



Animal Spirits and the International Transmission of Business Cycles

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Introduction: Some facts

- Let us first look at some facts

Bilateral correlations business cycle components GDP growth

| | Austria | Belgium | Finland | France | Germany | Greece | Ireland | Italy | Netherl | 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 |

Bilateral correlations business cycle components GDP growth

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

Figure 1: Business cycle components of GDP growth

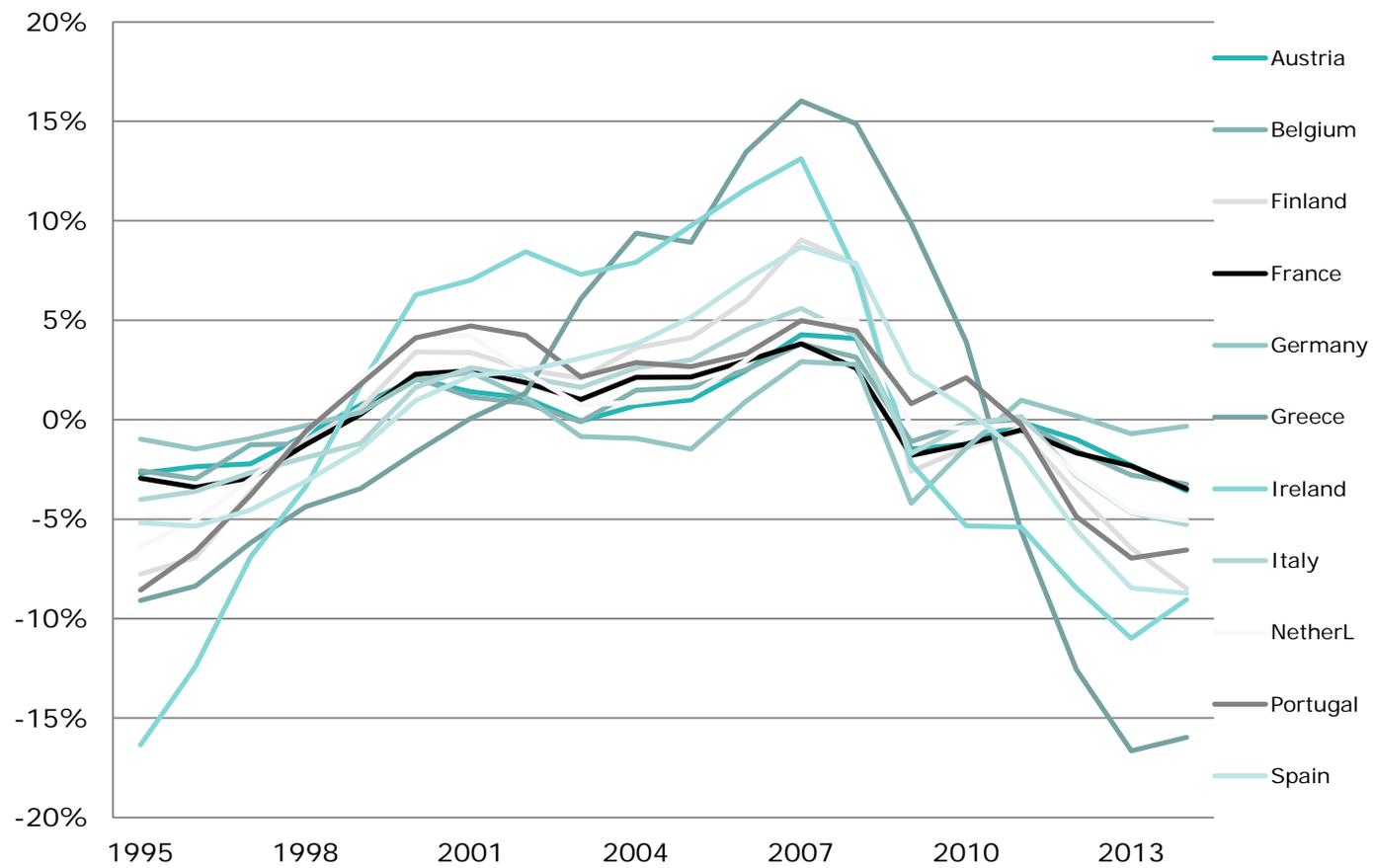


