Behavioural economics is useful also in macroeconomics : the role of animal spirits

Behavioral economics is useful also in macroeconomics: the role of animal spirits

Paul De Grauwe[1] and Yuemei Ji [2]

Abstract

Dynamic Stochastic General Equilibrium models are still dominant in mainstream macroeconomics, but they are only able to explain business cycle fluctuations as the result of exogenous shocks. This paper uses concepts from behavioural economics and discusses a New Keynesian macroeconomic model that generates endogenous business cycle fluctuations driven by animal spirits. Our discussion includes two applications. One is on the optimal level of inflation targeting under a zero lower bound (ZLB) constraint. The other is on the role of animal spirits in explaining the synchronization of business cycles across countries.

Keywords: animal spirits, behavioral macroeconomics, monetary policy, inflation target, zero lower bound, business cycles

[1] The London School of Economics and Political Science, UK
Email: p.c.de-grauwe@lse.ac.uk
[2] University College London, London, UK
Email: yuemei.ji@ucl.ac.uk

1. Introduction

Behavioral economics is increasingly accepted as a way of thinking about economic issues. The recent granting of the Nobel Prize to Richard Thaler testifies that there is a change of mind within the economics profession on the need to allow for departures from the paradigm of the "homo economicus".

That is much less the case in mainstream macroeconomics, however. The "homo economicus" continues to reign supreme in Dynamic Stochastic General Equilibrium (DSGE) models. In these models individual agents maximize an infinite horizon utility function using rational forecasts based on all available information including the information embedded in the model. Nothing really can go wrong in models populated by supreme agents peacefully optimizing and endowed with great cognitive abilities that allow them to understand the complexities of the world. Only exogenous disturbances can get these agents off the rail forcing them to re-optimize. These models then lead to the view that business cycle fluctuations occur as a result of exogenous events (shocks) that force individuals to reconsider their optimal plans. Nothing in the model creates endogenous business cycle movements. Booms and busts are all the result of exogenous disturbances (Smets ans Wouters(2007), Gali(2008)).

We have to do better than that. That's what we have been trying to do in a series of publications (De Grauwe(2012), De Grauwe and Macchiarelli (2015), De Grauwe and Ji(2017, 2018). We are, of course, not alone in exploring different tracks of macroeconomic modeling. There is a growing number of researchers developing "agent-based" models and "behavioral" macroeconomic models (Alfarano, et al. (2005) Tesfatsion, and Judd, (2006), Colander, et al. (2008), Farmer(2006), Farmer and Foley(2009), Gatti, et al.(2011), Gabaix(2014), Westerhoff and Franke(2012), Hommes(2016), Hommes and Lustenhouwer(2016), Muellbauer(2016) to name just a few. See also the recent criticism of Blanchard(2017) and the chapters in Gürkaynak and Tille (2017).

There are many ways in which one can depart from mainstream macroeconomic models. We have chosen to do so by assuming that agents experience cognitive limitations preventing them from having rational expectations. These agents use simple forecasting rules (heuristics) and evaluate the forecasting performances of these rules ex-post. This evaluation leads them to switch to the rules that perform best. It can be argued that in a world of great complexity that nobody fully understands this adaptive learning is the rational way to deal with this complexity (see Simon (1957), Gigerenzer and Selten(2002), Akerlof and Shiller(2009), Kahneman (2002)).

The rest of the paper is organized as follows. Section 2 provides a short discussion on the basic feature of the behavioural models. (i.e. the role of animal spirits and business cycle). Section 3 discusses an application of a one country behavioural model. This allows us to analyze the issue related to low inflation targets that can cause economies to hit the zero lower bound during deflationary periods caused by shocks. Section 4 discusses another application based on a two-country behavioural model. We use this model to explain the possible channel that could lead to a high degree of synchronization between the business cycles of different countries. We conclude in Section 4.

