

Labour Productivity: Are Diverging Trends between Developed Countries Durable?

- Michel Fouquin
 - (CEPII)

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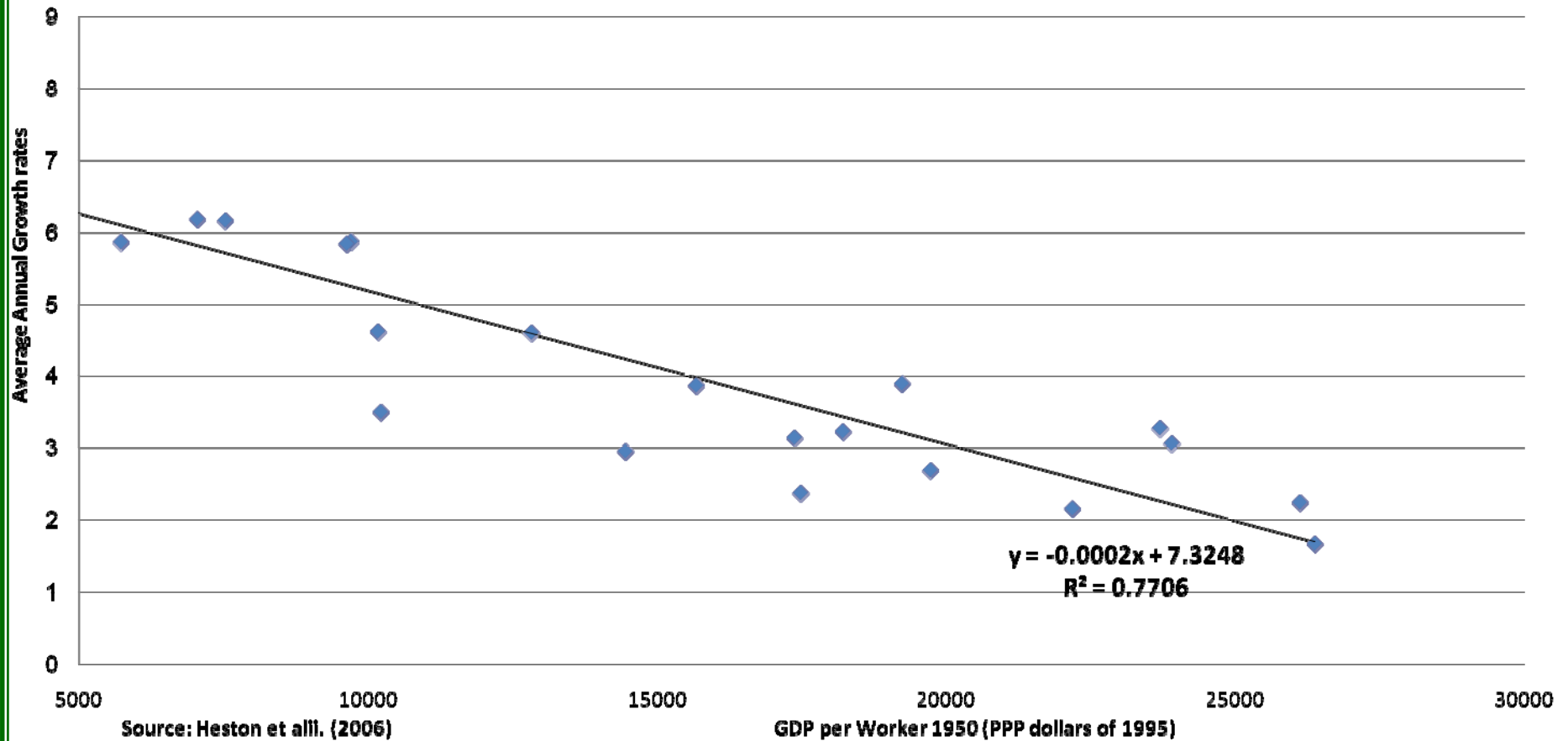
Convergent Economies

- One major issue for economic analysis and policy is to explain differing growth performances between nations. Labour productivity being a central issue
- Since WWII we have experienced at least for the 1950-1973 strong converging trends among developed economies (see graph 1)
- As illustrated by the seminal paper of Mankiw, Romer and Weil (1992), the lower the initial level of productivity the higher was the growth rate

