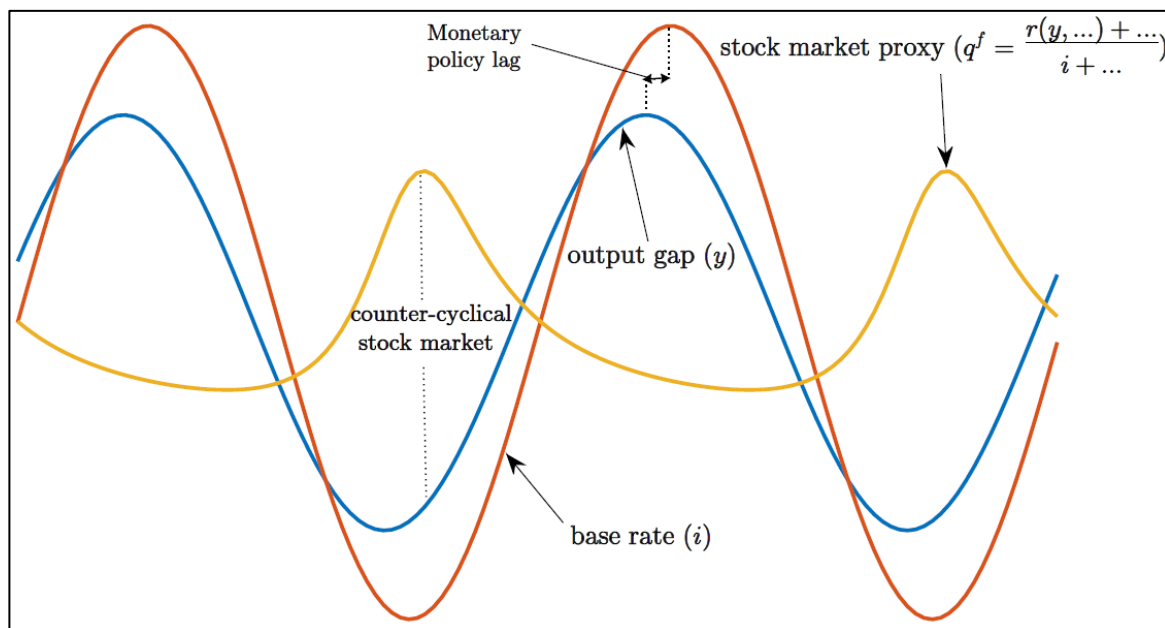


Figure 2: Very strong counter-cyclical monetary policy (strong fluctuations of the base rate relative to the output gap) resulting in a counter-cyclical stock market. The risk premium is fixed here. All fluctuations are deviations from the mean of the respective variable.

