The propagation of business sentiments within the European Union

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Introduction

- The outbreak of the financial crisis and subsequent European dept crisis reinforced the necessity to understand the transmission of shocks to economic activity within the European Union
- Policy relevance as common policy measures need to account for the likely spillover effects in order to effectively absorb external shocks
- Emphasis on goods and services markets instead of financial markets
- Analyse how shocks affect business sentiments of economic agents and create possible contagion effects

Objectives

- Investigate the propagation of business sentiments within and across European Union countries

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- Investigate the propagation of business sentiments within and across European Union countries
- Study how a shock to business sentiments in a certain industry in one member country affects business sentiments in other industries and member states both in the short- and long-run

Relevance of Microeconomic Shocks for the Macroeconomy

- Macroeconomic importance of microeconomic shocks dismissed by Lucas (1977) due to law of large numbers type of argument
- However, idiosyncratic shocks on firm or sector level can lead to aggregate volatility when considering
  - Granularity: the firm size distribution is sufficiently heavy tailed (e.g. Gabaix, 2011), empirical evidence for french firms by di Giovanni et al. (2014)
  - Network of input-output linkages (e.g Acemoglu et al., 2012), empirical evidence by Acemoglu et al. (2015)
- Sectoral heterogeneity in size and network relevance can also lead to macroeconomic tail risks, such that deviations of aggregate variables from their trends cannot be approximated by a normal distribution at the tails $\Rightarrow$ would underestimate the frequencies of economic downturns (Acemoglu et al., 2017)

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Expectations

- How decision making economic agents react to changes in information has been a fundamental and highly debated question
- Recent strand of literature investigates expectations of *firms*
  - ▷ Hellwig & Veldkamp (2009) provide micro-foundation for expectation formation, agents play strategic game where they can acquire costly information
  - ▷ Coibion et al. (2015) find widespread dispersion of beliefs concerning macroeconomic variables, Bachmann et al. (2013) investigate the impact of such uncertainty on economic activity
  - ▷ Bachmann & Elstner (2015) find systematic expectation biases by firms and are able to explain differences in these biases by observable firm characteristics
- Propagation of sentiments: Theoretical macroeconomic model by De Grauwe (2016) where the inter-country dependence of sentiments leads to international business cycle transmission

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Space-Time Model: Dynamic Spatial Durbin Model

$$\boldsymbol{y}_t = \phi \boldsymbol{y}_{t-1} + \rho \boldsymbol{W} \boldsymbol{y}_t + \boldsymbol{X}_t \boldsymbol{\beta} + \boldsymbol{W} \boldsymbol{X}_t \boldsymbol{\theta} + \boldsymbol{\mu} + \boldsymbol{\iota}_N \xi_t + \boldsymbol{u}_t \quad (1)$$

$$\boldsymbol{u}_t \sim \mathcal{N}(0, \sigma^2 \boldsymbol{I}_N) \quad (2)$$

$\boldsymbol{y}_t$	dependent variable (business sentiments) at time t $(N \times 1)$
ϕ	serial autocorrelation coefficient of business sentiments
ρ	"spatial" autocorrelation coefficient
$\boldsymbol{W}$	input-output weight matrix $(N \times N)$
$\boldsymbol{X}_t$	matrix of explanatory variables at time t $(N \times K)$
$\boldsymbol{\beta}$	vector of coefficients of the explanatory variables $(K \times 1)$
$\boldsymbol{\theta}$	vector of coefficients of the "spatially" lagged explanatory variables $(K \times 1)$
$\boldsymbol{\mu}$	country-industry specific effects $(N \times 1)$
ξ_t	time-period specific effect at time t
$\boldsymbol{u}_t$	error term at time t $(N \times 1)$
N	number of observations (country-industries) per cross section
K	number of explanatory variables

- Stationarity in time requires that $|\phi| < 1 - \rho\omega_{\text{max}}$ if $\rho \geq 0$ or that $|\phi| < 1 - \rho\omega_{\text{min}}$ if $\rho < 0$ (Elhorst, 2014)