Figure 2: Correlation of business cycle and trade links in 11 Eurozone countries

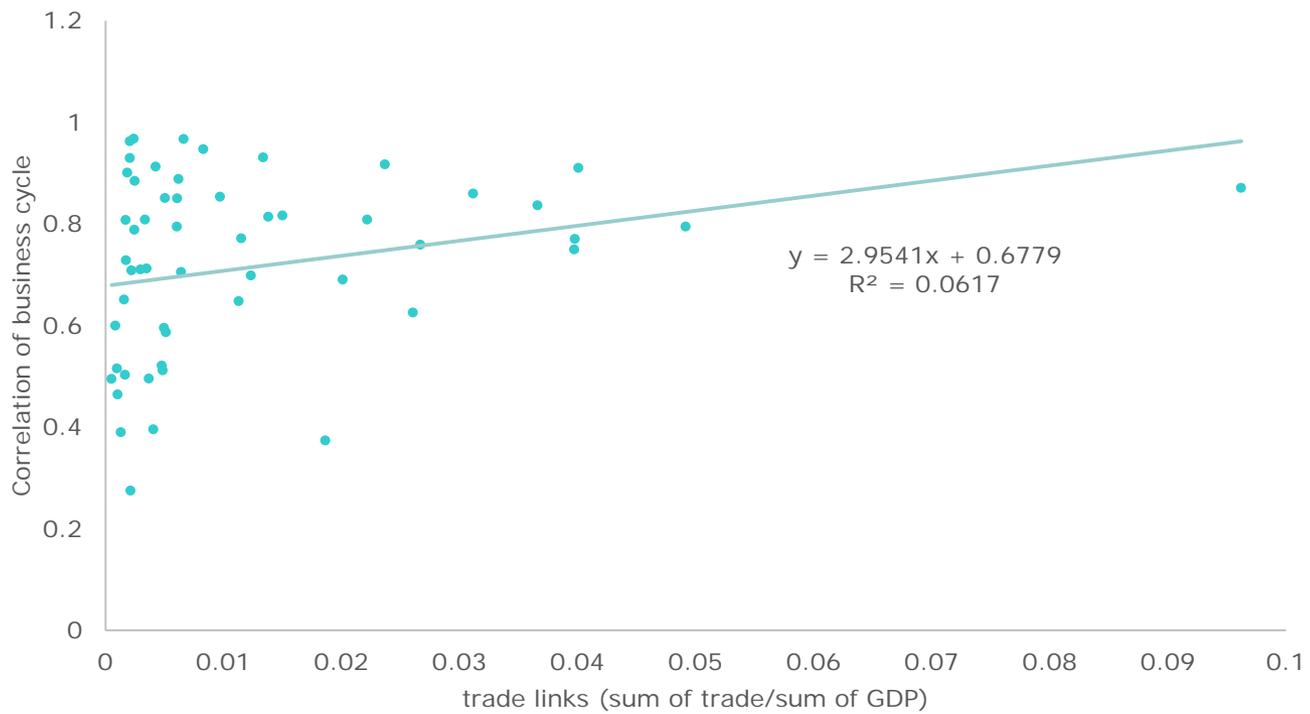
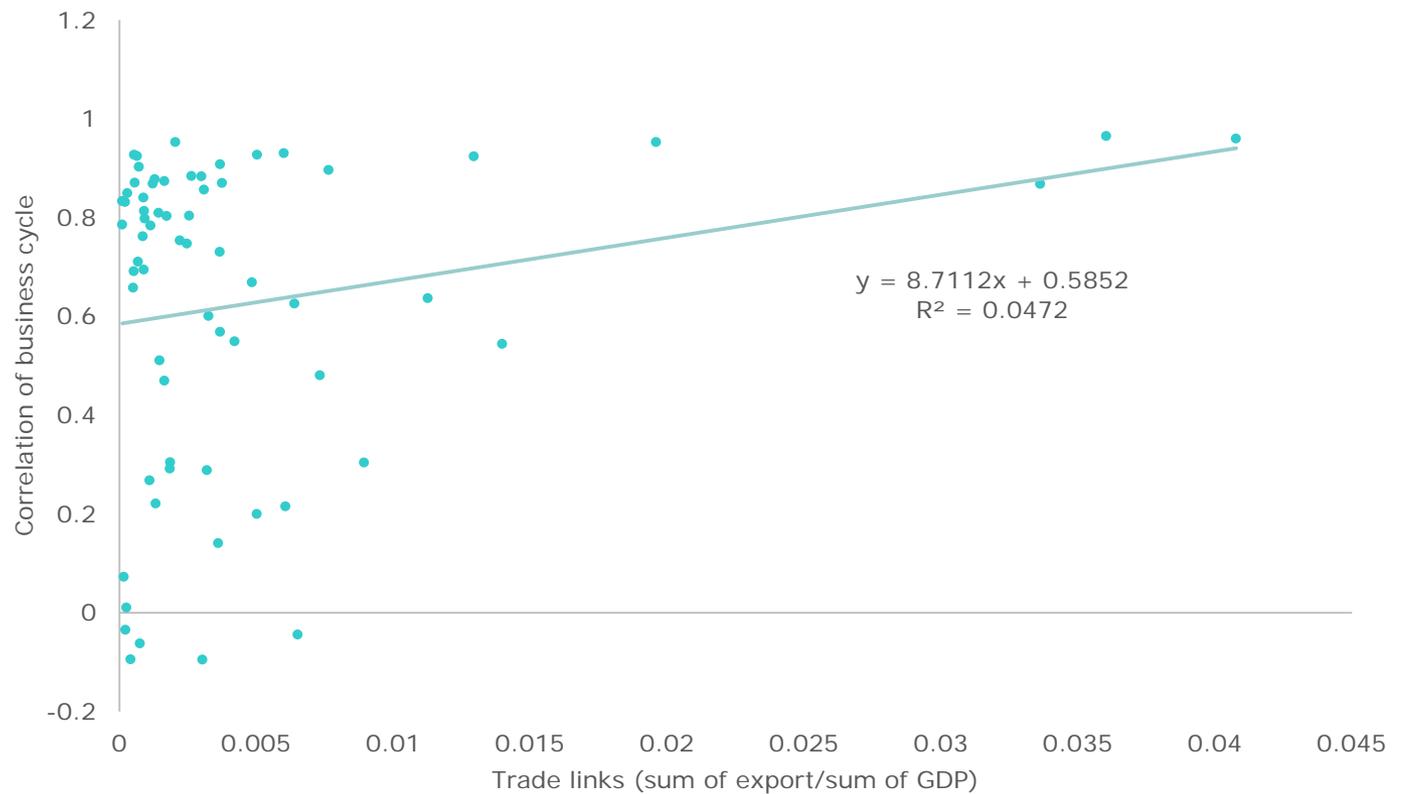


Figure 3: Correlation of business cycle and trade links in 12 stand-alone countries



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- Mainstream DSGE-models have been struggling to provide a good explanation.
 - Of course one can “solve” these problems by assuming high positive correlations of exogenous shocks.
 - But this is not really an explanation
 - it forces the designers of these models to admit that high correlations of the business cycles across countries are produced outside their models.

