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Keywords: TFP, institutions, domestic knowledge, spillovers
JEL Classification: 031, 040, 043

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INSTITUTIONS, KNOWLEDGE ACCUMULATION AND PRODUCTIVITY GROWTH IN THE SECOND HALF OF THE XXTH CENTURY

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Abstract

This paper studies the relevance of institutional differences in the way knowledge determines productivity for a set of 21 OECD countries in the second half of the XXth century. The relationship between Total Factor Productivity (TFP, from hereafter) and knowledge related variables is reconsidered after controlling for a new set of institutional variables. The new set has been specifically tailored to measure the post WWII institutional framework characterized by the development of the Welfare State and by an increasing exposure of countries to international competence. We estimate the differential impact of innovation variables over productivity during the Golden Age as compared to the whole period 1953-2007, after controlling by these specific institutional variables. Additionally, we distinguish the particular impact of these relationships for five groups of countries following Amable (2006) classification, which differ in the degree of development of post WWII institutions. Our results suggest that some of these institutions determine the response of TFP to the knowledge variables and that the resulting elasticities are higher during the Golden Age. When countries are grouped according to their similarities in this set of institutions, we find significant differences among them. In general, there are not significant differences between the different groups and the market oriented economies with regard to the elasticity of TFP to the indoor innovation, with the exception of Japan. However, the results suggest that in Anglo-Saxon market oriented economies, international spillovers of technology have a higher impact on TFP. Additionally, in continental and Mediterranean European countries and Japan, TFP is more sensitive to human capital accumulation than in the market-oriented economies (the US and the UK).

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1. Introduction.

In the last decades, the role of institutions and their adaptability to make the economies more prone to technological change has been at the core of the economic debate in Europe. This debate deals about the reasons that could explain why European countries, Japan and the U.S. have performed so differently in the last decades and why they have displayed differences in their adaptability to the new challenges brought by globalization, the development of the Information and Communication Technologies (ICT) and the emergence of the “knowledge based economy”.

The issue arises after observing that the trajectory followed by the Western European economies and Japan with regard to the US has reversal in in the last two decades, as compared with the one observed after the WWII. In the Golden Age period the Western European countries and Japan experienced fast growth rates letting them to catch-up with the U.S., by contrary the U.S. remained stagnant and lost positions in terms of industrial competitiveness in the world economy. However, in the last two decades Europe and Japan had performed quite poorly with regard to the U.S., that has enjoyed the highest rates of productivity growth since the end of the WWII. This vigorous growth has pushed the North-American economy again at the forefront of the new knowledge economy.

Some scholars attribute the gap in productivity between the countries on either side of the Atlantic to differences in the degree of adoption and

development of ICT technologies.[1] The U.S., with remarkably stable growth rates throughout the second half of the last century, has preserved its technological leadership by pioneering the development and dissemination of ICT technologies.[2] For the European countries, without overlooking the influences of other non-ICT determinants, differences in ICT adoption explains a big proportion of the gulf in productivity with respect to the U.S. Following a growth accounting approach, the low share of the ICT producing industries in total output and the low rates of investment in new ICT equipment in Europe seem to be the main sources of the disappointing performance of the European economies.

Furthermore, for Timmer and van Ark (2005) the poorer penetration of the ICT technologies prevents European economies developing the technological spillovers derived from this sort of new General Purpose Technology. With low levels of investment in ICT equipment is difficult to start up the "spillover effects" and to observe all those benefits, in terms of multifactor productivity, that experience the industries by using the new technology and that provoke changes in firms organizations, development of new products, services and processes, and a continuous up-grading of the labour force.

Additionally, a further the exploration of the causes of the European and Japanese slowdown in productivity considers that differences in the institutional framework are in the roots of the low dissemination in Europe and Japan of any kind of new technologies, not only the ICTs. According to this interpretation, countries need to develop higher levels of knowledge competence and to train a

[1] There is a vast literature that stresses the still poor assimilation in Europe of the ICT technologies as compared with the U.S. (Van Ark et al, 2003; Colecchia and Schreyer, 2001; Vijselar and Albers, 2002; Timmer and Van Ark, 2005; Timmer et al, 2003 and 2010).
[2] The increasing use of ICT equipment explains the acceleration of productivity growth in the U.S. since 1995 (Oliner and Sichel, 2000; Jorgenson and Stiroh, 2001; and, Oulton, 2012).

more skilled labour force to better accommodate new technologies (Mowery and Rosenberg, 2000).

The “knowledge based economy” refers to the idea that knowledge creation and diffusion play a more important role in competitiveness and economic growth than it used to be in previous technological eras. In the new competitive conditions innovation is crucial for the survival of firms, which have to adapt continuously to the changing market conditions and to frequent modifications of the production methods. In this new economy, the ability of firms to innovate will depend in a great extent of the availability of a more flexible workforce in terms of its ability to upgrade permanently its skills and of its willingness to mobility. The knowledge based economy demands more flexible labour and capital markets to ensure the permanent adaptability of the firms to the changing conditions.

Some works consider that the lower adaptability of Europe and Japan to the new competitive conditions lay on the characteristics of their institutions. These institutions, classified as “coordinated capitalism” and characterized by different sorts of arrangements between the State, the firms and the workers, are exemplified by the Japanese model of industrialization after the WWII, the French indicative planning of the 1960s, the German style codetermination in the 1970s, among other This kind of institutions that were appropriate for catching up with the U.S. during the Golden Age, could have become less adequate in a new economy where innovation and adaptability are crucial for economic growth. Thus, as Aghion and Howitt (2006) point out, to stay at the forefront of technological advancement, some aspects in the society, such as the resources devoted to investment in high-quality education, require

improvement, as well as the labour and product markets should seek to remove binding rigidities.

This paper analyses the relevance of institutional differences in the way knowledge related variables determine productivity for a set of 21 OECD countries in the second half of the XXth century. Our empirical analysis follows Coe *et al.* (2009) approach, where the relationship between TFP and domestic knowledge accumulation, international spillovers and human capital is estimated after controlling for institutional variables. However, we extend the set of institutional variables uses. In particular, we build a new set of institutional variables specifically tailored to measure the post WWII institutional framework characterized by the development of the Welfare State and by an increasing exposure of countries to international competence. Further, we will also account for the differences across countries by grouping them according to the degree of development of the institutional variables and following Amable (2003) classification.