Convergent Economies

- These trends were not seen for the developing world except for East Asian countries
- This analysis give rise to the conditional convergence hypothesis:
- Given some structural factors such as the initial human capital, the rate of investment etc. Each country was able to reach a certain level of development
- Developed country having similar structure could catch up with the leading economy ie the USA

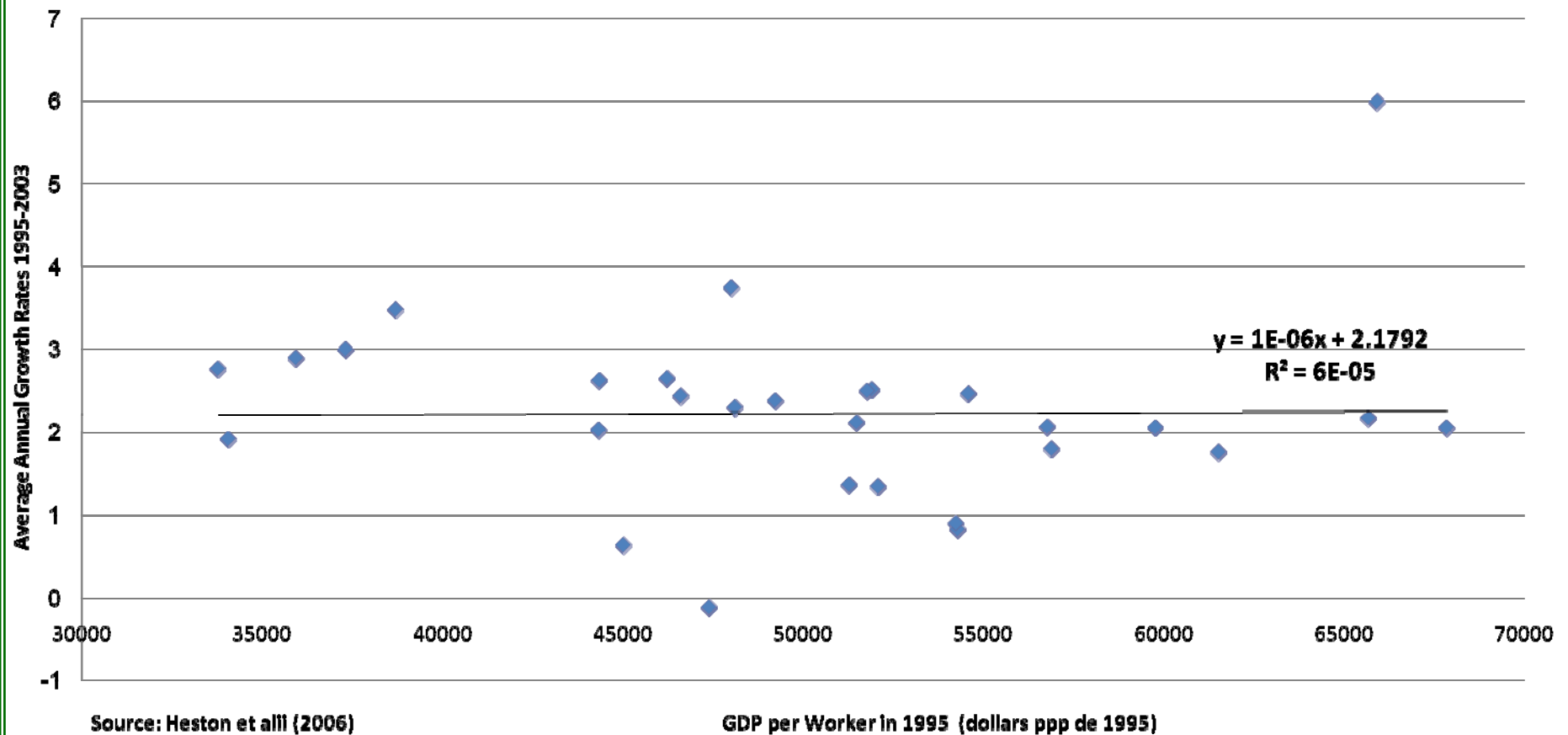
**Graph 1 : Developed Countries,
Average Annual Growth Rates 1950-1970 and Levels of 1950
For the GDP per Worker
(International Dollars of 1995)**