2. Animal spirits and business cycles: the basic feature

De Grauwe (2012) introduces an adaptive learning assumption into a standard New Keynesian Macroeconomic model setting. The aggregate demand and supply equations plus the Taylor rule are shown in equations (1), (2) and (3) respectively.

$$y_t = a_1 \widetilde{\mathrm{E}}_t y_{t+1} + (1 - a_1) y_{t-1} + a_2 \left(r_t - \widetilde{\mathrm{E}}_t \pi_{t+1}\right) + \varepsilon_t \qquad (1)$$

$$\pi_t = b_1 \widetilde{\mathrm{E}}_t \pi_{t+1} + (1 - b_1) \pi_{t-1} + b_2 y_t + \eta_t \qquad (2)$$

$$r_t = c_1 (\pi_t - \pi^*) + c_2 y_t + c_3 r_{t-1} + u_t \qquad (3)$$

where y_t is the output gap in period t, r_t is the nominal interest rate, π_t is the rate of inflation. π^* is the inflation target. y_{t-1}, r_{t-1} and π_{t-1} are lagged variables of

output gap, interest rate and inflation. This model also has two forward looking components concerning output gap and inflation, i.e. $\widetilde{\mathrm{E}}_{\mathrm{t}} y_{t+1}$ and $\widetilde{\mathrm{E}}_{\mathrm{t}} \pi_{t+1}$.

In the traditional DSGE model, agents are assumed to form rational expectations. In our model, the tilde above *E* refers to the fact that expectations are not formed rationally. Agents are assumed to experience cognitive limitations preventing them from having rational expectations. These agents use simple forecasting rules and evaluate the forecasting performances of these rules ex-post. This evaluation leads them to switch to the rules that perform best in forecasting output and inflation rate. Agents are assumed to use simple rules (heuristics) to forecast the future output gap and inflation. The way we proceed is as follows. For example, we assume two types of forecasting rules in output gap. A first rule is called a "fundamentalist" one. Agents estimate the steady state value of the output gap (which is normalized at 0) and use this to forecast the future output gap[i]. A second forecasting rule is an "extrapolative" one. This is a rule that does not presuppose that agents know the steady state output gap. They are agnostic about it. Instead, they extrapolate the previous observed output gap into the future.

This adaptive learning assumption produces endogenous waves of animal spirits (i.e. optimism and pessimism) that drive the business cycle in a self-fulfilling way. This also leads to a two-way causality i.e. optimism (pessimism) leads to an increase (decline) in output, and the increase (decline) in output in term intensifies optimism (pessimism), see De Grauwe(2012), and De Grauwe and Ji(2017 &2018).

An important feature of this dynamics of animal spirits is that the movements of the output gap are characterized by periods of tranquility alternating in an unpredictable way with periods of intense movements of booms and busts. Technically this means that the distribution of the output gap and output growth is non-Gaussian and exhibits fat tails.

There is now a significant body of empirical evidence showing that the output gap (and also the growth of output) in the OECD countries do not exhibit a Gaussian distribution, and that they are characterized by excess kurtosis and fat tails. Fagiolo et al. (2008) and Fagiolo et al. (2009) did important econometric analysis documenting the non-normality of the distribution of output gap and growth rates of GDP. Thus, our behavioral model predicts that in the real world the output gap does not follow a normal distribution but that it is characterized by excess kurtosis and fat tails. This feature of the higher moments of the output gap is generated endogenously in the model. It is not the result of imposing such a feature on the stochastic shocks hitting the economy.

The contrast with standard DSGE-models is significant. These models find it difficult explain the fat tails in the distribution of the output gap. They have to rely on large exogenous shocks as explanations of the boom and bust features of the business cycles. Such an explanation is not satisfactory as it shifts the burden of explaining the business cycle to outside forces.

In the next two sections, we discuss other features of our behavioural models in two specific applications.

3. Animal spirits and the optimal level of the inflation target

An inflation target too close to zero risks pushing the economy into a negative inflation territory even when mild shocks occur. During periods of deflation the nominal interest rate is likely to hit the lower zero bound. When this happens the real interest rate cannot decline further. In such a scenario the central bank loses its capacity to stimulate the economy in a recession, thereby risking prolonged recessions (Eggertson and Woodford(2003), Aruoba, & Schorfheide, F. (2013), Blanchard, et al. (2010), Ball(2014)).

The use of a behavioral macroeconomic model allows to shed new light on the nature of this risk (see De Grauwe and Ji(2018)). This model has three standard New Keynesian Macroeconomic equations (the aggregate demand and supply

equations plus the Taylor rule as described in Section 2). As explained earlier, agents in our model use simple rules of thumb to forecast the output gap and the rate of inflation. The constraint of the central bank in this model is the nominal interest rate has the zero lower bound (ZLB), i.e. $r_t \geq 0$.