2. Data and Total Factor Productivity.

We use Coe and Helpman (1995) specification, extended by Engelbrecht (1997), to add a human capital variable, and by Coe *et al.* (2009) to control for institutional variables, to explore the role of the institutional variables in the long-run evolution of TFP for 21 OECD countries throughout the second half of the 20th century. The institutional variables we propose account for the "coordinated capitalism" framework (Eichengreen, 2007) that was established (with different extent) in the advanced countries after the WWII. We will also introduce the following variables: domestic innovation, measured by the stock of domestic

patents; international technology diffusion, measured by the stock of foreign patents diffused through trade; and human capital. Equation 1 shows our empirical model:

$$\log TFP_{it} = \alpha^0 + \alpha^d \log S_{it}^d + \alpha^{mf} m_{it} \log S_{it}^f + \alpha^H \log H_{it} + \varepsilon_{it} \qquad (1)$$

where TFP_{it} is total factor productivity for country i and year t; S_{it}^d is the stock of domestic patents; S_{it}^f is the stock of foreign knowledge (obtained as a weighted sum of the domestic stocks of patents of the trading partners of a country); m_{it} is the propensity to import (measured by imports as a fraction of GDP); H_{it} is the domestic stock of human capital; and ε_{it} is a disturbance term. The model is estimated both with and without m_{it}. As Coe and Helpman (1995) propose, the transmission of international technology spillovers through trade may be proportional to the degree of openness of the country. This may only partially be captured by the foreign stock of knowledge as it is constructed. They therefore propose including an interaction between the foreign stock of knowledge and the country's average propensity to import, to account explicitly for the degree of openness of the economy.

Following Coe *et al.* (2009), we will extend specification (1) to account for the institutional framework (i.e., the "coordinated capitalism" institutions) proposed in this research. We will introduce the institutional variables together with domestic innovation, foreign innovation and human capital variables, to analyse the effect of the institutional framework on TFP. Further, we will also study the above relationship during the Golden Age.

Finally, we will research if there are differential patterns for different groups of countries, according to Amable (2003) classification (Market-based

Anglo-Saxon economies, Social-Democratic model, Continental European model, Mediterranean model, Nordic model and Asian model).

2.1. Knowledge related variables and TFP.

We use annual data for 21 OECD countries for the period 1953 to 2007[3]. In particular, for each country, we calculate TFP, the domestic stock of knowledge, the foreign stock of knowledge and human capital. The TFP is taken from the Penn World Table 8.0 (Feenstra, Inklaar and Timmer, 2013). TFP growth was positive in every country and grew a 66 per cent, on average, for the 21 countries. The highest growth was achieved in Japan, Finland and Greece and the lowest in Canada and Norway.

To build the series of domestic and foreign stock of knowledge, we use the flow of total patents applied for annually in each national office and registered in the *World Intellectual Property Organization (WIPO) Statistics Database.* Additionally, we take into account the patents directly applied for at the *European Patent Office* (EPO) since 1977*.* Despite this information being readily available, however, the use of patents statistics has some drawbacks. One of main shortcomings is the concern about the comparability of patent data over time and across countries. Mansfield (1986) finds no significant changes in the propensity to patent over time in the U.S. and other countries. Some authors consider that, since the Paris Convention of 1883 harmonised patenting rules, the number of claims per patent is approximately the same across all countries except for Japan (Okada, 1992). However, Lerner (2000 and 2002) points out some significant differences between countries concerning to patent fees,

[3] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

structure of patents renewals, patent office practices, etc. As such differences persist, even after the Paris Convention, this author suggests that the patents series should be corrected. We have addressed this problem by calculating a scaling factor for each country in a similar way than in Okada (1992) for Japan. In the Appendix 1 of Sanchis *et al* (2015) you can find more details about the way of calculating this scaling factor. We use the perpetual inventory method to construct knowledge stocks. The domestic stock of knowledge is calculated by cumulative patent applications in each country using a 5% depreciation rate.[4]

The increase in the domestic stock of patents is smoother than the rise in TFP. Japan and Ireland show the highest increase in the domestic stock of knowledge. Finland, Spain and the Netherlands also show growth rates higher than the average. In the opposite side, Australia and Switzerland didn't increase their stock and UK, Norway, Belgium and New Zealand didn't double the stock. The stock of patents in the U.S. shows a slight upward trend until the beginning of the 1990s and a sharp upswing afterwards The European countries display a different pattern of patenting, with a clear upward trend throughout the Golden Age, a flat trend for the period 1970–1990, and a slight increase since 1990.

The foreign stock of knowledge is computed as the weighted sum of the domestic stocks of patents of the trading partners of each country[5] Following

[4] Using data of citation patents granted for in the U.S., Caballero and Jaffe (1993) find that the average annual rate of knowledge or technological obsolescence rises from about 3% at the beginning of the century to about 10–12% in 1990. As we are using patent data since 1870 to calculate the initial stock of knowledge, we follow Madsen (2007) and apply an average depreciation rate of 5% for the whole period. Nonetheless, the literature fails to settle on an appropriate depreciation rate. For example, Pakes and Schankerman (1984) advocate a 20% depreciation rate. Madsen (2007), on the other hand, tests both depreciation rates and finds no significant differences.

[5] Coe and Helpman (1995) and Lichtenberghe and van Pottelsberghe de la Potterie (1998) use total imports as the channel for international technology spillovers.

Coe *et al* (1997) and Xu and Wang (1999) the bilateral import weights are based on highly technological products, since technological spillovers through imports are more likely to take place through imports of technologically sophisticated products.

Contrary to the domestic stock, the evolution of the foreign stock is more evenly distributed between countries. Two facts explain this common flat trend in the European countries: first, the construction of this variable as an average of the domestic stocks of patents for the countries; and, second, the use of a weighting procedure that switches the direction of trade of technologically advanced products. During this period, in the European countries the direction of trade evolved in favour of products coming from other European countries and against imports coming from the U.S. This fact had a negative impact on the evolution of the international technological spillovers penetrating in Europe because the share of imports arriving from the most innovative country decreased and the share of imports from the other European countries increased even do the domestic stocks of knowledge of the European countries remained almost stagnant between 1970–1990. On the other hand, the upward trend of the U.S. imports of knowledge could be explained by the increasing presence of technologically advanced goods coming from other parts of the world, as for example Japan.