Specification of the weights matrix I

- Weight matrix $\boldsymbol{W}$ based on inter-country input-output tables
- Prior to standardization, a typical element $w_{ik,jl}$ is defined as

$$w_{ik,jl} = \frac{\mathsf{IO}_{ik,jl}}{\mathsf{PROD}_{ik}}, \quad i \neq j \text{ if } k = l, \quad k \neq l \text{ if } i = j$$

  where $\mathsf{IO}_{ik,jl}$ is sales of industry k in country i to industry l in country j
- Similar to allocation coefficient matrix from input-output analysis
- Consistent with the construction of an **upstream network** to model the transmission of demand shocks in Acemoglu et al. (2015)
- $w_{ik,ik} = 0$, i.e. zero main diagonal
- $\boldsymbol{W}$ is constant over time

Specification of the weights Matrix II

- Additional weights matrix $\boldsymbol{W}_d$ to represent **downstream network**
  - Prior to standardization, a typical element $w^d_{ik,jl}$ is defined as

$$w^d_{ik,jl} = \frac{\mathsf{IO}_{jl,ik}}{\mathsf{PROD}_{ik}}, \quad i \neq j \text{ if } k = l, \quad k \neq l \text{ if } i = j$$

    where $\mathsf{IO}_{jl,ik}$ is sales of industry l in country j to industry k in country i, i.e. purchases of industry k in country i from industry l in country j

- Distinguish between **intra- and inter-industry** spillover effects:
  - Split original weights matrix into two $N \times N$ matrices

$$\boldsymbol{W}^{\text{inter}} + \boldsymbol{W}^{\text{intra}} = \boldsymbol{W}$$

    where $w^{\text{intra}}_{ik,jl}$ is non-zero for $k = l$ and zero otherwise, and where $w^{\text{inter}}_{ik,jl}$ is non-zero for $k \neq l$ and zero otherwise
  - Compute $\boldsymbol{W}^{\text{intra}}_d$ and $\boldsymbol{W}^{\text{inter}}_d$ respectively

Normalization of the weights matrix

- Equation (1) can only be solved if $(\boldsymbol{I}_N - \rho \boldsymbol{W})$ is non-singular
- Maximum-normalization of $\boldsymbol{W}$ (instead of row-normalization)
- Elements of $\boldsymbol{W}$ are divided by $\min\{\text{sum}^{\text{row}}_{\text{max}}, \text{sum}^{\text{col}}_{\text{max}}\}$
- Advantages (see Badinger & Egger, 2016):
  - Rescale estimate for ρ by single rescaling factor to yield result corresponding to specification with un-normalized matrix
  - Does not destroy the notion of absolute distance
  - When splitting $\boldsymbol{W}$ in multiple matrices (higher-order models), does not matter whether matrices are normalized jointly or separately
- Further rescale each weights matrix such that its average row sum is equal to one

Transmission of Shocks

- Common (positive) unitary shock to error term at period t:
  - ▷ Creates effects of $(\boldsymbol{I}_N - \rho\boldsymbol{W})^{-1}\boldsymbol{\iota}_N$ in period t
- Shocks to explanatory variables :
  - ▷ Direct and indirect impacts: Following Debarsy et al. (2012), the response of business sentiments at time $t+s$ to a transitory change in the k^{th} explanatory variable at time t is given by

$$\frac{\partial \boldsymbol{y}_{t+s}}{\partial \boldsymbol{x}_t^{(k)\prime}} = \phi^s(\boldsymbol{I}_N - \rho\boldsymbol{W})^{-1}(\boldsymbol{I}_N\beta_k + \boldsymbol{W}\theta_k), \quad s = 0, ..., S$$

  - ▷ Similarly,the cumulated impacts over the whole period from t to $t+S$ which arise from a change in the k^{th} explanatory variable at time t are given by

$$\frac{\partial \boldsymbol{y}_{t+S}}{\partial \boldsymbol{x}_t^{(k)\prime}} = \sum_{s=0}^{S} \phi^s(\boldsymbol{I}_N - \rho\boldsymbol{W})^{-1}(\boldsymbol{I}_N\beta_k + \boldsymbol{W}\theta_k)$$