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- There have been attempts to explain the high synchronization of the business cycles across countries by introducing financial integration in the models
 - This goes some way in explaining this synchronization.
 - But again too much is “explained” by introducing highly correlated exogenous financial shocks.



A behavioral model approach

- We want to go further
- And make the explanation endogenous in the model
- This will also allow us to better understand the transmission of demand and supply shocks

The model: structure is the same in behavioral model and in DSGE

○ **Aggregate demand**

$$\tilde{y}_t = a_1 \hat{E}_t \tilde{y}_{t+1} + (1 - a_1) \tilde{y}_{t-1} + a_2 (r_t - \hat{E}_t \pi_{t+1}) + \varepsilon_t$$

- Forward and backward looking term (habit formation)
- \hat{E} above E means: non rational expectation

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- **Aggregate supply:** New Keynesian Phillips curve

$$\pi_t = b_1 \hat{E}_t \pi_{t+1} + (1 - b_1) \pi_{t-1} + b_2 \tilde{y}_t + \eta_t$$

- **Taylor rule** describes behavior of central bank

$$r_t = c_1 (\pi_t - \pi^*) + c_2 \tilde{y}_t + c_3 r_{t-1} + u_t$$

when $c_2 = 0$ there is strict inflation target

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- We apply this model in a two-country setup
 - Thus there are two demand equations linked by trade flows
 - There are two supply equations
 - We apply model to
 - Monetary union: one central bank using Taylor rule
 - Monetary autonomy of two countries with two central banks applying their own Taylor rules



Introducing heuristics

- Instead of assuming RE we assume agents to have cognitive limitations
- They use simple forecasting rules (heuristics)
 - A fundamentalist rule
 - An extrapolative rule
- They learn from their mistakes and are willing to switch to rule that performs better
- We define animal spirits as the fraction of agents making positive forecast of output gap

Calibrating the model

- We calibrate the model by giving numerical values to the parameters that are often found in the literature
- And simulate it assuming i.i.d. shocks with std deviations of 0.5%
- We first apply the model to monetary union
- Later to countries keeping monetary independence

Figure 2: simulation of the output gaps in countries 1 and 2

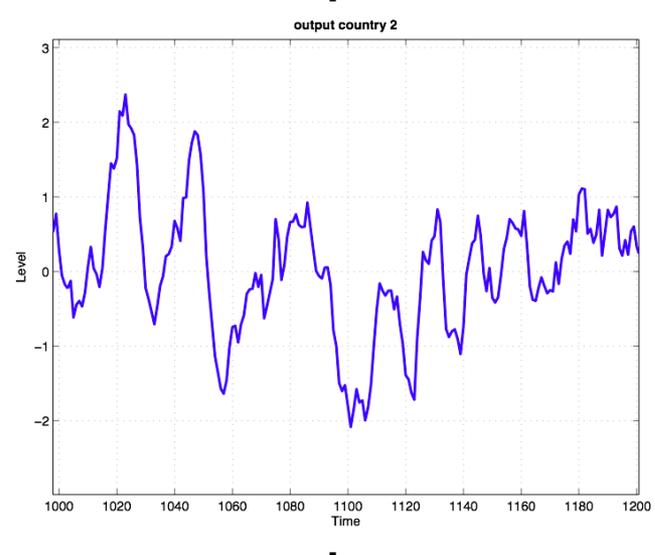
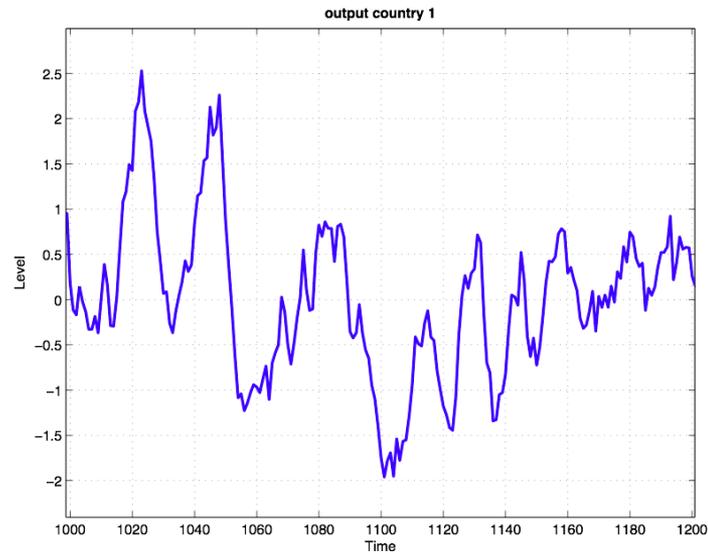
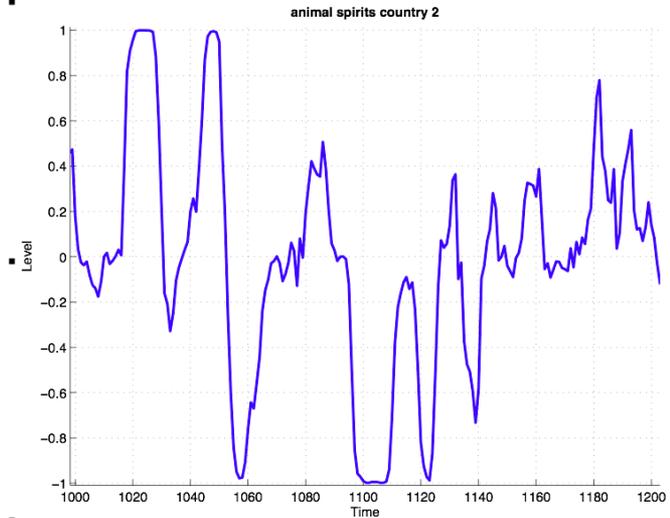
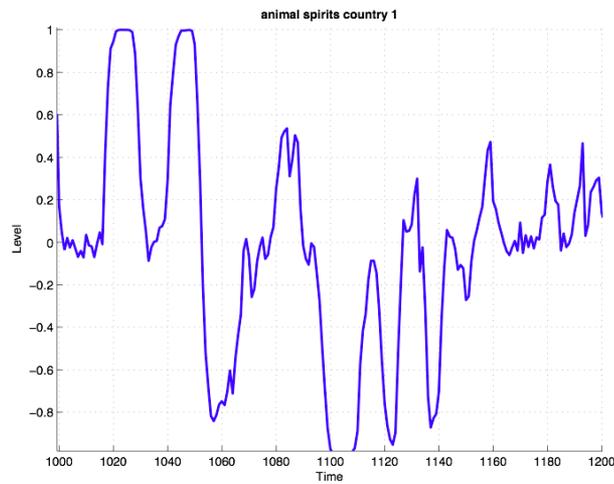