As Coe and Helpman (1995) explain, the transmission of international technology spillovers through trade may be proportional to the degree of openness of the country. It is therefore of interest to monitor the interaction between the foreign stock of knowledge and the country's average propensity to import (m_{ij}), in order to account explicitly for the effect of the degree of

openness on productivity. In general, the propensity to import has maintained a positive slope throughout the whole period, reinforcing the upward trend of the foreign stock of knowledge, but there is a wide variety of imports shares among countries, both on levels and on growth rates. For example, in Belgium the import share in 2007 was over 100 per cent while in Japan and U.S. it was only 17 per cent. The increase on import shares over the whole period has been higher in European countries than in the rest of the sample, and this fact is due to the low starting levels in 1953 and to the process of European integration in the subsequent years. In contrast, the increase in the imports share in non-European countries has been below the average.

Human capital has been measured as the average years of schooling of the population by using the Barro and Lee (2013) database. Schooling has increased in all countries, with an average gain of 4.5 years in 2007 over 1953. The largest increases occurred in Portugal, Italy, Greece, Finland and Spain, countries that doubled the years of schooling over the whole period. Moreover, in countries with higher initial levels (United States, Switzerland and Australia) increases are the lowest of the sample.

2.2. Data on institutions.

In recent times, there has been a growing concern in the relevance of institutions in economic growth; however, there is no consensus on which institutions are relevant and how they influence economic growth. The aim in this piece of research is testing if the institutional consensus, named by Einchengreen (1996, 2007) as “coordinated capitalism”, influenced the observed technology adoption patterns across countries during the second half of the XXth century. Coordinated capitalism is defined as the new set of rules

and institutions that facilitated the consensus among government, employers and workers, and the cooperation among countries after the Second World War (new international institutions).

According to Eichengreen (2007), under the concept of “coordinated capitalism” we may find diverse ways for coordination among the social agents in a country aiming at creating a socio-political environment more favourable to investment and economic growth. Focusing in the particular case of the European countries it is possible to observe different ways to obtain commitments among the political parties, the unions, firms and the government; or, we can observe different rules for the participation of workers in the executive boards in private companies; or different ways for dealing with foreign countries. These differences in the way of negotiating have lead to different policy outcomes, such as the degree of development of the Welfare State or in the degree of integration in the international markets of goods and factors.

The variables we use to represent the “coordinated capitalism” are: social conflict, job security, social expenditure openness and external liberalization. This selection is the result of data availability (for the whole period and for all the sample countries) and the objective to have both institutional and policy measures. Three of the variables used capture the existence of a social agreement within a country, that help to enjoy more stable environment that could favour economic growth and the absorption of foreign technology and knowledge. These are social expenditure, employment protection and a low degree of social conflict. I what follows, we briefly describe these variables.

Social expenditure is measured as the percentage of gross public social expenditure on current GDP. The data have been drawn from the OECD (1960-2007). For the period 1953-1960 we have extrapolate the data from the values reported in Flora (1987). Further, in some cases, we have also used domestic sources to complete the series.

Job security is a measure of the workers protection. This protection has three components: the law protecting workers with regular contracts, those affecting workers with temporary contracts and regulations applying specifically to collective dismissal. Employment protection laws and practices seek to promote a more stable employment relationship that might benefit both the worker and the firm. The worker is compensated for training and other incurred costs while the firm can expect more human capital formation and willingness of the workers to accept technological changes and internal mobility since jobs are not threatened. All of these benefits, however, have to be counterbalanced with potential erosions on the worker welfare (protection is effective only for the more protected employees) and economic efficiency (low unemployment flows and higher unemployment duration). Data on Job Security comes from Allard (2005), who extend back to 1950 the series of the Employment Protection Legislation Indicator of the OECD. We can observe unregulated labour markets during the 1950s and early 1960s, with an increase of the regulations in the period 1964-1978. The deregulation wave started in the 1980s. Another interesting pattern is the difference between European and non-European countries. The non-European, and specially the English speaking countries, have less regulated labour markets over the period of analysis.

Social conflict is an index that measures the number of working days lost per 1000 workers. Data come from Brady *et al.* (2014), which takes the original data from the International Labour Organization. Strikes are a mean to settling labour disputes that usually occur when the collective bargaining process fails to produce a negotiated agreement. As a way to solve a disagreement, strikes are very disruptive and costly. Alternative mechanisms can be adopted, such as conciliation, mediation or arbitration. Our view is that strikes are the last option to settle a dispute indicates that the alternative possibilities have failed. This failure is more probable when worker and management are less coordinated. So a lower number of conflicts indicates a more stable employment relationship between workers and the firm, which benefits both sides and has a positive effect on the efficiency of the economic system. During the 1960s we observe relative stability and low number of conflicts, an upsurge in the 1970s and first half of the 1980s and a return to low intensity of labour conflicts in the 2000s.

We use two variables to capture the cooperation between countries and the liberalization of external markets: trade openness and the liberalization of current and financial external transactions.

Data for trade openness are drawn from the Penn World Tables. Trade openness is computed as the ratio of the sum of exports and imports over GDP. There has been a constant increase in trade openness during the whole period of analysis, with a maximum for most of the countries during the 2000s. The institutional settlements for the post-war recovery (Bretton Woods's system, GATT, Regional Integration) during the 1950s and 1960s and the upsurge of globalization and global competition (transport cost reductions, integration of communist countries in the WTO) drove the growing tendency. However, the

evolution trade openness is asymmetric across countries, and depends on domestic characteristics such as the size of the country or the distance to international markets or even the level of development. Thus, the U.S., Japan and Australia are the less open countries, and Switzerland and Ireland are among the most open ones. In the European countries group, Portugal, Greece, Spain and France show lowest trade openness ratio, as compared to central and northern countries.

To assess the financial liberalization in international markets we use Quinn (1997) quantitative measure of the regulation of international financial transactions. This indicator is an index for a government's policy towards capital and financial liberalization by offering a measurement of the existence (absence) of restrictions and of the severity of those restrictions. As in the trade openness indicator, the trend during this period is towards liberalization in the financial markets. Only 6 countries of the sample were not fully liberalized in the 2000s (Australia, Austria, France, Sweden, Japan and Portugal). The most opened countries (the U.S., the U.K., Germany, Canada or Switzerland) reach the maximum level in the 1980s or before. Some European countries were fully liberalized in the 1990s and the more backward ones (Spain, Greece, Ireland) did not get full liberalization until the 2000s.

The final step we take on the coordinated capitalism variables it to is to normalise the indicators. Summary statistics for the data are presented in Table 1.

Table 1. Descriptive statistics.

