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Relationship between technology and employment

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Abstract

This short project will analyze the importance of the ICT capital levels and its relationship with the employment, and its differences across countries and years for a short period of time.

Keywords: NACE, employment, ICT, EUKLEMS.

1 Introduction

In this assingment we will use the EUKLEMS database (EUKLEMS, 2020), that uses a industrial organization system (NACE, 2020) to group a series of relevant labor, capital and growth variables for the european countries (and others like US or Japan) throughout several years. This variables will help us understand the relationsip between two key variables of labor economics, the ICT capital and the employment. This factors have undoubtly lots of importance for the Labor Economics field (0'Mahony, M & Marcel,2009), as they help to unravel the intrincate relationships that happen to exist between many relevant variables, as total factor productivity, total hours worked, etcetera.

For this purpose, I will choose a limited amount of variables: VA_QI or Gross value added, GO_QI or Gross output, EMP or total numbers of employed workers (in thousands), H_EMP or total hours worked (in thousands too), CAPIT_QI or ICT capital services (all capital variables are indexes with their abse on 2010), CAPNIT_QI or non ICT capital services, CAP_QI which groups the previous two variables; and the total factor productivity, per hours worked (LP1TFP_I) and per worker (LP2TFP_I). As I cannot analyze all countries I will choose, depending on the part of the assignment, different ones. I will try to focus the study of the relationship between ICT and employment on Spain.

The graphs are computed with stata, as well as the tables and the regressions. For the ease of the reading process, all graphs are located in the annex, as well as the do.file from stata. The tables are not in teh annex, as I thought it would be better for the understanding of the assignment to introduce them at the same time I refer to them.

2 Evolution of the key variables: employment and technology

Evolution of the ICT capital level

The first part of this analysis consits on determining similarities and differeces of the evolution of ICT between the chosen industries across all countries. My intention is centering this work around Spain so, for that purpose, I chose industries I considered relevant:

1. **A**: Agriculture, hunting and Forestry. Of course, the second and third subindustries are not that relevant, but Spain exports quite a bit of agricultural producto to the rest of Europe, so a comparison across countries would be interesting to see

2. **F**: Construction: this is self-explanatory, as being Spain one of the south countries that are blessed with sun and good weather, people generally wants to live here, so many houses are built each year. Plus, it is interesting to see how did the financial crisis affected this sector across all countries.

3. **H**: Hotels and restaurants, one industry that represents very well the tourist sector, one that is very relevant in Spain.

4. **M_N**: This industry groups a subset, education, health and social work. I chose this because I thought that, being Europe one of the places in the world where most of the healthcare is universal and public, analyzing the trend would be of interest.

5. **TOT**: This sub-variable, although not analyzed here, will be in other exercises. It is basically all of the industries in the market (not only the ones described, but all of them).

Once this is explained, I will proceed to highlight all I consider relevant. I chose 12 different countries to analyze, in no particular order: Spain, Finland, Belgium, Germany, Austria, United Kingdom, Netherlands, Italy, France, Denmark, the Czech Republic and Sweden. Why these in particular? All of them have existing data for the chosen industries, and are more or less well distributed geographically.

All indexes of ICT have their base at the 2010 year, as we can appreciate in the graph. From the analysis of the indexes I can distinguish between two types of countries: those that are affected by the financial crisis (mainly Spain, Italy, Belgium and the Czech Republic), and those that are not. I will first comment those that suffered the effects of the recession. Spain has his biggest ICT index (construction) decreased, from being the highest value to half of it. The causality of this effect can be blamed to the financial crisis. The sector declines steadily. The other industries do not seem to be affected as much, and keep growing steadily. Most notably, the ”Education, Health and Social Work” almost doubles.

Belgium has a very stable growth path, with a less steep curve than the rest. Agriculture experiments a great increase from 2008 to 2009. Italy has a very interesting convex form, the only one that shows this tendency, indicating that they were indeed affected by the financial crisis, but they managed to recover pretty well. The tourist sector was the one that suffered the most. The Czech Republic is the country with the most disperse evolution of the ICT across industries. At the end of 2017, two of the industries grows (when compared to the year 2010 index): Agriculture and Construction; and the other two decrease, the tourist sector and the public one.

For the other eight countries, the variables seems to have mor or less the same growth rates, with a constant rate. The UK has a more concave curve than the rest of the countries in this group. Construcion adn the public sector seem to be the ones that experiment the highest increase across all the studied industries. The public sector is the most stable one (which makes sense given that is the one that is usually better protected to the effects of a financial crisis), except for the Czech Republic. The tourist sector declines for those countries that depend most of it, as the financial crisis decreases the number of tourists, these countries suffer the most.

Evolution of the employment

Fpr this part of the analysis, I have made several tables and graphs to properly asses the evolution of employment. For this, I displayed the values of the two employment variables (EMP and H_EMP) for the year 2007 (before the crisis), 2014 (when it ended)) and for the mean of all the years considered (2007-2017) for Italy, Germany and Spain. I chose one country that resembles Spain (Italy), one that does not (Germany), and I also analyzed the employment for the EU14 and the EU28.[1]

Table 1: Evolution of employment, Spain (absolute values)

SPAIN						
	2007		MEAN		2014	
Industry	**EMP**[2]	**H_EMP**}[3]	**EMP**	**H_EMP**	**EMP**	**H_EMP**
A	853.8	1,674	*770.8*	*1,505*	733.3	1,427
F	2,731.2	5,212	*1,488.7*	*2,849*	976.1	1,850
H	942.8	1,665	*869.6*	*1,549*	793.8	1,438
M_N	2,109.6	3,462	*2,168.8*	*3,568*	2,119.6	3,445
TOT	21,284.9	36,300	*19,334.3*	*32,900*	18,039.2	30,600
Hrs/worker	1,705		1,701		1,696	

In Spain, as we can see, all of the industries suffer a decline because of the financial crisis, witht an spectacular decline of employment, both in terms of numbers and hours worked, of the cosntruction sector. If we compare the mean of the contemplated years, we are able to observe the stability of some industries, like the public sector, and both the agriculture and tourist industries, to a lesser extent. The construction sector, as we can also observe in the graph, not only is not stable, but a declining industry troughout all the years.

[1] EU14 groups all the countries that were in the EU in '95, and EU28 all in '13 (EUKLEMS, 2020).

Germany is the opposite of Spain, not only all of the industries are pretty stable, but almost all of them increases in the time period (except the less productive one, the agricultural sector). It would be interesting to analyze the productivity of each industry using more data. When comparing the hours worked by employed person, the Spanish average worker, has more total hours than the German counterpart.

Table 2: Evolution of employment, Germany (absolute values)

GERMANY						
	2007		**MEAN**		**2014**	
Industry	**EMP**	**H_EMP**	**EMP**	**H_EMP**	**EMP**	**H_EMP**
A	667	1,171	*651.2*	*1,099*	649	1,062
F	2,312	3,857	*2,388.5*	*3,908*	2,436	3,930
H	1,971	2,935	*2,070.2*	*2,979*	2,106	2,986
M_N	4,866	6,822	*5,434.4*	*7348*	5,634	7,518
TOT	40,325	57,400	*42,063.9*	*58,100*	42,671	58,300
Hrs/worker	1,423		*1,381*		1,366	

Analyzing the Italy data, we see that the average worked hours per worker are very similar to the Spanish ones, although bigger. The industries all suffer a bit, not as much as Spain though, but being more stable, speciacilly when comparing the construction sector.

Table 3: Evolution of employment, Italy (absolute values)

ITALY						
	2007		**MEAN**		**2014**	
Industry	**EMP**	**H_EMP**	**EMP**	**H_EMP**	**EMP**	**H_EMP**
A	985	2,709	*929*	*2,445*	890	2,347
F	1,960	3,812	*1,757*	*3,268*	1,578	2,800
H	1,158	2,335	*1,137*	*2,216*	1,106	2,144
M_N	2,669	4,696	*2,823*	*4,862*	2,867	4,838
TOT	25,294	46,000	*24,820*	*43,500*	24,339	41,800
Hrs/worker	1,818		1,752		1,717	

Regarding the graphs, we can see the biggest industry in Spain in terms of employed is the construction sector, fueled by the real state bubble. When the crisis starts, it suffers a very sharp decline to the second position, with it absolute value halved. The public sector is pretty stable, logically, only having a tiny reduction at the start of the recession. Analyzing the hours worked, the construction ones declines accordingly, while the other industries remain constant troughout the years, except for the initial years of the financial crash.

German industries, as one could predict, do not seem to be affected by the crisis, the growth rates are very stable and constant. The public sector is the one that increases almost a 20% of its original value. All of this is translated to the worked hours, that share the same analysis.

Italy resembles Spain in the sense that the construction sector is important, not as much though, as well as the tourism one. The industries generally stay the same in terms of employees, with the construction sector decreasing by 20% and the public one increasing by more than 10%. Regarding the hours worked, Italy has a similar situation to Spain, although construction is not at the top, and does not suffer as much.

If we study the EU14 and EU28 grouped members, we can observe that it resembles the Italy situation vey well for both variables (EMP and H_EMP) so, that country is a good proxy for the whole union. The main differences with Italy is that te construction sector has a less steep curve for both variables, and that the agriculture sector is below the tourism one (again, for both).

3 Relationsip between technology and emplyment, first approach

Analysis of the variables affecting the ICT capital levels

Studying the correlations is interesting to analyze up to which extent do the variables predict the informations and communications technology. As we can appreciate in the table for Spain, almost all the variables shows a very high correlation. It is important to know that many of these are very correlated between them. For example, the two total factor productivity variables are very very related. The same happens for the non ICT capital and total capital; and with the total number of workers and hours worked.[4]

Table 4: Correlations between ICT and other variables, Spain

	CAPIT_QI (ICT)				
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
CAPNIT_QI	0.8471	0.7801	0.9483	0.8399	0.8826
CAP_QI	0.8532	0.7975	0.9741	0.9788	0.9325
EMP	-0.9261	0.8596	-0.8867	0.2846	-0.7983
H_EMP	-0.9605	0.8596	-0.8809	0.1697	-0.8029
LP1TFP_I	0.4592	0.5352	0.3573	-0.2123	-0.8113
LP2TFP_I	0.4592	0.5353	0.3573	-0.2123	-0.8113

If we look at the table for Spain, we can observe that all variables shows very a very high correlation with the ICT variable. This will induce some problems when we try to make a few simple OLS regressions, as the estimations will be unbiased if we have multicollinearity or if one independent variable is related to the dependent one. The correlations od ICT with the other measures of capital (total and non ICT) is pretty high, so both have predictive power over the ICT capital.

[4]As there are no observations for the gross and value output for Spain, I did not include them in the tables. The same happens for other variables in other countries.

For most industries, there exists a negative relationship of the number of employed with the ICT maybe because and increase of the ICT will make capital more productive over labor and therefore less labor will be needed. This is not true for the public sector, as firing is more difficult; and for the construction sector, as it is a industry where labor is very much necessary. The total factor productivity has a positive relationship for all observed industries except for the public sector (which is not very efficient), because when the ICT increases, so does (generally) the productivity. Counterfactually, the total factor productivity for all the industries is negative, this needs further investigation.

