



# Cambio estructural en Argentina, Brasil, Chile y México. Una comparación internacional

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# Introduction

- ✓ Structural change has received great attention, specially in Latin America.
- ✓ A central insight in development economics is that development entails structural change.
- ✓ The main argument of the so called structuralist school is that the economic structure is very relevant, so that structural change is the clue for explaining growth & convergence from a Schumpeterian perspective (CEPAL 2007, 2012; BID 2010)
- ✓ One of the best documented patterns of structural change is the shift of labor and capital from production of primary goods to manufacturing and later to services. This featured prominently in explanations of divergent growth patterns across Europe, Japan, and the US in the post WWII period (Denison, Maddison, Jorgenson, Timer)
- ✓ In Latin America the relevant literature goes back to the works of Raúl Prebisch and Fernando Fajnzylber whose ideas have been revised from many different perspectives.

# Introduction

- ✓ **More recently** an important number of Latin American, as well as non LA authors, have focused on the role played by structural change in LA productivity growth.
- ✓ Among **LA authors** need to be mentioned (without aim of exhaustivity) J. Weller, M. Cimolli, C. Pagés, D. Restuccia, and M. Duarte just to mention a few of them.
- ✓ And within the **non-LA authors**, D. Rodrik, M. McMillan, M. Timmer & G. de Vries among others.
- ✓ **Recent literature** has focused on productivity determinants by using **micro data**. The results highlight the **relevance of the structural change** even for developed economies (Bartelsman & Dooms, 2000; Syverson, 2011).
- ✓ In what follows **we will take McMillan & Rodrik (2012) work as reference**. Our results are very close to the ones obtained by D. Restuccia (2012) following a somehow different avenue.

## McMillan & Rodrik (2011)

Countries: 38

9 High Income; 10 Asia; 1 Middle East (Turkey); 9 Africa and 9 LA (Argentina, Chile, Mexico, Venezuela, Costa Rica, Colombia, Peru, Brazil & Bolivia)

Variable analyzed: Labor Productivity

Sectoral Dissagregation: 9 sectors

Period: 1990-2005

Source: GGDC 10-Sector Database

Methodology: Shift-Share Analysis (Fabricant, 1942)

## McMillan & Rodrik (2011) Main findings

- ✓ The bulk of the **difference between Asia & LA** countries productivity performance is accounted for by differences in the **pattern of structural change** –with labor moving from low to high productivity sectors in Asia, but in the opposite direction in LA & Africa.
- ✓ In countries with a relative **large share of natural resources** in exports, structural change has typically been **growth reducing**. **Reason:** those sectors have very high productivity but they cannot absorb the surplus of labor from agriculture.
- ✓ Developing countries are characterized by **large productivity gaps** between different parts of the economy. They are **indicative of the allocative inefficiencies** that reduce overall labor productivity.
- ✓ The **upside** of these **allocative inefficiencies** is that they can potentially be an **important engine of growth**. When labor & other resources move from less to more productive activities, the economy grows even if there is no productivity growth within sectors.
- ✓ **Main result: Countries that do well are those that start out with a lot of workers in agriculture but do not have a strong comparative advantage in primary products.**

## This paper's contribution

- ✓ Takes as reference 4 LA countries (Argentina, Brazil, Chile & Mexico); and 7 more countries to which we will refer from now on as *reference* countries: 5 EU countries (France, Germany, UK, Italy & Spain); USA & Japan, for period 1995-2008/2009 and 9 sectors.
- ✓ **Major drawback:** Asian countries are not included (yet) in the exercise for lack of comparable data.
- ✓ Presents *Growth Accounting* results, decomposing labor productivity growth in the contribution of 4 sources of growth (ICT and non-ICT capital; labor qualification; and TFP).
- ✓ Shows a set of **descriptive statistics** in order to help understand what happens inside each country
- ✓ Applies *shift-share* analysis to each individual variable:
  - ✓ Labor productivity;
  - ✓ capital per worker
    - ✓ ICT and
    - ✓ non-ICT capital
  - ✓ Total Factor Productivity
- ✓ Illustrates the **sensitivity** of the results to the level of **industry disaggregation** taking Mexico and the *reference* countries as illustration.

# Growth Accounting Results

## Labor productivity. 1995-2007

(percentage)

	Labor productivity growth rate	Contributions (percentage points) to labor productivity growth					Reallocation effect
		Changes in labor composition	Total capital per hour worked	ICT capital per hour worked	Non-ICT capital per hour worked	TFP	
France	1.53	0.31	0.64	0.27	0.37	0.49	0.08
Germany	1.55	0.05	0.75	0.39	0.36	0.59	0.15
Italy	0.51	0.09	0.61	0.22	0.39	-0.34	0.15
Spain	0.67	0.38	0.93	0.36	0.56	-0.63	-0.02
UK	2.06	0.48	1.04	0.66	0.39	0.63	-0.09
EU-15ex <sup>1</sup>	1.39	0.19	0.80	0.42	0.38	0.40	0.01
US	2.02	0.26	1.15	0.76	0.39	0.72	-0.11
Japan <sup>2</sup>	2.10	0.39	1.20	0.34	0.86	0.28	0.23
Argentina	0.84	0.46	-1.21	0.17	-1.38	1.38	0.23
Brazil	0.63	0.94	0.24	0.55	-0.31	-1.17	0.62
Chile	2.56	0.80	2.04	0.32	1.71	-0.55	0.28
Mexico	1.21	0.39	0.69	0.38	0.31	-0.22	0.34

<sup>1</sup> EU-15ex is formed by Germany, Austria, Belgium, Denmark, Spain, Finland, France, Italy, Netherlands and UK.