	TFP	S_d	S_f	m	H	Liberalization Index	Trade Openness	Social Conflict	Social Expenditure	Job Security
Market-Oriented										
United Kingdom	0.79	349082.7	592616.1	0.22	11.11	0.77	0.21	0.20	0.44	0.24
United States	0.80	1438318	595428.5	0.09	11.8	0.99	0.05	0.19	0.30	0.07
Continental Europe										
Austria	0.85	44234.45	447274.4	0.31	9.88	0.73	0.29	0.02	0.59	0.41
Belgium	0.85	40889.26	459451.9	0.73	9.02	0.79	0.53	0.09	0.60	0.4
Germany	1.01	393747.7	517227.1	0.27	11.66	0.96	0.19	0.01	0.60	0.53
Netherlands	0.86	30714.31	514428.2	0.50	9.84	0.9	0.50	0.03	0.57	0.48
Switzerland	0.94	111156.6	479249.5	0.32	11.95	0.98	0.72	0.00	0.36	0.17
Australia	0.82	61219.35	953962.8	0.14	11.60	0.66	0.13	0.23	0.28	0.13
Canada	1.00	45226.74	1325296	0.26	11.14	0.96	0.23	0.38	0.38	0.14
Ireland	0.78	5784.96	625094.5	0.48	8.65	0.73	0.49	0.25	0.41	0.23
New Zealand	0.91	17259.74	775630.6	0.23	10.41	0.68	0.24	0.12	0.39	0.13
Nordic countries										
Denmark	0.80	14495.58	409988.4	0.35	10.6	0.77	0.32	0.12	0.57	0.35
Finland	0.71	17572.93	484002.1	0.31	9.22	0.65	0.24	0.21	0.51	0.34
Norway	0.82	19886.41	443183.3	0.46	10.93	0.67	0.34	0.05	0.46	0.59
Sweden	0.79	73663.25	459322.9	0.37	10.55	0.77	0.27	0.05	0.67	0.63
Mediterranean countries										
France	0.90	378634.8	522590.9	0.2	10.74	0.46	0.16	0.07	0.62	0.46
Greece	0.89	891.75	503675	0.18	7.68	0.66	0.18	0.41	0.34	0.66
Italy	0.92	152108.5	479962.7	0.18	7.87	0.73	0.16	0.45	0.46	0.73
Portugal	0.91	1521.75	381578.6	0.24	5.20	0.61	0.23	0.06	0.25	0.61
Spain	1.00	60988.83	510706.6	0.16	7.45	0.68	0.13	0.25	0.32	0.68
Other										
Japan	0.83	1239619	978489.5	0.14	10.94	0.64	0.07	0.04	0.27	0.37
All countries	0.87	214143.6	593293.3	0.29	9.92	0.76	0.27	0.15	0.45	0.40

3. The effect of the domestic stock of knowledge and the international knowledge spillovers on TFP.

The objective of this study is to analyse the long-term impact of the stock of knowledge, domestic and foreign, measured through the stock of patents, on TFP by taking into account the role played by the particular institutional framework developed after the WWII. To account for the institutional framework, following to Coe et al. (2009), we will analyse how a series of institutional variables, specifically adapted to take into account the arrangements adopted both within and between countries after the WWII, influence the way innovation is incorporated into the economy and its effects over TFP. The question to answer is whether this institutional framework had a differential positive impact on TFP during the Golden Age when compared with the whole period, and whether those set of countries with different degree of development in this institutional framework experienced differences in the relationship between innovation related variables and TFP growth when compared with a reference group of countries (the Anglo-Saxon group).

First, we present the results of the estimation of the three specifications presented in Coe et al. (2009), for the period 1953-2007. The results are reported in Table 2. All specifications are estimated by Chiang (2000) *Dynamic Ordinary Least Squares for Cointegrated Panel Data* method.

In general, the coefficients estimated for the S_d, S_f, H variables are in line with Coe and Helpman (1995) and Coe *et al.* (2009) works. As it can be seen in the basic estimation of the Coe and Helpman (1995) model (see column 1 of table 2), the domestic stock of knowledge, S_d, has a positive and statistically significant effect on TFP. The foreign stock of knowledge, S_f, also has a

significant and positive impact on TFP, but its impact is smaller than the impact of the domestic stock. When we interact the foreign stock of knowledge with the proportion of imports (see column 2), $m \cdot S_f$, the results remain quite stable, although the impact of overseas and domestic stock of knowledge is reduced.

In column (3), we report the results when we also include a variable of human capital, *H*, as a determinant factor on the evolution of productivity (Engelbrencht, 1997). The inclusion of a measure of human capital becomes increasingly important, as the time span is larger. This is so as the measures of human capital for the economically most advanced countries tend to change slowly, but increases significantly for the less advanced countries included in the analysis. For example, Spain had an important inversion in human capital formation since the 1970's . Our results confirm this hypothesis, which indicates that the human capital variable is cointegrated with TFP and with the domestic and foreign stocks of knowledge, and that human capital is an important determinant of TFP. Column (3) shows the results including the logarithm of human capital (H) as an additional explanatory variable. The estimated coefficient for human capital is positive and significant, and it is as important as the coefficient for the variable S_d. Furthermore, we observe that the impact of the stock of foreign knowledge, $m \cdot S_f$, shrinks when we include the stock of human capital.

Finally, and in a way analogous to Coe et al. (2009), in column (4) we include the interaction of the domestic stock of knowledge, the weighted stock of foreign knowledge and the human capital variables with the variable *G7* (which takes on value 1 if the country in question belongs to the *G7* group and 0 otherwise). Similarly to Coe et al. (2009), when the interaction of the *G7* is

included, we get that the coefficient estimated for $G7 \cdot logS_d$ is smaller (with negative sign), indicating that the elasticity of TFP with respect to the variable S_d is lower for the *G7* countries (0.136) and greater for countries that are not part of the *G7* (0.139). Further, the elasticity of TFP with respect to the variable $m \cdot log\ S_f$ is not significant for the countries belonging to *G7* whereas it is positive and significant for countries that are not part of the *G7* (0.043). Finally, the coefficient estimated for $G7 \cdot H$ is larger (with a positive sign) than the corresponding to *H*, indicating that the elasticity of TFP with respect to the variable *log H* is higher for the *G7* countries (0.145) and lower for countries that are not part of the *G7* (0.110)[6], being this difference significant at the 15% level of significance.

Table 2. Foreign knowledge *spillovers*, 1953-2007.

	(1)	(2)	(3)	(4)
log S_d	0.207***	0.192***	0.145***	0.139***
	0.009	0.008	0.008	0.010
log S_f	0.167***	-	-	-
	0.011			
$m \cdot$log S_f	-	0.113**	0.017**	0.043***
		0.053	0.007	0.011
log H	-	-	0.127***	0.110***
			0.007	0.007
G7·log S_d	-	-	-	0.136*
				0.014
G7·m·log S_f	-	-	-	-0.009
				0.010
G7·log H	-	-	-	0.145***
				0.013

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

[6] The difference between G7·logSd and logSd, m·log Sf and G7·m·log Sf and log H and G7·log H are significant at the 15%, 0% and 5% levels of significance, respectively.