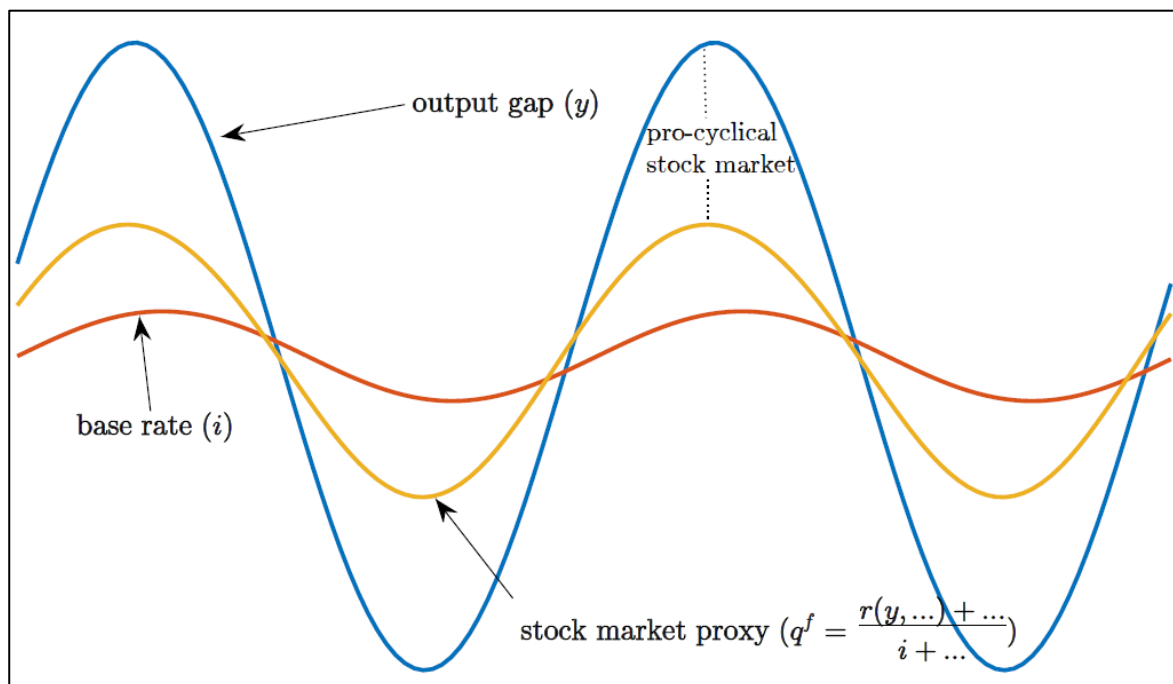


Figure 3: Weak monetary policy (small fluctuations of the base rate relative to the output gap) resulting in a pro-cyclical stock market. The risk premium is fixed here. All fluctuations are deviations from the respective mean of the variable.

In reality the risk premium is not fixed and can fluctuate strongly depending on the measure used. If we make the risk premium endogenous and allow it to depend on firm performance, we arrive at a scenario in which monetary policy is active but is being counteracted by the endogenous risk premium (see Equation 2). Under this setting the model can replicate many features of the data, like the magnitudes of the fluctuations of the various variables involved (real interest rate, risk premium, output gap, stock market indices, etc.) and their relative positions over the business cycle.

$$q^f = \frac{r(y, \dots) + \dots}{i + \xi(r) + \dots}$$

q^f – stock market proxy

r – the profit rate in the economy, which is a function of the output gap

y – economic performance proxy (output gap)

i – central bank base rate

ξ – risk premium, **now a function of firm performance (r)**

In the context of this model an active counter-cyclical monetary policy can be compatible with a strongly pro-cyclical stock market only if the policy is ineffective. Thus one can see the evolution of the stock market over the business cycle as an indicator of the effectiveness of monetary policy in controlling the current borrowing conditions in the economy. The model in conjunction

Equation 2: The equilibrium value of Tobin's Q and the key factors determining it. The equilibrium value of Tobin's Q is driving the stock market in the model. The risk premium is endogenous and counteracts monetary policy.

with the data suggests that the stock market is strongly pro-cyclical because monetary policy is rendered ineffective by the endogenous risk premium. We consider this as evidence in favour of the hypothesis that monetary policy in the US during the last 25 years has been overall ineffective in controlling the current borrowing conditions over the business cycle. In Figure 1 we can see that monetary policy has indeed been counter-cyclical during that period as evidenced by the strongly pro-cyclical real base interest rate. See the last section for a discussion of some of the assumptions on which the above conclusions hinge.

POLICY IMPLICATIONS AND RECOMMENDATIONS

The first obvious implication of this research is that in the presence of strong endogenous components driving the overall borrowing conditions in an economy, monetary policy might be ineffective. To improve their effectiveness central banks can attempt to employ more aggressive measures. Changing the base rate more strongly whenever an economic imbalance is observed might help. In order to have more room for base rate manoeuvring, a higher inflation target is needed to avoid the zero-lower-bound problem that central banks are currently facing. However, it should be noted here that even if successful, manipulations of the borrowing conditions in the economy are associated with market distortions. For example, changes in the interest rate affect the relative profitability of long-term vs. short-term projects, which can lead to excessive investment in particular sectors of the economy (like the housing sector, for example). This is a key feature of Austrian business cycle theory (see, for example, Von Mises (1966)).

In addition, a general implication of endogenous business cycle models, such as the one used in this research, is that monetary policy might not be able to effectively reduce the magnitude of the fluctuations of the business cycle even if it would react very strongly to observed output gaps and inflation. This is due to the local instability of the model economy (around its steady state growth path) and due to the lags involved in the reactions of monetary policy and in the transmission of its measures. In such a setting, a more active monetary policy might simply increase the frequency of the business cycle fluctuations or might even have a destabilizing effect if the lags are long enough. The potential existence of long transmission lags has been amply discussed in the literature (see,

for example, the meta-analysis by Havranek and Rusnak (2012)). Destabilizing effects have been suggested, for example, by Friedman (1961) and Sprinkel (1986). In the context of an endogenous business cycle model, Paul Beaudry et al. (2016) find that reducing the variance of shocks in their model tends to increase the frequency of the fluctuations in the economy rather than their amplitude. These points make an argument against a continuous business cycle management approach to monetary policy. Strong one-time reactions to small economic imbalances might offset the destabilizing tendencies present around the steady state growth path (in endogenous business cycle models). However, information about small economic imbalances is often within the bounds of measurement errors and is thus not reliable. Thus, it might be a good idea for monetary policy to focus on counteracting long-term fundamental imbalances. The “global savings glut”, for example, might be considered a fundamental and long-term phenomenon (see Bernake (2005)).