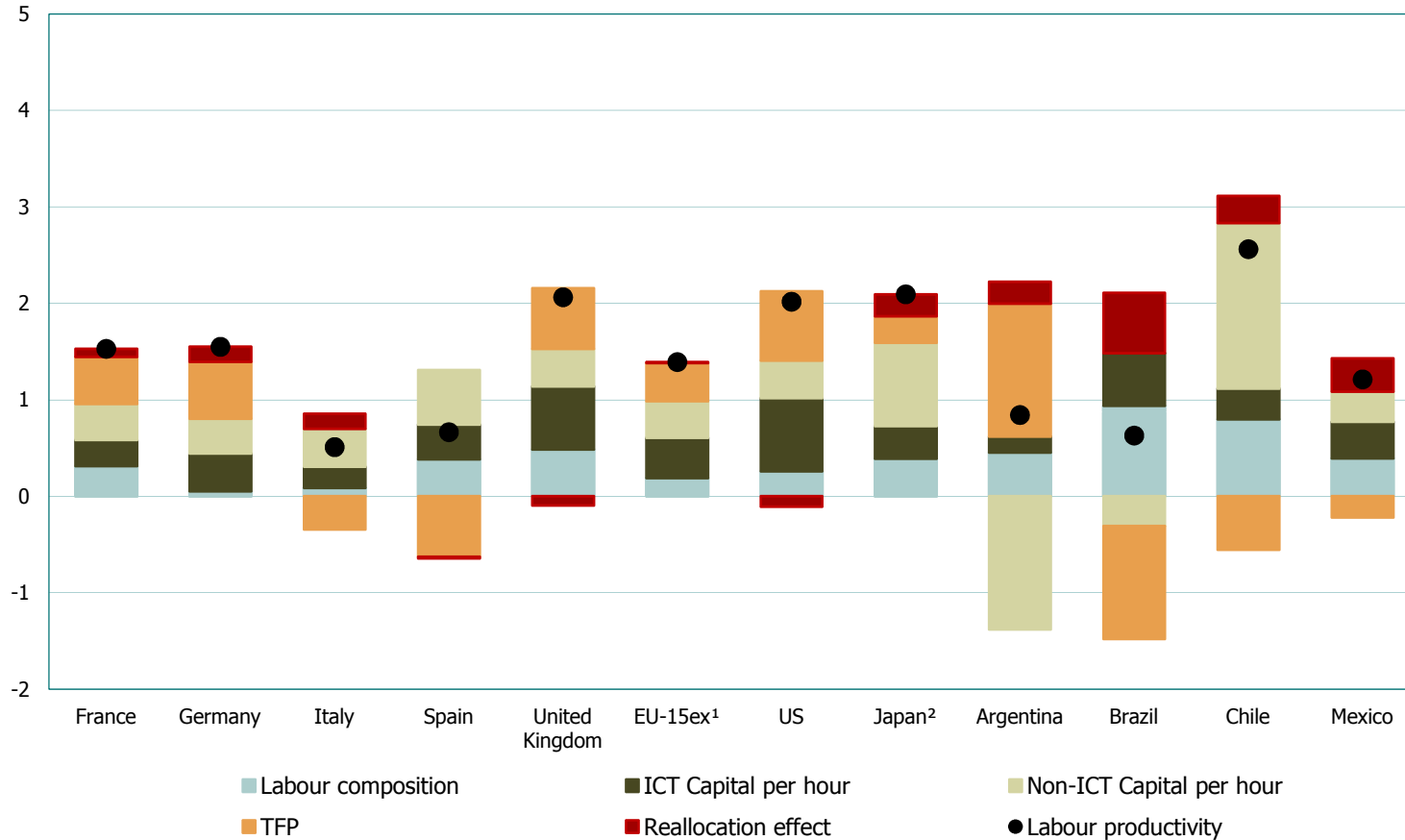
<sup>2</sup> 1995-2006

Source: EU KLEMS (2011), LA KLEMS (2013) and own elaboration

# Growth Accounting Results

## Labor productivity. 1995-2007

(percentage)



<sup>1</sup> EU-15ex consist of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and United Kingdom

<sup>2</sup> 1995-2006 period for Japan

Source: EU KLEMS (2011), LA KLEMS (2013) and own elaboration



# Growth Accounting Results

## Comparison of LA with *reference countries* (period 1995-2007):

- **Great array** of labour productivity growth rates among both, *reference* and LA countries.
- The contributions of changes in **labor composition** (human capital) **was higher** in LA countries (as expected due to the LA relative laggard position).
- The **contribution of K/L** was more **heterogeneous** in LA than in *reference* countries: rather **modest** in Mexico and Brazil. In **Chile** was **very high**, while in **Argentina** was **negative**.
- The **contribution of ICT K/L** was in line with the EU average, with the exception of Argentina where it was lower.
- The **contribution of non ICT K/L** was also more **heterogeneous** in LA than in *reference* countries. It was **very high** in **Chile** but **negative** in **Argentina & Brazil**.
- **TFP contribution** was **negative** in 3 out of 4 LA countries (the exception is Argentina).

## Growth Accounting Results

- Generally speaking, **negative TFP** contribution was the **main cause** for **low productivity growth**. If TFP growth would have been zero (instead of negative) Labour Productivity growth would have been almost three times higher in Brazil; 21.5% higher in Chile, and 18.2% higher in Mexico.
- It is also important to notice that the “**Reallocation effect**” –which is a measure of **structural change**- was **positive in LA countries** & (slightly) negative in *reference countries*



## Descriptive Statistics

Labor Productivity

K/L ratio

Non ICT K/L ratio

ICT K/L ratio

TFP (US 1995=100)

# Descriptive Statistics. Labor Productivity (\$ PPP 1995)

	France	Germany	Italy	Spain	United Kingdom	United States	Japan	Argentina	Brazil	Chile	Mexico
<b>Economy-wide Labor productivity</b>											
1995	25,59	25,76	23,95	22,76	20,71	25,80	19,88	12,93	6,27	7,79	10,02
2007	30,83	31,03	25,44	24,45	26,74	33,32	25,66	14,44	6,74	10,92	11,70
<b>Standard deviation of log of sectoral labor productivity</b>											
1995	0,49	0,50	0,65	0,56	0,84	0,59	0,73	0,68	0,91	0,91	0,94
2007	0,58	0,54	0,68	0,71	0,79	0,69	0,86	0,57	0,86	0,85	0,94
<b>Max-min ratio</b>											
2007	6,49	6,46	7,88	10,56	9,40	12,01	20,58	5,53	14,68	12,87	14,19
<b>Sector with Highest Labor productivity in 2007</b>											
Sector	E	E	E	E	C	E	E	E	E	C	C
Labor productivity	124,05	102,09	118,26	176,83	151,12	163,52	190,95	51,05	42,26	72,93	46,17
<b>Sector with Lowest Labor productivity in 2007</b>											
Sector	AtB	AtB	AtB	F	F	F	AtB	GtH	AtB	AtB	AtB
Labor productivity	19,12	15,81	15,00	16,74	16,08	13,61	9,28	9,24	2,88	5,66	3,25
<b>Compound Annual Growth rate of Econ. Wide Labor productivity</b>											
1995-2007	1,53	1,55	0,51	0,67	2,06	2,02	2,10	0,84	0,63	2,56	1,21

TOTAL ECONOMY	TOT
Agriculture and fishing	AtB
Mining and quarrying	C
Manufacturing	D
Electricity, gas and water supply	E
Construction	F
Wholesale and retail trade; hotels and restaurants	GtH
Transport and communications	I
Finance, insurance, real estate and business services	JtK
Community social and personal services	LtQ

## Labor Productivity

- Labor productivity in LA countries is around 1/3 of *reference* countries. Specially low in Brasil, highest in Argentina.
- In the majority of countries the **sector** with the **highest level** of labor productivity is *Electricity, gas & water supply*. The exceptions are UK, Chile & Mexico for which it is *Mining & Quarrying*.
- In most countries the **sector** with the **lowest level** of labor productivity is *Agriculture and Fishing*. In Argentina it is *Wholesale and retail trade; hotels & restaurants*, while in Spain, UK, and USA it is *Construction*.
- The **dispersion of sectoral labor productivities** –as measured by the standard deviation of logs- is **higher in 3 LA countries** (the exception is Argentina) than in the EU average.
- The **same result** holds when using the **ratio max/min** as dispersion indicator.
- These results are **in line** with those highlighted in the **literature**