After checking that the results of our specifications are similar to those obtained by Coe *et al*. (2009), we take a step further and extend our specifications to include a series of institutional variables: the effect of the quality of the Government, the EU membership and the degree of patent protection.

4. The institutions and the international knowledge spillovers.

Institutions are increasingly viewed as key determinants of TFP and, hence, of economic growth. In this section, we test if the estimated parameters on domestic and foreign stock of knowledge, and on human capital vary among countries according to various proxies for institutions. Thus we seek to account for heterogeneity based on country-specific institutions rather than by estimating country-specific parameters based on limited time-series observations. First, we focus on four institutions that have been emphasized in the literature:

- The Ease of doing business, which is an average ranking of countries according to the ease of doing the following 10 actions: starting a business, dealing with licenses, employing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts, and closing a business (World Bank, 2007).
- The Quality of tertiary education, which is a composite measure of the extent to which tertiary institutions have: freedom to manage resources, including the selection of students, autonomy to decide on the sources and structure of funding, and staff personnel policies; freedom in setting objectives, including deciding on course content; and are accountable, including various types of evaluation (Oliveira Martins et al., 2007).

- The Strength of intellectual property rights, as measured by an index of patent protection (Park and Lippoldt, 2005)
- The Origins of legal systems in French, German, Scandinavian, or English law (La Porta et al., 1999, 2008).

Each of these institutional variables could potentially affect the degree to which domestic and foreign R&D capital affects total factor productivity. In the quality ladders approach, for example, a given R&D effort could result in larger quality improvements in countries where the quality of tertiary education is relatively high since these countries may produce more productive researchers than other countries. Similarly, countries where the ease of doing business is relatively high or intellectual property rights are well protected may encourage more entrepreneurial R&D that results in larger quality improvements for a given R&D effort. Different legal systems may also affect the type or productivity of R&D.

Our institutional variables are broad based, and some of them, like the ease of doing business, consist of averages of more detailed variables. We feel that for our country-level analysis with a sample of 21 countries, broad measures provide the appropriate choice. The effects of finer features of institutional design can possibly be estimated with a large sample of countries, but not with our sample size. For this reason we confine the analysis to the broad-based measure of institutions.

Similarly to Coe *et at.* (2009), we will start with 2 institutional variables that have been used in the literature: ease in doing business and patent protection. Further, we will add as institutional variable pertaining to the EU.

In a second step, new series of institutional variables will be used to better approximate the particular institutional environment developed after the WWII and lasted during the second half of the XXth. The variables we have used to represent the “coordinated capitalism” are: social conflict, job security, social expenditure, trade openness and external liberalization.

Further, we will investigate the extent to which these variables affect TFP by interacting them with the type of country and with the Golden Age period. These institutional variables proxy for the particular institutional framework established in the developed countries after the WWII. Some authors consider that this new institutional order made a difference in the evolution of the European countries and Japan with regard to the US (and the UK). This difference that was positive during the Golden Age easing the technological catch-up with the US, could have turned into a negative influence for innovation and technological progress in the last decades.

Now we explain with details all the institutional variables and the interacting variables we use in our empirical exercise. The first institutional variable we use is a measure on the ease of carrying out business in countries ("The ease of doing business"). In particular, we will use the indicator ICRG ("International Country Risk Guide"). This variable is a measure of the quality of a Government (on a scale of 0-1) calculated by the average value of the variables "Corruption", "Law and order" and "Quality" of the bureaucracy. Higher values indicate better quality of Government. To calculate the indicator ICRG, 22 variables are used in three sub-categories of risk: political, economic and financial. An index for each of the subcategories is calculated first. The political risk index is based on 100 points, the financial risk index on 50-point and the

economic risk on 50 points. To produce weights to include the country in the classification of risk rating, the total number of points of the three indices is divided by two. The scores obtained range from zero to 100. From this score, countries are divided into categories of very low risk (80 to 100 points) to very high risk (zero to 49.9 points). The political risk rating includes 12 variables weighted using both political and social attributes. This variable is similar to the variable "Easy doing business" of the World Bank (2007). To capture the effect of this variable on the coefficients of the determinants of the TFP, we have classified the countries into three groups based on the value of the ICRG indicator: high, medium and low.

The second variable that we use to measure the institutional environment is the intellectual property rights degree of protection, measured by a patent protection index (Park and Lippoldt, 2005).

The third variable is an indicator that accounts for belonging to the European Union (or institutions that preceded, for example the EEC). This institutional variable is probably the variable that best picks up the most important institutional change for European countries during the Golden Age. We believe that given the objective of this study, the EU membership includes many of the possible indicators on institutions: ease of doing business, reduced financial, economic and other risks, etc. This variable has been calculated as a dummy variable taking value 1 from the year in which a country entered the EU.

Each of these institutional variables could affect the degree that domestic and foreign stock of knowledge, and also human capital, affect TFP. As pointed out by Coe *et al.* (2009), in the quality ladders approach, a particular effort in

R&D could result in higher quality improvements in countries where the quality of tertiary education is relatively high since these countries can produce better researchers than other countries. Further, countries where the ease of doing business is relatively high or where intellectual property rights are well protected can stimulate more entrepreneurial activity, what would imply more patenting activity. And this would eventually provide greater improvements on TFP and result in higher rates of growth.

In table 3, we present the results of the estimation for the *Ease of doing business* variable. To facilitate comparisons, the results in the first column are the results for the reference specification (fourth column of table 2). The estimated coefficients for the interaction of the variable "High ICRG" and (domestic and foreign) stock of knowledge are positive and significant. The interaction with the human capital variable is not significant. The interactions of the variable “Low ICRG” with the 3 determinants of TFP are negative and significant. Thus countries where it is relatively easy to do business get greater benefits from their own knowledge efforts, S_d, and from the spillovers of international knowledge, S_f. Countries where it is relatively difficult to make business benefit less by their own domestic knowledge efforts, the spillovers from foreign knowledge and the investment in human capital.[7] These results point out the fact that the different ease of doing business between countries produces considerable heterogeneity in the estimated coefficients.

[7] The coefficients for the interactions associated with the high and low IRCG indicators have to be interpreted in relation to countries with a medium value.

Table 3. The effect of the quality of the Government (*ICRG*), 1953-2007.