Figure 3: simulation of the animal spirits in countries 1 and 2



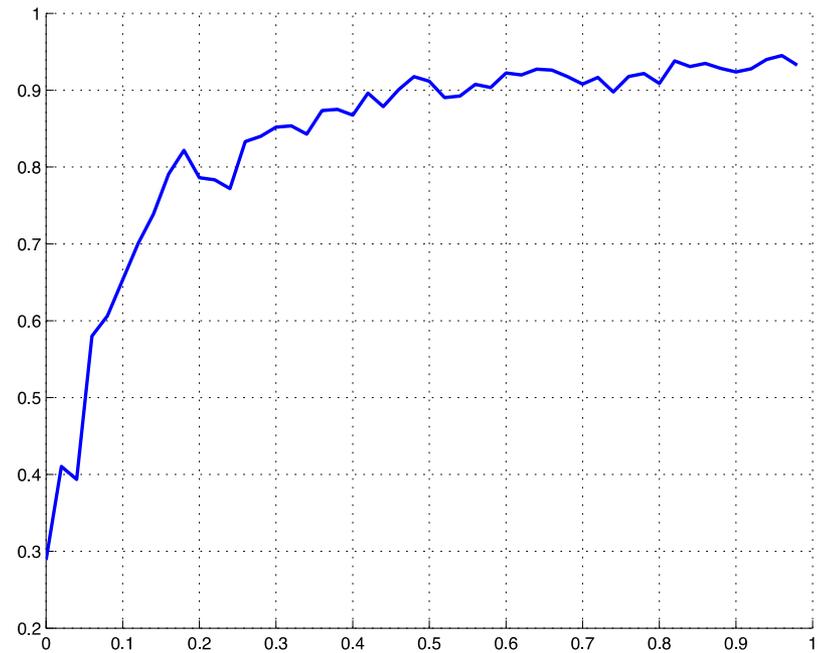
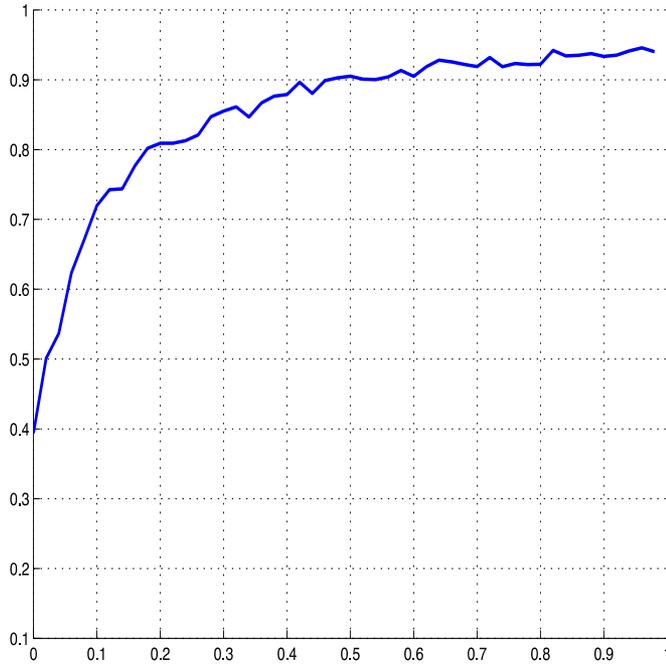
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- Model produces international contagion of animal spirits.
 - Animal spirits are highly correlated between the two countries reaching 0.95.
 - Why? When a wave of optimism is set in motion in country 1, it leads to more output and imports in that country, thereby increasing output in country 2.