# Descriptive Statistics: K/L ratio (\$ PPP 1995)

	France	Germany	Italy	Spain	United Kingdom	United States	Japan	Argentina	Brazil	Chile	Mexico
<b>Economy-wide Capital / Labor ratio</b>											
<b>1995</b>	52,88	50,30	99,21	45,92	31,55	40,87	46,04	38,49	9,23	10,80	20,03
<b>2007</b>	62,18	66,28	113,47	57,39	45,99	60,02	65,37	27,02	10,58	21,83	23,81
<b>Standard deviation of log of Capital / Labor ratio</b>											
<b>1995</b>	1,03	1,02	1,24	1,02	1,60	1,45	1,30	0,62	1,17	1,40	1,73
<b>2007</b>	1,03	1,11	1,15	1,15	1,49	1,37	1,39	0,77	1,27	1,55	1,56
<b>Max-min ratio</b>											
<b>2007</b>	41,28	50,52	32,89	40,43	135,94	74,06	164,66	15,37	34,18	155,70	126,35
<b>Sector with Highest Capital / Labor ratio in 2007</b>											
<b>Sector</b>	E	E	E	E	C	E	E	GtH	E	E	E
<b>Capital / Labor ratio</b>	568,82	582,90	911,76	785,04	1113,84	888,16	1633,41	53,47	84,81	375,28	645,86
<b>Sector with Lowest Capital / Labor ratio in 2007</b>											
<b>Sector</b>	F	F	F	F	F	F	F	F	GtH	F	AtB
<b>Capital / Labor ratio</b>	13,78	11,54	27,72	19,42	8,19	11,99	9,92	3,48	2,48	2,41	5,11
<b>Compound Annual Growth rate of Econ. Wide Capital / Labor ratio</b>											
<b>1995-2007</b>	2,49	3,48	2,33	2,56	3,97	3,71	3,45	-3,00	0,79	6,05	1,64

Japan: 2007 not available, data correspond to 2006

TOTAL ECONOMY	TOT
Agriculture and fishing	AtB
Mining and quarrying	C
Manufacturing	D
Electricity, gas and water supply	E
Construction	F
Wholesale and retail trade; hotels and restaurants	GtH
Transport and communications	I
Finance, insurance, real estate and business services	JtK
Community social and personal services	LtQ

# Descriptive Statistics: Non-ICT K/L (\$ PPP 1995)

	France	Germany	Italy	Spain	United Kingdom	United States	Japan	Argentina	Brazil	Chile	Mexico
<b>Economy-wide Non-ICT Capital / Labor ratio</b>											
1995	50,88	47,93	96,91	43,65	29,46	37,78	43,93	37,59	7,96	10,72	19,39
2007	57,50	57,65	106,87	50,82	34,99	45,66	60,18	24,41	7,30	19,94	21,13
<b>Standard deviation of log of non-ICT Capital / Labor ratio</b>											
1995	1,04	1,04	1,25	1,03	1,63	1,48	1,31	0,62	1,24	1,41	1,74
2007	1,05	1,16	1,17	1,19	1,59	1,50	1,42	0,79	1,30	1,62	1,65
<b>Max-min ratio</b>											
2007	43,27	54,15	35,35	41,95	159,22	98,08	171,86	16,06	43,57	208,09	124,09
<b>Sector with Highest non-ICT Capital / Labor ratio in 2007</b>											
Sector	E	E	E	E	C	E	E	GtH	E	E	E
non-ICT Capital / Labor ratio	540,25	559,55	900,28	755,59	1109,78	825,58	1600,01	50,72	60,29	367,47	618,58
<b>Sector with Lowest non-ICT Capital / Labor ratio in 2007</b>											
Sector	F	F	F	F	F	F	F	F	JtK	F	AtB
non-ICT Capital / Labor ratio	12,49	10,33	25,47	18,01	6,97	8,42	9,31	3,16	1,38	1,77	4,99
<b>Compound Annual Growth rate of Econ. Wide non-ICT Capital / Labor ratio</b>											
1995-2007	1,63	2,09	1,64	1,61	1,44	1,26	2,74	-3,76	-1,03	5,23	0,79

Japan: 2007 not available, data correspond to 2006

TOTAL ECONOMY	TOT
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Mining and quarrying	C
Manufacturing	D
Electricity, gas and water supply	E
Construction	F
Wholesale and retail trade; hotels and restaurants	GtH
Transport and communications	I
Finance, insurance, real estate and business services	JtK
Community social and personal services	LtQ

# Descriptive Statistics: ICT K/L (\$ PPP 1995)

	France	Germany	Italy	Spain	United Kingdom	United States	Japan	Argentina	Brazil	Chile	Mexico
<b>Economy-wide ICT Capital / Labor ratio</b>											
1995	2,00	2,37	2,30	2,27	2,09	3,08	2,11	0,90	1,26	0,07	0,64
2007	4,68	8,63	6,60	6,57	11,00	14,36	5,19	2,61	3,28	1,89	2,67
<b>Standard deviation of log of ICT Capital / Labor ratio</b>											
1995	1,74	1,14	1,76	2,00	1,65	1,36	1,48	2,28	1,17	1,04	1,92
2007	1,51	1,18	1,25	1,68	1,66	1,21	1,64	1,98	1,39	1,08	1,46
<b>Max-min ratio</b>											
2007	164,81	24,92	82,45	219,45	208,15	30,32	159,05	4823,51	54,34	32,88	215,18
<b>Sector with Highest ICT Capital / Labor ratio in 2007</b>											
Sector	E	JtK	I	E	E	E	E	LtQ	C	E	E
ICT Capital / Labor ratio	28,57	23,96	25,07	29,45	58,12	62,58	33,40	3,80	44,23	7,81	27,27
<b>Sector with Lowest ICT Capital / Labor ratio in 2007</b>											
Sector	AtB	AtB	AtB	AtB	AtB	AtB	AtB	AtB	AtB	AtB	AtB
ICT Capital / Labor ratio	0,17	0,96	0,30	0,13	0,28	2,06	0,21	0,00	0,81	0,24	0,13
<b>Compound Annual Growth rate of Econ. Wide ICT Capital / Labor ratio</b>											
1995-2007	7,72	10,75	8,80	8,85	13,86	12,82	8,18	8,86	7,96	27,23	11,92

Japan: 2007 not available, data correspond to 2006

TOTAL ECONOMY	TOT
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Mining and quarrying	C
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## K/L, ICT K/L and Non-ICT K/L ratios

- ✓ The level of capitalization –as measured by the three ratios- is lower in LA than in the other countries. Only Argentina gets close thanks to its high Non-ICT K/L ratio.
- ✓ The sector with the highest K/L and Non-ICT K/L ratio is, in almost all countries, *Electricity, gas & water supply*. In UK is *Mining & quarrying*, and in Argentina *Wholesale & retail trade, hotels & restaurants*.
- ✓ These results confirm that, generally speaking, the highest the K/L ratio, the highest labor productivity.
- ✓ The sector with the lowest level of K/L and Non-ICT K/L ratio is *Construction*. In Brazil it is *Finance, insurance, real state & business services*, and in Mexico, *Agriculture & fishing*.
- ✓ For ICT K/L the lowest level corresponds, in all countries, to *Agriculture & fishing*.
- ✓ The dispersion of the K/L and Non-ICT K/L ratio is (only slightly) higher in LA (with the exception of Argentina) than in EU countries.
- ✓ For ICT K/L ratio the dispersion in LA countries is not different from the other countries (high variability of the dispersion indicators among all countries)

## Descriptive Statistics: TFP (US 1995=100)

- Levels of TFP have been calculated following Hulten & Schwab (1993) using a reference to obtain a transitive indicator which is comparable across sectors, countries and years.
- The reference used is Total US economy in the initial year (1995).
- TFP is calculated according to the following expression:

$$\ln TFP_{itk} = (\ln Y_{itk} - \ln Y_0) - \sum_j \frac{1}{2} (s_{jitk} + s_{j0}) (\ln X_{jitk} - \ln X_{j0})$$

Where:

- $i$  sector;  $t$  year;  $k$  country
- Subscripts  $0$  refer to the values of each variable in the Total US economy in 1995.
- $Y$ : Value added
- $s$ : factor share
- $X_j$ : production factors (Labor quantity and quality, KICT and KNICT)
- TFP is calculated as the  $\exp(\ln TFP) * 100$  and takes the value 100 for the reference country (US).