Table 5: Correlations between ICT and other variables, Italy

			CAPIT_QI (ICT)		
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
CAPNIT_QI	0.2729	-0.5013	0.1466	-0.5399	-0.5259
CAP_QI	0.2796	-0.4801	0.2723	-0.0661	-0.3981
EMP	0.5912	-0.3355	0.7087	0.6823	0.5149
H_EMP	0.7063	-0.2423	0.7889	0.7004	0.1694
LP1TFP_I	-0.6549	0.0651	0.8627	-0.0021	0.2987
LP2TFP_I	-0.6549	0.0651	0.8627	-0.0021	0.2987
VA_Q	0.1116	-0.1662	0.8844	0.2404	0.3120

Strangely enough, in Italy the correlations with the others capital measure variables is much less. This will prove useful when calculating the regressions. Contrary to Spain, an increase in the ICT will increase also the number of employed for all industries except for the construction sector, where I suppose, Italy is less advanced than Spain and an increase in ICT will make capital much more productive than labor. Also, the total factor productivity measures are much less correlated with the ICT than in Spain. The gross value added, variable not present in the Spain table shows that, generally, the output of an average worker increases with the ICT, as we would have guessed.

Table 6: Correlations between ICT and other variables, Germany

CAPIT_QI (ICT)					
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
CAPNIT_QI	-0.1500	0.9858	0.5061	0.5595	0.8911
CAP_QI	-0.1414	0.9891	0.5527	0.6222	0.9129
EMP	-0.4128	0.8463	0.8536	0.5274	0.9278
H_EMP	-0.3051	0.6102	0.8803	0.5992	0.9451
LP1TFP_I	0.3133	0.7580	-0.2194	0.1467	0.9320
LP2TFP_I	0.3133	0.7580	-0.2194	0.1467	0.9320
GO_Q	0.2333	0.7753	0.5789	0.8051	0.9621

In Germany, both capital measures variables are very correlated with the ICT, except the agriculture, where it shows an inverse relationship. The same happens to the number of workers. This could be explained by the fact that Germnay does not have a very strong agricultural sector, and an overall increase in the ICT would mean that workers go to others, more productive, jobs with higher wages. For the rest of the industries, if the ICT volume is increased, so does the number of workers. Both the total productivity factor and the gross value added are highly correlated, this means that an increase in the ICT makes the average worker much more productive than before.

In order to asses better how these variables affect or predict the level of ICT, I will make several OLS regressions; first I will make estimations for each industry, and then for each industry within each country. The variables were selected by calculating correlations (checking that the variables used are not related between them) and making vif (to check the multicollinearity) and t-tests, to avoid wrong specifications of the models. Unfortunately, for many regressions, the model is not good enough as we can only use one variable, or because the significance is very low.

For example, when estimating the ICT levels for each industry we find that the measure of non-ICT capital has generally a low correlation with the ICT, so we can use it as independent variable. The total productivity factor is also relevant, and has a positive value except for the (very needed) public sector, maybe because of the inefficiency that it usually carries.

Table 7: ICT OLS for each industry

	A	F	H	M_N
	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value
CAPNIT_QI value	1.566***	2.651***	0.821***	1.040***
	(7.32)	(13.45)	(5.95)	(11.34)
LP1TFP_I value	0.259	0.182	0.277*	-0.376**
	(1.69)	(1.20)	(2.25)	(-3.01)
GO_Q value		-0.000000418*		
		(-2.49)		
Constant	-78.60**	-184.4***	-7.327	38.40*
	(-2.82)	(-6.38)	(-0.36)	(2.56)
Observations	244	189	263	263
Adjusted R^2	0.180	0.504	0.120	0.329

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the Italy regressions, the variable that measure non-ICT level capital, can be used as it is not very correlated for some industries. The public sector has a very good model estimation, as both variables are relevant. There are very few variables as they are highly correlated between them, for example, if we include VA_Q in the construction sector, the R^2 jumps to 80%, but if we calculate the vif, we observe that this high increase of the statistical measure is because of the high multicollinearity between the variables.

Table 8: ICT OLS for each industry, ITALY

	A	F	H	M_N
	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value
VA_Q value	0.00877			
	(0.93)			
H_EMP value	-0.0000241			
	(-0.32)			
LP1TFP_I value	-2.413	0.516	0.857*	1.307**
	(-0.90)	(1.47)	(3.20)	(4.23)
CAPNIT_QI value		-0.604*	1.191	
		(-2.35)	(1.43)	
EMP value			0.120	0.0591***
			(2.22)	(6.36)
Constant	158.3	106.4**	-242.2	-191.0**
	(0.64)	(3.52)	(-2.21)	(-3.69)
Observations	11	11	11	11
Adjusted R^2	0.365	0.264	0.791	0.794

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Germany we have low correlation for three of the observed industries, that makes the estimation much easier. This can be observed in the general increase of the goodness of fit of the models. The tourism sector benefits greatly from ICT increases as the total productivity factor estimated coefficient is pretty high, not so for the others sectors.

Table 9: ICT OLS for each industry, GERMANY

	A	F	H	M_N
	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value
VA_Q value	-0.00119		-0.00170	
	(-2.14)		(-1.66)	
LP1TFP_I value	0.184	0.477	2.226	0.335*
	(2.28)	(0.44)	(2.04)	(2.88)
EMP value		0.0902	0.106**	0.00486**
		(2.07)	(3.80)	(3.76)
Constant	102.1***	-155.6*	-149.0	40.88*
	(65.75)	(-2.62)	(-1.85)	(2.39)
Observations	11	11	11	11
Adjusted R^2	0.283	0.654	0.757	0.557

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For Spain, as we lack the gross value variables, the proper estimation is very difficult. Because of this, the coefficients are not very significant or we lack variables (when testing for correlation or multicollinearity, most of them are not useful).

Table 10: ICT OLS for each industry, SPAIN

	A	F	H	M_N
	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value	CAPIT_QI value
LP1TFP_I value	1.037	3.799	3.249	-2.977
	(1.46)	(1.79)	(1.08)	(-0.59)
EMP value				0.131
				(0.80)
Constant	-4.677	-289.4	-216.9	147.2
	(-0.06)	(-1.38)	(-0.71)	(0.23)
Observations	10	10	10	10
Adjusted R^2	0.112	0.197	0.019	-0.125

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

I would say that these models need much more work behind them, to properly understand the relationships between these variables. Maybe the choice of countries is not the best, it would be interesting to make estimations for those countries whose data is best for this purpose.

Analysis of the variables affecting the ICT employment

In the same way as I did in the previous analysis, it is interesting to see how is the change rate of employed workers related to other relevant variables.

For Spain, the number of employed workers is generally highly correlated to the others variables of interest, specially to those measuring the levels of capital. For the construction sector, all capital variables are inversely correlated. This may seem conterfactual, but it is because the change rate has negative values for all the considered time period, as the level of workers employed in that industry decreases a lot throughout the years, but the ICT levels stays the same. The others variables benefit generally from an increase of the employed workers, except the total factor productivity, as expected.

For Italy the gross and value output benefits from an increase in the number of employed workers, as the total productivity factos has a positive correlation. In Germany, a positive increase in the change rate will increase the overall variables for most industries: this means that the gross value added is increased because of this new workers, that are still very productive, as the total productivity factor, in a similar way as Italy, is very much increased.

Table 11: Correlations between EMP and other variables in change rates, Spain

EMP_change					
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
H_EMP	-0.3941	-0.4858	0.1628	0.4671	-0.1361
CAPIT_QI	0.6160	-0.8038	0.0703	0.2993	0.6306
CAPNIT_QI	0.4954	-0.8715	-0.0703	0.5224	0.2988
CAP_QI	0.5017	-0.8706	-0.0342	0.3990	0.4156
LP1TFP_I	0.6547	-0.5280	0.3245	0.5446	-0.1260
LP2TFP_I	0.6547	-0.5280	0.3245	0.5446	-0.1260

Table 12: Correlations between EMP and other variables in change rates, Italy

EMP_change					
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
H_EMP_	0.1033	0.5941	0.2503	0.8855	-0.0195
CAPIT_QI	0.0234	0.7677	-0.1317	0.1756	0.5649
CAPNIT_QI	-0.3972	0.3948	-0.3875	-0.1717	-0.4483
CAP_QI	-0.3947	0.4169	-0.3837	-0.1242	-0.4093
LP1TFP_I	-0.2099	0.4550	-0.1334	-0.1635	0.4376
LP2TFP_I	-0.2099	0.4550	-0.1334	-0.1635	0.4376
GO_Q	-0.0764	0.6149	0.3382	0.1094	0.1410
VA_Q	0.1026	0.6133	-0.0516	0.1621	0.2873

Table 13: Correlations between EMP and other variables in change rates, Germany

EMP_change					
variables\industries	**A**	**F**	**H**	**M_N**	**TOT**
H_EMP_	0.5881	0.5614	0.6871	0.2778	0.7390
CAPIT_QI	-0.1076	-0.1640	0.6766	0.2406	0.4673
CAPNIT_QI	0.4433	-0.2497	0.5863	0.1559	0.3459
CAP_QI	0.4414	-0.2388	0.5993	0.1667	0.3619
LP1TFP_I	0.3028	0.3308	-0.0655	0.1274	0.7012
LP2TFP_I	0.3028	0.3308	-0.0655	0.1274	0.7012
GO_Q	0.2610	0.3077	0.7466	0.4172	0.6945
VA_Q	0.3585	0.3830	0.7107	0.3273	0.6384

4 Relationsip between technology and emplyment: ”Deep into the relation between Employment and ICT capital across industries”

Lets analyze deeply the relationship between employment and ICT capital levels across industries, countries and years. First we need to make the panel data to properly estimate the fixed effects we want to use in our model. In order to understand better our results, I will use the logarithm of numbers of employed workers in order to explain better our results, as an increase of one unit of an independent variable will mean a change of $x\%$, with x being the estimated coefficient of that variable.

First of all let’s check the relationship between the levels of ICT capital and the employed workers:

$$\boldsymbol{lnEMP = \beta_1 + \beta_2 * CAPIT\_QI + vt} \tag{1}$$

An estimation of this model is contained in the following table:

Table 14: Regressing lnEMP

	(1)
	lnEMP
CAPIT_QI value	-0.00397***
	(-3.32)
Constant	6.214***
	(47.21)
Observations	3722
Adjusted R^2	0.003

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The estimated coefficient tell us that an increase of one unit of the ICT levels (from 100 to 101 for example) at the mean, will increase the number of employed workers in $\mathbf{0.397\%}$.

Although the independent variable is relevant, the goodnes of fit is very low, and the model is not properly made, as we only have one variable.

In order to better this model, I will introduce fixed effects: for each country I will be analyzing in this part, each year will be estimated separately. By adding years as fixed effects we can asses the real effect of the ICT over the employment, by separating the effect each year has over the mean.

$$lnEMP = \beta_1 + \beta_2 * CAPIT\_QI + YEARFE + vt \tag{2}$$

As we can observe, the goodness of fit greatly increases for the southern countries (Italy and Spain), but for the northern, richer, more stable ones, the model is not yet well estimated. Maybe this is because the industries have been much more stable in those countries regarding growth of ICT capital, and it is difficult to estimate the real relationship between the relevant variables.

For a final analysis, lets check if by adding more covariates, the model improves. Because of the multicollinearity, I will only add the variables I consider best that are not related with another: total productivity factor per hours worked, and for those countries that have the observations, the gross value added.

$$lnEMP = \beta_1 + \beta_2 * CAPIT\_QI + H\_EMP + VA\_QI + LP1TFP\_I + YEARFE + vt \tag{3}$$

As expected, when adding covariates that help to explain the changes of the dependent variable, the goodness of fit increases enormously for all the countries except for, yet again, Germany and Denmark. This may be beause of the lack of variety of growth rates of ICT capital throughout the years. For the other countries, the level of ICT capital has a direct relationship with the numbers of employed workers, except for the case of Italy.