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Data

- Business Sentiment Indicator (BSI) provided by European Commission
  - Based on survey data to track cyclical movements in specific sectors or in the economy as a whole
  - Around 135,000 firms surveyed about their production expectations for the next 3 months, current levels of stocks, recent developments in their business situation etc.
  - Questions are answered by $+$, $=$, $-$ and aggregated as "balances": the difference between the percentages of respondents giving positive and negative replies
  - Monthly, for 66 subsectors (2-digit NACE Rev.2) in EU28 and candidate countries

Data

- World Input Output Tables (WIOD), release October 2016
  - Construction of input-output weight matrix (year 2004)
  - Industry demand components to explain expectation formation: intermediate production, final demand (compute growth rates)
  - Yearly, for 56 industries (2-digit ISIC Rev.4) in EU28 and 15 other major countries
- Eurostat Database for industry-level labour costs for each country
  - Labour costs other than wages and salaries
  - Quarterly, 2-digit NACE Rev.2
- Merging
  - Panel with 679 observations per cross section in 24 EU countries for the period 2005-2014
  - BSI and indirect wage costs quarterly, industry demand characteristics yearly

Table: *Estimates of the baseline space-time model*

Variables	Coefficient	t-stat
β_1 Intermediate production growth	0.013^{***}	3.674
β_2 Final demand growth	0.017^{***}	5.301
β_3 Indirect labor costs	-0.015	-1.257
β_4 Indirect labor cost growth	0.033	1.535
θ_1 $\boldsymbol{W}$ Intermediate production growth	0.021^{**}	2.453
θ_2 $\boldsymbol{W}$ Final demand growth	-0.031^{***}	-3.946
θ_3 $\boldsymbol{W}_d$ Indirect labor costs	-0.013	-0.909
θ_4 $\boldsymbol{W}_d$ Indirect labor cost growth	-0.101^{**}	-2.320
$\phi \boldsymbol{y}_{t-1}$	0.720^{***}	159.490
$\rho \boldsymbol{W} \boldsymbol{y}_t$	0.141^{***}	18.664
Input-output multiplier$_{\text{SR}}$	1.161	
Input-output multiplier$_{\text{LR}}$	4.147	
Corr. R^2	0.509	
σ^2	94.083	
Log-Likelihood	-95272	
Number of observations	26481	

Notes Dynamic spatial panel data model with country-industry and time period fixed effects; ***significant at 0.01 level, **significant at 0.05 level, *significant at 0.1. level; N=679, T=39.