# Descriptive Statistics: TFP (US 1995=100)

	France	Germany	Italy	Spain	United Kingdom	United States	Japan	Argentina	Brazil	Chile	Mexico
<b>Economy-wide TFP</b>											
<b>1995</b>	94,37	95,92	75,59	86,26	86,31	100,00	75,39	52,65	37,41	46,03	49,57
<b>2007</b>	99,61	100,84	71,42	79,50	92,82	109,72	77,99	59,40	33,00	43,55	47,01
<b>Standard deviation of log of TFP</b>											
<b>1995</b>	0,24	0,34	0,30	0,18	0,25	0,24	0,40	0,71	0,65	0,57	0,71
<b>2007</b>	0,26	0,19	0,25	0,26	0,25	0,43	0,42	0,57	0,58	0,51	0,66
<b>Max-min ratio</b>											
<b>2007</b>	2,36	2,04	2,61	2,00	2,00	4,42	4,61	8,62	5,48	5,99	9,66
<b>Sector with Highest TFP in 2007</b>											
<b>Sector</b>	E	D	C	E	D	D	C	E	Jtk	C	JtK
<b>TFP</b>	153,36	142,54	133,56	140,15	133,98	180,06	126,57	267,79	107,63	134,63	186,52
<b>Sector with Lowest TFP in 2007</b>											
<b>Sector</b>	AtB	AtB	AtB	LtQ	LtQ	C	AtB	GtH	GtH	LtQ	E
<b>TFP</b>	64,86	69,96	51,22	70,19	66,85	40,72	27,47	31,05	19,63	22,48	19,30
<b>Compound Annual Growth rate of Econ. Wide TFP</b>											
<b>1995-2007</b>	0,45	0,42	-0,47	-0,68	0,61	0,77	0,31	1,01	-1,04	-0,46	-0,44

Japan: 2007 not available, data correspond to 2006

TOTAL ECONOMY	TOT
Agriculture and fishing	AtB
Mining and quarrying	C
Manufacturing	D
Electricity, gas and water supply	E
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Wholesale and retail trade; hotels and restaurants	GtH
Transport and communications	I
Finance, insurance, real estate and business services	JtK
Community social and personal services	LtQ

# TFP

- ✓ The level of TFP is lower in LA countries (around half that of the reference countries)
- ✓ There is not a common sectoral pattern among countries.
  - ✓ The highest TFP corresponds to *Electricity, gas & water supply* (France, Spain & Argentina); *Manufacturing* (Germany, UK, US); *Mining & quarrying* (Italy, Japan & Chile); or *Finance & insurance* (Brazil & Mexico)
  - ✓ The lowest TFP corresponds to *Agriculture & fishing* (France, Germany, Italy & Japan); *Community, social & personal services* (Spain, UK & Chile); and *Wholesale & retail trade, hotels & restaurants* (Argentina & Brazil)
- ✓ The dispersion –as measured by the standard deviation of logs- is clearly higher in LA countries (around twice that of the reference countries)
- ✓ The same is true for the max/min ratio (more than double in LA countries than in the reference countries)
- ✓ In fact, this is the variable for which the dispersion is clearly highest in LA countries. This means that the differences in the levels of efficiency achieved by the different sectors in LA countries is very high. In fact, most of the dispersion found in Labour Productivity can be attributed to TFP.



## Shift-Share Analysis

Labor Productivity

K/L ratio

Non ICT K/L ratio

ICT K/L ratio

TFP

## Shift-shares

- Labor productivity shift-share has been calculated according to the following precise expression:

$$\frac{VA_t}{L_t} - \frac{VA_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{VA_{jt}}{L_{jt}} - \frac{VA_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{VA_{j0}}{L_{j0}}}_{\text{Structural change component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \left( \frac{VA_{jt}}{L_{jt}} - \frac{VA_{j0}}{L_{j0}} \right)}_{\text{Dynamic component}}$$

- Where  $\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$ . The subscript 0 refers to the initial year, 1995.
- However, the last term of the expression is of no direct interpretation. Thus in the following slides, only the *within* component and *structural change* components are shown.
- Additionally, to make the decomposition exact after dropping the dynamic component, the total variation of labor productivity is broken down in the *within* and *structural change* component according to the weight of each components in the sum of these two.
- In the rest of the shift-shares the procedure has been analogous.
- When changes in employment share are positively correlated with productivity levels, the “structural change” term will be positive meaning that the structural change increases economy wide productivity growth.

# Decomposition of labour productivity. 1995-2007

$$\frac{VA_t}{L_t} - \frac{VA_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{VA_{jt}}{L_{jt}} - \frac{VA_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{VA_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007

	Labor productivity growth	Whithin component	Structural change component
France	1.53	1.46	0.06
Germany	1.55	1.37	0.18
Italy	0.51	0.36	0.16
Spain	0.67	0.69	-0.02
UK	2.06	2.22	-0.16
US	2.02	2.10	-0.08
Japan <sup>2</sup>	2.10	1.89	0.20
Argentina	0.84	0.58	0.27
Brazil	0.63	0.10	0.53
Chile	2.56	2.34	0.23
Mexico	1.21	0.88	0.33

Japan: 1995-2006

## Percent distribution 1995-2007

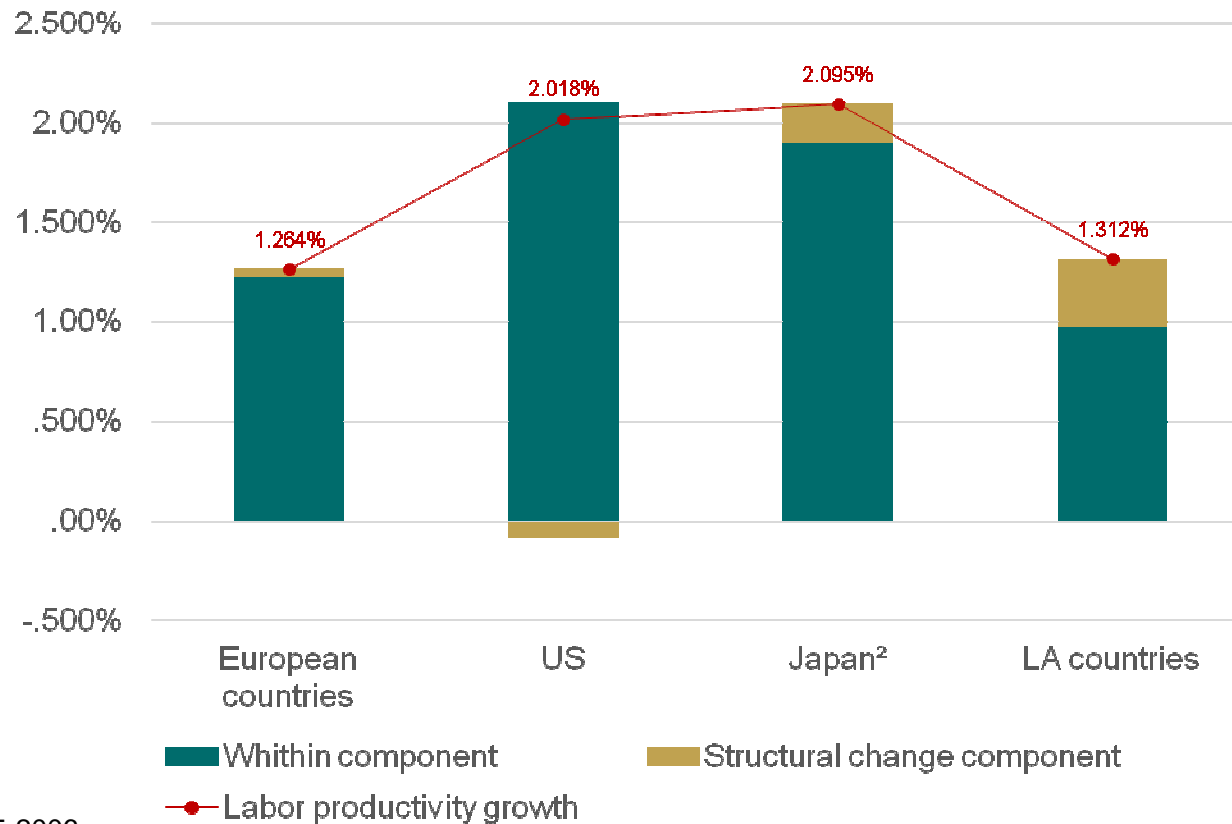
	Labor productivity growth	Whithin component	Structural change component
France	100.00	95.77	4.23
Germany	100.00	88.13	11.87
Italy	100.00	69.52	30.48
Spain	100.00	103.16	-3.16
UK	100.00	107.78	-7.78
US	100.00	104.07	-4.07
Japan <sup>2</sup>	100.00	90.41	9.59
Argentina	100.00	68.34	31.66
Brazil	100.00	16.55	83.45
Chile	100.00	91.17	8.83
Mexico	100.00	72.51	27.49