No convergence

- After the first oil shock, developed economies registered declining labour productivity gains
- Several reasons were search to explain this decline:
 - GDP growth decline;
 - Rising cost and Declining return of new technology investment;
- As a consequence the catching up Process disappear (see graph 2)

**Graph 2: Developed Countries,
Average Annual Growth Rates 1995-2003 and Levels in 1995
For the GDP per Worker
(International Dollars of 1995)**



Tests

- Many economic series show a constant trend over time
- This is often the case for GDP growth data: in the long run growth remain for many countries constant once short term fluctuations are eliminated
- But in some cases there are permanent breaks in the trends therefore there is a trend before a certain date and another one after that date
- Econometric Tests Developed by Bai and Perron allow us to Discriminated between the two cases
- The tests used here are applied to labour productivity and/or hourly labour productivity data

Tests

We choose to test the breaks on the series of GDP per worker annual growth, but to check the results with series in the form of indices

$$\Delta y_t = b + e_t$$

$$\Delta y_t = b_1 + (b_2 - b_1)I(t > T_1) + e_t$$

Breaks in Secular Perspective

- There are few breaks in the long term period
- For example for the USA Maury and Pluyaud (2007) found only three breaks over a century:
- In 1922 (or 1933) -according to the kind of test used- Productivity accelerate from 1.3% to 2.5%
- Then in 1967 (or 1973) it declined from 2.5% to 1.3%
- Last since 1995 hourly productivity accelerate from 1.4% to 2.2%

The first break since WWII is concomitant to the first oil shock

- We used data from OECD data base for the period 1960-2007 for 19 countries
- 11 out of 19 countries registered a break around 1974 labour productivity declined by 60%
- 4 more countries –Germany included- registered a late break around 77 and 79
- 3 countries got a single break in 1996 Korea, Italy and Spain which are emerging countries at least Korea and Spain
- Globally we may consider this break as having a macro-economic cause rather than a technical one

The second Break in the eighties

- This time three countries registered a rise USA, Sweden and Greece
- Eight countries registered a decline, of which five are at a second decline EU-15 as a whole France, Belgium, Portugal, and Japan
- Australia does not got any break what ever the period

Table 1: Breaks in workers' productivity trends, 1960-2007

	Countries	Tests for 1960-2007				Tests for 1975-2007			
		Break Year	Break Year	Break Year	Break Year	Break Year	Break Year	Break Year	
Break and Rise	USA	1.8%	1974	1.3%	1992	1.8%	1.3%	1992	1.8%
Second period	Sweden	3.3%	1974				1.3%	1992	2.3%
	Greece	7.8%	1974				0.8%	1996	2.6%
Double break and drop	EU 15	4.3%	1974				2.0%	1990	1.2%
	France	4.9%	1974				2.4%	1990	1.2%
	Belgium	4.4%	1974				2.1%	1996	1.0%
	Portugal	5.3%	1974				2.6%	1996	0.8%
	Japan	8.2%	1973				2.8%	1991	1.2%
Single break and drop	Austria	5.5%	1972						1.4%
	Finland	4.4%	1974						2.4%
	United Kingdom	2.5%	1974						2.0%
	Netherlands	3.9%	1977						0.7%
	Denmark	3.0%	1977						1.7%
	Germany	3.8%	1978						1.2%
	Ireland	4.0%	1979						3.0%
	Korea		4.8%		1996	3.3%	5.1%	1996	3.2%
	Italy		3.6%		1996	0.3%	2.5%	1996	0.3%
	Spain		4.0%		1995	-0.3%	2.5%	1995	-0.3%
No break	Australia				1.6%				1.4%

Sources: GDP constants prices, CHELEM-CEPII 2008; Emplois strategies OECD 2008.