The use of this model leads to three key findings. First, our behavioural model predicts that with an inflation target of 2% (and assuming standard Taylor rule parameters) the probability of hitting the ZLB is about 20%. This finding is in contrast to standard linear DSGE models which have tended to underestimate the probability of hitting the ZLB (Chung, et al., (2012)). Most of these models have led to the prediction that when the central bank keeps an inflation target of 2%, it is very unlikely for the economy to be pushed into the ZLB (Reifschneider and Williams (2000), Coenen(2003), Schmitt-Grohe and Uribe(2007)).

Second, we find that when the inflation target is too close to zero, the economy can get gripped by "chronic pessimism" that leads to a dominance of negative output gaps and recessions, and in turn feeds back on expectations producing long waves of pessimism. The mechanism that produces this chronic pessimism can be described as follows. Endogenous movements in animal spirits regularly produce recessions and negative inflation rates. When that happens, the central bank cannot use its interest rate to boost the economy and to raise inflation as the nominal interest rate cannot become (sufficiently) negative. When inflation becomes negative this also implies that the real interest rate increases during the recession, aggravating the latter, and increasing pessimism. The economy can get stuck for a long time in this cycle of pessimism and negative output gap.

Not surprisingly, when the inflation target is close to zero the output gap and the rate of inflation will be pushed more often into negative territory than when the target is set farther away from zero, thereby producing more periods of "chronic pessimism". Put differently, when the inflation target is set too close to zero the distribution of the output gap is skewed towards the negative territory.

The question then is what "too close to zero" means. The simulations of our model, using parameter calibrations that are generally found in the literature, suggests that 2% is too low, it risks putting the output gap skewed towards the negative territory. We show this idea in Figure 1 by producing skewness in the distribution of the output gap. Without assuming the ZLB, the skewness of the output gap is around zero (De Grauwe 2012). Assuming ZLB, Figure 1 presents the skewness of the output gap as a function of the inflation target. We find that for inflation targets below 3% the skewness is negative, i.e. the distribution of the output gap is skewed towards the left with more negative than positive output gaps. An inflation target in the range of 3% to 4% comes closer to producing a symmetric distribution of the output gap.

Figure 1

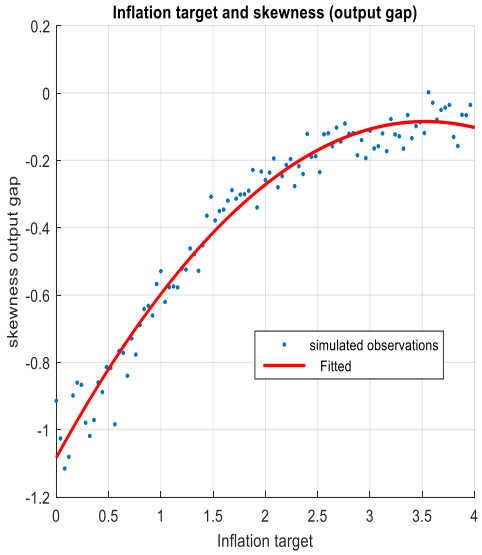
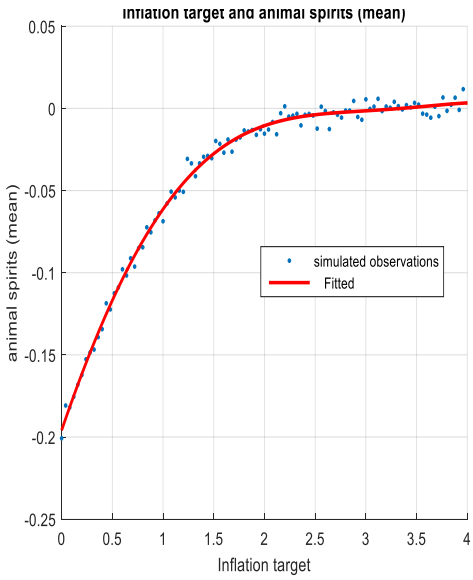


Figure 2



The negative skewness of the output gap is related to the asymmetry of animal spirits when the inflation target is low. In our model we measure animal spirits by an index reflecting the fractions of agents, which make a positive (negative) forecast of the output gap. When all agents make a positive forecast the index is 1; when they all make a negative forecast the index is -1. When positive and negative forecasts balance out, the index is 0. Thus, our index measures optimism and pessimism about the future output gap. In Figure 2 we show the relation between the mean animal spirits and the level of the inflation target. We observe that when the inflation target is low, agents are pessimistic on average.

In this sense, low inflation targets create "chronic pessimism" about the future economic conditions. This result is in contrast to the case when we assume the ZLB, the mean animal spirits is zero across different inflation targets.