Table 15: Regressing lnEMP on FE: time and country

	SPAIN	GERMANY	ITALY	DENMARK	FRANCE
	lnEMP	lnEMP	lnEMP	lnEMP	lnEMP
CAPIT_QI value	0.00151***	0.00116*	-0.00188***	-0.00156***	0.00167***
	(5.10)	(2.13)	(-5.53)	(-3.55)	(3.83)
year=2007	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
year=2008	-0.00748	0.0110	0.00339	0.0199	-0.00381
	(-0.21)	(0.64)	(0.23)	(0.93)	(-0.21)
year=2009	-0.0782*	0.0105	-0.0158	0.00616	-0.0234
	(-2.17)	(0.61)	(-1.08)	(0.29)	(-1.28)
year=2010	-0.101**	0.00858	-0.0261	-0.0143	-0.0304
	(-2.79)	(0.50)	(-1.78)	(-0.66)	(-1.63)
year=2011	-0.143***	0.0146	-0.0295*	-0.00553	-0.0273
	(-3.91)	(0.86)	(-2.01)	(-0.25)	(-1.43)
year=2012	-0.195***	0.0239	-0.0377*	0.00102	-0.0308
	(-5.31)	(1.41)	(-2.54)	(0.05)	(-1.55)
year=2013	-0.239***	0.0207	-0.0626***	-0.0159	-0.0387
	(-6.45)	(1.22)	(-4.19)	(-0.70)	(-1.88)
year=2014	-0.250***	0.0235	-0.0576***	0.00444	-0.0450*
	(-6.51)	(1.38)	(-3.91)	(0.19)	(-2.07)
year=2015	-0.240***	0.0188	-0.0447**	0.0342	-0.0581*
	(-6.03)	(1.09)	(-3.04)	(1.36)	(-2.48)
year=2016	-0.214***	0.0189	-0.0187	0.0634*	-0.0667**
	(-5.37)	(1.07)	(-1.27)	(2.29)	(-2.64)
year=2017		0.0235	-0.00460	0.0991**	-0.0949**
		(1.31)	(-0.31)	(3.15)	(-3.35)
Constant	6.945***	7.547***	7.371***	5.162***	7.088***
	(200.40)	(130.86)	(205.03)	(117.29)	(174.99)
Observations	160	176	176	176	176
Adjusted R^2	0.302	-0.070	0.143	0.015	-0.056

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: Regressing lnEMP on FE: time and country

	SPAIN	GERMANY	ITALY	DENMARK	FRANCE
	lnEMP	lnEMP	lnEMP	lnEMP	lnEMP
CAPIT_QI value	0.00152***	0.00139*	-0.00137***	-0.00154***	0.00147***
	(5.03)	(2.52)	(-3.97)	(-3.48)	(4.03)
LP1TFP_I value	-0.000197	-0.00127*	-0.00186***	0.000283	-0.00471***
	(-0.17)	(-2.19)	(-4.12)	(0.65)	(-7.87)
year=2007	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
year=2008	-0.00772	0.0126	0.00119	0.0213	-0.00922
	(-0.21)	(0.76)	(0.09)	(0.99)	(-0.61)
year=2009	-0.0794*	0.0141	-0.0173	0.0126	-0.0413**
	(-2.16)	(0.83)	(-1.18)	(0.57)	(-2.67)
year=2010	-0.102**	0.00571	-0.0278	-0.0101	-0.0501**
	(-2.76)	(0.34)	(-1.94)	(-0.46)	(-3.19)
year=2011	-0.144***	0.00775	-0.0280	-0.00273	-0.0443**
	(-3.87)	(0.46)	(-1.97)	(-0.12)	(-2.78)
year=2012	-0.197***	0.0173	-0.0309*	0.00333	-0.0535**
	(-5.18)	(1.04)	(-2.09)	(0.15)	(-3.21)
year=2013	-0.241***	0.0139	-0.0536***	-0.0145	-0.0633***
	(-6.20)	(0.83)	(-3.52)	(-0.64)	(-3.64)
year=2014	-0.252***	0.0160	-0.0504***	0.00431	-0.0673***
	(-6.20)	(0.95)	(-3.37)	(0.18)	(-3.66)
year=2015	-0.243***	0.00953	-0.0424**	0.0321	-0.0851***
	(-5.75)	(0.56)	(-2.88)	(1.26)	(-4.27)
year=2016	-0.216***	0.00854	-0.0163	0.0583*	-0.0973***
	(-5.17)	(0.49)	(-1.12)	(2.06)	(-4.51)
VA_Q value		0.000000234*	0.000000459	0.000000271	0.000000660***
		(2.41)	(1.89)	(1.09)	(3.64)
year=2017		0.0136	0.000207	0.0908**	-0.109***
		(0.75)	(0.01)	(2.81)	(-4.48)
Constant	6.965***	7.557***	7.389***	5.052***	7.388***
	(56.04)	(98.29)	(94.75)	(58.33)	(80.82)
Observations	160	176	176	176	176
Adjusted R^2	0.297	-0.022	0.227	0.017	0.274

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5 Conclusion

The relationship between the employment and the level of ICT capital is not general for all countries. Each country has a different industrial structure, productivity, comparative advantages and distinct levels of stability against demand or supply shocks. Usually the increase of these ICT capitals is associated to a relative decrease of the labor force, but this is not always true, as the last estimated model shows. The total productivity factor is a very important variable to properly understand this relationship as, if the TPF has a positive relationsip with the ICT capital, generally, an increase of this variable will prove to be beneficial to that industry, as the gross value added will increase.

I will enumerate a few things that I could have done better: first of all, the chosen countries. Even though analyzing Spain is of high interest, it may have not been the best choice, as it lacked data for some key variables. The same can be said for Germany and Denmark, whose estimations proved not to be very useful. This may also be because of the chosen industries, a set of industries relevant for all countries would have surely been a better choice. Lastly, a proper analysis of the productivity per worker would have also helped understanding the relationships between all these relevant variables used to understand the relationship between technology and employment.

References

[1] EUKLEMS. (2020): *”Analytical Modules”*, retrieved from http://www.euklems.net/.

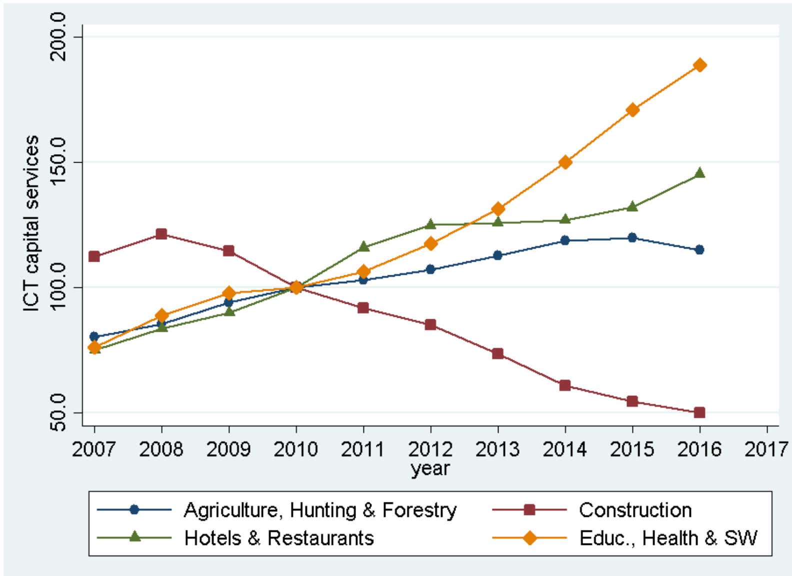
[2] Eurostat. (2020): *”NACE industrial classification”*, retrieved from https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/CA-80-93-436.

[3] 0’Mahony, M & Marcel, P (2009): *”OUTPUT, INPUT AND PRODUCTIVITY MEASURES AT THE INDUSTRY LEVEL: THE EU KLEMS DATABASE*”*, retrieved from www.egela.ehu.eus.

6 ANNEX

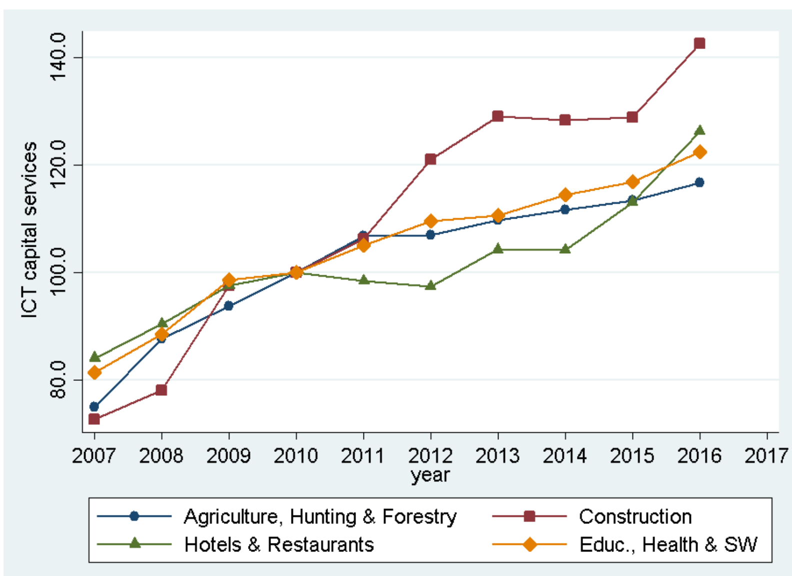
6.1 Graphs

Figure 1: Evolution of ICT, Spain



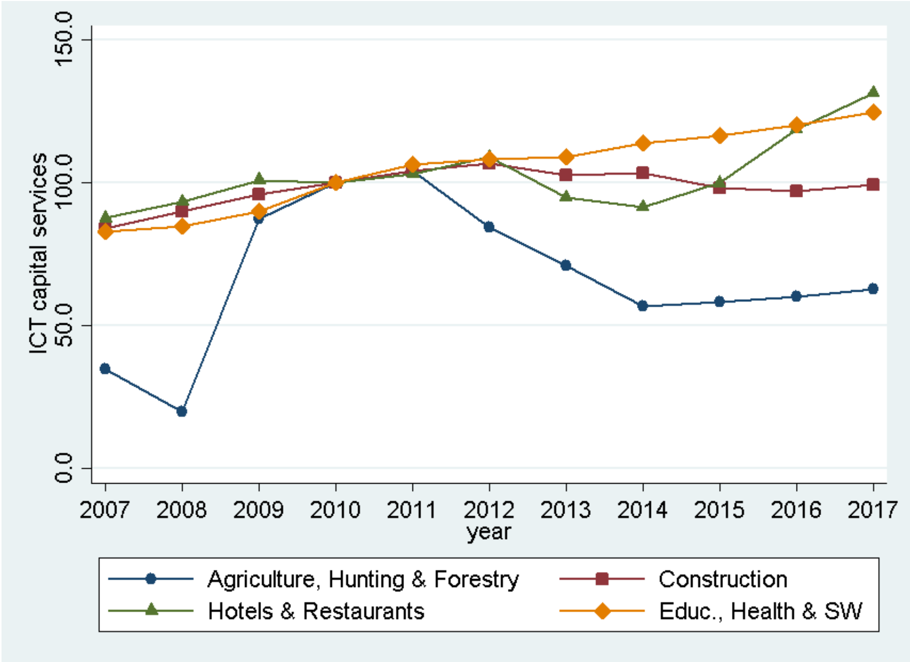
Source: made with STATA and the EUKLEMS database.