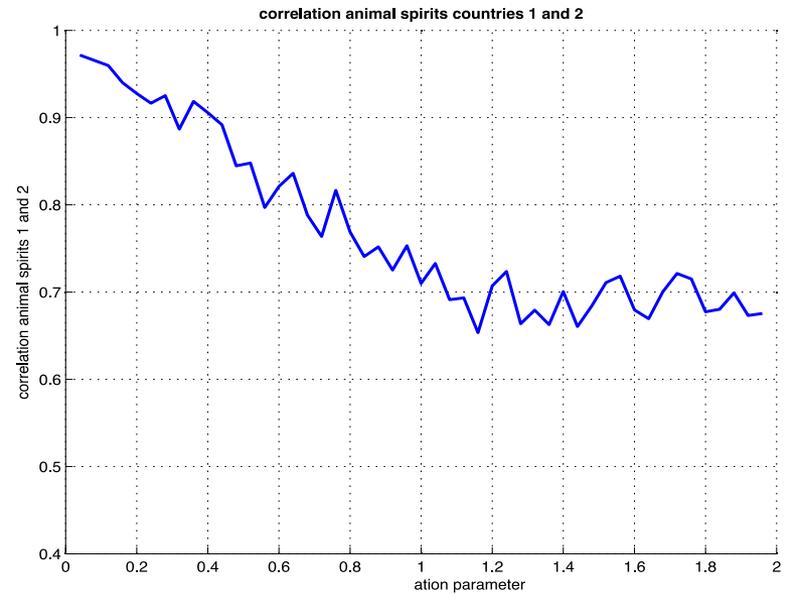
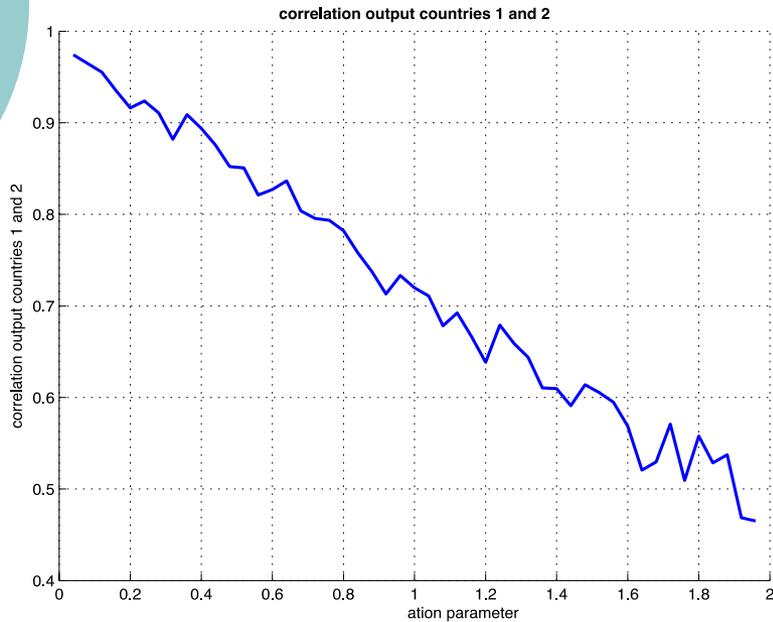
Positive transmission, even if small, makes it more likely that agents in country 2 that make optimistic forecasts are vindicated, thereby increasing the fraction of agents in country 2 that become optimists.

- We obtain transmission dynamics that triggered by trade flows is amplified leading to strong synchronization of the business cycles across countries.
- Similar result in model with monetary independence

