

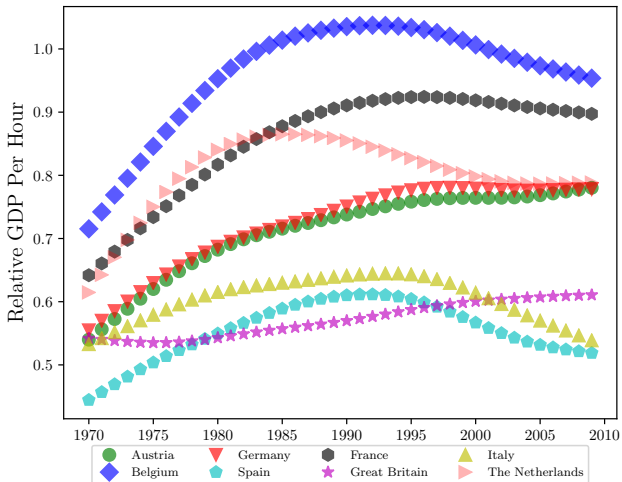
Why is Europe Falling Behind? Structural Transformation and Services' Productivity Differences between Europe and the U.S.

Cesare Buiatti Joao B. Duarte Luis Felipe Sáenz

May 10, 2018

ADEMU Final Conference

Labor productivity in Europe: Rise and Fall



Notes: GDP per hour worked, relative to the United States.

“The trend is your friend until the bend at the end”



What we do

- 1 We use the World KLEMS data – Austria, Belgium, France, Germany, Italy, the Netherlands, Spain, Great Britain, and the U.S., between 1970 and 2009 – to document labor shares and sectoral labor productivity dynamics in Europe and the U.S across 11 service industries. Services' Disaggregation

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- 2 We explain aggregate labor productivity differences between Europe and the U.S. using a structural transformation model that decomposes the service sector into 11 industries.
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Findings I

- Labor has reallocated from agriculture and manufacturing mainly towards business services and health services.
- The calibrated model explains the observed labor reallocation across sectors as well as the observed time paths of aggregate labor productivity.
- Europe is on average relatively more productive on health, education, post and telecommunication, real estate services. And that it is relatively less productive in wholesale and retail trade, transport and storage, and business services.

Findings II: Why is Europe Falling Behind?

- We identify **Wholesale and Retail Trade** (*trd*), **Business Services** (*bss*), and, to a lesser extent, **Financial Services** (*fin*) to be the sectors responsible for most of the lack of catch-up and decline in labor productivity between Europe and the U.S.

Findings II: Why is Europe Falling Behind?

- We identify **Wholesale and Retail Trade** (trd), **Business Services** (bss), and, to a lesser extent, **Financial Services** (fin) to be the sectors responsible for most of the lack of catch-up and decline in labor productivity between Europe and the U.S.
- Most of the European sectoral relative productivity gap in– and its widening over time – is primarily accounted for by sectoral TFP differences.
- However, in the period 1990-2009 the relative levels of physical and ICT capital endowment per hour worked in European services also fell significantly, particularly in wholesale and retail trade and business services.

A Model of Structural Transformation

Firms

The model economy consists of I sectors, with production: $Y_i = A_i L_i$

$$\max_{L_i \geq 0} p_i A_i L_i - w L_i \quad \forall i$$

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Representative Household

Non-homothetic CES preferences (Comin et al. (2015)):

$$\max_{c_i \geq 0} \sum_i \Omega_i^{\frac{1}{\sigma}} C^{\frac{\epsilon_i}{\sigma}} c_i^{\frac{\sigma-1}{\sigma}} \quad \text{s.t.} \quad \sum_i p_i c_i = wL$$