Breaks around 1995

- In order to confirm the tests for 1995 we made a second serie of tests on hourly productivity data
- Tests are made for the after oil-shock period in order to eliminate its remnant effect
- This time 12 countries out of 18 are experiencing a large decline between 1990 and 1996 (one point of percentage decline)
- The same 3 –USA, Sweden and Greece- registered an increase
- While for 3 others we did not find a break

Table 2 : Breaks in hourly labor productivity trends, 1975-2005

	Countries	Break year	Average annual growth rates		Gap
			before	after	
Break and rise	USA	1996	1.2%	2.6%	1.4
	Greece	1996	1.0%	2.7%	1.7
	Sweden	1992	1.3%	2.6%	1.3
Break and drop	EU 15	1996	2.4%	1.4%	-1
	Germany	1996	2.6%	1.6%	-1
	France	1990	3.0%	1.8%	-1.2
	Belgium	1986	3.2%	1.6%	-1.6
	Luxembourg	1992	3.8%	1.1%	-2.7
	Italia	1996	2.1%	0.5%	-1.6
	Spain	1986	2.6%	1.2%	-1.4
	Portugal	1993	4.8%	1.5%	-3.3
	Austria	1996	2.4%	1.6%	-0.8
	Denmark	1996	2.3%	0.9%	-1.4
	Finland	1995	3.1%	2.2%	-0.9
	Netherlands	1986	2.4%	1.4%	-1
	Japan	1992	4.4%	2.4%	-2
Korea	1992	6.4%	4.1%	-2.3	
No break	Australia		1.7%		
	Ireland		3.4%		
	United Kingdom		2.1%		

Source: EUKLEMS, 2008.

Tests on quarterly data up to early 2008

- The big question mark is to decide whether the diverging trends in labour productivity are durable or not
- That is why we choose to test the idea on quarterly data up to the first quarter of 2008 before the slow down of the financial crisis
- We find that 10 countries experience a decline : EU and the US included
- But if we look at the gap between EU and the US it remains in favour of the US with an advantage of 0.6% per year
- So our conclusion is that divergence continues