# Decomposition of labour productivity. 1995-2007

$$\frac{VA_t}{L_t} - \frac{VA_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{VA_{jt}}{L_{jt}} - \frac{VA_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{VA_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007





# Decomposition of the Capital / labor ratio. 1995-2007

$$\frac{K_t}{L_t} - \frac{K_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{K_{jt}}{L_{jt}} - \frac{K_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{K_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

Within component      Structural change component

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007

	Capital / labor growth	Whithin component	Structural change component
France	2.49	2.78	-0.29
Germany	3.48	3.36	0.13
Italy	2.33	0.21	2.12
Spain	2.56	3.06	-0.51
UK	3.97	4.45	-0.48
US	3.71	4.10	-0.39
Japan <sup>2</sup>	3.45	3.39	0.06
Argentina	-3.00	-3.09	0.09
Brazil	0.79	0.53	0.26
Chile	6.05	6.23	-0.18
Mexico	1.64	1.64	0.00

Japan: 1995-2006

## Percent distribution 1995-2007

	Capital / labor growth	Whithin component	Structural change component
France	100.00	111.56	-11.56
Germany	100.00	96.41	3.59
Italy	100.00	9.09	90.91
Spain	100.00	119.85	-19.85
UK	100.00	112.14	-12.14
US	100.00	110.40	-10.40
Japan <sup>2</sup>	100.00	98.24	1.76
Argentina	100.00	102.99	-2.99
Brazil	100.00	66.91	33.09
Chile	100.00	102.93	-2.93
Mexico	100.00	100.20	-0.20

# Decomposition of the Capital / labor ratio. 1995-2007

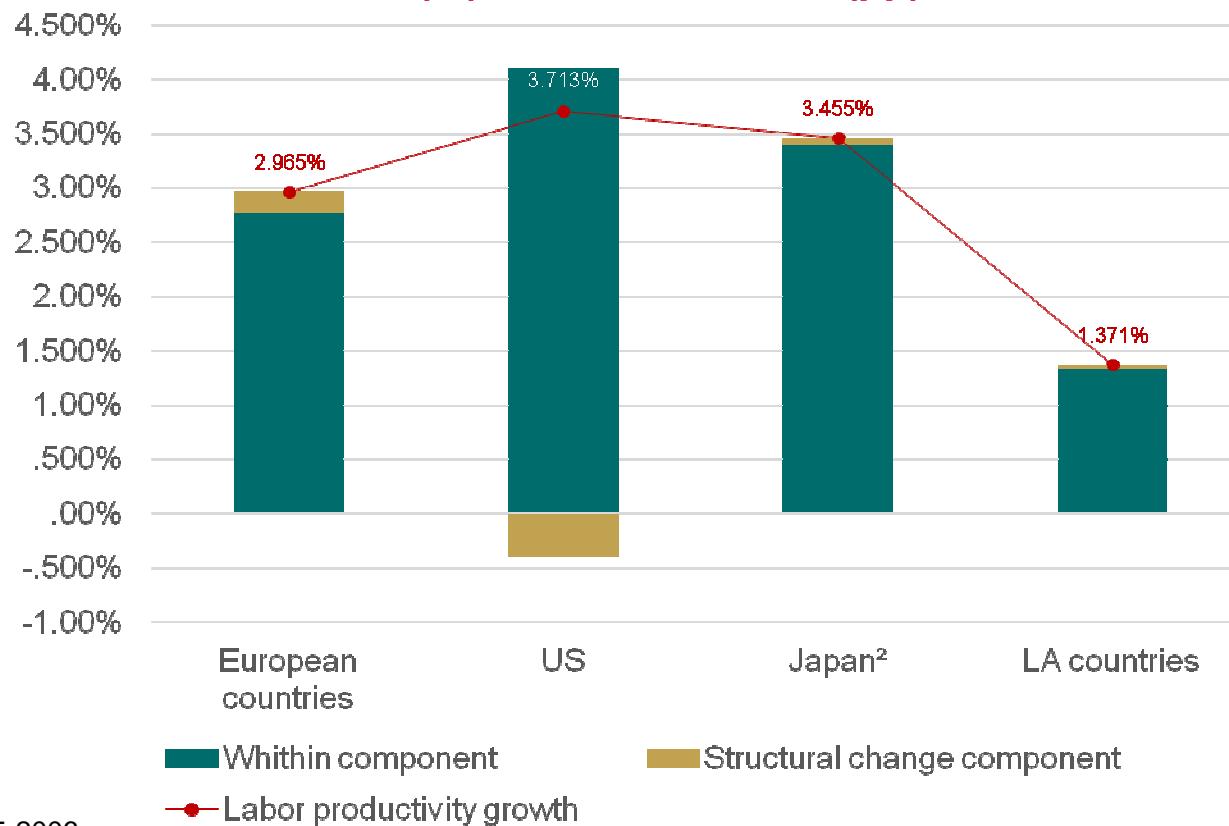
$$\frac{K_t}{L_t} - \frac{K_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{K_{jt}}{L_{jt}} - \frac{K_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{K_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

Within component

Structural change component

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007



# Decomposition of the ICT Capital / labor ratio . 1995-2007

$$\frac{KICT_t}{L_t} - \frac{KICT_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{KICT_{jt}}{L_{jt}} - \frac{KICT_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{KICT_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007

	ICT capital / labor growth	Whithin component	Structural change component
France	7.72	7.60	0.13
Germany	11.03	10.67	0.36
Italy	8.03	7.73	0.29
Spain	8.77	8.79	-0.02
UK	12.51	12.42	0.09
US	12.46	12.49	-0.03
Japan <sup>2</sup>	8.03	7.34	0.69
Argentina	8.11	7.86	0.25
Brazil	7.56	7.04	0.52
Chile	26.79	26.75	0.04
Mexico	13.13	12.82	0.32