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Market clearing

$$c_i = Y_i \quad \forall i \quad L = \sum_i L_i$$

Equilibrium

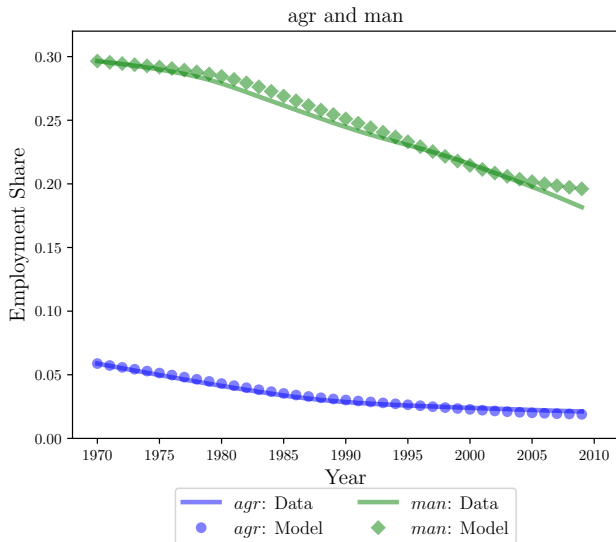
From profit maximization:

$$p_i = \frac{1}{A_i} \quad \forall i$$

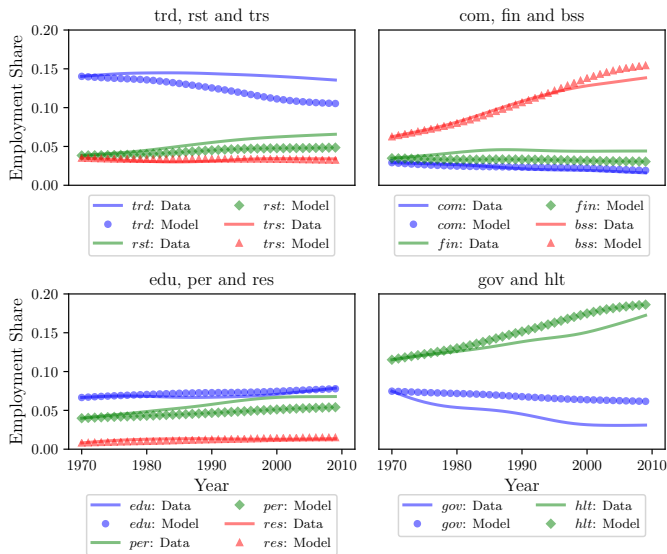
From utility maximization and market clearing conditions:

$$\frac{L_i}{L} = \frac{\Omega_i C^{\epsilon_i} A_i^{\sigma-1}}{\sum_j \Omega_j C^{\epsilon_j} A_j^{\sigma-1}} \quad \forall i$$

Mechanisms of the Structural Transformation



Calibration: Account for U.S. Structural Transformation



Measuring sectoral productivities in Europe

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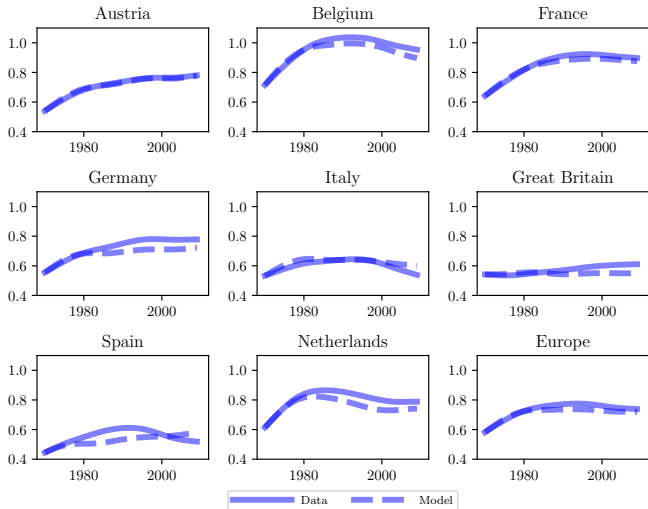
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- We simulate **sectoral labor shares implied by model**:
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- We compute model-implied **aggregate labor productivity**:
 - ▶ As a weighted average of sectoral labor productivity levels.