Table 3: Recent trends in labor productivity 1995 Q1 to 2008 Q1

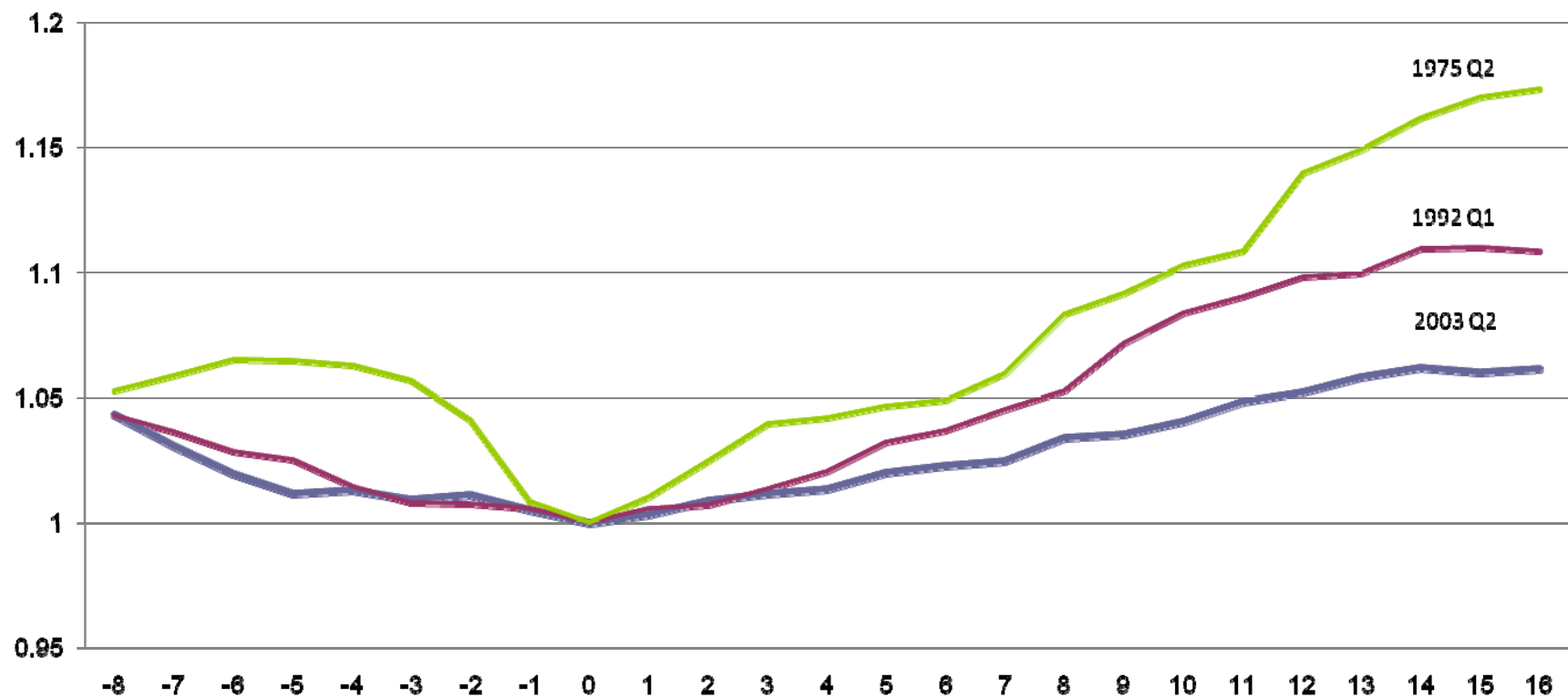
	Countries	Break year	Average annual growth rates		Gap
			Before	After	
Rise	Germany	2004Q4	1.2%	3.6%	2.4
	Denmark	2001Q2	1.3%	1.6%	0.3
					0
Drop	Australia	1999Q1	2.9%	1.0%	-1.9
	Canada	2000Q4	1.8%	0.5%	-1.3
	USA	2000Q1	2.1%	1.5%	-0.6
	USA hourly productivity	2003Q4	2.9%	1.9%	-1
	EU 11	2000Q2	1.5%	0.9%	-0.6
	Austria	2000Q4	2.7%	1.0%	-1.7
	Spain	1998Q3	0.0%	-0.5%	-0.5
	France	2000Q2	1.8%	0.9%	-0.9
	Ireland	2004Q1	3.5%	0.8%	-2.7
	Italia	2001Q2	0.8%	-0.4%	-1.2
	Norway	2004Q3	1.6%	0.6%	-1
	Poland	2004Q2	5.4%	1.9%	-3.5
No break	United Kingdom		1.8%		
	Finland		2.2%		
	Sweden		2.0%		
	Switzerland		1.0%		
	Portugal		0.6%		
	Korea		3.5%		
	Japan		1.5%		
	New Zealand		1.2%		

Source: OCDE, authors calculations.

“What Happened to the Great US Job Machine?”

- Baily and Lawrence (2004) try to explain why the US economy did not create as much job during the last recovery as in the past?
- They show that imports from the low wage countries did not contribute significantly to the decline in manufacturing jobs but that it was the overvalued dollar that reduce sharply the capacity of the US to export and the accelerating gains in manufacturing productivity that were the main causes

**Graph 3: United States Labour Cycles since 1970
(Quarterly Data, Trough point =0.0)**



Source: Payroll Employment non Farm Business, Bureau of Labor Statistics

How do we explain the diverging trends?

- Using EUKLEMS data base we find some explanations
- Table 4 gives the differences in US rates of growth and EU rates before and after 1995
- Before the labour contribution was much higher (1.18) in the US than in EU while Investment were almost the same resulting in a lower US PGF (-0.32)
- After 1995 US PGF rise much higher (1.29) than EU and this gap grow even higher after 2000 (1.74)
- Labour contribution was much lower in the US and even negative compare to EU for the last period (-0.77)
- Overall ICT did not play the first role although it was significant (+0.2)

Table 4: Gaps in GFP between the US and EU in the merchant sector

	1980-1995	1995-2005	1995-2000	2000-2005
GDP (1+2+3)	0.91	1.49	2.07	0.92
Factor contribution				
Work (1)	1.18	0.06	0.89	-0.77
Hours	1.24	-0.03	0.82	-0.89
Quality	-0.06	0.09	0.07	0.12
Capital (2)	0.06	0.15	0.35	-0.04
ICT	0.14	0.2	0.25	0.15
Non-ICT	-0.08	-0.04	0.1	-0.19
GFP (3)	-0.32	1.29	0.84	1.74

Note: During 1980-1995 US GDP Growth rate is 0.91% higher than EU in the merchant sector

Source: EUKLEMS, March 2008.