Factors affecting synchronization of business cycle: trade



Factors affecting synchronization of business cycle: output stabilization



Transmission of demand shock

Figure 17: Short-term output responses to demand shock in country 1

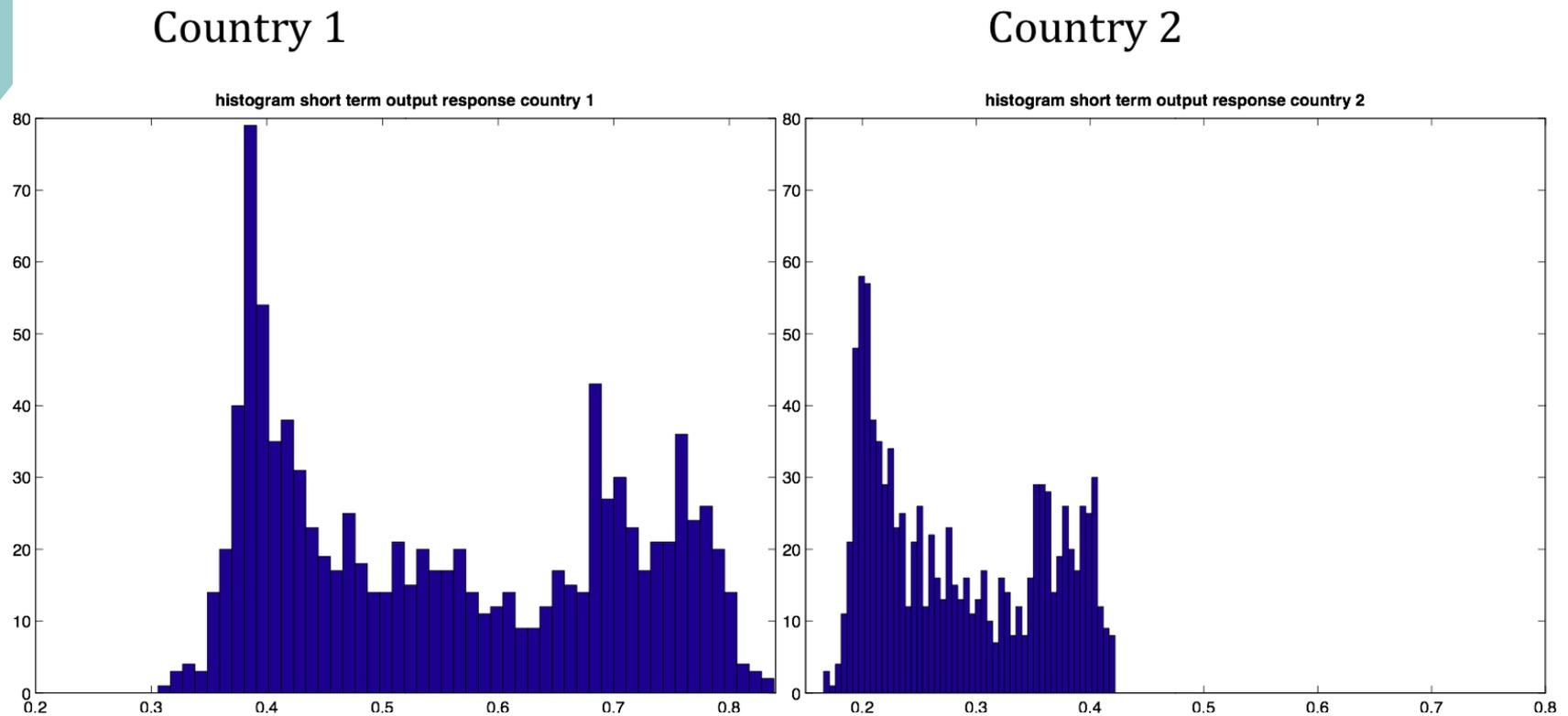


Figure 18: Short-term output responses and animal spirits

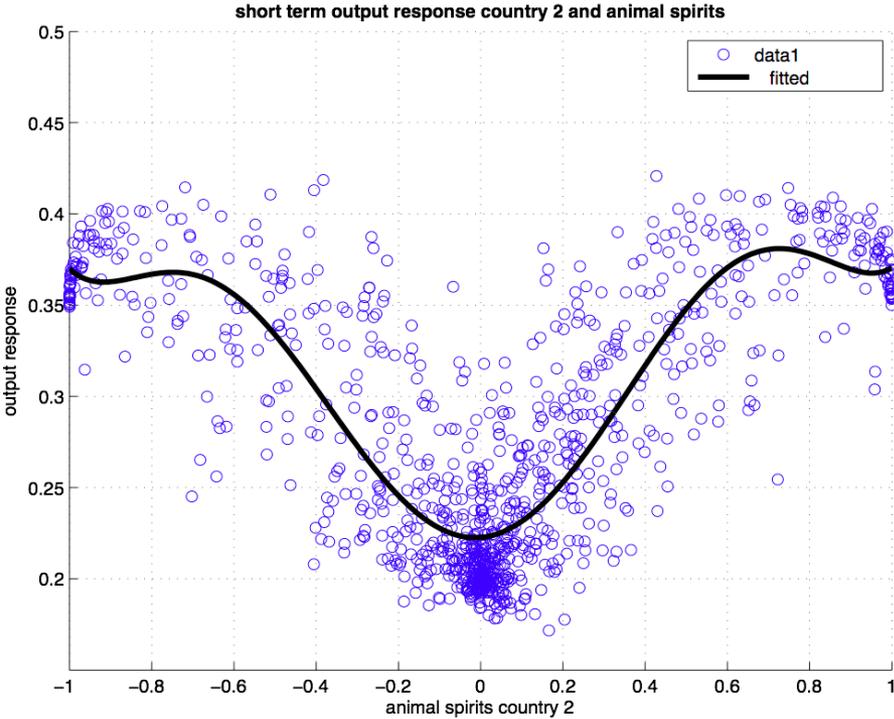
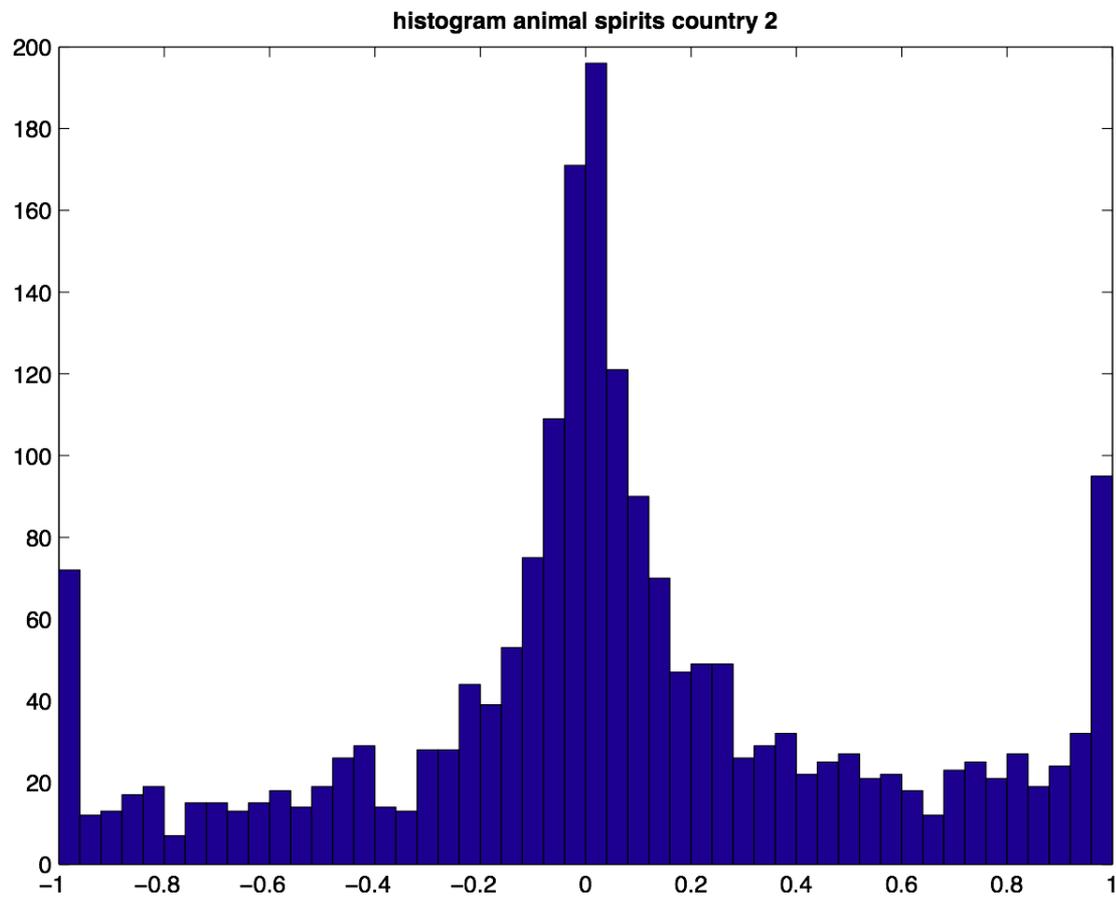
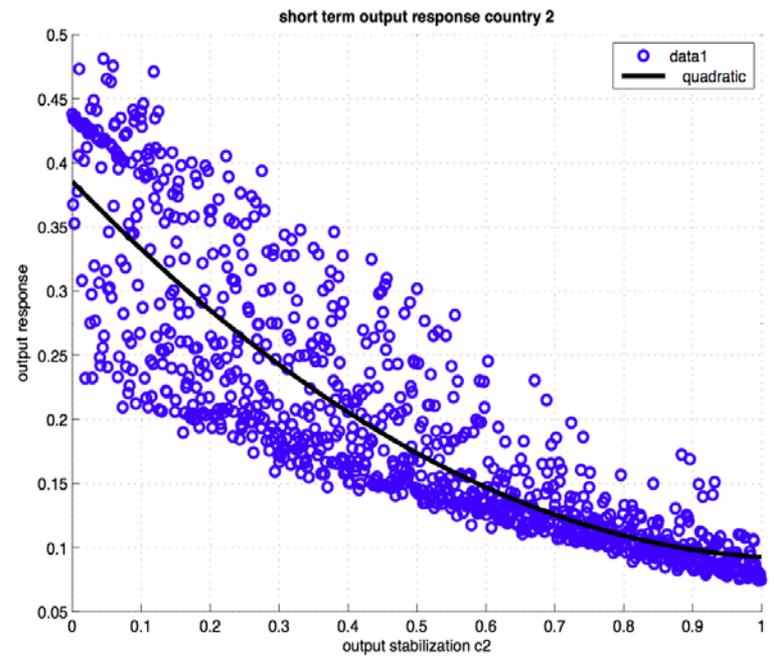
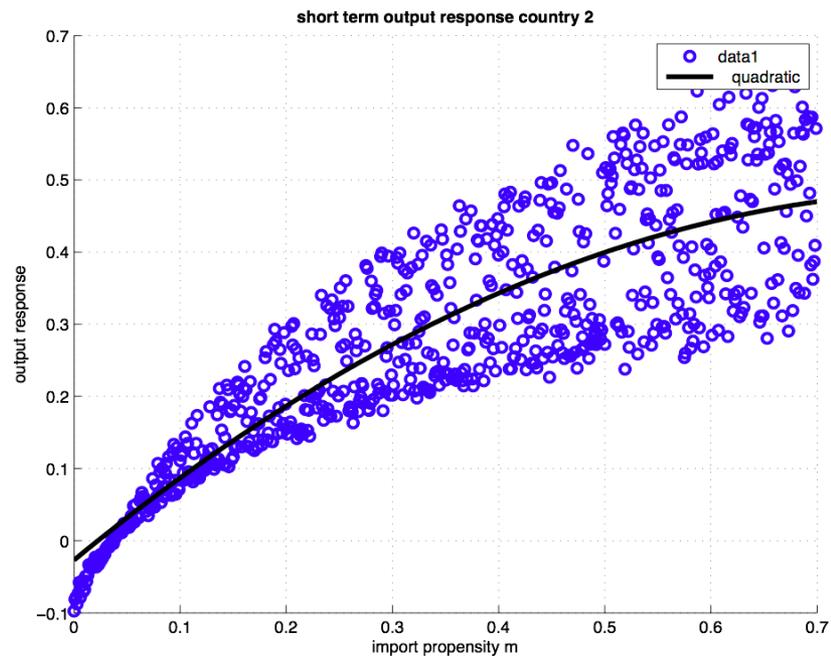


