NOTES D'ÉTUDES

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Trends in "structural" productivity levels in the major industrialized countries

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Résumé :
L'estimation des rendements de la durée du travail et du taux d'emploi permet un calcul de la productivité horaire « structurelle », c'est-à-dire à durée du travail et à taux d'emploi constants pour les Etats-Unis ou identiques aux Etats-Unis pour les autres pays. Une lecture originale des inflexions de la productivité aux Etats-Unis et du phénomène de rattrapage, sur les dernières décennies, des niveaux de productivité des Etats-Unis par les autres pays industrialisés est alors proposée.

Codes JEL : J24, E24, F01

Mots clefs : Productivité, Taux d'emploi, durée du travail, Frontière technologique

Abstract:
Estimating returns to hours worked and the employment rate provides us with an original interpretation of changes in US productivity and other industrialized countries' catch-up with US productivity levels over recent decades.

JEL Codes: J24, E24, F01

Key words: Productivity, Employment rate, Working time, Technical frontier

1. Introduction

Hourly labor productivity levels in a number of European countries are thought to be very close to, or possibly even higher than, the levels "observed" in the United States (see Cette, 2005 or Bourlès and Cette, 2005 for a survey). At the same time, however, there are large differentials between hours worked and/or employment rates in these countries and in the United States. Several empirical studies make mention of diminishing returns to hours worked and the employment rate.

Estimating returns to hours worked and the employment rate allows us to: (i) calculate "structural" hourly productivity for the United States, i.e. the productivity level assuming hours worked and the employment rate are constant, and to compare changes in this level with those in "observed" productivity; (ii) calculate "structural" hourly productivity levels for the other main industrialized countries, i.e. productivity levels assuming hours worked and the employment rate are the same as in the United States, expressed as a percentage of the US level, and to compare, for each country, the trends in this indicator with those in "observed" productivity.

Such a methodology leads to the following interpretation of changes in international productivity levels. Firstly, regarding the United States, it seems that the negative effects of the first oil crisis on US hourly productivity was not as big as thought and that contrarily to "observed" productivity, US "structural" productivity growth seems to decrease since 2000. Then, the computation of "structural" hourly productivity levels for the other main industrialized countries induce us to state that those countries' catch-up with US productivity levels is partially due to changes in hours worked and the employment rate.

2. The estimates

Bourlès and Cette (2005) propose an econometric estimate of decreasing returns on hours worked and the employment rate. The data used are mainly from the OECD. The specification adopted, which corresponds to the relationship presented further down, is similar to the one used by Gust and Marquez (2002, 2004) or Bélorgey, Lecat and Maury (2004). It concerns the entire economy of each country and is estimated on a panel of OECD countries for the 1992-2001 time period. It makes variations of the logarithm of hourly productivity dependent on an autoregressive term, variations of the logarithm of the employment rate, working time, absolute changes in the capacity utilization rate (to correct for cyclical effects), ICT (Information and Communication Technology) production as a share of GDP and a constant term. Many other explanatory variables were alternatively introduced but their estimated coefficients either carried the opposite sign to the one expected or were not significantly different from zero. Moreover, those estimates were carried out using the instrumental variables method to correct for errors of measurement and simultaneity bias. Many ranges of instruments were tested for relevance, the one finally chosen was the one that gave the best results for the Nelson and Startz test (1990a and 1990b) and the Sargan test (1958) on the overall quality of the adjustment and the overall relevance of the instruments, and the Durbin-Wu-Hausman test (Durbin, 1954; Wu, 1973; Hausman, 1978) on the exogeneity of the instruments. This range of instruments groups together the second difference of the explained variable, present and lagged variations of the log of output, the lagged variation in the employment rate and the investment rate. Lastly, our panel contains 14 OECD countries; this restriction is due either to data availability problems or to the relative stability of the results of estimates to the presence of each country. This panel corresponds to countries set out in Table 2 below.

Following the re-basing of European countries' national accounts (from base year 1995 to 2000), the OECD updated its assessments of hourly labor productivity for all of its members. This updating has resulted in some cases in sizeable modifications in relative levels of productivity. These changes have led us to re-estimate, using this new database, the relation explaining hourly productivity variations previously estimated in Bourlès and Cette (2005). The specification of the estimated equation and the conditions of this re-estimate are the same as in the previous study. The estimate was thus based on annual data, for the same time period (1992-2001), on the same panel of 14 countries set out in Table 2, and with the same range of instrumental variables. The results of the new estimate are the following:

$$\underset{}{\Delta \text{ph}} = -\underset{(0.239)}{0.318}.\Delta \text{ph}_{-1} - \underset{(0.186)}{0.569}.\Delta \text{ER} - \underset{(0.227)}{0.558}.\Delta \text{h} + \underset{(0.046)}{0.106}.\Delta \text{CUR} + \underset{(0.220)}{0.676}.\text{ITPR} - \underset{(0.009)}{0.023}$$

Sargan test statistic: 10.94 (P-value: 0.012); Durbin-Wu-Hausman test: 50.92 (P-value: 0.0); Nelson & Startz test: $R^2.n = 37.86$ (Threshold: 2).