Labour intensity

- According to G.Cette and Bourles (2007) productivity decrease with a growing rate of employment as well as with the length of employment

$$\Delta ph = -0.318 \Delta ph_{-1} - 0.569 \Delta ER - 0.558 \Delta h + 0.106 \Delta CUR + 0.676 ITPR - 0.023$$

(0.239)
(0.186)
(0.227)
(0.046)
(0.220)
(0.009)

- Where Δph is the variation of the log of hourly productivity, ΔER is the variation of the log of the rate of *employment*, Δh represents the variation of the log of annual average duration of work, ΔCUR represent the variations in the use of production capacity, and $ITPR$ is the share of ICT in production in the GDP. (Standard error of the parameter are between brackets).
- Sargan *test statistic* : 10.94 (P-value : 0.012) ; Durbin-Wu-Watson *test* : 50.92 (P-value : 0.0) ; Nelson et Startz *test* : $R^2.n = 37.86$ (seuil : 2).

Table 5: Change in growth rates 1995-2006 versus 1985-1995

	Employment ratio	Average individual duration of work	Impact on productivity	GAP relative to the USA	Recall: change in hourly labor productivity
Spain	1.49	0.21	- 0.73	- 1.05	- 1.17
Italia	0.74	0.03	- 0.33	- 0.65	- 1.68
Netherlands	- 0.70	0.79	- 0.03	- 0.35	- 0.26
Belgium	0.04	0.07	- 0.05	- 0.37	- 0.94
Denmark	0.11	1.20	- 0.55	- 0.88	- 1.41
France	0.36	- 0.05	- 0.14	- 0.46	- 0.61
Norway	0.21	- 0.22	0.00	- 0.32	- 0.49
Japan	- 0.11	0.40	- 0.12	- 0.44	- 1.38
Germany	- 0.08		0.04	- 0.29	- 0.98
Finland	1.68	- 0.05	- 0.70	- 1.03	- 0.76
United Kingdom	0.01	- 0.52	0.21	- 0.11	0.22
Ireland	0.95	- 0.75	- 0.09	- 0.42	0.52
Canada	0.23	- 0.19	- 0.02	- 0.34	0.67
New Zealand	0.67	- 0.35	- 0.14	- 0.46	0.05
Austria	- 0.04	- 0.33	0.16	- 0.16	0.77
United States	- 0.45	- 0.31	0.32	-	0.88
Sweden	0.86	- 0.76	- 0.05	- 0.37	1.14

Source: OCDE, authors calculations.

Analysis by Main Sectors

- Evolutions by sector may contribute to explain macro-economic variations
- In the US case increases in productivity is large in the manufacturing sector, in the business services and in the financial services were there is also a large reduction in hours of work, this is a confirmation of former remarks
- For Germany the decrease in productivity is large in the service sector while hours continue to be on the positive side
- In France Global Hours of work increase while individual hours decrease, productivity decline

Table 6: Sectorial change in hours of work and hourly labor productivity between 1995-2005 and 1970-1995

(Gap between Average Annual Growth rates for 1995-2005 compared to 1970-1995)

	USA		Germany		France	
	Hourly productivity	Hours of work	Hourly productivity	Hours of work	Hourly productivity	Hours of work
	y		y		y	
Total	1.1	-0.7	-1.2	+0.1	-1.4	0.9
Manufacturing (electronic and electric machinery excluded)	+2.3	-2.1	-0.7	+0.6	-0.4	+0.3
Electric and Electronic machinery	+4.4	-2.0	+1.2	-0.9	+1.8	-0.4
Other manufacturing sector and construction	-0.1	1.0	-0.3	-1.9	-2.7	+2.5
Distribution	+1.0	-0.9	-0.6	-0.4	-2.2	+1.2
Finance and business services	+1.8	-1.8	-4.0	+0.6	-0.4	+0.1
Personnal services	+1.1	-0.8	-1.7	-0.3	+1.4	-0.4
non merchant	+0.4	-0.5	-0.6	-0.7	-0.4	-1.2

Source: EUKLEMS, 2008.