Figure 19: Frequency distribution of animal spirits in country 1

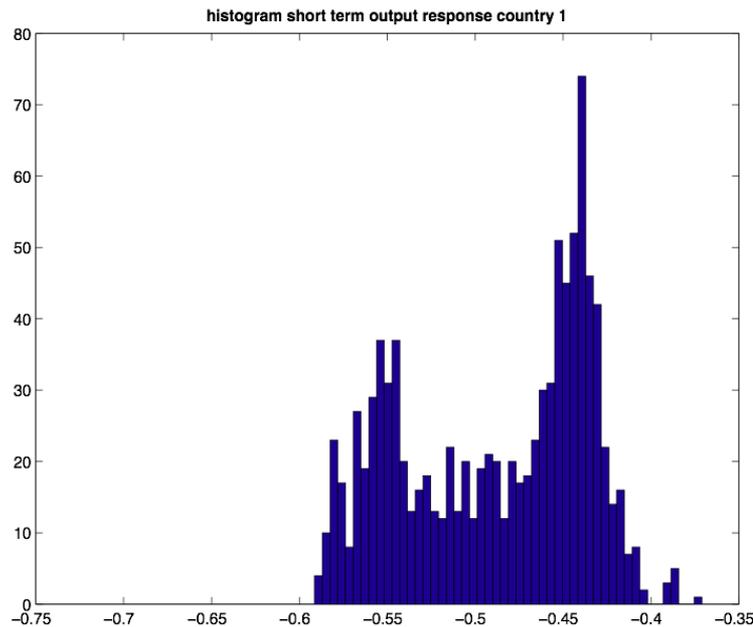




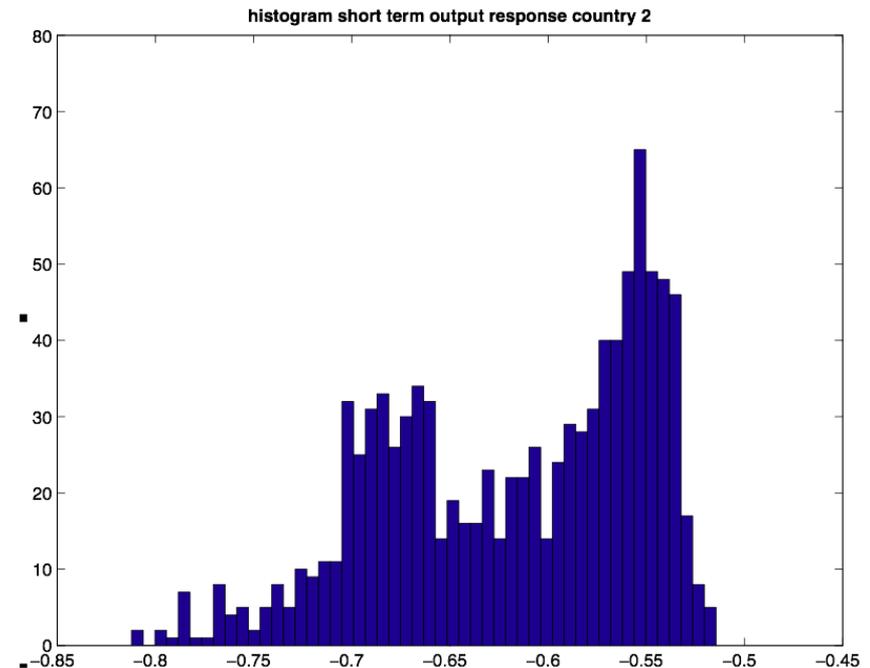
Transmission of supply shock: monetary union

Figure 26: Short-term output responses to supply shock in country 1

Country 1



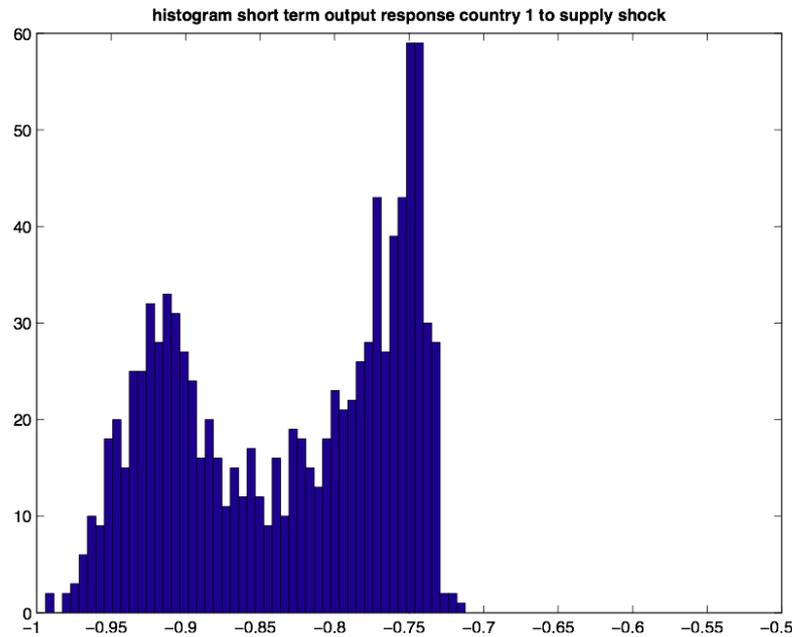
Country 2



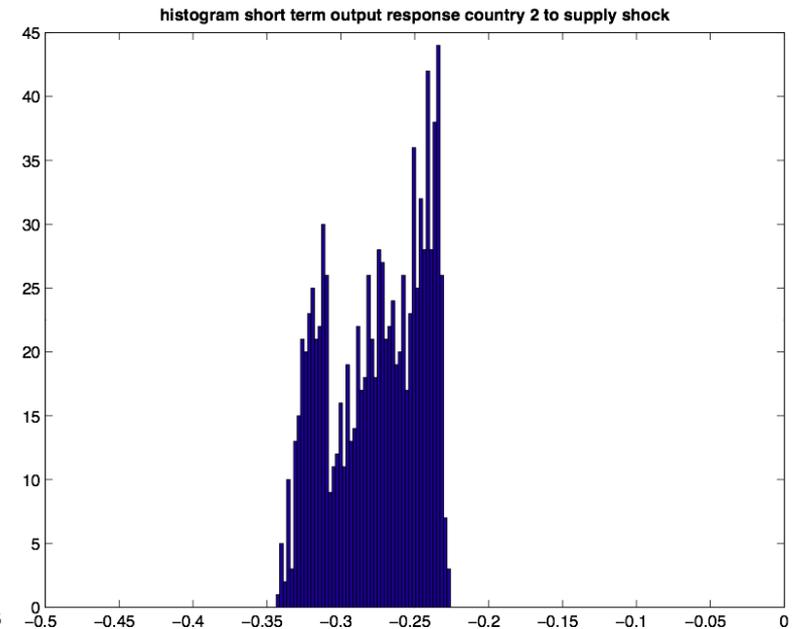
Transmission supply shock: monetary independence

Figure 28: Short-term output responses to supply shock in country 1

Country 1



Country 2



Conclusion

- Main channel of international synchronization business cycles occurs through a propagation of “animal spirits”,
 - i.e. waves of optimism and pessimism that get correlated internationally.
 - this propagation occurs with relatively low levels of trade integration.
- Degree of synchronization is influenced by the intensity with which the central bank stabilizes output.

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- Propagation of animal spirits is stronger among countries in monetary union than among “standalone countries” with own independent central banks.
 - This difference occurs because in a monetary union the common central bank is a source of common shocks.
 - This introduces correlation between the animal spirits of the member countries

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- Transmission of demand and supply shocks depends on “initial conditions”, i.e. the business cycle situation of the countries involved.
 - When business cycle is extreme, i.e. dominated by extreme pessimism or optimism transmission of demand and supply shocks is higher than when “Great Moderation” prevails.

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- When countries are part of a monetary union, a negative supply shock in one country is transformed into a strong negative demand shock in the other country.
 - This does not occur between monetary independent countries