Figure 2: Evolution of ICT, Sweden



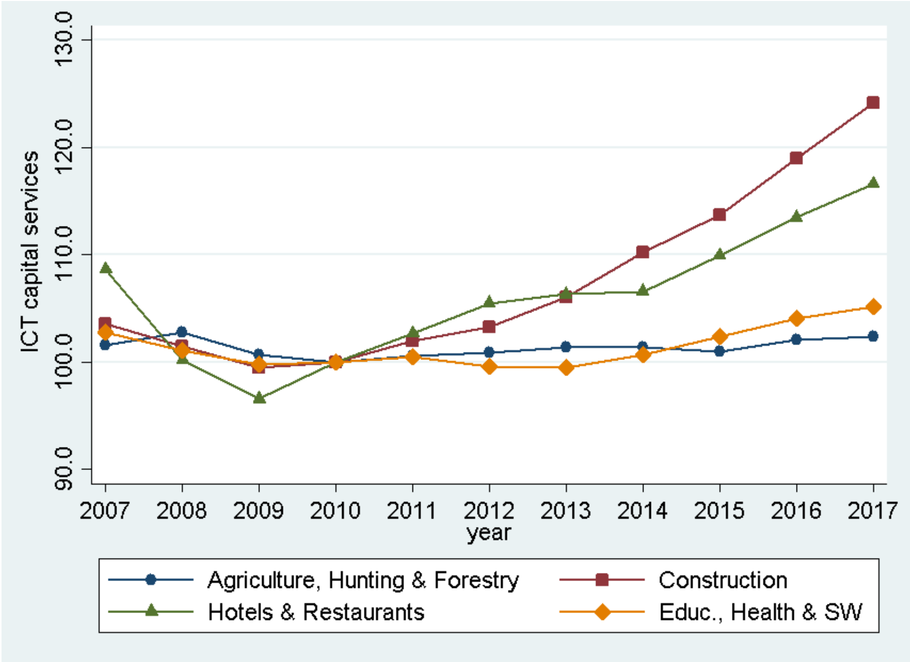
Source: made with STATA and the EUKLEMS database.

Figure 3: Evolution of ICT, Belgium



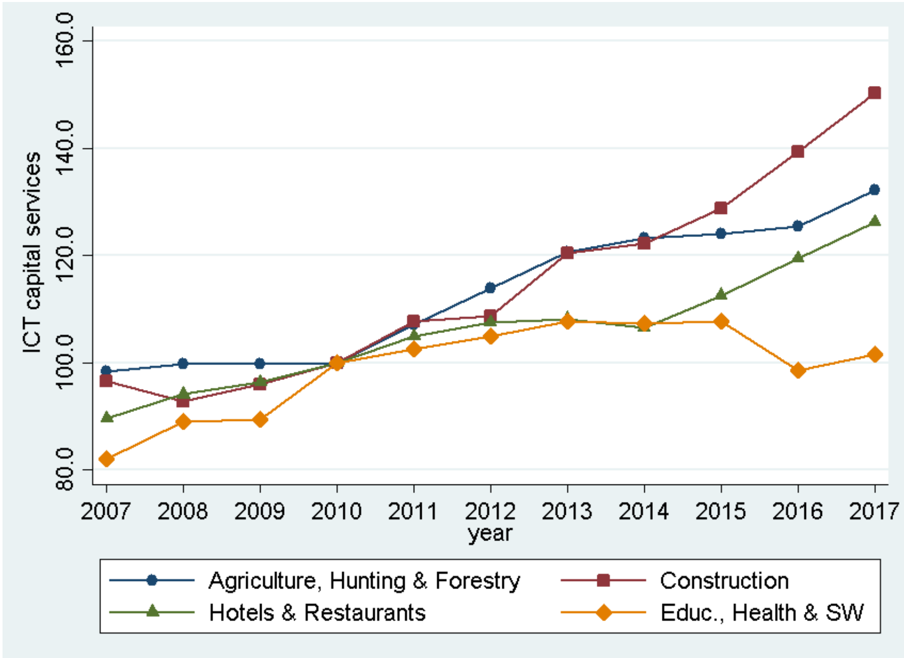
Source: made with STATA and the EUKLEMS database.

Figure 4: Evolution of ICT, Germany



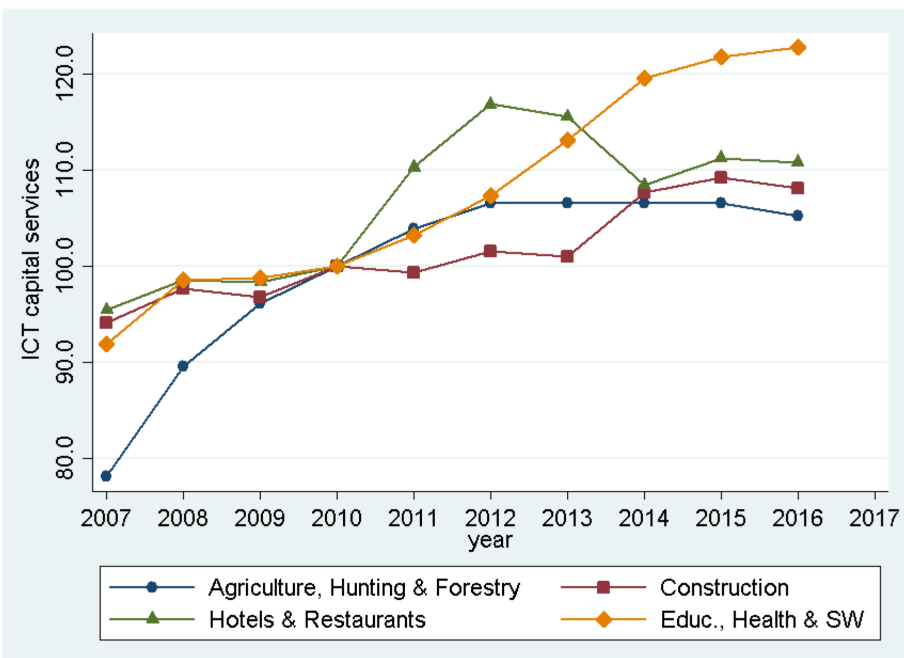
Source: made with STATA and the EUKLEMS database.

Figure 5: Evolution of ICT, Austria



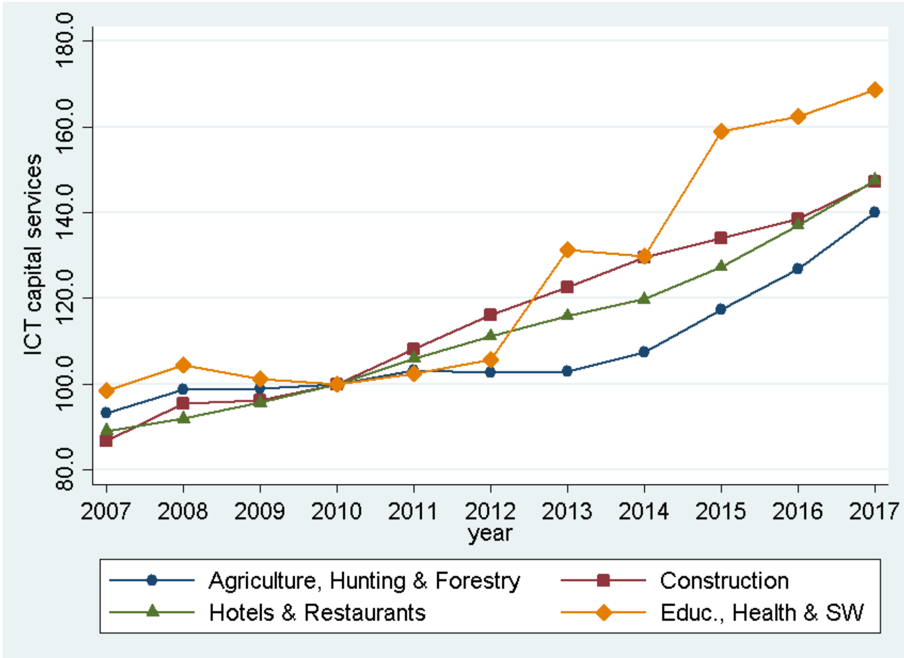
Source: made with STATA and the EUKLEMS database.

Figure 6: Evolution of ICT, UK



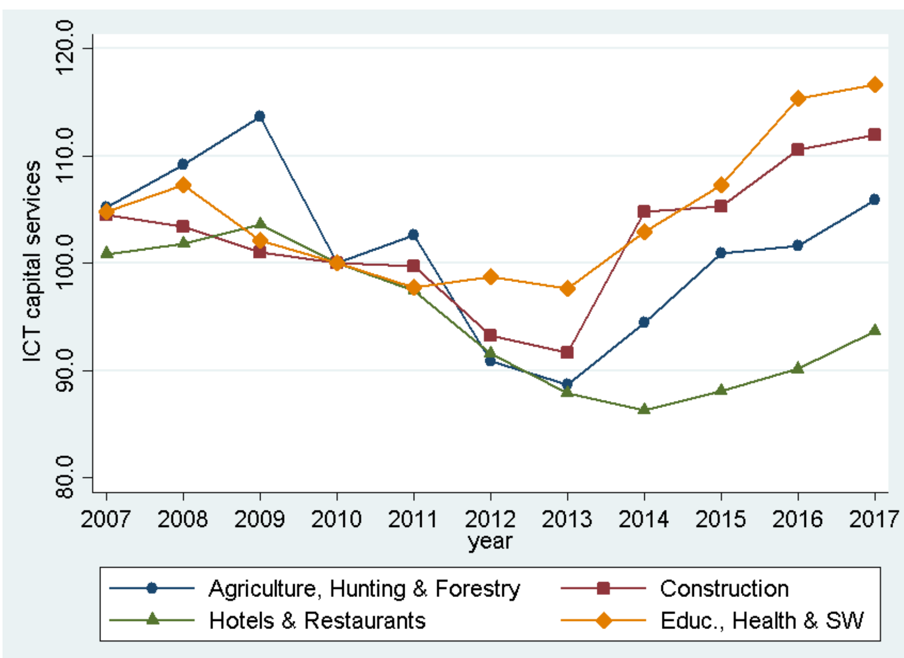
Source: made with STATA and the EUKLEMS database.

Figure 7: Evolution of ICT, Netherlands



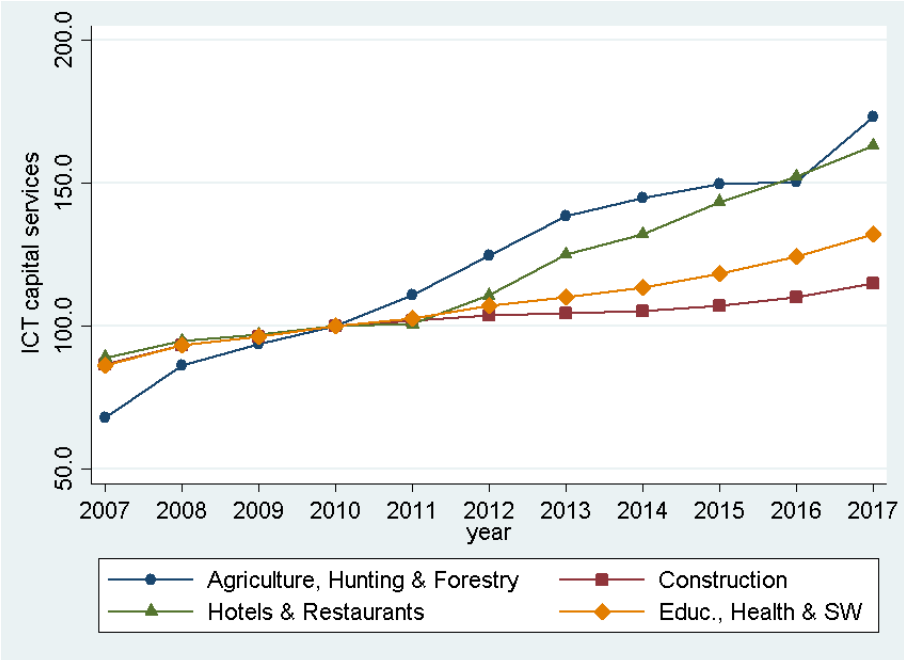
Source: made with STATA and the EUKLEMS database.