Japan

- The large decline of value added growth is shared between a decrease in hours worked and a decrease in labour productivity almost equal
- Electric and electronic industries, as well as distribution services are reducing their hours of work by the largest margin
- Personal and social services reflect effort made to soften the effects of the economic low growth

Japan 1995-2005 versus 1973-1995

TOTAL INDUSTRIES

.Electrical machinery, post and communicatio

.Manufacturing, excluding electrical

.Other goods producing industries

.Distribution services

.Finance and business services

.Personal and social services

.Non-market services

Value Added hours worked Productivity

-2.7 -1.3 -1.4

-3.3 -2.5 -0.8

-3.4 -1.4 -2.0

-2.1 -1.6 -0.5

-5.3 -2.2 -3.0

-2.7 -1.9 -0.8

-1.5 -1.9 0.4

-1.7 -0.3 -1.5

Korea

- The decline in labour productivity comes first from the service industries: business and financial services (-5.1) in spite of a reduction of hours worked of (-5.3). It is the result of the Korean financial crisis
- Second cause comes from the social and personal services (-3.8) where hours of work grow by 0.4 in stark contrast with the other sectors
- ITC sector appears to be the most resilient sector

Korea	Value Added hours worked productivity		
TOTAL INDUSTRIES	-4.3	-2.4	-1.9
.Electrical machinery, post and communica	-3.1	-7.1	3.9
.Manufacturing, excluding electrical	-8.3	-6.9	-1.4
.Other goods producing industries	-3.7	-1.9	-1.8
.Distribution services	-5.1	-5.8	0.7
.Finance and business services	-10.4	-5.3	-5.1
.Personal and social services	-3.3	0.4	-3.8
.Non-market services	-2.2	0.0	-2.2

Breaks in Manufacturing industries

- Four countries –Finland, Sweden and the United States- greatly improve their productivity with more than 6%.
- Eight countries register a decrease of which six are European, the strongest decreases are seen in Belgium with 4 points , Spain (-2,5 points), Italia (-5 points) and Japan (-2,4 points).
- And last, six European countries plus EU-15 do not registered a break

Table 7: Trend breaks in manufacturing industries 1975-2005 (Average annual growth rate)

	Countries	Break year	Labor productivity		Break year	Hourly productivity	
			before	after		before	after
Rise	USA	1996	3.2%	6.2%	1996	3.0%	6.5%
	Finland	1992	4.7%	5.9%		5.5%	
	Sweden	1992	2.7%	7.2%	1992	2.4%	6.5%
	Greece	1993	-0.3%	2.3%	1993	-0.3%	2.2%
Rise	Australia	1988	3.2%	1.9%	1986	3.3%	1.9%
	Belgium	1986	6.6%	3.0%	1986	7.2%	3.2%
	Netherlands		3.2%		1986	4.5%	3.1%
	Luxembourg	1994	5.4%	2.4%		3.3%	
	United Kingdom	1995	3.5%	2.8%	1995	3.7%	3.1%
	Spain	1996	2.7%	-0.1%	1989	3.6%	1.1%
	Italia	1996	4.0%	-0.4%	1996	4.0%	0.0%
	Japan	1990	6.4%	3.1%	1990	6.2%	3.8%
No break	Korea		8.7%			9.4%	
	EU 15		2.8%			3.1%	
	Germany		2.3%			2.9%	
	Austria		3.7%			4.1%	
	France		3.2%			3.6%	
	Denmark		1.8%			1.9%	
	Ireland		7.4%			7.5%	
	Portugal		2.9%			3.3%	

Source: EUKLEMS, 2008.