Japan: 1995-2006

## Percent distribution 1995-2007

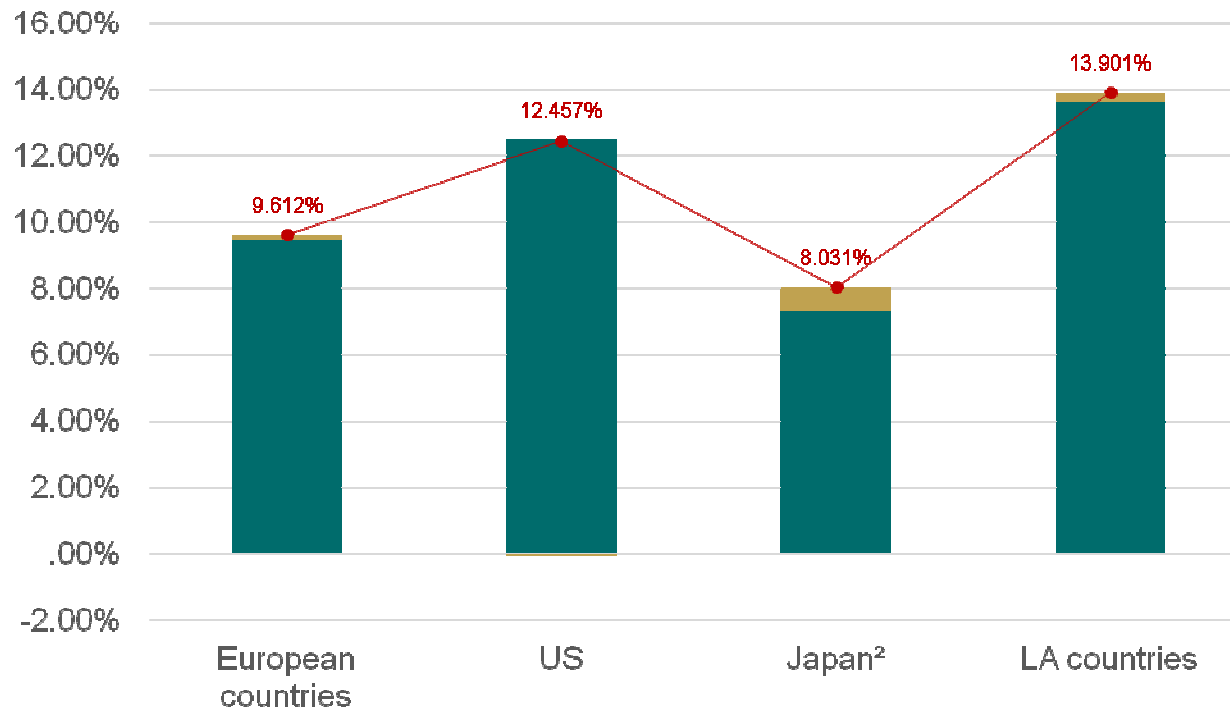
	ICT capital / labor growth	Whithin component	Structural change component
France	100.00	98.36	1.64
Germany	100.00	96.76	3.24
Italy	100.00	96.35	3.65
Spain	100.00	100.20	-0.20
UK	100.00	99.29	0.71
US	100.00	100.28	-0.28
Japan <sup>2</sup>	100.00	91.35	8.65
Argentina	100.00	96.94	3.06
Brazil	100.00	93.07	6.93
Chile	100.00	99.85	0.15
Mexico	100.00	97.60	2.40

# Decomposition of the ICT Capital / labor ratio. 1995-2007

$$\frac{KICT_t}{L_t} - \frac{KICT_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{KICT_{jt}}{L_{jt}} - \frac{KICT_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{KICT_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007



Japan: 1995-2006

■ Within component      ■ Structural change component  
—●— Labor productivity growth

## Decomposition of the non-ICT Capital / labor ratio. 1995-2007

$$\frac{KNICT_t}{L_t} - \frac{KNICT_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{KNICT_{jt}}{L_{jt}} - \frac{KNICT_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{KNICT_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$

### Growth rate (%) and contribution (pp) 1995-2007

	non-ICT Capital / labor growth	Whithin component	Structural change component
France	1.63	1.892	-0.267
Germany	2.09	2.016	0.079
Italy	1.64	-0.171	1.815
Spain	1.61	2.088	-0.478
UK	1.44	1.856	-0.417
US	1.26	1.559	-0.296
Japan <sup>2</sup>	2.74	2.727	0.017
Argentina	-3.76	-3.845	0.081
Brazil	-1.03	-1.918	0.886
Chile	5.23	5.417	-0.183
Mexico	0.79	0.806	-0.020

Japan: 1995-2006

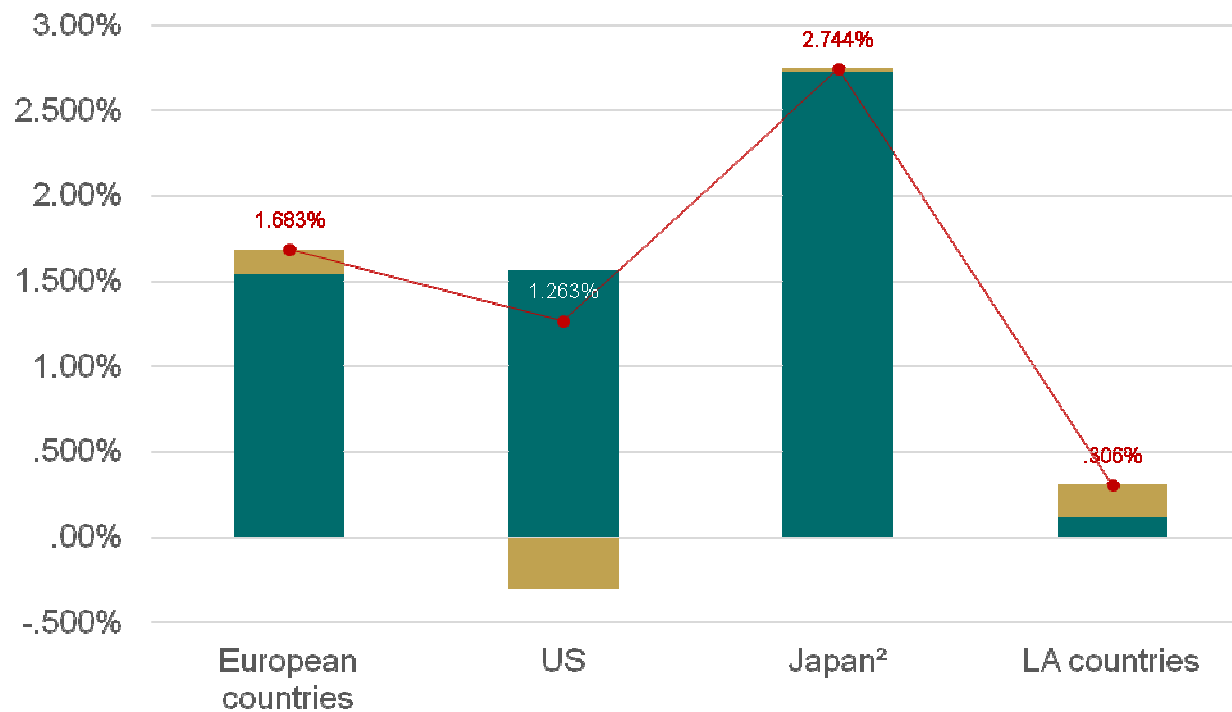
### Percent distribution 1995-2007

	non-ICT Capital / labor growth	Whithin component	Structural change component
France	100.0	116.4	-16.4
Germany	100.0	96.2	3.8
Italy	100.0	-10.4	110.4
Spain	100.0	129.7	-29.7
UK	100.0	128.9	-28.9
US	100.0	123.4	-23.4
Japan <sup>2</sup>	100.0	99.4	0.6
Argentina	100.0	102.2	-2.2
Brazil	100.0	185.9	-85.9
Chile	100.0	103.5	-3.5
Mexico	100.0	102.5	-2.5