Figure: Relative Aggregate Labor Productivity - Data vs. Model



More

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- Counterfactual aggregate productivity is computed and compared with the baseline one.

Tables

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From reduced-form production function to fully-fledged Cobb-Douglas technology:

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Labor productivity:

$$A = \frac{Y}{L} = Mk^{\alpha} s^{\beta} L^{(\alpha+\beta+\gamma-1)}$$

with $k = K/L$ and $s = S/L$

Empirical Analysis

Consider service i in country c , in year t . Take relative to the U.S. and in logs:

$$\log \hat{A}_{i,t,c} = \log \hat{M}_{i,t,c} + \alpha \log \hat{k}_{i,t,c} + \beta \log \hat{s}_{i,t,c} + (\alpha + \beta + \gamma - 1) \log \hat{L}_{i,t,c}$$

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Estimates [Table](#):

$$\log \hat{A}_{i,t,c} = -2.733 + 0.108 \log \hat{k}_{i,t,c} + 0.060 \log \hat{s}_{i,t,c} - 0.484 \log \hat{L}_{i,t,c}$$

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Decreasing returns to scale!

Change in Capital to Labor ratios

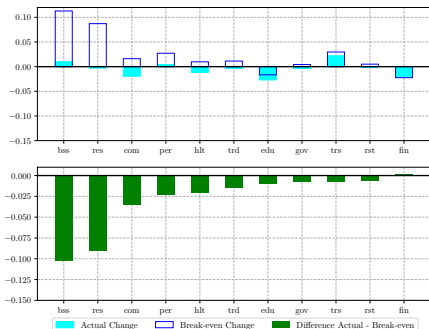
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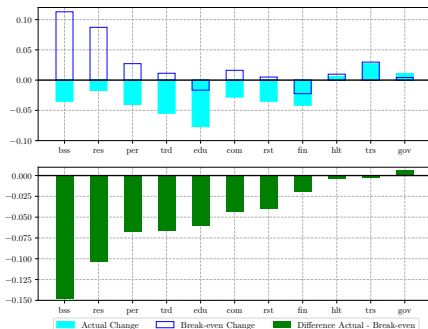
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Actual vs. Breakeven change in Capital inputs

Physical capital



ICT capital



Total Factor Productivity

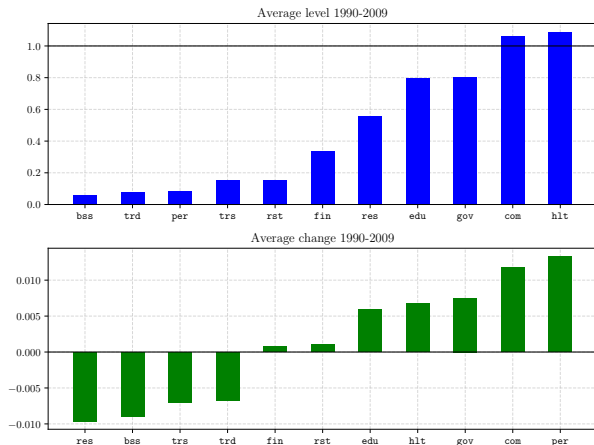
TFP as residual:

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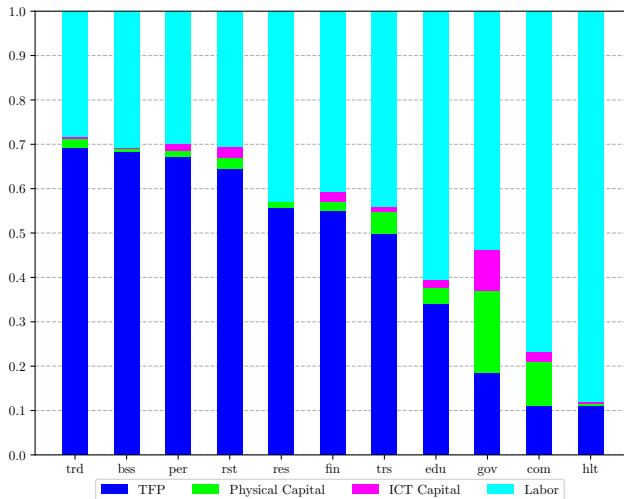
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Decomposition of Labor Productivity