A third result concerns credibility of the inflation target. Our model gives a precise definition of credibility, as the fraction of agents that use the announced inflation target as their rule of thumb to forecast inflation. It turns out that an inflation target of 3% or 4% has more credibility than a target of 2%. The reason has to do with what we said earlier. With an inflation target of 2% the output gap and inflation are more often pushed into negative territory than when the inflation target is 3% or 4%. Once these variables are in the negative territory the power of the central bank to affect the output gap and inflation is weakened. As a result, the observed inflation rate will deviate more often from the target, thereby undermining the credibility of the central bank.

Our analysis leads to the conclusion that central banks should raise the inflation target from 2% to a range between 3% to 4% (see also Blanchard, et al. (2010) and Ball(2014) on this). One issue that we have not analysed so far is how periods of prolonged pessimism that are produced by an inflation target that is set too low affects long term growth. It is not unreasonable to believe that "chronic pessimism" lowers investment in a persistent way thereby lowering long-term growth. As we have not incorporated these long-term growth effects in our model, it is difficult to come to precise conclusions. We leave this issue for further research.

4. Animal spirits and synchronization of business cycles

A second application of our behavioural model finds its use in explaining how Business cycle across countries are highly correlated. We first show some empirical evidence in the literature concerning this feature both for the group of Eurozone countries and a group of industrialized countries outside the Eurozone. Then we provide our explanation using our behavioural model compared to the current models using DSGE models. Our simple two-country

behavioural model has the advantage that it allows to generate high synchronization of business cycles without relying on common shocks as in the standard DSGE model.

Tables 1 and 2 present the bilateral correlations of the business cycle component of GDP in the Eurozone and in the rest of the OECD. The business cycle component is obtained by using a Hodrick-Prescott (HP) filter on GDP data.

It is striking to find how high these correlation coefficients are. This is especially the case within the Eurozone where we find many correlation coefficients of the business cycle components exceeding 0.9. On average we find that this correlation coefficient is 0.82, suggesting a very high degree of synchronization of the business cycles within the Eurozone. We are aware of the fact that measuring business cycles is fraught with difficulties. However, our findings are consistent with others (see de Haan et al. (2008), Giannone et al. (2009)).

Outside the Eurozone we observe smaller bilateral correlations of the business cycles than in the Eurozone. However, these correlations can still be called quite high. They often reach levels of 0.6 or more. The average of all the correlation coefficients in table 2 is 0.61. Thus it appears that in the group of industrial countries outside the Eurozone business cycles are also quite synchronized.

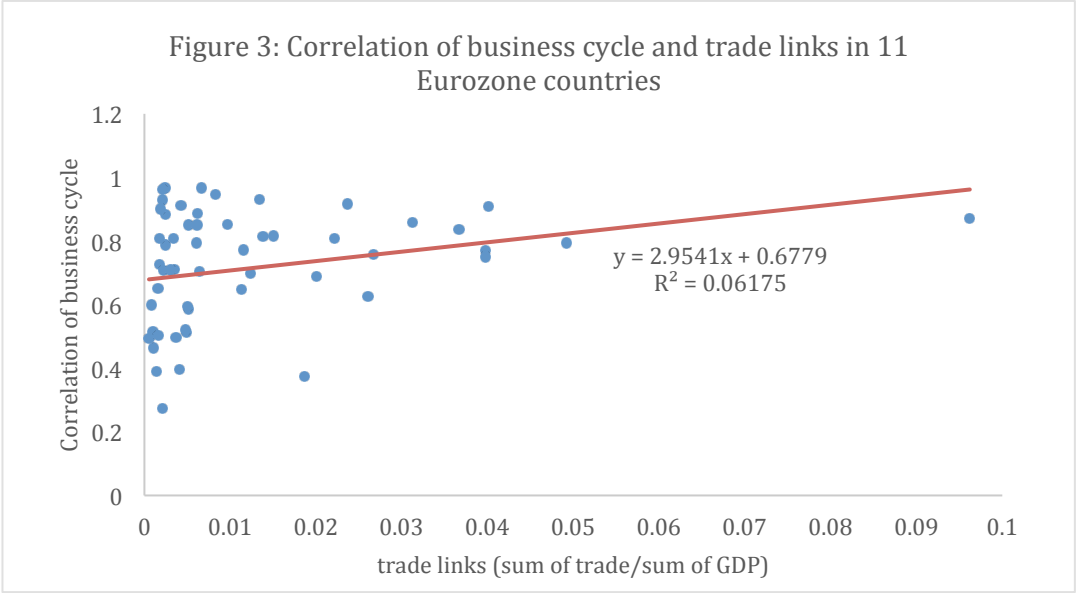
There exists empirical evidence that the degree of synchronization of the business cycles is influenced by the degree of trade integration. Frankel and Rose(1998) found that increasing trade integration leads to more synchronization of the business cycles. This has been confirmed by other empirical studies (see Artis and Cleays(2005), Bordo and Helbling(2004)).