# Decomposition of the non-ICT Capital / labor ratio . 1995-2007

$$\frac{KNICT_t}{L_t} - \frac{KNICT_0}{L_0} = \underbrace{\sum_j \theta_{j0} \left( \frac{KNICT_{jt}}{L_{jt}} - \frac{KNICT_{j0}}{L_{j0}} \right)}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) \frac{KNICT_{j0}}{L_{j0}}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of employment of sector  $j$  in total employment in year  $t$



Japan: 1995-2006

# Decomposition of the TFP increase. 1995-2007

$$TFP_t - TFP_0 = \underbrace{\sum_j \theta_{j0} (TFP_{jt} - TFP_{j0})}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) TFP_{j0}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of the aggregation of inputs of sector  $j$  in total aggregated inputs in year  $t$

## Growth rate (%) and contribution (pp) 1995-2007

	TFP growth	Whithin component	Structural change component
France	0.45	0.45	0.00
Germany	0.42	0.40	0.02
Italy	-0.47	-0.64	0.17
Spain	-0.68	-0.72	0.04
UK	0.61	0.79	-0.19
US	0.77	0.82	-0.05
Japan <sup>2</sup>	0.31	0.41	-0.10
Argentina	1.01	0.63	0.37
Brazil	-1.04	-1.28	0.24
Chile	-0.46	-0.41	-0.06
Mexico	-0.44	-0.30	-0.14

Japan: 1995-2006

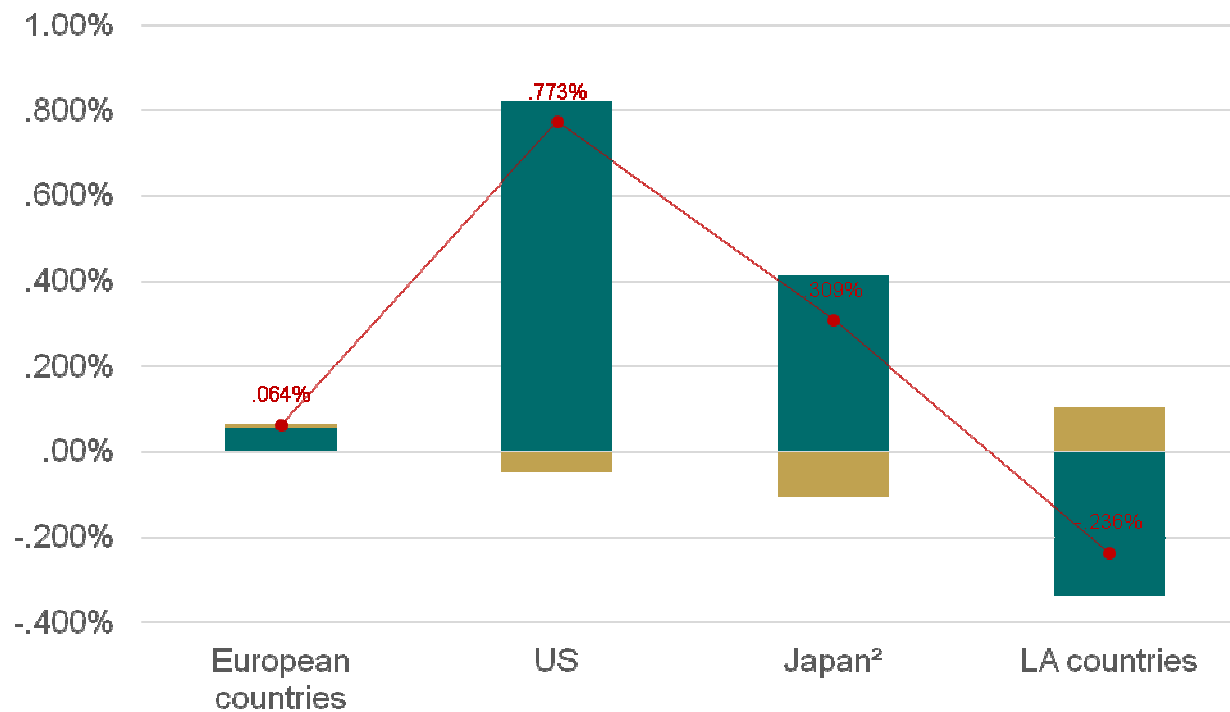
## Percent distribution 1995-2007

	TFP growth	Whithin component	Structural change component
France	100.00	99.58	0.42
Germany	100.00	95.95	4.05
Italy	100.00	136.07	-36.07
Spain	100.00	106.34	-6.34
UK	100.00	131.11	-31.11
US	100.00	106.12	-6.12
Japan <sup>2</sup>	100.00	133.16	-33.16
Argentina	100.00	62.84	37.16
Brazil	100.00	122.70	-22.70
Chile	100.00	87.92	12.08
Mexico	100.00	67.89	32.11

# Decomposition of the TFP increase. 1995-2007

$$TFP_t - TFP_0 = \underbrace{\sum_j \theta_{j0} (TFP_{jt} - TFP_{j0})}_{\text{Within component}} + \underbrace{\sum_j (\theta_{jt} - \theta_{j0}) TFP_{j0}}_{\text{Structural change component}}$$

$\theta_{jt}$  is the weight of the aggregation of inputs of sector  $j$  in total aggregated inputs in year  $t$



Japan: 1995-2006



# Shift-share and growth accounting. Summary

	Labor productivity growth rate			Contributions (percentage points) to labor productivity growth										Reall. effect
				Changes in labor comp.	ICT capital per hour worked			Non-ICT capital per hour worked			TFP			
	Total	Within	Structural change		Total	Within	Structural change	Total	Within	Structural change	Total	Within	Structural change	
France	1.53	1.46	0.06	0.31	0.27	0.27	0.00	0.37	0.43	-0.06	0.49	0.49	0.00	0.08
Germany	1.55	1.37	0.18	0.05	0.39	0.38	0.01	0.36	0.35	0.01	0.59	0.57	0.02	0.15
Italy	0.51	0.36	0.16	0.09	0.22	0.21	0.01	0.39	-0.04	0.43	-0.34	-0.46	0.12	0.15
Spain	0.67	0.69	-0.02	0.38	0.36	0.36	0.00	0.56	0.73	-0.17	-0.63	-0.67	0.04	-0.02
UK	2.06	2.22	-0.16	0.48	0.66	0.66	0.00	0.39	0.50	-0.11	0.63	0.83	-0.20	-0.09
US	2.02	2.10	-0.08	0.26	0.76	0.76	0.00	0.39	0.48	-0.09	0.72	0.76	-0.04	-0.11
Japan <sup>2</sup>	2.10	1.89	0.20	0.39	0.34	0.31	0.03	0.86	0.85	0.01	0.28	0.37	-0.09	0.23
Argentina	0.84	0.58	0.27	0.46	0.17	0.16	0.01	-1.38	-1.41	0.03	1.38	0.87	0.51	0.23
Brazil	0.63	0.10	0.53	0.94	0.55	0.51	0.04	-0.31	-0.58	0.27	-1.17	-1.44	0.27	0.62
Chile	2.56	2.34	0.23	0.80	0.32	0.32	0.00	1.71	1.77	-0.06	-0.55	-0.48	-0.07	0.28
Mexico	1.21	0.88	0.33	0.39	0.38	0.37	0.01	0.31	0.32	-0.01	-0.22	-0.15	-0.07	0.34