Figure: *Cumulative input-output multiplier over time*

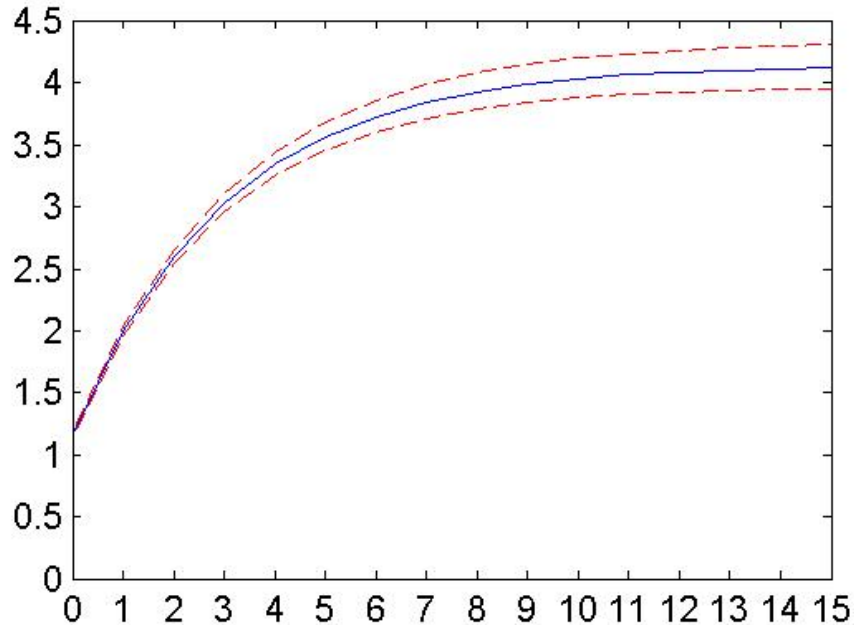

Table: Intermediate production growth

Period	Lower 0.025	Mean	Upper 0.975	Cumulative
		Average direct impacts		
0	0.0066	0.0133	0.0201	0.0133
1	0.0047	0.0096	0.0144	0.0229
2	0.0034	0.0069	0.0104	0.0297
3	0.0024	0.0050	0.0075	0.0347
4	0.0018	0.0036	0.0054	0.0383
10	0.0002	0.0005	0.0008	0.0462
		Average indirect impacts		
0	0.0139	0.0265	0.0387	0.0265
1	0.0100	0.0191	0.0280	0.0455
2	0.0072	0.0137	0.0202	0.0592
3	0.0052	0.0099	0.0146	0.0691
4	0.0037	0.0071	0.0105	0.0762
10	0.0005	0.0010	0.0015	0.0920

Table: Final demand growth

Period	Lower 0.025	Mean	Upper 0.975	Cumulative
		Average direct impacts		
0	0.0110	0.0171	0.0231	0.0171
1	0.0080	0.0123	0.0166	0.0294
2	0.0058	0.0089	0.0119	0.0383
3	0.0042	0.0064	0.0086	0.0447
4	0.0030	0.0046	0.0062	0.0493
10	0.0004	0.0006	0.0009	0.0594
		Average indirect impacts		
0	−0.0450	−0.0330	−0.0207	−0.0330
1	−0.0324	−0.0237	−0.0149	−0.0567
2	−0.0234	−0.0171	−0.0107	−0.0738
3	−0.0169	−0.0123	−0.0077	−0.0861
4	−0.0121	−0.0089	−0.0055	−0.0950
10	−0.0017	−0.0012	−0.0008	−0.1146

Table: Indirect labor costs

Period	Lower 0.025	Mean	Upper 0.975	Cumulative
		Average direct impacts		
0	-0.0377	-0.0151	0.0075	-0.0151
1	-0.0271	-0.0108	0.0054	-0.0259
2	-0.0192	-0.0078	0.0039	-0.0337
3	-0.0137	-0.0056	0.0028	-0.0393
4	-0.0099	-0.0040	0.0020	-0.0433
10	-0.0014	-0.0006	0.0003	-0.0523
		Average indirect impacts		
0	-0.0186	-0.0174	-0.0169	-0.0174
1	-0.0135	-0.0125	-0.0121	-0.0299
2	-0.0100	-0.0090	-0.0087	-0.0389
3	-0.0073	-0.0065	-0.0062	-0.0454
4	-0.0053	-0.0047	-0.0045	-0.0501
10	-0.0007	-0.0007	-0.0006	-0.0604

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Table: Indirect labor cost growth

Period	Lower 0.025	Mean	Upper 0.975	Cumulative
		Average direct impacts		
0	-0.0117	0.0318	0.0731	0.0318
1	-0.0085	0.0229	0.0527	0.0547
2	-0.0061	0.0165	0.0381	0.0711
3	-0.0044	0.0119	0.0275	0.0830
4	-0.0032	0.0085	0.0199	0.0915
10	-0.0005	0.0012	0.0028	0.1105
		Average indirect impacts		
0	-0.1547	-0.1141	-0.0730	-0.1141
1	-0.1112	-0.0821	-0.0527	-0.1962
2	-0.0799	-0.0591	-0.0381	-0.2553
3	-0.0576	-0.0426	-0.0275	-0.2978
4	-0.0415	-0.0306	-0.0199	-0.3285
10	-0.0058	-0.0043	-0.0028	-0.3963

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Figure: *Average impacts of* ***intermediate production growth***