Where Δph and Δph_{-1} respectively represent present and lagged variations of the logarithm of hourly labor productivity, ΔER changes in employment rate, Δh variations of the logarithm of hours worked, ΔCUR changes in the capacity utilization rate and ITPR ICT production as a share of GDP. The numbers in brackets beneath the coefficients are standard deviations.

These estimate results are very similar to those found in Bourlès and Cette (2005). Only the autoregressive term is less significant[3]. It emerges that in the long term, (i) a one-point variation in the employment rate changes hourly productivity by -0.43% (compared with a short-term effect of -0.57%); (ii) a 1% variation in hours worked changes hourly productivity by -0.42% (-0.56%); (iii) a one-point change in the utilization rate raises hourly productivity by 0.08% (0.11%); (iv) a one-point change in ICT production as a share of GDP raises the growth in hourly productivity by 0.51% (0.68%). These long-term effects do not differ much from those estimated by Bélorgey, Lecat and Maury (2004) using GMM on a panel of 25 countries, nor, for employment rates, from those of Gust and Marquez (2002, 2004) estimated on a panel of 13 countries without explicit allowance for possible decreasing returns on working time. Long-term returns on hours worked are lower (in absolute terms) than those (of about -0.50) estimated by Malinvaud (1973) on a panel of firms.

The lack of data prevents us to estimate this relationship on a longer time period. However, the apparent robustness of our long term coefficients to the shrinkage of one or two years at the beginning or the end of the sample, allows us to assume relative stability of our estimates. Thus it seems that we can use those long term coefficient to study trends in “structural” productivity levels in the major industrialized countries since 1970.

3. Main findings

With regard to the trends in US hourly labor productivity, it emerges then that (Table 1):

- 2/3 of the slowdown of “observed” productivity at the time of the first oil crisis is attributable to an increase in employment rates and to a smaller decrease in working time. So, between the first and the second half of the 1970s, annual productivity growth decreased by about one point for the “observed” indicator and 1/3 of a point for the “structural” indicator.

- The maintenance of strong growth in “observed” productivity since 1995 comes partly, in recent years, from decreases in employment rates and average working time. For the 2000-2004 time period, “structural” productivity slowed down and its growth (about 2.0% a year) was between that of the second half of the 1990s (2.6%) and that of the 1980-1995 time period (1.6%). There is no

[3] Under the same conditions, the estimate of the same relationship on its static form (without the autoregressive term) gives long term coefficients very similar to those of the dynamic form estimate :

$$\Delta ph = -\underset{(0.136)}{0.476}.\Delta ER - \underset{(0.207)}{0.507}.\Delta h + \underset{(0.040)}{0.099}.\Delta CUR + \underset{(0.145)}{0.624}.ITPR - \underset{(0.007)}{0.023}$$

such slowdown for "observed" productivity, because it is offset by the effects of decreases in the employment rate and average working time. Therefore, since 2000, US productivity gains seem to have been "structurally" less large than those of the second half of the 1990s.

With regard to other industrialized countries' productivity catch-up with the United States, it emerges that (Table 2):

- The very high levels, compared with the United States, of "observed" productivity in some European countries in recent years are generally attributable to lower hours worked and employment rates. Therefore, in 2004, in all the countries, relative "structural" productivity was lower than "observed" productivity (Table 3 even illustrates that this result is always significant at 95% level), with the gap being all the greater when the "observed" relative productivity level was also high.While the "observed" productivity level is similar to (over 95%) or even higher than the US level in Germany, France, Ireland, Norway and The Netherlands, the "structural" level is also very high in only two small countries: Ireland and Norway. For these two countries, observed productivity is "artificially" raised by specific features, namely the impact of profit transfers stemming from very atypical corporate tax incentives in the case of Ireland, and a highly capital-intensive structure with the focus on three industries -- oil, timber and fisheries -- in the case of Norway. Apart from those two special cases, the fact that "structural" hourly productivity levels are higher in the United States than elsewhere shows that the United States is indeed setting the "technical frontier" in terms of productive efficiency and that other countries are lagging behind to varying degrees. Similar results were obtained and commented on in Cette (2005) and Bourlès and Cette (2005);

- Relative "observed" and "structural" hourly productivity levels, compared to the United States, were very similar for almost all countries in 1970, the gap being higher than five points only for Italy and Japan. Progressive catch-up with US productivity levels until the 1990s was always more considerable for "observed" productivity than for "structural" productivity. This is explained by the relative decrease, compared with the United States, of hours worked and/or the employment rate. In 2004, the gap between "observed" and "structural" relative productivity levels exceeded five points for six other countries: France, Germany, Ireland, The Netherlands, Norway and Spain.