	(1)	(2)	(3)	(4)
log Sd	0.145***	0.127***	0.150***	0.145***
	0.008	0.011	0.008	0.008
m·log Sf	0.017***	0.183***	0.002	0.017***
	0.007	0.007	0.012	0.007
log H	0.127***	0.124***	0.128***	0.132***
	0.007	0.007	0.007	0.009
High ICRG·log Sd	-	0.036***	-	-
		0.013		
Low ICRG·log Sd	-	-0.004*	-	-
		0.003		
High ICRG·m·log Sf	-	-	0.016**	-
			0.011	
Low ICRG·m·log Sf	-	-	-0.005***	-
			0.002	
High ICRG·log H	-	-	-	-0.007
				0.009
Low ICRG·log H	-	-	-	0.012
				0.012

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

The second variable we consider is the degree of patent protection. In general, there has been a strengthening of the intellectual property rights in the last few decades in all the countries in our sample, see Figure 6 in Coe *et al.* (2009). As indicated by these authors, in general, the variance between countries is not large, and the increased protection over time has been most pronounced among countries where the protection was initially weaker. In 1971 the rate of patent protection was in average 2.61, on a scale of 1 to 5, and ranged between a minimum of 1.33 in Portugal and a maximum value of 3.83 in United States. In 2004 the average had increased to 4.42 and the range of values has been reduced to a minimum of 3.48 in Iceland and a maximum of 4.88 in United States.

Patent protection is an important determinant for total factor productivity in itself, as shown in the second column of table 4. In addition, patent protection

can also affect TFP through its impact on the stock of domestic knowledge, since it can operate as an incentive for innovators to work in risky projects where the potential profitability is higher. Therefore the strengthening of the protection of patents can result in a social stock of domestic knowledge that has a greater impact on TFP. Our results confirm this hypothesis (see column 2 in table 4), as we obtain that countries where patent protection is relatively greater obtain a higher benefit from their domestic stock of knowledge (the coefficient for the interaction of the protection of patents variable and *log* S_d is positive and significant) and a lower benefit from the foreign stock of knowledge (the coefficient associated with the interaction of the protection of patents variable and $m \cdot log\ S_f$ is negative and significant), as compared to countries where patent protection is relatively weak.

Table 4. The effect of patent protection on TFP, 1953-2007.

	(1)	(2)
log Sd	0.145***	0.105***
	0.008	0.009
m·log Sf	0.017***	0.049***
	0.007	0.013
log H	0.127***	0.088***
	0.007	0.008
Patent protection*log Sd	-	0.008***
		0.002
Patent protection*m·log Sf	-	-0.011***
		0.003
Patent protection	-	0.316***
		0.068

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

Finally, in table 5 we present the results of the interactions of the dummy variable EU with the domestic and foreign stocks of knowledge variables and the human capital variable. The coefficients of the interaction of the EU variable and the (domestic and foreign) stocks of knowledge variables are positive and

significant, while the interaction with human capital is not significant. Therefore, these results indicate that pertaining to the EU reinforces the impact of stocks of knowledge on TFP. We interpret this effect in a similar way to the variable ease of doing business. The EU is an economic and political area where the institutional environment has been developed significantly, improving the conditions for carrying out business by companies. This is reflected both in the domestic knowledge stock variable and on the impact of the foreign knowledge spillovers.

Table 5. The effect of the UE, 1953-2007.

	(1)	(2)	(3)	(4)
log Sd	0.145***	0.145***	0.145***	0.145***
	0.008	0.008	0.008	0.008
m log Sf	0.017***	0.014**	0.014**	0.016***
	0.007	0.007	0.007	0.007
log H	0.127***	0.119***	0.120***	0.132***
	0.007	0.007	0.007	0.008
UE*log Sd	-	0.004***	-	-
		0.001		
UE *m log Sf	-	-	0.003***	-
			0.001	
UE*log H	-	-	-	0.003
				0.005

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

The second group of institutional variables we introduce in our analysis are: social conflict, job security, social expenditure, capital liberalization and trade openness.[8]

In table 6 below we present the results using this set of variables. We report in column (1) the results of our baseline specification. From column (2) to (5) we introduce each variable in turn. The four variables have a positive and

[8] The variable trade openness might be in conflict with the variable $m \cdot logS_f$ and therefore in some specifications we do not include it.

significant effect on TFP. Further, the coefficients for the main variables in our analysis (i.e., *Sd*, *m·Sf* and *H*) remain quite stable and maintain their statistical significance. However, when we introduce the variables job security or social expenditure the variable *m·Sf* loses its significance. Finally, in columns (6) we enter all the above variable altogether. Although the variables *Sd* and *H* still maintain its sign and statistical significance, the coefficient for *m·Sf* reverses its sign. Further, the institutional variables *Social conflict* and *Social Expenditure* are no longer significant.

Table 6. Institutional variables, 1953-2007.

	(1)	(2)	(3)	(4)	(5)	(6)
log S_d	0.145***	0.146***	0.159***	0.148***	0.139***	0.153***
	0.008	0.008	0.007	0.007	0.007	0.007
m·log S_f	0.017**	0.018**	-0.001	0.002	0.012*	-0.005
	0.007	0.007	0.007	0.007	0.007	0.007
log H	0.127***	0.126***	0.088***	0.092***	0.088***	0.053***
	0.007	0.007	0.007	0.009	0.008	0.009
Social conflict	-	0.018**	-	-	-	0.013
		0.009				0.009
Job security	-	-	0.239***	-	-	0.216***
			0.019			0.021
Social expenditure	-	-	-	0.224***	-	0.025
				0.032		0.033
				-		
Capital liberalization	-	-	-		0.206***	0.185***
					0.103	0.023

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

5. Institutional variables and varieties of capitalism

In the following exercise we have grouped the countries according to the Amable (2003) classification of capitalistic economies in five groups[9] (see Table

[9] Following Amable (2003), we classify as: market based economies the United Kingdom and the United States, as social democratic countries Denmark, Norway, Sweden and Finland, as

11): Market-based Anglo-Saxon economies, Social-Democratic model, Continental European model, Mediterranean model, Nordic model and Asian model. To make this classification Amable (2003) considers five fundamental institutional areas: product-market competition; the wage–labour nexus and labour-market institutions; the financial intermediation sector and corporate governance; social protection and the Welfare State; and the education sector. Different economic models are not simply characterized by different institutional forms, but also by particular patterns of interaction between complementary institutions which are the core characteristics of these models.