Table 1: Bilateral correlations of the business cycle component of GDP growth in Eurozone countries(1995-2014), Source: OEC

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	1,00										
Belgium	0,97	1,00									
Finland	0,97	0,98	1,00								
France	0,93	0,95	0,97	1,00							
Germany	0,69	0,57	0,55	0,59	1,00						
Greece	0,73	0,82	0,84	0,74	0,09	1,00					
Ireland	0,85	0,89	0,92	0,95	0,41	0,81	1,00				
Italy	0,91	0,96	0,98	0,96	0,50	0,86	0,93	1,00			
Netherlands	0,93	0,94	0,93	0,91	0,60	0,75	0,86	0,90	1,00		
Portugal	0,98	0,89	0,89	0,87	0,37	0,82	0,87	0,90	0,94	1,00	
Spain	0,85	0,91	0,94	0,87	0,27	0,97	0,90	0,95	0,86	0,90	1,00

Table2: Bilateral correlations of the business cycle component of GDP growth in non-Eurozone countries(1995-2014), Source: OECD

	Australia	Canada	Czech	Denmark	Hungary	Japan	Korea	Norway	Poland	Sweden	Switzerland	UK	US
Australia	1,00												
Canada	0,81	1,00											
Czech	0,41	0,24	1,00										
Denmark	0,84	0,90	0,61	1,00									
Hungary	0,83	0,79	0,67	0,88	1,00								
Japan	0,48	0,60	0,63	0,71	0,69	1,00							
Korea	0,63	0,75	0,48	0,76	0,81	0,54	1,00						
Norway	0,85	0,87	0,56	0,95	0,87	0,66	0,69	1,00					
Poland	0,07	-0,09	0,50	0,20	-0,04	0,01	-0,06	0,14	1,00				
Sweden	0,80	0,87	0,62	0,96	0,86	0,80	0,78	0,87	0,21	1,00			
Switzerland	0,22	0,29	0,67	0,57	0,29	0,47	0,27	0,51	0,75	0,55	1,00		
UK	0,88	0,91	0,52	0,93	0,95	0,73	0,80	0,92	-0,10	0,90	0,30	1,00	
US	0,87	0,96	0,33	0,93	0,83	0,64	0,67	0,92	-0,04	0,88	0,30	0,93	1,00



Source: authors' own estimation using data from OECD and IMF, direction of trade

Trade integration is one explanatory factor, but it does not explain everything. This is made clear by figure 3 which plots the bilateral correlation coefficients obtained from table 1 with the bilateral trade flows (as a percent of the sum of the GDPs of the pairs of countries involved). We observe that there is a positive relation between the degree of bilateral trade integration and bilateral correlations. This relation, however, is weak and explains only a small fraction of the variation in the bilateral correlations. (We obtain the same result with the other industrial countries outside the Eurozone). Clearly there are other mechanisms at work driving the synchronization of business cycles.

Mainstream macroeconomic models (both real business cycle models and DSGE models) have found it difficult to replicate the observed high synchronization of business cycles in the industrialized world. This problem was first pointed out by Backus et al.(1992) who found that standard open economy versions of real business cycle models could not explain the high level of synchronization of the business cycles across countries (see also Canova and Dellas(1993)). Open economy versions of DSGE-models have experienced the same problem (see Alpanda and Aysun(2014)). Of course one can solve these problems in these models by assuming high positive correlations of exogenous shocks. But this is

not really an explanation as it forces the designers of these models to admit that high correlations of the business cycles across countries are produced outside their models. This is not a very satisfactory analysis.

There have been attempts to explain the high synchronization of the business cycles across countries by introducing financial integration in the models (see e.g. Gertler et al.(2007), Devereux and Yetman(2010), Kollmann(2012), Alpanda and Aysun(2014)). This goes some way in explaining this synchronization. But again too much is "explained" by introducing highly correlated exogenous financial shocks (see Rey(2014)).