Figure 8: Evolution of ICT, Italy



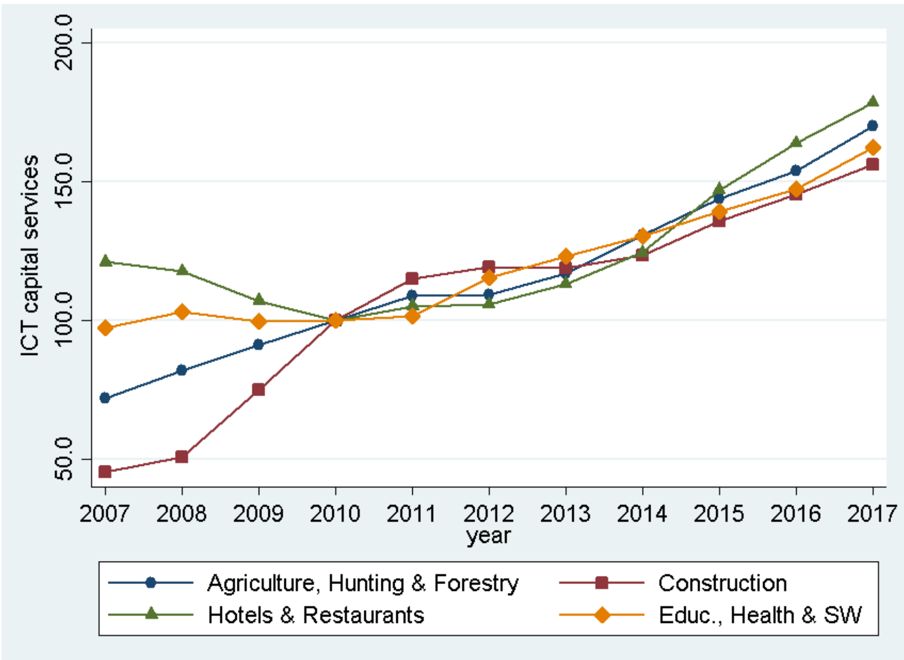
Source: made with STATA and the EUKLEMS database.

Figure 9: Evolution of ICT, France



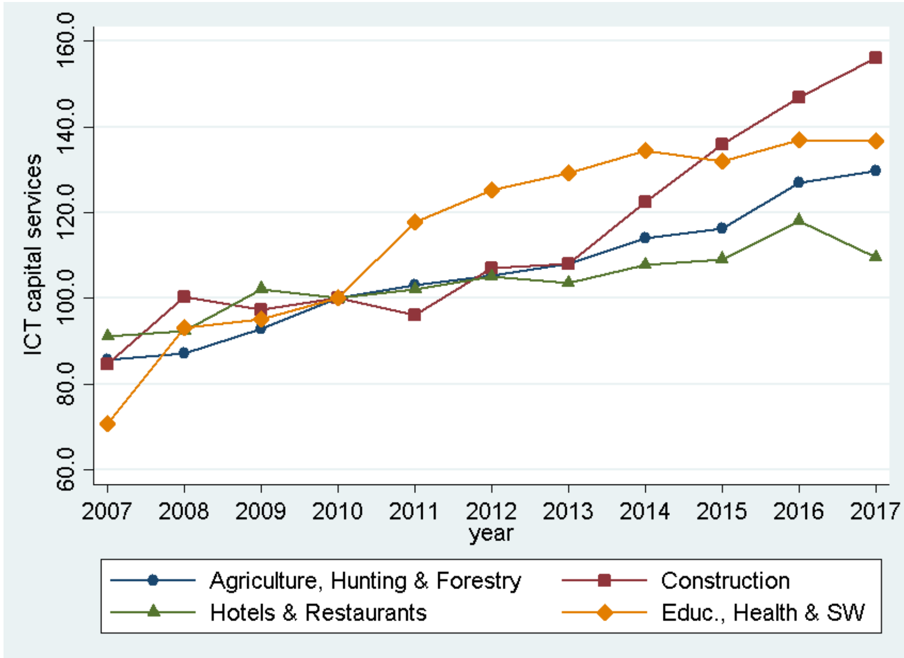
Source: made with STATA and the EUKLEMS database.

Figure 10: Evolution of ICT, Denmark



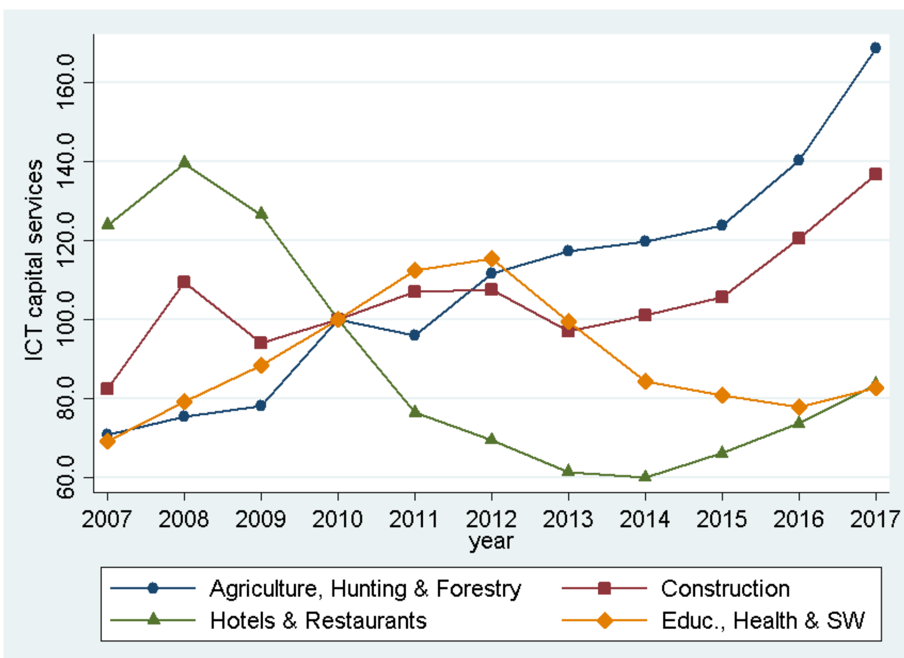
Source: made with STATA and the EUKLEMS database.

Figure 11: Evolution of ICT, FInalnd



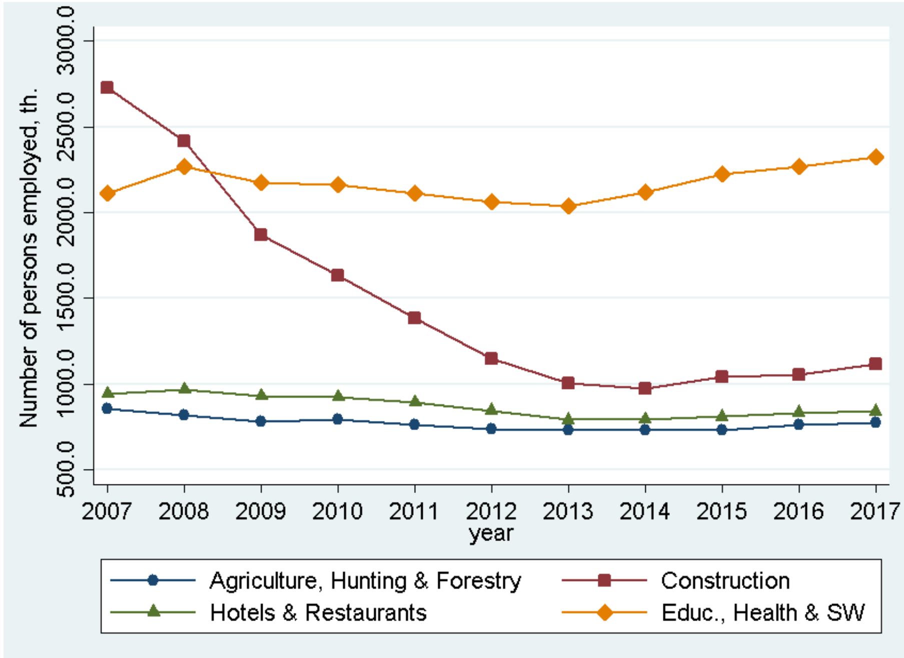
Source: made with STATA and the EUKLEMS database.

Figure 12: Evolution of ICT, Czech Republic



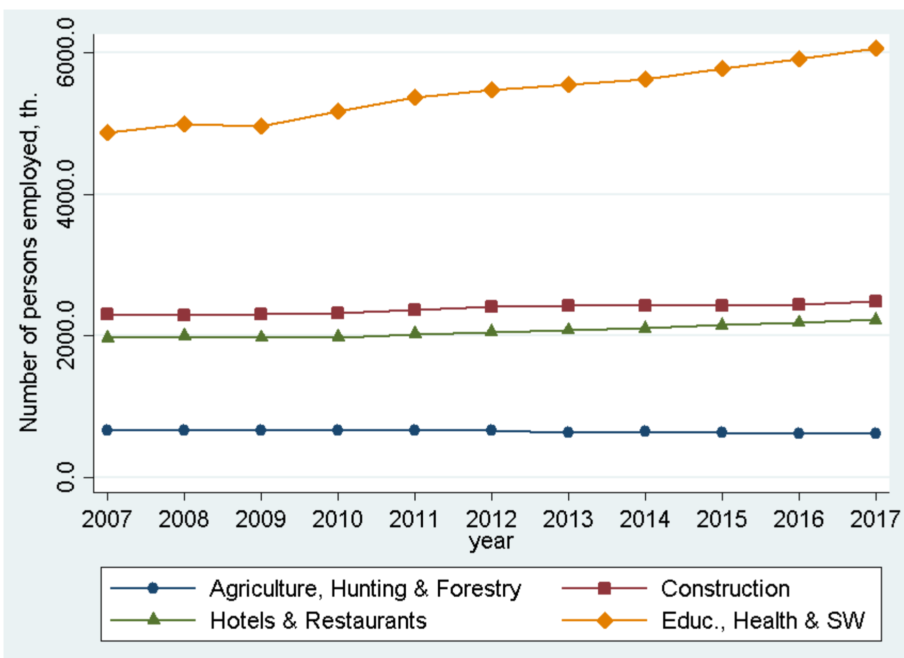
Source: made with STATA and the EUKLEMS database.