Since the beginning of the 1990s it has been observed an inferior macroeconomic performance in continental Europe and the remaining models compared to the Anglo-Saxon economies. The non-Anglo-Saxon economies have been alleged to have too rigid markets to adapt their firms to the new international competitive scenario and to react to technological change. More specifically, they find difficulties to generate innovation and to catch-up with the technological change developed by the leading economies, especially the United States[10].

In what follows, we interact the Amable's classification of models of capitalism with the knowledge variables in our analysis. Thus, to interpret the results, we use as reference the group of *Market based* countries. In these

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continental European countries Austria, Belgium, Germany, Ireland, Netherlands and Switzerland, as Mediterranean countries France, Italy, Greece, Portugal and Spain, and as Asian countries Japan. As pointed out by Amable (2003) Canada, Australia and New Zealand are similar to continental European countries and thus we include them in that group of countries.

[10] There is a vast literature that stress the still poor assimilation in Europe of the ICT technologies as compared with the U.S. (Van Ark et al, 2003; Colecchia and Schreyer, 2001; Vijselar and Albers, 2002; Timmer and Van Ark, 2005).;

specifications with interactions, the coefficients for the main variables capture the effect of these variables for the reference category (*Market based* countries) and the interactions coefficients should be added to (if they have a positive and significant value) or subtracted from (should they have a negative and significant coefficient) the base coefficients. In column (1) of table 7 we report the results for the main variables and the country type interactions. In columns 2-4 we add to the first specification the institutional variables.

So, for the stock of domestic knowledge we get a significant and positive effect on TFP (with a value of 14.2%), which corresponds to the effect for the *Market based* countries. This effect is the same for the *Social democratic*, *Continental Europe* and *Mediterranean* groups as none of the interactions with the domestic stock of knowledge is statistically significant. This means that the particularities of the institutional framework do not make a difference in the elasticities of TFP with regard to domestic innovation in the tree groups of European countries with regard to the Anglo-Saxon economies. However, for the *Asian* economies the domestic stock of knowledge has a large, positive and significant effect (64.8%, i.e. 14.2% plus 50.6%). In this case we have to take into account that Japan in the only country included in the Asian group and that this country has exhibited the highest propensity to apply for new patents in the whole sample. We obtain this result even after scaling down the Japan stock of patents to correct this bias introduced by the particularities of the Japan patenting system. This result reflects one of the particularities of the Japan after the WWII such is the articulation of a strong coordination between the government, the academic system and the big corporations conducive to generate an endogenous capacity to innovate (Freeman, 1987).

As regards, the foreign knowledge stock effect, we get a positive and significant effect (4.5%) for the reference group of countries (*Market Based*). This effect gets reinforced for the *Continental Europe* group (the effect is 8.1%), and gets reduced for the *Mediterranean* and *Asian* groups (with effects -17.3% and -18.4%, respectively). The significant and negative sign that we find for some coefficients of the non-Anglo-Saxon countries compared with the market-based economies could be associated with the lower investment in Europe in new technologies as compared with the U.S. and the U.K. that is still too low to generate the spillover effects coming from innovation generated abroad (van Ark and Timmer, 2005). For example, network externalities depend crucially on a critical mass of users of the new technologies and on organizational changes in the firms in order to assimilate the technologies developed by others in their particular environments (Oulton, 2002).

The third variable we include in our specifications is human capital. We get a positive and significant effect for the *Marked based* economies (10.7%). This effect increases both for the Social Democratic and Mediterranean countries (with values 16.1% and 27.8%, respectively). However, the impact of human capital although still positive and significant gets reduced for the Continental Europe (5.0%) and even gets negative for the *Asian* group (-5.4%). In the case of the continental Europe this differences disappears when we include control institutional variables. Again the results are mixed. By the one hand we find that those countries that had made a stronger effort to increase their stock of human capital since the 1950s, measured as average years of schooling, had found higher returns to education, such as the case of the Mediterranean countries. By contrary, those groups of countries with attainment

levels more close to the reference group, such as the Continental Europe do not present any significant difference with the Anglo-Saxon group or it is very weak in the case of the Nordic group.

Table 7. Country classification and institutional variables, 1953-2007.

	(1)	(2)	(3)	(4)
log Sd	0.142**	0.131**	0.125*	0.131**
	0.072	0.066	0.066	0.064
m·log Sf	0.045***	0.065***	0.061***	0.064***
	0.015	0.013	0.014	0.013
log H	0.107***	0.028*	0.021	0.021
	0.017	0.017	0.017	0.016
log Sd·Social Dem.	0.029	-0.004	-0.016	0.003
	0.075	0.069	0.069	0.067
log Sd·Continental E.	-0.067	-0.066	-0.084	-0.098
	0.073	0.067	0.067	0.065
log Sd·Mediterranean	0.088	0.145**	0.148**	0.105*
	0.073	0.068	0.067	0.066
log Sd·Asian	0.506***	0.438***	0.436***	0.398***
	0.096	0.089	0.088	0.086
m·log Sf·Social Dem.	-0.010	-0.054**	-0.058**	-0.069***
	0.024	0.023	0.023	0.022
m·log Sf·Continental E.	0.036**	-0.037**	-0.048***	-0.038**
	0.018	0.018	0.018	0.017
m·log Sf·Mediterranean	-0.213***	-0.214***	-0.225***	-0.200***
	0.030	0.028	0.028	0.027
m·log Sf·Asian	-0.234***	-0.253***	-0.263***	-0.246***
	0.043	0.040	0.039	0.038
log H·Social Dem.	0.054**	0.062***	0.064***	0.077***
	0.022	0.020	0.020	0.020
log H·Continental E.	-0.057***	0.010	0.011	0.014
	0.020	0.020	0.020	0.019
log H·Mediterranean	0.171***	0.128***	0.126***	0.128***
	0.026	0.025	0.024	0.024
log H·Asian	-0.646***	-0.510***	-0.495***	-0.458***
	0.087	0.081	0.080	0.079
Social conflict	-	0.017**	0.019***	-
		0.008	0.007	
Job security	-	0.218***	0.204***	-
		0.020	0.020	
Social expenditure	-	-0.047	-0.033	-0.075**
		0.032	0.035	0.031
Capital liberalization	-	0.208***	0.214***	0.252***
		0.023	0.023	0.023

Trade openness	-	-	0.266***	0.283***
			0.053	0.052
Social conflict 1960-1990	-	-	-	0.006
				0.008
Social conflict rest	-	-	-	-0.036
				0.029
Job security 1970-1990	-	-	-	0.200***
				0.020
Job security rest	-	-	-	0.124***
				0.023

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

In the third exercise we take into account the special period of the Golden Age (see Table 8). For that purpose, we create a dummy variable that accounts for this period and that is interacted both with the main variables (the foreign and domestic stocks of knowledge and the human capital variable) and the institutional variables. In general we get that the Golden Age period reinforces the effects found for the variables of interest and the effects of the institutional variables. In particular, we observe that the effect of the domestic stock of knowledge effect (that is significant and positive, with an effect of 15.2%) increases by 12.2% during the Golden Age period, being the total effect 27.4%. The effect of the foreign stock of knowledge is not significant off the Golden Age period, but turns positive and significant (with an effect of 1.7%) during the Golden Age. Finally, the effect of human capital gets also reinforced by 4.9% during the Golden Age (the effect goes from 2.8% to 7.7%).