Our research also suggests a new indicator for the effectiveness of the central bank in controlling the borrowing conditions over the business cycle. Since the stock market is driven by the business cycle (via the evolution of profits) and affected by the borrowing conditions, comprised of the base rate and the risk premium, its evolution over the business cycle is determined by the relative strength of the fluctuations in these three components. Thus, if the stock market is strongly pro-cyclical this signals a weakness or an ineffectiveness of the counter-cyclical monetary policy.

REMARKS

The general philosophy of the model underlying this research is that the agents in the economy react primarily to observed imbalances in their immediate environment because of limited available information about the true data generating process for the whole economy and because of limited processing capabilities. The agents do not use the macro model itself as a source of information about the future paths of the relevant variables as is assumed under the “rational expectations” paradigm. Thus, in the mathematical sense, our model has no forward looking components and is thus purely backwards looking. We consider the persistence observed in macroeconomic data as strong evidence against the “rational expectations” hypothesis. Models in which forward looking components are given a significant weight have a hard time replicating the observed persistence in the data (cf. Franke et al. (2015)). We consider it theoretically more reasonable as well as more practical to simply use a mathematically backwards looking model instead of one having forward looking components that have to be “compensated” by very strong backwards looking ones to achieve realism.

The analysis and recommendations in the previous section are also dependent on more specific modelling decisions and assumptions that we are going to discuss next.

We assume that the steady state growth path of the economy is locally unstable (but globally stable) or at least that a convergence to the steady state growth path takes place in an oscillatory manner. In terms of intuition, this assumption reflects the idea that the business cycle comes about as a result of an asynchronous interplay of destabilizing and stabilizing economic forces over time. In this context, the lags in the reactions and transmission of monetary policy might make it very hard for monetary policy to reduce the volatility of the cycle.

The concept of firm value used for the stock market reflects the general philosophy of the modelling approach in that the agents adjust their behaviour (they buy or sell stocks) based on currently observed imbalances (a discrepancy between the borrowing conditions and stock returns). Other valuation concepts (like the present discounted value, for example) require the knowledge of the future path of the above economic variables. Under the latter concept one is often tempted to use the “rational expectations” approach because the future values (or the expectations thereof) are already present in the formula for the present discounted value. If we assume, however, that the expectations necessary for the present discounted value approach are formed on the basis of currently observed local imbalances and that the agents are not using the model itself to form their expectations, then our approach and the present discounted value approach would be very similar.

In this research we take the evolution of Tobin's Q as a proxy for the evolution of the stock market. We consider this to be justified since measures of Tobin's Q and the stock market indices behave very similarly in terms of their business cycle fluctuations (see Figure 4). The fluctuations in stock prices seem to be the main factor for the fluctuations in Tobin's Q. However, generally, Tobin's Q also depends on the replacement cost of the capital stock, on the number of stocks outstanding and on firm debt in the economy (see Tobin and Brainard (1976)).