Fractions of relative labor productivity accounted for by each component, by service



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- Capital endowment did not follow changes in labor allocation.
- Services' TFP lower in Europe than in the U.S, and decreasing.
- Issues particularly severe in `trd` and `bss`.

Thank You!

Comments/Suggestions?

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Disaggregation of the service sector

Table: Service Sub-sectors

Code	Name
trd	Wholesale and retail trade
rst	Hotels and restaurants
trs	Transport and storage
com	Post and telecommunication
fin	Financial intermediation
res	Real estate activities
bss	Business services
gov	Public administration and defense
edu	Education
hlt	Health and social work
per	Other community, social and personal activities

[Back](#)

Related literature

- STRUCTURAL TRANSFORMATION
Kuznets (1957), Kongsamut, Rebelo, and Xie (2001), Ngai and Pissarides (2007), Buera and Kaboski (2009)
 - ▶ NON-HOMOTHETIC CES PREFERENCES: Comin et al. (2015)
- PRODUCTIVITY
Baily and Solow (2001), Lewis (2004), Inklaar, Timmer, and Ark (2009), Van Welsum et al.(2013)
- PRODUCTIVITY CHANGE THROUGH STRUCTURAL TRANSFORMATION
Duarte and Restuccia (2010), Cavalcanti and Fonseca (2014)

$$\frac{L_i}{L} = \frac{\Omega_i C^{\epsilon_i} A_i^{\sigma-1}}{\sum_j \Omega_j C^{\epsilon_j} A_j^{\sigma-1}} \quad \forall i$$

Mechanisms of the Structural Transformation

- *Income effect:*
As C rises, L_i/L will rise if income elasticity ϵ_i is relatively high.
- *Substitution effect:*
With $0 < \sigma < 1$, L_i/L will fall if A_i grows relatively faster.

Assigning parameter values

- *Estimation* of ϵ_i and σ

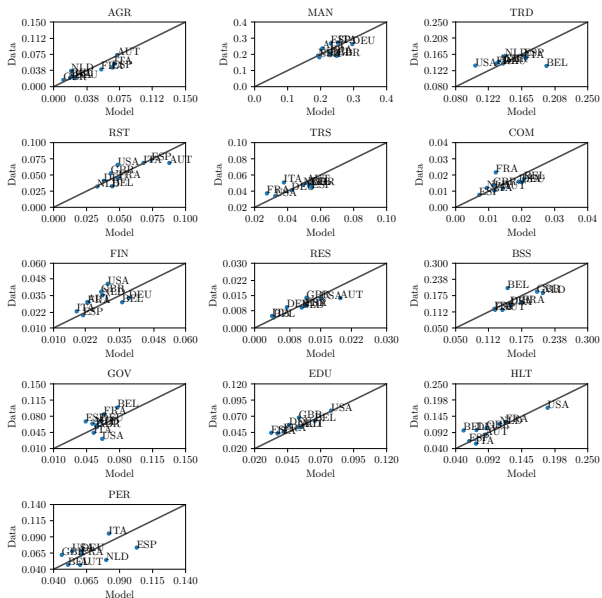
$$\log \left(\frac{L_{i,t}^c}{L_{m,t}^c} \right) = \zeta_{im}^c + (1 - \sigma) \log \left(\frac{A_{mt}^c}{A_{it}^c} \right) + (\epsilon_i - \epsilon_m) \log C_t^c + \nu_{im,t}^c$$

SUR estimation based on World KLEMS data.