Breaks in business and finance industries

- Although the gains in productivity are much lower than in the manufacturing industries changes are strong
- Five countries -the US and Ireland included- which use to have low or negative performance do make significant progress
- On the contrary European countries – excepted Netherlands, Ireland, and Luxembourg- reduce their productivity gains and some do registered negative results

Table 8: Trend breaks in financial and business services
1975-2005 (Average annual growth rate)

	Countries	Break year	Labor productivity		Break year	Hourly productivity	
			before	after		before	after
Rise	Australia	1986	-1.3%	0.6%	1990	-1.0%	0.8%
	Portugal	1986	-0.7%	1.5%	1986	-0.2%	1.8%
	Italia		-2.1%		1986	-4.5%	-1.4%
	Irland	1996	-2.4%	3.8%	1996	-2.4%	4.4%
	Sweden	1991	-2.2%	0.0%	1991	-1.6%	0.2%
	United Kingdom	1991	0.4%	1.7%	1991	0.6%	1.6%
	USA	1988	-0.6%	1.2%	1991	-0.1%	1.3%
Drop	EU 15	1994	0.1%	-0.4%	1986	0.7%	0.0%
	France		0.0%		1986	1.2%	0.1%
	Germany	1996	1.0%	-1.7%	1996	1.9%	-0.9%
	Austria	1996	0.5%	-1.6%	1996	0.8%	-1.7%
	Finland	1996	1.1%	-1.8%	1995	1.1%	-1.1%
	Denmark	1995	0.7%	-0.4%	1995	1.3%	-0.8%
	Netherlands		0.3%		1989	1.4%	0.3%
	Luxembourg	1986	4.2%	-0.9%	1986	6.3%	-1.4%
	Japan	1995	1.5%	0.4%		1.7%	
No break	Korea		-0.7%			-0.5%	
	Belgium		0.5%			0.6%	
	Spain		1.2%			-0.8%	
	Greece		-1.0%			-1.1%	

Source: EUKLEMS, 2008.

Breaks in distribution

- The USA in spite of no significant breaks maintained high hourly productivity gains over 3.2%
- While Japan and France got bad and declining results
- Most European countries did not registered a break but they remain in the low productivity gains range

Table 9 : Trend breaks in distribution services (Average annual growth rates)

	Countries	Break year	Labor productivity		Break year	Hourly productivity	
			before	après		avant	après
Rise	Australia	1991	0.0%	2.6%	1991	0.2%	3.2%
	Netherlands	1996	1.4%	2.8%		2.7%	
	Sweden	1992	1.4%	4.5%	1993	1.4%	4.7%
	Greece	1996	-1.3%	2.6%	1996	-1.2%	2.6%
	Korea	1986	0.0%	3.3%		2.7%	
Drop	Japan	1992	5.9%	1.3%	1992	6.8%	3.0%
	Austria		1.9%		1993	2.6%	1.9%
	France	1996	2.6%	1.0%	1996	3.3%	1.8%
	Luxembourg		1.6%		1992	3.2%	1.1%
No break	USA		2.8%			3.2%	
	EU 15		1.6%			2.0%	
	Germany		1.4%			2.2%	
	Belgium		0.5%			0.8%	
	Denmark		2.2%			2.6%	
	Finland		2.2%			2.6%	
	United Kingdom		2.2%			2.6%	
	Ireland		2.9%			3.5%	
	Italia		1.4%			1.6%	
	Spain		0.4%			0.9%	
	Portugal		1.7%			2.1%	

Source: EUKLEMS, 2008.

Conclusions

- Divergences remain between the USA and some Northern Europe countries such as Sweden, Finland, Ireland, the United Kingdom and the continental and central Europe
- Labour input plays a major role in the period since 1995, while the High-Tec issue although not negligible came in second place to explain the divergence
- Last it seems that other factors have to be taken into account such as the intangible investment and the way it should be included into the national account framework

Table 10 : Intangible investment (% of GDP)

Countries	Years	Intangible Investment	of which Software	National account Investment
USA	1998-2000	11.7	1.7	19.0
United Kingdom	2004	10.1	1.7	17.0
Japan	2000-2002	8.3	1.8	23.0
Netherlands	2004	8.3	nd	19.0
Finland	2005	9	nd	19.0

Note : The National Accounts did already include some intangible expenditures as investment, such as for example part of software expenditures

Sources: for intangible

USA, Corrado et alii.(2006)

United Kingdom, Marrano et alii.(2007)

Japan, Fukuao et alii.(2007)

Pays Bas, van Rooijen-Horsten et alii.(2008)

Finland, Jalava (2007)

For National account investment

World bank WDI 2008