Figure 13: Evolution of EMP, Spain



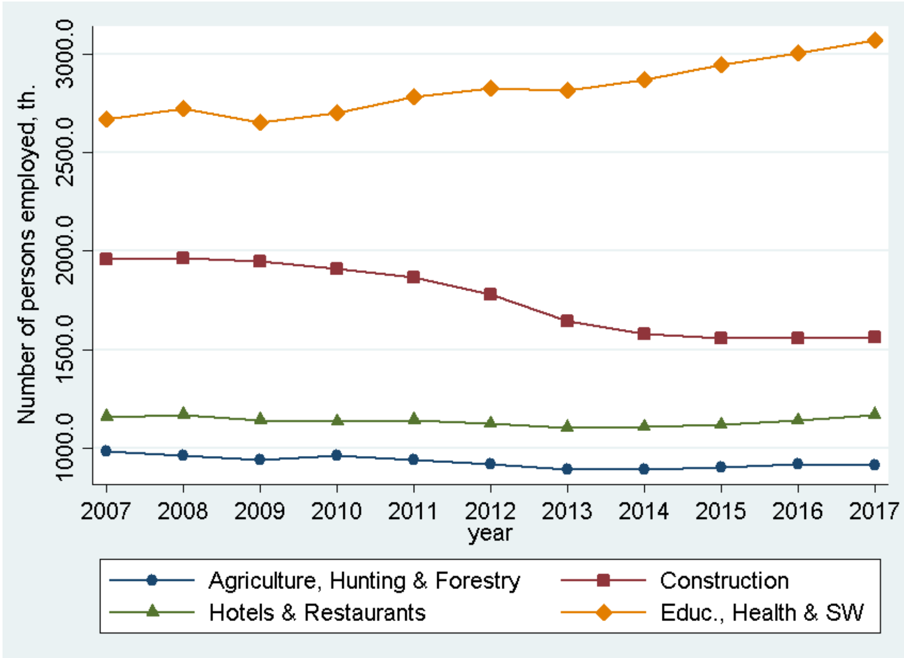
Source: made with STATA and the EUKLEMS database.

Figure 14: Evolution of EMP, Germany



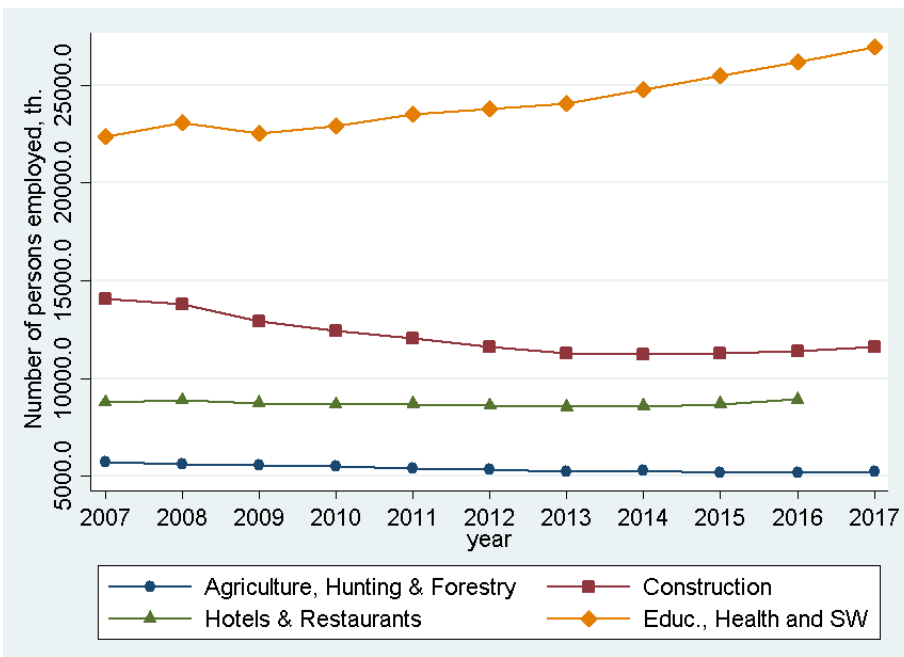
Source: made with STATA and the EUKLEMS database.

Figure 15: Evolution of EMP, Italy



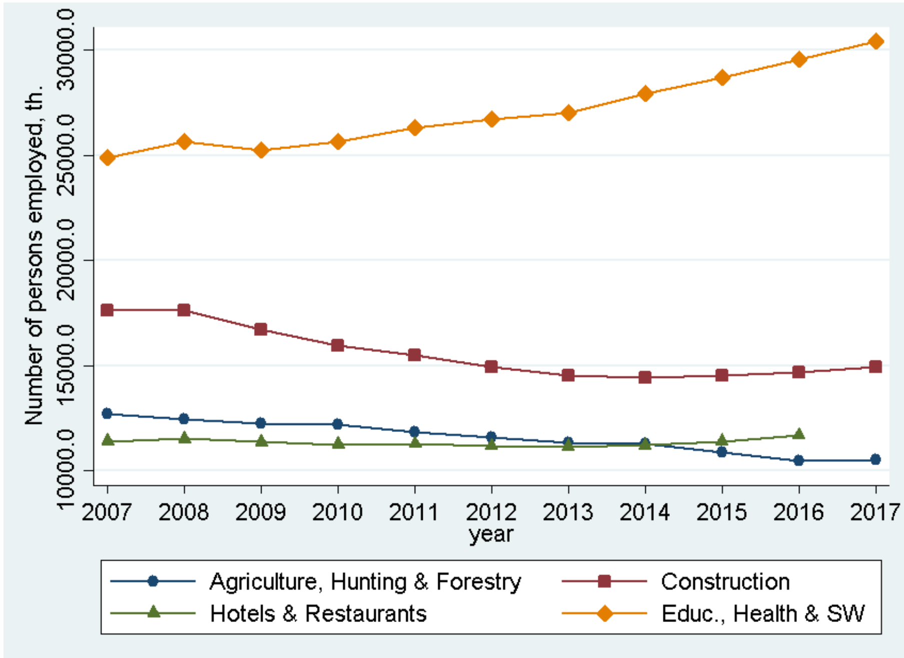
Source: made with STATA and the EUKLEMS database.

Figure 16: Evolution of EMP, EU-14



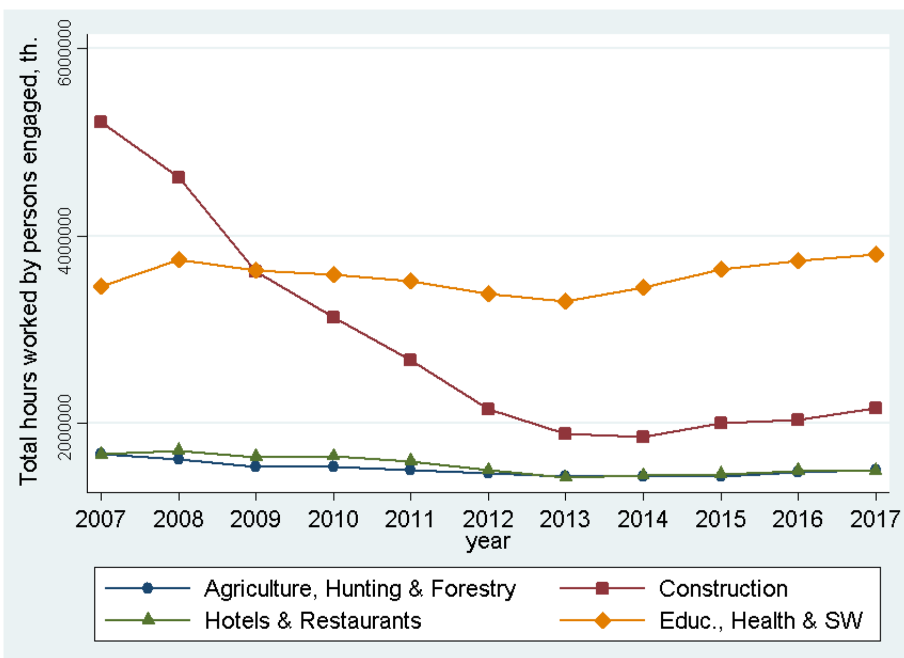
Source: made with STATA and the EUKLEMS database.

Figure 17: Evolution of EMP, EU-28



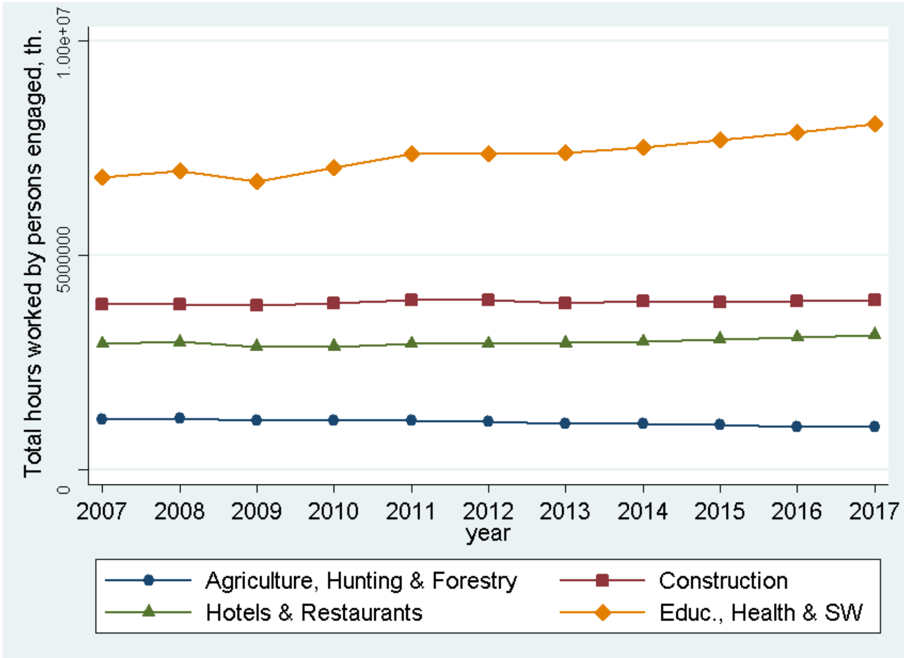
Source: made with STATA and the EUKLEMS database.

Figure 18: Evolution of HEMP, Spain



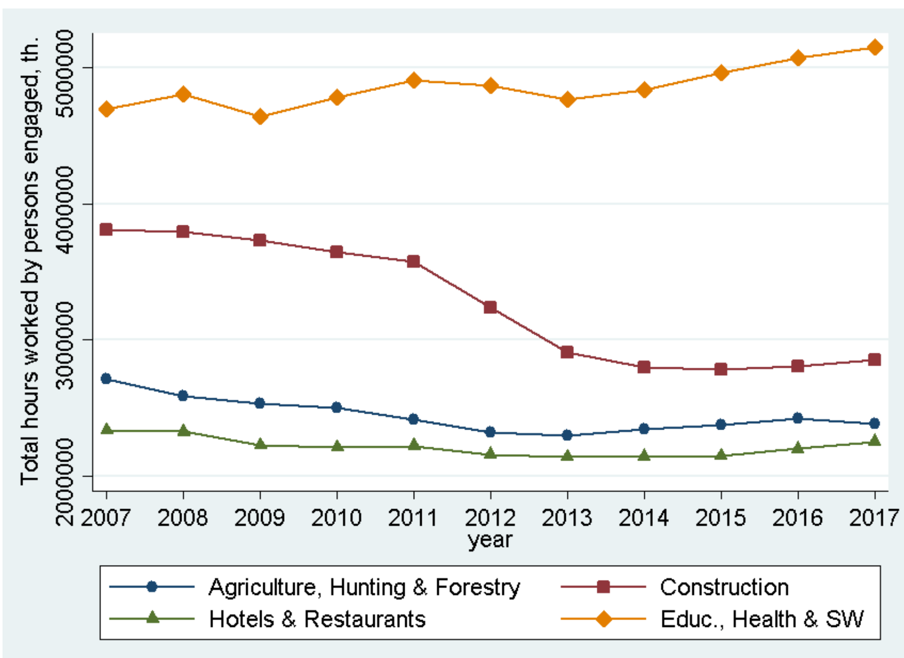
Source: made with STATA and the EUKLEMS database.