## Shift Share Analysis: Main Results

- The *main contributor to growth* for all countries and all variables is the *within* effect.
- The *structural change* component for labor productivity has, on average, a *positive* & also a higher contribution in LA countries than in the *reference* ones. However, it is not homogenous within LA countries: very high in Brazil and low in Chile.
- For the K/L ratio, as well as for ICT K/L and non ICT K/L ratio, the *structural change* component is only relevant for Brazil but not for the rest of LA countries. Thus, the *within* component is the main determinant of K/L growth.
- The *within* component for TFP is *negative* in 3 LA countries, specially in Brazil (Argentina is the exception). Thus, the *main responsibility* for the negative contribution of TFP must be found *inside the individual sectors*.
- However, the *structural change* component for the TFP variable is *positive* in *Brazil and Argentina*, indicating the existence of positive spillover effects among sectors in these two countries. For *Mexico and Chile* the structural change effect is negative though negligible.

# Importance of the level of disaggregation

- Is the relevance of the structural change contribution dependent upon the level of available industry disaggregation?
- Labor productivity is available for 65 industries in the case of Mexico and for 31 industries in the case of the *reference* countries. In both cases for period 1995-2007.
- For the *reference* countries the level of disaggregation does not really affect the shift-share results. The exceptions are Spain & Italy. For the former, the 31 industries disaggregation generates a higher, and positive, *structural change* component. For Italy it happens the opposite.
- For Mexico, the *structural change* component increases continuously with the level of industry disaggregation. For the 9 industries disaggregation it represents 27.5% of total LP variation, while for the 65 industries it goes up to 45.8%.

	France		Germany		Italy		Spain		UK		US		Japan <sup>2</sup>		Mexico		
	31 inds	9 inds	31 inds	9 inds	31 inds	9 inds	31 inds	9 inds	31 inds	9 inds	31 inds	9 inds	31 inds	9 inds	65 inds	31 inds	9 inds
Total variation	100.0	100	100.0	100	100.0	100	100.0	100	100.0	100	100.0	100	100.0	100	100	100.0	100
Within	97.7	95.77	82.8	88.13	101.7	69.52	49.7	103.16	103.4	107.78	103.1	104.07	97.6	90.41	54.18	67.6	72.51
Structural change	2.3	4.23	17.2	11.87	-1.7	30.48	50.3	-3.16	-3.4	-7.78	-3.1	-4.07	2.4	9.59	45.82	32.4	27.49

## Conclusions

- ✓ The importance of structural change in LA growth performance has a long lasting tradition thanks to the works made by ECLAC.
- ✓ This paper contributes to this tradition making use of the LA KLEMS database for four LA countries (Argentina, Brazil, Chile and Mexico) and for seven developed countries to which we have referred as *reference countries* (EU: France, Germany, Italy, Spain, UK; US & Japan) using EU KLEMS database, for the period 1995-2007.
- ✓ It takes three complementary perspectives:
  - ✓ 1. Growth Accounting;
  - ✓ 2. Descriptive Statistics;
  - ✓ 3. Shift-share analysis.

The main conclusions can be summarized as follows:

# Conclusions

**Growth Accounting** (applied to labor productivity growth):

- ✓ LP growth does not follow a given pattern: some *reference* countries present high growth rates (i.e. Japan (2.10%), UK, 2,06%) but also Chile (2.56%), while some other have very low rates both in *reference* and LA area (i.e. Italy (0.51%), Spain (0.67%) or Brazil (0.63%))
- ✓ The main source of LP growth in LA arises from improvements in human capital, as should be expected according to its level of development.
- ✓ The contribution of capital accumulation (K/L) has been very uneven among countries, without sharing a common pattern in *reference* or LA countries.
- ✓ In 3 LA countries (the exception is Argentina) TFP contribution was negative. This variable has been the main burden for LA labor productivity growth.
- ✓ It is remarkable that the 4 LA countries present a high and positive reallocation effect, which is another way of looking at (positive) structural change.

# Conclusions

## Descriptive Statistics

- ✓ LA countries have lower levels of LP, K/L ratios (both Non-ICT K/L & ICT K/L) and also lower levels of TFP than *reference* countries.
- ✓ The sectoral LP dispersion is (slightly) higher in LA countries than in *reference* countries.
- ✓ The pattern of sectoral dispersion is not that clear for K/L.
- ✓ But it is very clear in terms of TFP (more than doubling that of EU countries). Here is where the main difference can be found.
- ✓ Overall, the sectors with better performance are: *Energy, gas & water supply, Mining & quarrying, and Manufacturing.*
- ✓ And those with the worse performance: *Agriculture and fishing together with Construction.*

# Conclusions

## Shift-Share analysis

- ✓ For all variables and countries the *within* effect is the **driver of growth**.
- ✓ For **Labor Productivity** the *structural change* component has a **higher and positive** impact on **LA countries** than in the other countries considered. However, its **magnitude** is very **different** between countries (the highest in Brazil and the lowest in Chile).
- ✓ The contribution of the *structural change* component **increases** with the **level of industry disaggregation** as Mexico's data shows. This is not so for *reference* countries (with the exceptions of Spain & Italy)
- ✓ It is **remarkable** to notice that in **3 LA countries** (Argentina is the exception) the **TFP *within*** component had a **highly negative contribution** indicating that the **efficiency problems** shown by LA countries rely, **mainly, inside the sectors**.

## Summarizing

- ✓ The *within* effect is the **most relevant** for all variables and countries growth
- ✓ The results seem to indicate that **LA countries have benefited from a positive**, through small, **structural change** in comparison with the reference countries. Only after comparing with Asian countries included in the WORLD KLEMS project we will be able to conclude if structural change has been less important in LA as McMillan & Rodrik conclude.
- ✓ The results for Mexico indicate that **structural change analysis** should widen the scope moving from traditional Agriculture / Manufacturing / Services sequence, to **a more detailed sectoral analysis**. What is relevant, at least for that country, is **to which** manufacturing or service sectors is labor moving (not the general move)
- ✓ The relatively **low productivity growth in LA** had its origin in the **(negative) TFP contribution** in 3 out of 4 LA countries (Argentina is the exception)
- ✓ This **negative TFP contribution** must be **blamed** on the *within* component in the 3 countries, and **not on** the **structural change** component which was positive in Argentina & Brazil, (slightly) negative in Chile and Mexico.



## Summarizing

- ✓ Taken all together the results indicate that LA countries need **improving the efficiency** of their production process through measures that go beyond standard tangible capital accumulation.
- ✓ They need to take measures oriented to **accomplish improvements *within the sectors***.
- ✓ **These measures include enhancing** the functioning of the labor markets, increasing R&D, improving human capital both at the school but especially at the workplace, and most of the **intangibles assets** which help to obtained more efficient results from the same quantity of capital and labor.
- ✓ They also need **to intensify the structural change** but taking into account that a mere movement form Agriculture to Manufacturing and Services is not enough.
- ✓ Both **Manufacturing** and **Services** aggregates are very **heterogeneous**, so the focus should move to the most productive industries within these two big aggregates.



# Cambio estructural en Argentina, Brasil, Chile y México. Una comparación internacional

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