- From the beginning, or the middle of the 1990s depending on the country, "observed" and "structural" productivity relative to the United States declined in all countries apart from Norway and Sweden. This relative deterioration was attributable not only to the acceleration in productivity in the United States but also to the slowdown in productivity in almost all the other countries. For the reason described above, it was generally larger for "structural" than for "observed" productivity.

4. Conclusion

The above analysis should of course be viewed with the usual caution: proposed calculations of "structural" productivity rely on a large number of strong assumptions such as, for example, returns to employment rates and hours worked that are uniform for the period under consideration and similar for all the countries. The analysis nevertheless provides an original interpretation of changes in US productivity and other industrialized countries' catch-up with US productivity levels over recent decades.

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Table 1

Average annual trends in "observed" and "structural" hourly productivity of labor in the United States

Coverage: Economy as a whole

	1970-1975	1975-1980	1980-1990	1990-1995	1995-2000	2000-2004
"Observed" productivity [a]	2.08	1.11	1.34	1.45	2.49	2.54
Effect of changes…						
… in the employment rate [b]	0.08	-0.35	-0.22	-0.03	-0.13	0.31
… in hours worked [c]	0.29	0.11	-0.04	-0.05	0.07	0.19
"Structural" productivity [d] = [a] – [b] – [c]	1.71	1.36	1.60	1.54	2.56	2.04

[a]: OECD source; [b] and [c]: authors' calculations, see text.

Table 2 **"Observed" and "structural" hourly productivity as a percentage of the United States level**

	"Observed" productivity [a]						"Structural" productivity [b]					
	1970	**1980**	**1990**	**1995**	**2000**	**2004**	**1970**	**1980**	**1990**	**1995**	**2000**	**2004**
Australia	74.3	75.0	74.1	75.8	76.2	75.0	71.7	74.8	72.3	73.6	74.0	74.0
Canada	83.1	84.1	81.6	81.6	80.7	76.1	82.4	83.1	79.2	77.2	76.9	74.6
Finland	54.1	68.7	80.4	86.1	86.9	84.6	57.8	70.3	79.2	79.0	81.3	80.8
France	72.1	88.2	104.3	107.6	106.2	103.2	73.3	86.2	94.8	96.2	94.0	92.3
Germany			90.7	97.7	95.6	91.0			80.5	86.3	82.9	79.7
Ireland	44.8	60.8	77.0	85.4	98.5	101.8	49.3	63.1	69.4	76.3	90.5	95.1
Italy	67.9	84.8	90.0	93.9	87.0	78.4	61.3	75.7	76.9	78.9	72.7	66.9
Japan	44.4	57.5	70.6	73.6	71.8	70.2	52.8	63.7	72.9	72.4	68.7	68.3
Netherlands	79.2	99.6	107.6	112.7	103.4	95.4	77.7	88.8	93.9	97.6	91.4	84.9
Norway	74.7	100.4	113.5	125.6	124.5	122.4	71.2	95.0	104.1	115.7	115.3	113.6
Spain	56.5	77.3	89.1	91.2	82.5	78.9	58.8	72.5	77.5	77.5	73.2	73.1
Sweden	79.7	85.7	84.2	87.0	87.0	86.2	78.7	83.6	82.1	81.3	81.7	81.6
United Kingdom	68.3	76.8	81.0	88.3	87.4	85.5	68.3	75.0	79.0	83.7	83.0	82.5
United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]: OECD source; [b]: authors' calculations, see text

Table 3 **Significance of 2004 "structural" hourly productivity estimates**

	"Observed" productivity	**"Structural" productivity**	**95% confidence interval ***
Australia	75.0	74.0	[73.3 ; 74.7]
Canada	76.1	74.6	[73.4 ; 75.8]
Finland	84.6	80.8	[79.1 ; 82.5]
France	103.2	92.3	[87.9 ; 96.7]
Germany	91.0	79.7	[75.3 ; 84.1]
Ireland	101.8	95.1	[92.3 ; 97.8]
Italy	78.4	66.9	[61.2 ; 72.5]
Japan	70.2	68.3	[67.2 ; 68.3]
Netherlands	95.4	84.9	[79.8 ; 90.1]
Norway	122.4	113.6	[108.0 ; 119.1]
Spain	78.9	73.1	[69.5 ; 76.7]
Sweden	86.2	81.6	[78.7 ; 84.5]
United Kingdom	85.5	82.5	[80.6 ; 84.4]
United States	100.0	100.0	

*: Variances and covaraince used to compute the 95% confidence interval have been estimated using the delta method.

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