We have attempted to go further and to explain the international synchronization of business cycles endogenously (see De Grauwe and Ji(2017)). Using the same framework described in Section 2, we develop the model in a two-country behavioural macroeconomic model setting. To keep the model simple we assume the two countries are exact the same. These countries are linked with each other by trade. The characteristic feature of this model is again that agents have cognitive limitations preventing them from forming rational expectations. Instead, they use simple rules of thumb (heuristics) to forecast. They select those forecasting rules that perform best.

As mentioned in the previous section the model produces waves of optimism and pessimism (animal spirits) endogenously. These animal spirits arise because optimistic (pessimistic) forecasts are self-fulfilling, leading to booms and recessions, and therefore attract more agents into being optimists during booms and pessimists during recessions. Thus there is a two-way causality between animal spirits and the business cycle.

In a two-country model this mechanism produces a synchronization of the business cycles endogenously. We find that, even if exogenous shocks are not correlated there is an endogenous mechanism that transforms uncorrelated shocks into positive correlations of output across countries. The mechanism that produces this can be described as follows. Small shocks in output (positive or negative) in one country set in motion a *domestic* and an *international* self-reinforcing mechanism. The *domestic* one comes about through the interaction between changes in the output gap and animal spirits, whereby the positive

(negative) output gap creates optimistic (pessimistic) expectations. The latter then feeds back on the output gap. This is the two-way causality between the output gap and animal spirits in each country.

The *international* self-reinforcing mechanism starts from a shock (either demand or supply side) in one country that is transmitted through trade to the other country, where it sets in motion a self-reinforcing mechanism with animal spirits. This is then transmitted back to the first country. All this leads to the result that an idiosyncratic (uncorrelated) shock in one country leads to correlated output and animal spirits across countries.

Thus, the main channel of the international synchronization business cycles occurs through a propagation of "animal spirits", i.e. waves of optimism and pessimism that become correlated internationally. We find that one does not need much trade to trigger this endogenous synchronization of the business cycles. We applied empirical tests that confirmed the existence of a domestic and international propagation mechanism through animal spirits (see De Grauwe and Ji (2017)).

A monetary union matters. We find that the propagation of animal spirits and thus the synchronization of the business cycles are stronger among countries that are members of a monetary union than among "standalone countries" that have their own independent central banks. This difference occurs because in a monetary union there is a common central bank imposing the same interest rate and thereby helping in transmitting animal spirits from one country to the other.

Finally, the degree of synchronization of business cycles is very much influenced by the intensity with which the central banks stabilize output. When that intensity is high, the central banks are able "to tame the animal spirits" in each individual country (De Grauwe (2012)). In so doing they reduce the propagation dynamics of these animal spirits.

5. Conclusion

In this paper we discussed a behavioral New Keynesian macroeconomic framework that produces endogenous waves of optimism and pessimism (animal spirits). We argued that this model is better capable of understanding the dynamics of booms and busts that is a characteristic of capitalist economies. This contrasts with mainstream Dynamic Stochastic General Equilibrium (DSGE) models. The latter typically explain the business cycles by a sequence of exogenous shocks that disturb the peaceful optimization of utility maximizing agents with rational expectations. In these DSGE-models booms and busts are the result of exogenous disturbances and not the outcome of an endogenous macroeconomic dynamics.

We used our behavioral macroeconomic model to analyze two macroeconomic issues. The first one was the issue of the Zero Lower Bound on the nominal interest rate and the inflation target. This led to new insights. For example, we found that when the inflation target is set too close to zero it leads to a skewed distribution of the output gap and animal spirits. Put differently, when the inflation target is set too close zero this creates "chronic pessimism", i.e. long periods of negative animal spirits that depress economic activity and leads to long and protracted recessions. We argued that this leads to the need to raise the inflation target, presently closed to 20% in many countries, to a range of 3% to 4%.

A second application of our behavioral model consisted in extending it to a two-country setup. This allowed us to shed new light on the puzzle of the high synchronization of the national business cycles in the industrialized world. These cannot easily be explained in standard macroeconomic models except by assuming common exogenous shocks (again). We used our two-country behavioral model and found that the model is capable of generating a strong international transmission of animal spirits, which in turn leads to a strong correlation of the business cycles. These come close to the observed correlations. We achieve this without the need to invoke common exogenous shocks (De Grauwe and Ji(2017)).

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[i] In De Grauwe(2012) more complex rules are used, e.g. it is assumed that agents do not know the steady state output gap with certainty and only have biased estimates of it. This is also the approach taken by Hommes and Lustenhouwer(2016).