Figure 19: Evolution of HEMP, Germany



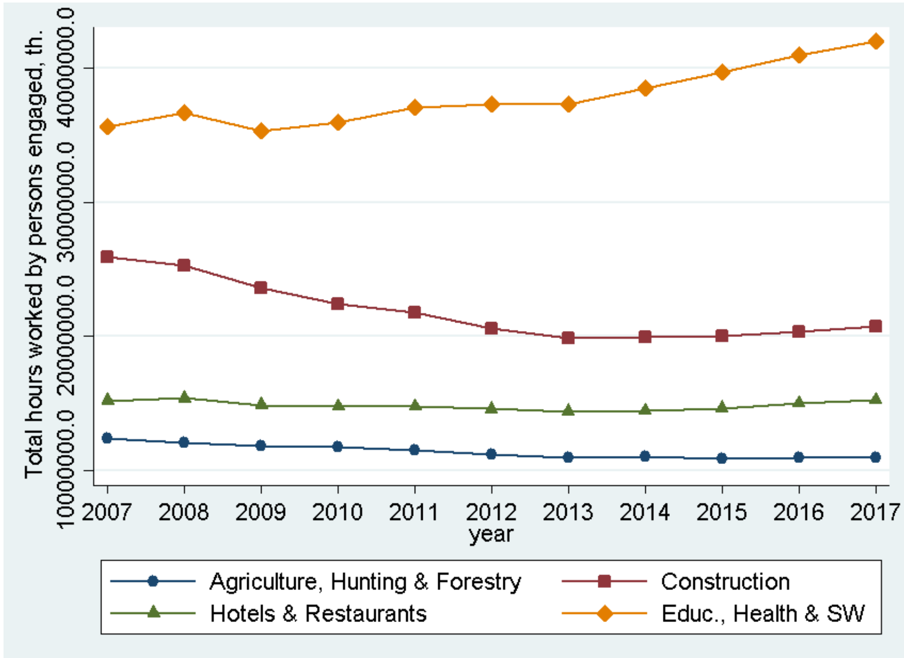
Source: made with STATA and the EUKLEMS database.

Figure 20: Evolution of HEMP, Italy



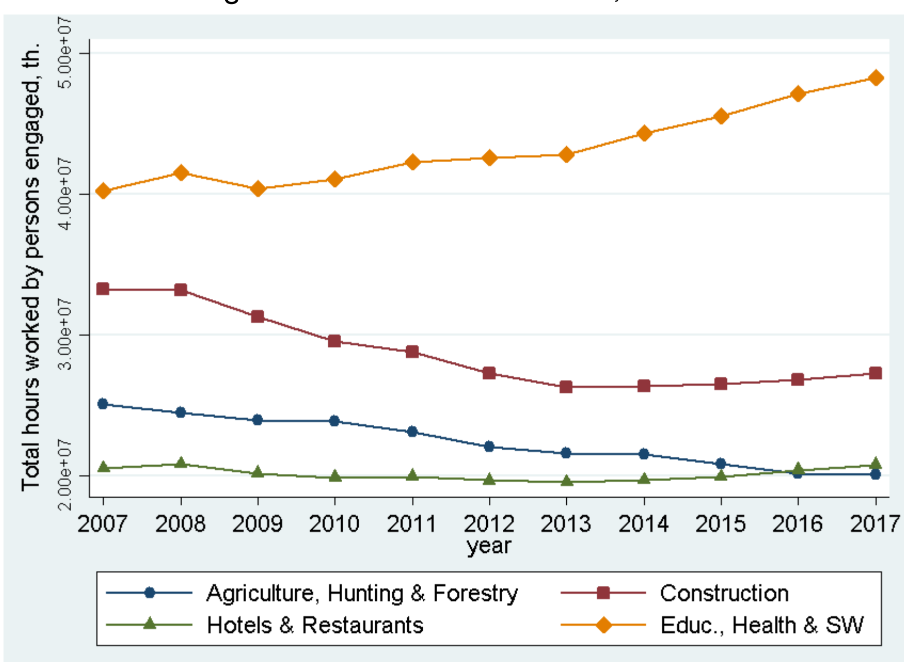
Source: made with STATA and the EUKLEMS database.

Figure 21: Evolution of HEMP, EU-14



Source: made with STATA and the EUKLEMS database.

Figure 22: Evolution of HEMP, EU-28



Source: made with STATA and the EUKLEMS database.