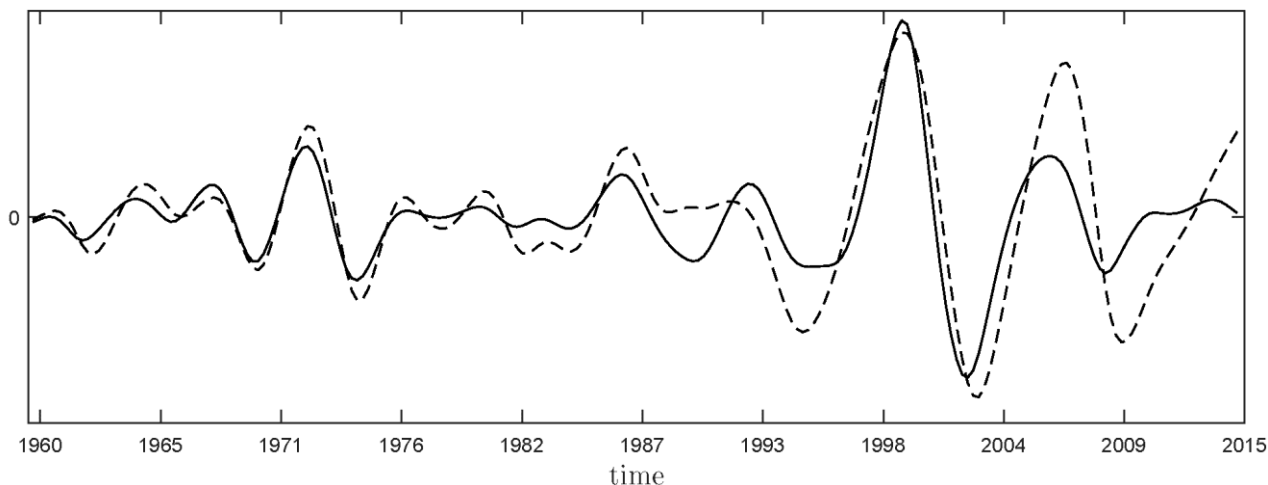


Figure 4: The filtered fluctuations of the stock price index S&P 500 (dashed line) and of a measure of Tobin's Q (solid line) around their respective long run trends for the US over the period (1960-2014). The fluctuations have been re-scaled to make them comparable by means of visual inspection.

In this line of thought, it should also be noted that our research focuses on the borrowing conditions in terms of the interest rates that the agents are facing. Obviously, the borrowing conditions in the economy also depend on the amount of credit available provided by the banks. We abstract from this because in the context of our model the most parsimonious way of introducing endogenous borrowing conditions is to allow for the risk premium to vary. Of course, this simplification leaves out of the analysis the important issue of financial instability related to the accumulation of debt.

Finally, the model underlying this research suggests that the risk premium should generally be counter-cyclical and should fluctuate significantly. In reality, the magnitude of the fluctuations of the risk premium depends on the measure taken. In particular, stronger fluctuations are associated with riskier loans. We take the spreads on bonds issued by companies rated BB or below as a proxy for the relevant economy wide risk premium. We consider spreads associated with companies with better ratings to not be relevant for the bulk of economic agents. In Figure 5 we can see the extent to which this measure of the risk premium can be considered counter-cyclical. Our model suggests a lag of the negative of the risk premium of one quarter (behind the output gap), while in the data a lag of 5 quarters is observed on average.

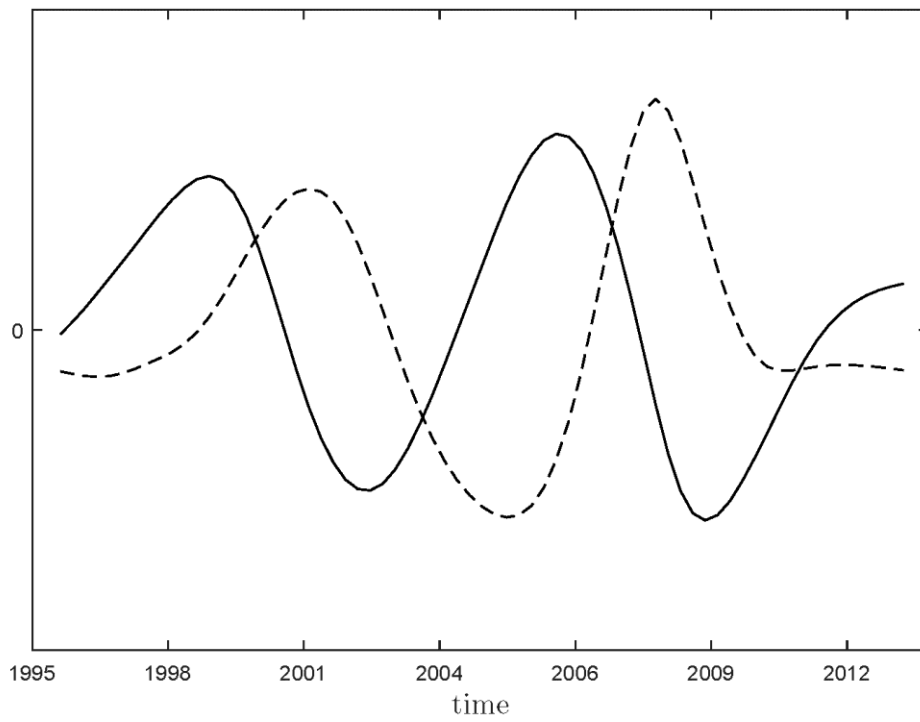


Figure 5: The filtered fluctuations of real gross value added of the non-financial sector (solid line) and of the BofA Merrill Lynch US High Yield Master II Option-Adjusted Spread (dashed line) around their respective long run trends for the US over the period (1983-2014). The fluctuations have been re-scaled to make them comparable by means of visual inspection.

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