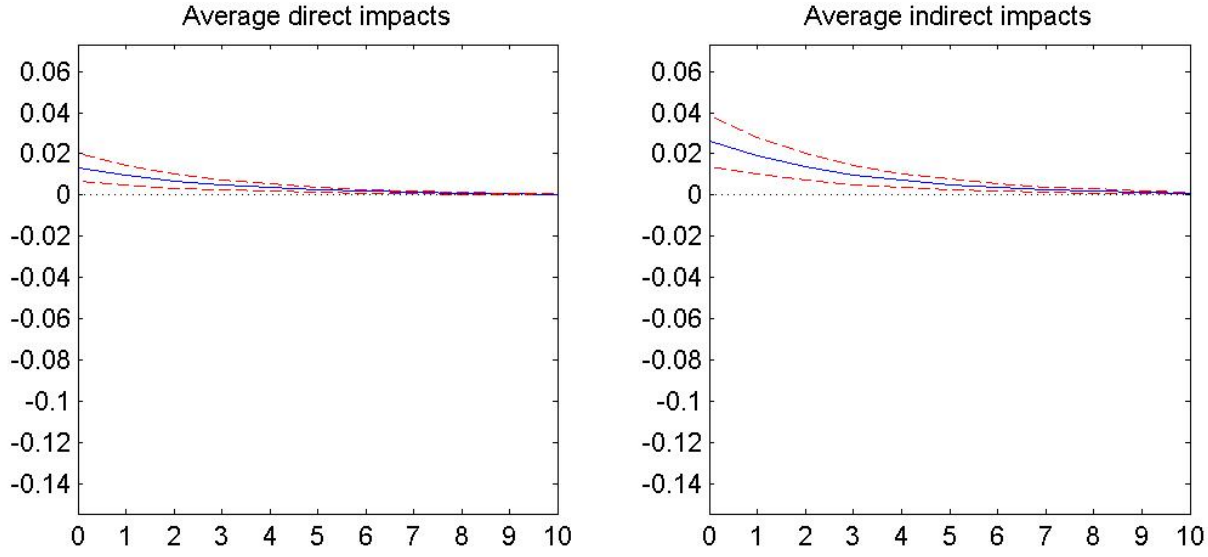

Figure: *Average impacts of* ***final demand growth***

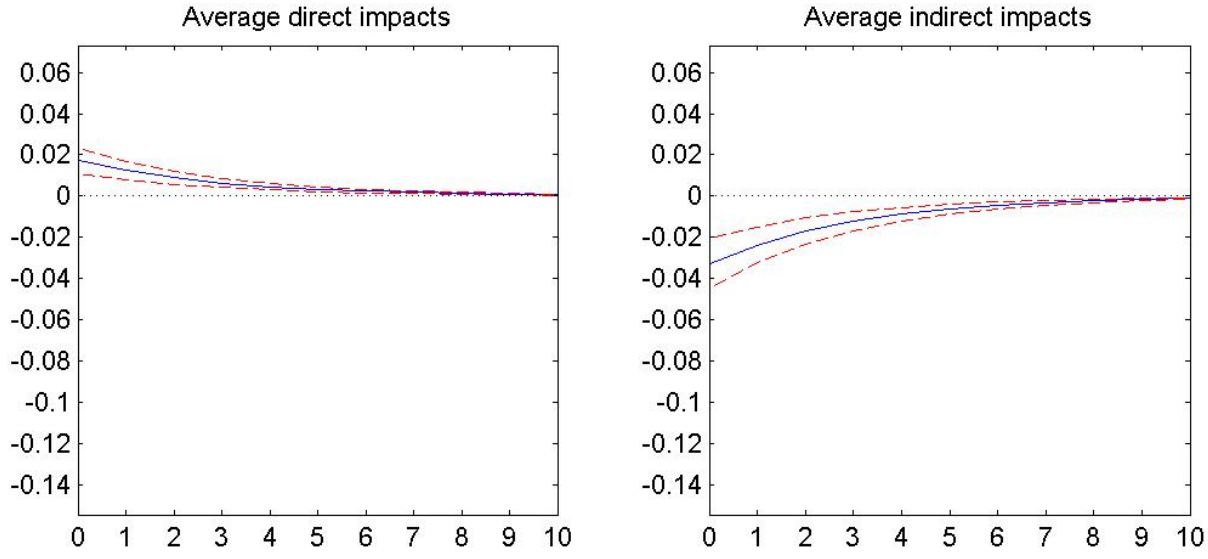

Figure: *Average impacts of* ***indirect labor costs***

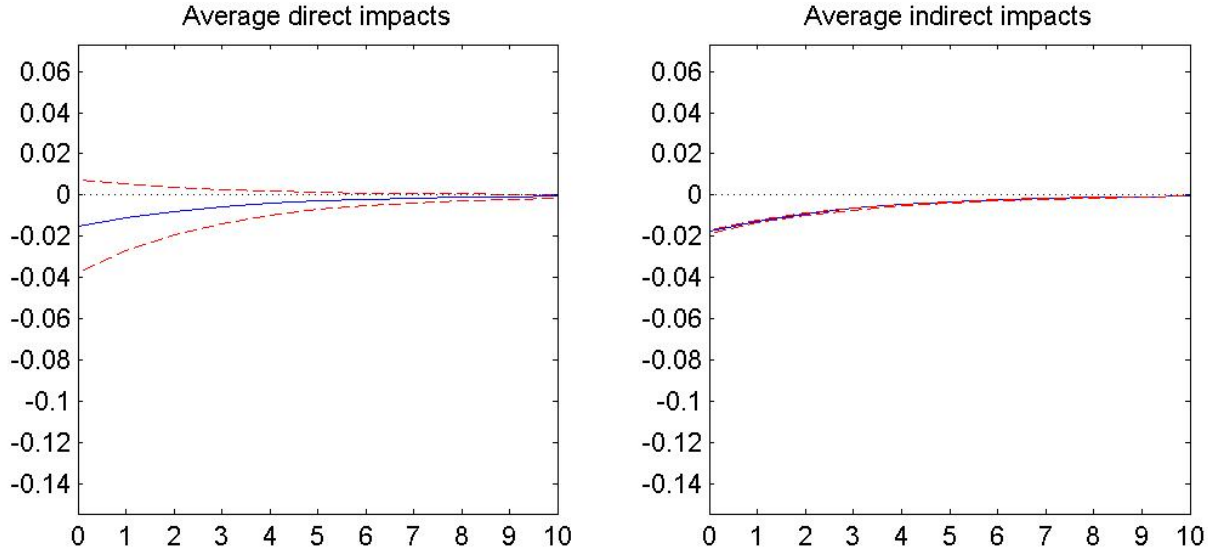

Figure: *Average impacts of* ***indirect labor cost growth***

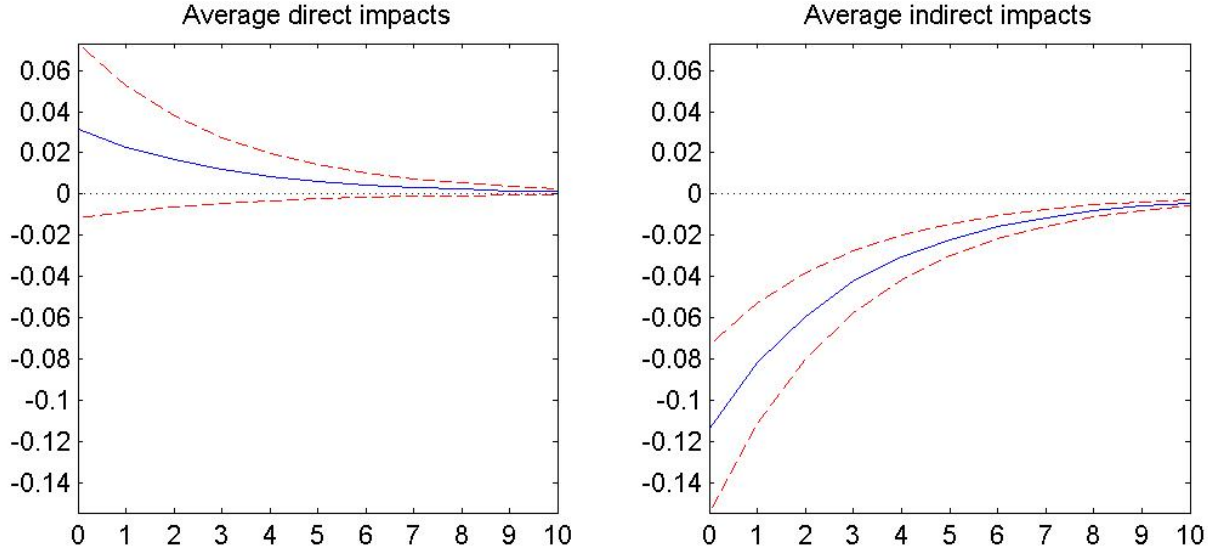

Table: *Estimates of space-time model with differing intra- and inter-industry spillovers*

Variable		Coefficient	t-stat
β_1	Intermediate production growth	0.014^{***}	3.915
β_2	Final demand growth	0.017^{***}	5.373
β_3	Indirect labor costs	-0.011	-0.970
β_4	Indirect labor cost growth	0.034	1.566
θ_1^{intra} $\boldsymbol{W}^{\text{intra}}$	Intermediate production growth	0.003	0.537
θ_2^{intra} $\boldsymbol{W}^{\text{intra}}$	Final demand growth	-0.015^{***}	-2.688
θ_3^{intra} $\boldsymbol{W}_d^{\text{intra}}$	Indirect labor costs	0.006	1.067
θ_4^{intra} $\boldsymbol{W}_d^{\text{intra}}$	Indirect labor cost growth	-0.016	-0.475
θ_1^{inter} $\boldsymbol{W}^{\text{inter}}$	Intermediate production growth	0.023^{***}	2.882
θ_2^{inter} $\boldsymbol{W}^{\text{inter}}$	Final demand growth	-0.023^{***}	-3.228