6.2 Do file

```
clear all
set more off
capture log close



* Working directoty
cd C:\Users\pimpeter\Desktop\labormarkets\first_homework

use "Statistical_Capital.dta"

drop if year<2007

save "Statistical_Capital.dta", replace
drop if year<2007
append using "Statistical_Growth-Accounts.dta"
drop if year<2007
append using "Statistical_National-Accounts.dta"
drop if year<2007

* Keeping relevant variables.

keep if code=="A" | code=="B" | code=="C" | code=="D_E"///
 | code=="F" | code=="G"| code=="H"| code=="I" ///
| code=="J" | code=="K" | code=="L" | code=="M_N" | ///
code=="O_Q" | code=="P" | code=="R_S"  ///
| code=="T"| code=="TOT" | code=="TOT_IND" | code=="U"



*Save the dataset before start working on it
save capital_GA_NA.dta, replace

use capital_GA_NA.dta, clear
```

```
*Now, we destring country and code and give them a number, so we can work easier with the data.
*We will need "var" as string variable, as you will notice soon.


encode country, gen(country2)
encode code, gen (code2)

order country2, after (country)
tab country2, nolab
order code2, after(code)

drop country code

rename country2 country
rename code2 industry
rename var variable

*Similar choice: order country code2, first

* We are interested in the variable INDUSTRY
* in order to have the analysis: industry country year var1 var2 var3
*

*Choose the years and the countries of interest
*drop if...
*keep if...




* We prepare the varibles to create the panel
```

```
help reshape

reshape wide value, i(industry country year) j(variable) string


order industry country year, first

*Sort the data
sort country industry year

* We have look for the variable/swith the more data as possible.

des

*We rename the variables and delete the word "value" in all of them
rename (value*) (*)


*Before start working with the base, save it!
save wide.dta, replace


*Now, you start working with the variables:
use wide.dta, clear


*We want to calculate the change in the variables.
*1) We need to sort the data in the adecuated way
sort country industry year

* keeping vars of interest:
keep industry country year EMP H_EMP VA_Q GO_Q CAP_QI CAPIT_QI ///
CAPNIT_QI LP1TFP_I LP2TFP_I
```

```
* --------------------------------------------------

* Differences in capital penetration and employment
bysort country industry: gen EMP_change=(EMP[_n]-EMP[_n-1])/EMP[_n-1]

bysort country industry: gen H_EMP_change=(H_EMP[_n]-H_EMP[_n-1])/H_EMP[_n-1]

bysort country industry: gen VA_Q_change=(VA_Q[_n]-VA_Q[_n-1])/VA_Q[_n-1]

bysort country industry: gen GO_Q_change=(GO_Q[_n]-GO_Q[_n-1])/GO_Q[_n-1]

bysort country industry: gen CAP_QI_change=(CAP_QI[_n]-CAP_QI[_n-1])/CAP_QI[_n-1]

bysort country industry: gen CAPIT_QI_change=(CAPIT_QI[_n]-CAPIT_QI[_n-1])/CAPIT_QI[_n-1]

bysort country industry: gen CAPNIT_QI_change=(CAPNIT_QI[_n]-CAPNIT_QI[_n-1])/CAPNIT_QI[_n-1]

bysort country industry: gen LP1TFP_I_change=(LP1TFP_I[_n]-LP1TFP_I[_n-1])/LP1TFP_I[_n-1]

bysort country industry: gen LP2TFP_I_change=(LP2TFP_I[_n]-LP2TFP_I[_n-1])/LP2TFP_I[_n-1]


*Save the new dataset

save base0.dta, replace

*-------------------------------------------------------------------
clear all
set more off
capture log close
```

```
*Now, you start working with the variables:
use base0.dta, clear

* ----------------SUM STAT
egen country_industry = group(country industry), label


xtset country_industry year
tabstat *, s(n min p25 p50 p75 max) c(s)

*------------------------



/* 1.        Describe the evolution of ICT capital across industries,
highlighting differences across countries
(not necessarily displaying the evolution of ALL countries). */




br industry year CAPIT_QI
*CAPIT_QI: Capital services, volume indices, 2010=100. Comparable across countries




/********************** GRAPHS ***********************/
tab country, nolabel



*ANALYZING CHOSEN COUNTRIES

************** 1)SPAIN **************

br industry year CAPIT_QI if country==11
```

```
twoway (line CAPIT_QI year, sort) if country ==11, by(industry)
*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==11




************** 2) FINLAND **************

br industry year CAPIT_QI if country==34
twoway (line CAPIT_QI year, sort) if country ==34, by(industry)

*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==34




************** 3) BELGIUM **************
br industry year CAPIT_QI if country==2
twoway (line CAPIT_QI year, sort) if country ==2, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
```

```
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==2




************** 4) GERMANY DE 6 **************
br industry year CAPIT_QI if country==6
twoway (line CAPIT_QI year, sort) if country ==6, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==6


************** 5) AUSTRIA AT 1 **************
br industry year CAPIT_QI if country==1
twoway (line CAPIT_QI year, xlabel(2007(1)2017) sort) if country ==1, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==1


************** 6) UK 37 **************
br industry year CAPIT_QI if country==37
```

```
twoway (line CAPIT_QI year, sort) if country ==37, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==37


************** 7) NETHERLANDS NL 30 **************
br industry year CAPIT_QI if country==30
twoway (line CAPIT_QI year, sort) if country ==30, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==30


************** 8) ITALY IT 24 **************
br industry year CAPIT_QI if country==24
twoway (line CAPIT_QI year, sort) if country ==24, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==24
```

```
************** 9) FRANCE FR 20 **************
br industry year CAPIT_QI if country==20
twoway (line CAPIT_QI year, sort) if country ==20, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==20


************** 10) DENMARK DK 7 **************
br industry year CAPIT_QI if country==7
twoway (line CAPIT_QI year, sort) if country ==7, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==7


************** 11) FINLAND FL 19 **************
br industry year CAPIT_QI if country==19
twoway (line CAPIT_QI year, sort) if country ==19, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
```

```
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==19


************** 12) CZEK REP. CZ 5 **************
br industry year CAPIT_QI if country==5
twoway (line CAPIT_QI year, sort) if country ==5, by(industry)


*Select some industries of interest:
twoway (line CAPIT_QI year if industry==1,xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==5, xlabel(2007(1)2017) sort) ///
(line CAPIT_QI year if industry==7, xlabel(2007(1)2017) sort)///
 (line CAPIT_QI year if industry==12, xlabel(2007(1)2017) sort) if country==5




/*########################   2.
Describe the evolution of employment
(number of employees and number of hours worked)
across industries, highlighting differences across countries. */
* Declining industries, homogeneity between countries, three, four countries

br industry year EMP H_EMP

************** 1) SPAIN **************

/* summary table*/
tabstat EMP H_EMP if  country==11 & year==2007, by(industry)


tabstat EMP H_EMP if country==11 & year==2014, by(industry)
```

```
tabstat EMP H_EMP if country==11, by(industry)

* EMP
twoway (line EMP year if industry==1, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==7, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==12, xlabel(2007(1)2017) sort) if country==11
*H_EMP
twoway (line H_EMP year if industry==1, xlabel(2007(1)2017) sort) ///
 (line H_EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==7, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==12, xlabel(2007(1)2017) sort) if country==11



************** 2) GERMANY **************

/* summary table*/
tabstat EMP H_EMP if  country==6 & year==2007, by(industry)

tabstat EMP H_EMP if country==6 & year==2014, by(industry)

tabstat EMP H_EMP if country==6, by(industry)



* EMP
twoway (line EMP year if industry==1, xlabel(2007(1)2017) sort)///
 (line EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==7, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==12, xlabel(2007(1)2017) sort) if country==6
*H_EMP
twoway (line H_EMP year if industry==1, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==7, xlabel(2007(1)2017) sort) ///
```

```
(line H_EMP year if industry==12, xlabel(2007(1)2017) sort) if country==6


************** 3) ITALY **************

/* summary table*/
tabstat EMP H_EMP if  country==24 & year==2007, by(industry)

tabstat EMP H_EMP if country==24 & year==2014, by(industry)

tabstat EMP H_EMP if country==24, by(industry)



* EMP
twoway (line EMP year if industry==1, xlabel(2007(1)2017) sort)
(line EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==7, xlabel(2007(1)2017) sort) ///
 (line EMP year if industry==12, xlabel(2007(1)2017) sort) if country==24
*H_EMP
twoway (line H_EMP year if industry==1, xlabel(2007(1)2017) sort)
(line H_EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==7, xlabel(2007(1)2017) sort)  ///
(line H_EMP year if industry==12, xlabel(2007(1)2017) sort) if country==24

************** 4) EU14 **************

/* summary table*/
tabstat EMP H_EMP if  country==14 & year==2007, by(industry)

tabstat EMP H_EMP if country==14 & year==2014, by(industry)

tabstat EMP H_EMP if country==14, by(industry)
```

```
* EMP
twoway (line EMP year if industry==1, xlabel(2007(1)2017) sort)
(line EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==7, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==12, xlabel(2007(1)2017) sort) if country==14
*H_EMP
twoway (line H_EMP year if industry==1, xlabel(2007(1)2017) sort)
 (line H_EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==7, xlabel(2007(1)2017) sort)///
 (line H_EMP year if industry==12, xlabel(2007(1)2017) sort) if country==14

************** 5) EU28 **************

/* summary table*/
tabstat EMP H_EMP if  country==18 & year==2007, by(industry)

tabstat EMP H_EMP if country==18 & year==2014, by(industry)

tabstat EMP H_EMP if country==18, by(industry)


* EMP
twoway (line EMP year if industry==1, xlabel(2007(1)2017) sort)
 (line EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line EMP year if industry==7, xlabel(2007(1)2017) sort)  ///
(line EMP year if industry==12, xlabel(2007(1)2017) sort) if country==18
*H_EMP
twoway (line H_EMP year if industry==1, xlabel(2007(1)2017) sort)
(line H_EMP year if industry==5, xlabel(2007(1)2017) sort) ///
(line H_EMP year if industry==7, xlabel(2007(1)2017) sort)  ///
(line H_EMP year if industry==12, xlabel(2007(1)2017) sort) if country==18
```

```
/* 3.        Display the observed correlation between ICT and other
related variables (such as non-ict capital) at industry level,
as well as with other income related variables and try to explain such correlations.
Estimate  ICT levels on other technological and income variables
to see the extent to which each of them help predict ICT. */


************** 1) SPAIN **************


corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I  ///
if industry==1 & country==11

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I  ///
if industry==5 & country==11

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I  ///
if industry==7 & country==11

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I  ///
if industry==12 & country==11

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I  ///
if industry==16 & country==11
```

```
************** 2) ITALY **************
corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==1 & country==24

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==5 & country==24

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==7 & country==24

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q ///
if industry==12 & country==24

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==16 & country==24


************** 3) GERMANY **************

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==1 & country==6

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==5 & country==6

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==7 & country==6

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==12 & country==6

corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q  ///
if industry==16 & country==6
```

```
********* REGRESSIONS*********
corr CAPIT_QI CAPNIT_QI CAP_QI EMP  H_EMP LP1TFP_I  LP2TFP_I VA_Q GO_Q
quiet regress CAPIT_QI CAPNIT_QI CAP_QI
vif
* Very high MC for both CAPIT vars.
* lets use the other variables that do not show that high correlation, we can use
*one of those two. We choose one variable for each pair of correlated ones:
* except the labor variables. VAQ GOQ are not significant either



*** 1) FOR EACH INDUSTRY
eststo clear
eststo: regress CAPIT_QI CAPNIT_QI  LP1TFP_I if industry==1
vif
eststo: regress CAPIT_QI    CAPNIT_QI  LP1TFP_I  GO_Q if industry==5
vif
eststo: regress CAPIT_QI CAPNIT_QI  LP1TFP_I if industry==7
vif
eststo: regress CAPIT_QI  CAPNIT_QI LP1TFP_I if industry==12
vif

esttab using regress1.tex, ar2 label  ///
title(ICT OLS for each industry)




*** 1) FOR EACH INDUSTRY AND COUNTRY
* ITALY

eststo clear
eststo: regress CAPIT_QI VA_Q H_EMP LP1TFP_I if industry==1  & country==24
```

```
eststo: regress CAPIT_QI CAPNIT_QI LP1TFP_I if industry==5  & country==24
eststo: regress CAPIT_QI CAPNIT_QI EMP  LP1TFP_I if industry==7  & country==24
eststo: regress CAPIT_QI EMP  LP1TFP_I if industry==12  & country==24

esttab using italy.tex, ar2 label  ///
title(ITALY: ICT OLS for each industry)

* GERMANY
eststo clear
eststo: regress CAPIT_QI VA_Q  LP1TFP_I if industry==1  & country==6
eststo: regress CAPIT_QI   EMP LP1TFP_I if industry==5  & country==6
eststo: regress CAPIT_QI VA_Q EMP  LP1TFP_I if industry==7  & country==6
eststo: regress CAPIT_QI  EMP LP1TFP_I if industry==12  & country==6

esttab using ger.tex, ar2 label  ///
title(GERMNAY: ICT OLS for each industry)

* SPAIN
eststo clear
eststo: regress CAPIT_QI   LP1TFP_I if industry==1  & country==11
eststo: regress CAPIT_QI   LP1TFP_I if industry==5  & country==11
eststo: regress CAPIT_QI   LP1TFP_I if industry==7  & country==11
eststo: regress CAPIT_QI  EMP LP1TFP_I if industry==12  & country==11

esttab using spain.tex, ar2 label  ///
title(SPAIN: ICT OLS for each industry)


/*4.        Display the correlation between
the evolution of Employment across industries
and other technology and income related variables. */

br country industry year EMP EMP_change
```

```
*Now, get the correlation:
corr EMP_change CAPIT_QI_change CAPNIT_QI_change CAP_QI_change H_EMP_change ///
LP1TFP_I_change  LP2TFP_I_change GO_Q_change VA_Q_change


************** 1) SPAIN **************


corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
if industry==1 & country==11

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
if industry==5 & country==11

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
if industry==7 & country==11

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
if industry==12 & country==11

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
if industry==16 & country==11


************** 2) ITALY **************
corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q if industry==1 & country==24

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q if industry==5 & country==24
```

```
corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
GO_Q VA_Q if industry==7 & country==24

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
GO_Q VA_Q if industry==12 & country==24

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q if industry==16 & country==24


************** 3) GERMANY **************

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q  if industry==1 & country==6

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q  if industry==5 & country==6

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
GO_Q VA_Q  if industry==7 & country==6

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I ///
GO_Q VA_Q  if industry==12 & country==6

corr EMP_change H_EMP CAPIT_QI CAPNIT_QI CAP_QI LP1TFP_I  LP2TFP_I  ///
GO_Q VA_Q  if industry==16 & country==6



********* REGRESSIONS*********
corr EMP_change H_EMP_change CAPIT_QI_change CAPNIT_QI_change CAP_QI_change LP1TFP_I_change  LP2T
quiet regress CAPIT_QI CAPNIT_QI CAP_QI
vif
```

```
* Very high MC for both CAPIT (they are very correlated, explain why)
* lets use the other variables that do not show that high correlation, we can use
*one of those two. We choose one variable for each pair of correlated ones:
* except the labor variables. VAQ GOQ are not significant either

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry!=16


*** 1) FOR EACH INDUSTRY

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==1

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==5

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==7

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==12


*** 1) FOR EACH INDUSTRY AND COUNTRY
* ITALY

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==1 & country==24

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==5 & country==24

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==7 & country==24
regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==12 & country==24


* GERMANY
regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==1 & country==6
```

```
regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==5 & country==6

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==7 & country==6

regress EMP_change CAP_QI_change  LP2TFP_I_change GO_Q_change if industry==12 & country==6

* SPAIN does not have the GO_Q VA_Q values, so we cannot use them

regress EMP_change CAP_QI_change  LP2TFP_I_change if industry==1 & country==11

regress EMP_change CAP_QI_change  LP2TFP_I_change  if industry==5 & country==11

regress EMP_change CAP_QI_change  LP2TFP_I_change if industry==7 & country==11

regress EMP_change CAP_QI_change  LP2TFP_I_change if industry==12 & country==11




/*5.Deep into the relation between
Employment and ICT capital across industries
(either number of employees or hours or both). */


clear all
use base0.dta
gen lnEMP=ln(EMP)
egen country_industry = group(country industry), label
global var_list CAPIT_QI  LP1TFP_I

xtset country_industry year
tabstat *, s(n min p25 p50 p75 max) c(s)
```

```
/*A.        Estimate the level of Employment on the level of ICT  without adding any other variab
eststo clear
eststo: regress lnEMP CAPIT_QI
esttab using regols.tex, ar2 label  ///
title(Regressing lnEMP)


/*B.        Estimate the former equation by adding fixed effects (time and country fixed effects)
Discuss the estimated coefficients and interpret it with respect to the coefficients found in A.
/*https://www.stata.com/features/overview/linear-fixed-and-random-effects-models */

eststo clear
eststo: xtreg lnEMP CAPIT_QI i.year if country==11, fe
eststo:xtreg lnEMP CAPIT_QI i.year if country==6, fe
eststo: xtreg lnEMP CAPIT_QI i.year if country==24, fe
eststo: xtreg lnEMP CAPIT_QI i.year if country==7, fe
eststo: xtreg lnEMP CAPIT_QI i.year if country==20, fe

esttab using fe.tex, ar2 label  ///
title(Regressing lnEMP on FE: time and country)



/* C.Add other covariates available in the dataset that you think may affect employment.
Discuss the changes observed in the coefficient of ICT.*/

/*
D.        Select 5 countries and run estimation C for each of the 5 selected countries (year fixe
Discuss what you observed in the relation between ICT penetration and Employment.
*/
```

```
eststo clear
eststo: xtreg lnEMP $var_list i.year if country==11, fe
eststo:xtreg lnEMP $var_list VA_Q i.year if country==6, fe
eststo: xtreg lnEMP $var_list VA_Q i.year if country==24, fe
eststo: xtreg lnEMP $var_list VA_Q i.year if country==7, fe
eststo: xtreg lnEMP $var_list VA_Q i.year if country==20, fe

esttab using fe2.tex, ar2 label  ///
title(Regressing lnEMP on FE: time and country)


log close
```