- *Normalization* of $A_{i,0} = 1$, and $A_{i,t}$ for $t > 0$ from World KLEMS productivity growth data.
- *Calibration* of Ω_i to match U.S. labor shares in 1970.
 - ▶ At $t = 0$, $L_i/L = \Omega_i / \sum \Omega_i = \Omega_i$: Ω_i set to match actual sector i 's employment share in 1970.

Back

Figure: Shares of Hours in the last year - Data vs. Model [Back](#)



Counterfactual 1: Keeping the U.S. pace

Under the counterfactual, U.S. sectoral productivity growth for the entire period.

	AUT	BEL	FRA	DEU	ITA	GBR	ESP	NLD	Europe
Counterfactual:									
(1) $g_i = g_i^{USA}$									
agr	-0.2	0.9	-2.8	-1.0	-0.4	1.7	-3.0	-0.1	-0.6
man	-14.6	-23.7	-15.6	-13.5	-6.8	-13.4	-8.0	-12.3	-13.5
trd	5.1	12.3	4.2	4.2	12.0	9.6	11.1	2.4	7.6
rst	-2.7	-1.6	-0.8	0.6	1.7	-0.3	1.2	-0.6	-0.3
trs	-0.1	-0.2	-1.5	-2.1	0.1	-0.7	-0.5	-0.7	-0.7
com	-0.6	1.5	-2.9	1.4	1.7	-1.0	-1.9	0.7	-0.1
fin	0.4	1.4	1.9	2.7	6.0	1.6	1.7	0.8	2.1
res	-0.5	-0.3	-0.4	-0.5	1.0	0.4	0.6	-0.5	0.0
bss	1.7	-0.4	7.2	0.9	14.5	-4.6	11.8	4.5	4.4
gov	-0.1	0.7	-1.1	-3.4	0.5	0.5	3.0	-2.0	-0.3
edu	-1.6	-2.0	0.2	-1.0	-0.5	-0.1	-1.1	0.3	-0.7
hlt	-2.1	-3.6	-6.5	-4.6	-4.1	-6.4	2.0	-4.1	-3.7
per	-1.7	-4.1	-3.2	-1.9	2.4	-1.9	-2.8	1.8	-1.4
(2) $g_i = g_i^{USA}$ in services	-2.6	2.6	-3.6	-3.8	40.3	-3.6	26.8	2.3	7.3
(3) $g_i = g_i^{USA} \quad \forall i$	-16.8	-21.3	-20.9	-17.5	29.4	-14.9	12.5	-10.6	-7.5

% Difference in 2009 aggregate productivity - counterfactual vs. baseline.

Counterfactual 2: Taking off with the U.S.

Under the counterfactual, U.S. sectoral productivity growth starting from 1990.

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res	0.2	0.7	0.0	0.0	0.6	0.5	1.3	0.3	0.5
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gov	0.1	0.2	-0.6	-0.9	-1.2	-0.8	-0.4	-0.5	-0.5
edu	-0.4	0.6	0.5	0.1	0.1	0.4	-1.5	1.2	0.1
hlt	-1.0	-1.1	-1.2	-3.6	-0.8	-4.1	0.2	-0.2	-1.5
per	-0.9	-1.1	-1.4	-0.6	0.8	-1.0	-0.7	-0.7	-0.7
(2) $g_i = g_i^{USA}$ in services	3.5	12.0	5.9	3.9	13.2	-6.8	14.5	6.2	6.5
(3) $g_i = g_i^{USA} \forall i$	-0.7	10.4	2.8	0.1	18.4	-9.7	18.5	7.6	5.9