As regards the institutional variables, we get that the better the social conflict the higher the effect (positive and significant) on TFP during the Golden Age (this coefficient is not significant outside this period). For the variable job security, we get a positive and significant effect that is reinforced during the Golden Age period (the effect increases from 22.5% to 42.0%). For the social

security index we also get that the variable is significant and positive during the Golden Age (with an effect of 15.5% on TFP), although it was not significant outside this period. The institutional variable capital liberalization, which has a positive and significant effect (13.9%) also gets reinforced during the Golden Age period (being the effect 7.2% larger). Finally, we get that the variable trade openness, with a positive and significant effect on TFP, does not have an extra effect during the Golden Age.[11]

Table 8. Institutional variables and the Golden Age, 1953-2007.

log Sd	0.152***
	0.080
m·log Sf	0.009
	0.009
log H	0.028**
	0.011
log Sd·Golden Age	0.122***
	0.008
m·log Sf·Golden Age	0.017**
	0.008
log H·Golden Age	0.049***
	0.009
Social conflict	-0.002
	0.009
Job security	0.225***
	0.029
Social expenditure	-0.024
	0.038
Capital liberalization	0.139***
	0.055
Trade openness	0.116**
	0.030
Social conflict·Golden Age	0.043**
	0.017
Job security·Golden Age	0.195***
	0.026
Social expenditure·Golden Age	0.155***
	0.045

[11] However, it is probable that the effect of this variable is captured in the interaction of imports and foreign stock of knowledge.

Capital liberalization·Golden Age	0.072***
	0.067
Trade openess·Golden Age	0.330
	0.030

Note: ***, **, **, mean significant at 1%, 5% and 10%, respectively.

4. Conclusions

This study compares the relationship between TFP and innovation-related variables (domestic stock of knowledge, imports of knowledge, and human capital) for 21 OECD countries between 1953 and 2007 after controlling for specific institutional characteristics. To conduct our analysis we use the same econometric approach as Coe, Helpman and Hoffmaister (2009), but taking into account a new set of institutional variables. The new set has been specifically tailored to measure the post WWII institutional framework characterized by the development of the Welfare State and by an increasing exposure of countries to international competence.

These selected variables let us to proxy the particular institutional environment opened after WWII which has been called “coordinated capitalism” (Eichengreen, 2007). Some authors consider that these new institutional order has marked a difference in the evolution of the European countries and Japan with regard to the US (and the UK). This difference that was positive during the Golden Age easing the technological catch-up with the US, could have turned into negative for innovation and technological progress in the last decades. The variables we have used to represent the “coordinated capitalism” are social conflict, job security, social expenditure, openness and external liberalization.

We have estimated several sets of econometric specifications. First, we have entered in the analysis the same set of institutional variables than Coe, Helpman and Hoffmaister (2009): the ease of doing business, the quality of tertiary education, the strength of intellectual property rights and the origins of legal systems (French, German, Scandinavian, or English law). The results confirm that countries where it is relatively difficult to make business benefit less by their own domestic knowledge efforts, the spillovers from foreign knowledge and the investment in human capital. Countries where patent protection is relatively greater obtain a higher benefit from their domestic stock of knowledge and a lower benefit from the foreign stock of knowledge, as compared to countries where patent protection is relatively weak. Therefore, these results indicate that pertaining to the EU reinforces the impact of stocks of knowledge on TFP.

Second, we deal with the set of institutional variables representative of the "coordinated capitalism" developed after WWII by estimating the differential impact of innovation related variables over productivity during the Golden Age when compared with the whole period 1953-2007. In general, we get that those variables with a positive effect on TFP find their effect reinforced during the Golden Age. The better the social conflictivity, the higher the positive effect on TFP during the Golden Age (this coefficient is not significant outside this period). For job security, we get a positive and significant effect that is reinforced during the Golden Age period. For the social security index we also get that the variable is significant and positive during the Golden Age, although it was not significant outside this period. Capital liberalization, which has a positive and significant effect, also gets reinforced during the Golden Age

period. Finally, we get that the variable trade openness, with a positive and significant effect on TFP, does not have an extra effect during the Golden Age.

Third, when countries are grouped according to their similarities in the set of institutions representative of the post-war framework (Amable, 2006), we find significant differences among them. In general, there are not significant differences between the different groups and the market oriented economies with regard to the elasticity of TFP to indoors innovation, with the exception of Japan where this impact is huger. However, the results suggest that in Anglo-Saxon market oriented economies, international spillovers have a higher impact on TFP than in the rest of European economies and Japan. This means that economies more opened to international competition are more sensitive to innovation developed abroad because they have to compete with foreign producers and because the improvements in product quality developed by others will be embodied as inputs in the domestic production processes.

Additionally, the elasticity of TFP to human capital tends to be higher in the Mediterranean and Nordic economies than in the market-oriented and Continental European economies. Possibly this result is biased by the way of measuring the human capital variable, such as average years of school. The reason is that this variable has increased more in the Mediterranean economies since the WWII because they started the period from a lower level than the rest the countries. In the case of Japan this variable exhibits a high negative coefficient, possibly to counterbalance the high positive effect of domestic knowledge.

The results of our study highlight some noticeable differences in the way knowledge-related variables influenced overall productivity in countries with different combinations of institutions. Current technologies are highly intensive in knowledge and European countries must confront the stagnation in their overall productivity levels by reinforcing the ways knowledge in entered in the economy. For this reason, efforts in education have demonstrated to be effective in incrementing the TFP, but possibly it would be necessary to go on with the efforts to upgrading workers until to reach levels similar to the U.S. and the U.K. Similarly, the weak point of the non-market economies is their low elasticity with regard to international spillovers of technology and more effort should make to ease the arrival of innovation developed abroad.

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