θ_3^{inter} $\boldsymbol{W}_d^{\text{inter}}$	Indirect labor costs	-0.015	-1.137
θ_4^{inter} $\boldsymbol{W}_d^{\text{inter}}$	Indirect labor cost growth	-0.095^{**}	-2.421
$\phi \boldsymbol{y}_{t-1}$		0.720	159.231
$\rho \boldsymbol{W} \boldsymbol{y}_t$		0.137	18.111
Input-output multiplier$_{\text{SR}}$			1.156
Input-output multiplier$_{\text{LR}}$			4.131
Corr. R^2			0.510
σ^2			93.996
Log-Likelihood			-95260
Number of observations			26481

Concluding remarks

- Provide empirical evidence for spillover-effects of sentiments induced by EU-wide value chains
  - Unexpected changes in business sentiments are multiplied due to repercussion effects
  - The long-run effect of a common unitary shock to business sentiments amounts to 4.15
- Identify positive direct impacts of the growth rate of intermediate production and final demand
- Find positive spillovers of intermediate production growth, while the spillovers of final demand growth are negative
- Further study the impact of economic policy reforms for business sentiment formation
  - Find that a reduction of indirect wage costs leads to increases of business sentiments in the affected industry
  - Provide evidence for substantial positive spillovers arising from policy reforms directed at indirect wage costs

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Thank you for your attention.

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Table: *Number of industries per country*

Country	Number of industries in sample
Austria	28
Belgium	33
Bulgaria	36
Czech Republic	33
Germany	25
Denmark	19
Spain	20
Finland	21
France	27
Great Britain	33
Greece	35
Hungary	25
Italy	33
Lithuania	33
Luxembourg	13
Lativa	32
Malta	12
Netherlands	22
Poland	41
Portugal	32
Romania	33
Slovakia	35
Slovenia	30
Sweden	28
Total	679

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Table: *Summary statistics*

Variable	Min	Max	Mean	Median	St. Dev.
Business Sentiment Indicator	-96.97	97.97	-2.80	-2.17	20.48
Intermediate production growth	-86.12	349.47	6.78	5.48	22.07
Final demand growth	-86.14	62.40	6.04	4.62	23.48
Indirect labor costs	37.90	152.10	90.58	93.10	13.38
Indirect labor cost growth	-35.68	62.40	0.95	0.84	3.48

Notes Growth rates are denoted in percent.

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