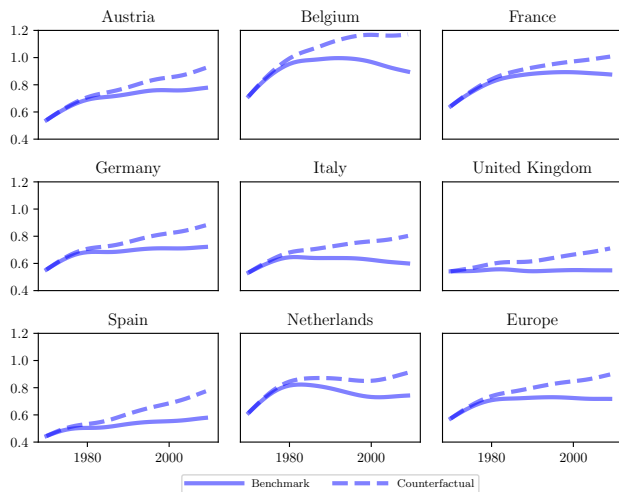
% Difference in 2009 aggregate productivity - counterfactual vs. baseline.

Counterfactual 3: Catching Up with the U.S.

	AUT	BEL	FRA	DEU	ITA	GBR	ESP	NLD	Europe	
Counterfactual:										
(1) Catch-up in <i>trd</i>	12.1	24.5	9.5	11.0	21.4	18.6	24.4	11.7	16.6	%
(2) Catch-up in <i>bss</i>	4.5	5.1	15.5	6.5	11.0	14.3	12.4	16.0	10.7	
(2) Catch-up in <i>fin</i>	-0.6	2.3	0.0	3.6	0.6	2.1	0.7	0.9	1.2	

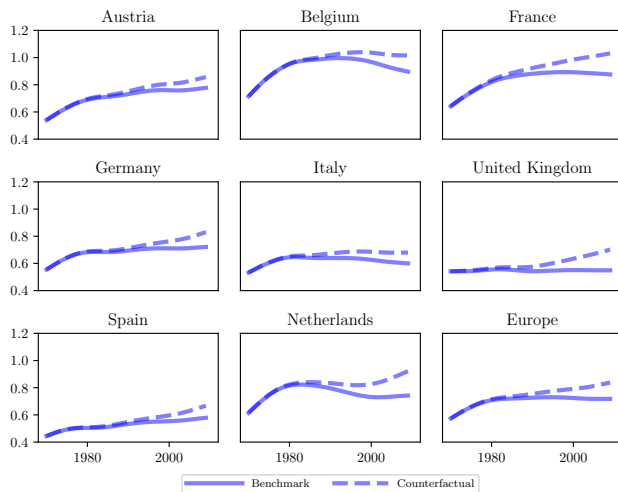
Difference in 2009 aggregate productivity - counterfactual vs. baseline. [Back](#)

The Importance of Wholesale and Retail Trade



Notes: Relative Aggregate Labor Productivity cross countries, data vs. model under the Full Catch-Up in TRD Counterfactual.

The Importance of Business Services



Notes: Relative Aggregate Labor Productivity across countries, data vs. model under the Full Catch-Up in BSS Counterfactual. [Back](#)

Estimation of Capital and Labor effects on Labor Productivity

	(1)	(2)	(3)	(4)	(5)
Physical Capital	0.321*** (0.049)	0.026 (0.032)	0.108*** (0.019)	0.154*** (0.042)	-0.008 (0.034)
ICT Capital	-0.276*** (0.037)	0.084*** (0.021)	0.061*** (0.011)	-0.051* (0.029)	0.063*** (0.021)
Labor	-0.394*** (0.049)	-1.860*** (0.065)	-0.484*** (0.029)	-2.257*** (0.078)	-1.982*** (0.066)
FIXED EFFECTS					
Year		X	X	X	X
Country		X	X	X	X
Sector		X	X	X	X
Country × Sector			X		
Year × Sector				X	
Country × Year					X
N	1485	1485	1485	1485	1485
R^2	0.11	0.87	0.99	0.90	0.87
AIC	5223.50	2469.60	-1911.35	2644.71	2600.16
BIC	5244.71	2782.49	-1280.28	4575.07	3385.03