SOCIAL CAPITAL AND KNOWLEDGE SPILLOVERS: IS SOCIAL CAPITAL THE FORCEMAJEURECONTROLLING EU COHESION?

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Abstract - The paper contributes to scholarly debate on impacts of social capital on total factor productivity. Earlier studies employed rather narrow meaning of social capitaland came to ambiguous conclusions. Our approach is to employ a composite indicator of social capital – KOFsoc launched by ETH Zürich that appears to lead to robust estimates in growth regressions and assume that social capital captures spillover effects unfoldedthrough knowledge networks. On the EU panel data spanning 1995 through 2010 our estimations suggest that social capital indeed accounts for large variation in the total factor productivity, and that the effects are larger for countries lagging in knowledge capacities.

Key Words - social capital, total factor productivity, European Union, knowledge spillover, endogenous growth
JEL:O3, R1

I. INTRODUCTION

Current literature exhibits vast amount of evidence that the key essence to economic growth – total factor productivity (TFP) – aligns well with the knowledge capitalvolumes (Griliches, 1979; Fischer et al., 2009). Knowledge capital formation however appears to be still some sort of mystery. Most commonly, scholars accentuate the role of prior knowledge and human capital (Jones, 1995). More recent studies argue that most knowledge is born within networks (De Noni et al., 2017).Networks give access to the pool of knowledge and facilitate learning. The impact of so called knowledge spillovers appears to bequite sizeable (Jaffe, 1986; Kemeny, 2010). Commonly, the network might be delineated geographically (Bottazzi and Peri, 2003; Puskarova and Piribauer, 2016), or alongside international flows of goods, investments or labor (Krammer, 2014).In any case, knowledge dissolution is subject to social ties (Fagerberg et al., 2010), and we assume that this network effect might fit conveniently under the roof of social capital concept.

In order to justify this assumption, we follow upon the scholarly work on social capital. Scholars view social capital as combination of trust, values and communication (Putnam, 1993; Akçomak and ter Weel, 2009). Just right, the scholars point to the trust and communication as the key features of networks that determine network productivity. Asset holders opt for ventures where they trust the executive board (De Noni et al., 2017). Akcomak and ter Weel (2009) suggest that trust materializes in informal norms that help to prevent egoistic behaviour, as well as in lower monitoring costs and higher capital accumulation. In addition, Ishise and Sawada (2009) showed that the elasticity of aggregate producton social capital is rather sizeable. Some scholars see the link attributable to strong institutions (Acemoglu et al., 2014).Last but not least, empirical studies point to the striking evidence that in the European Union (EU) the delineation of social regimes (Esping-Andersen, 1990) aligns well with the different patenting volumes. Historically entrenched elements of social capital standing behind social regime concept and productivity thus might be inextricably linked. (Puškárová, 2013).

The structure of our paper is as follows: In the following section we demonstrate the model and data handling. The third section reports on the estimation results and robustness checks, and the final section summarizes the key findings of the paper.

II. MODEL

Our model draws on the augmented Cobb-Douglas functionintroducedby Krammer (2014):

$$Y = Ae^{\lambda}L^{\alpha}K^{1-\alpha}DRD^{\psi}FRD^{\varphi} \quad (1)$$

where Y stands for aggregate output in the economy, λ is the rate of external technological change, A is the constant,L and K stand for labour and physical capital respectively.DRDdenotes domestic, and FRD foreign research and development performance. ψ and φ are elasticities of aggregate output on DRD and FRD respectively.

Resolving the equation for total factor productivity (TFP) as a measure of impact of efficiency gains and technological improvements, andtaking logarithms gives us the following equation form:

$$\ln TFP = \lambda + \psi \ln DRD + \varphi \ln FRD \quad (2)$$

Following Jaffe (1995), we letDRDbe a function of human capital (HC) and research and development (RD), and we add social capital (SC) as the additional explanatory term – Eq. (3a).Following knowledge spillover literature (Krammer, 2014), we let FRD be a function of imports (IMP) and foreign direct investments (FDI), and yet again we add social capital – Eq. (3b). Combining Eq. (3a) and Eq. (3b)

with Eq. (2), we arrive to our baseline model - Eq. (4):

$$\ln DRD = \eta_{it} + \psi_1 \ln HC_{it} + \psi_2 \ln RD_{it} + \psi_3 \ln SC_{it} + \vartheta_{it} \quad (3a)$$

$$\ln FRD = \theta_{it} + \varphi_1 \ln FDI_{it} + \varphi_2 \ln IMP_{it} + \varphi_3 \ln SC_{it} + \omega_{it} \quad (3b)$$

Combining Eq. (3a) and Eq. (3b) with Eq. (2), we arrive to our baseline model - Eq. (4):

$$\ln TFP = \lambda_{it} + \beta \ln SC_{it} + \psi_1 \ln HC_{it} + \psi_2 \ln RD_{it} + \varphi_1 \ln FDI_{it} + \varphi_2 \ln IMP_{it} + \tau_{it} + \varepsilon_{it} \quad (4)$$

where λ_{it} is a country specific intercept; τ_{it}represents the random effects, and ε_{it} is an i.i.d. error term. We decided to relax on fixed effects as various scholars suggest them producing non-robust estimates (Hall and Ahmad, 2013).β represents the combination effect of social capital for domestic knowledge formation $\psi_2$and effects of social capital on imports of knowledge φ_2.

HCis represented in our estimations by mean years of schooling taken from World Bank Database. RD is measured as gross domestic expenditures on research and developmentper capita in Euros withdrawn from Eurostat database. FDI stock and import volumes were taken from Eurostat in PPP fixed 2010 volumes.

Social capital represents an abstract and comprehensive concept (Putnam, 1993). Thus, finding a single proxy is rather challenging. Scholars most commonly use various trust and communication questions from Eurobarometer, European Social Survey, European Values and World Values Survey as an aggregated response to the question "Are most people to be trusted?". Even though nominal trust values may demonstrate the disparities between the countries, they fail to work as reliable proxies for econometric operations (Hall and Ahmad, 2013). Alternatively, scholars employ the usage of internetor phone lines as proxies of social capital and argue that communication brings us closer to other people and helps to discard cultural differences. However, communication proxies may be endogenous to FDI and import variables (Hall and Ahmad, 2013). Our approach is to rely on a recently deployed composite indicator that appears to work robustly in growth regressions – KOF index of globalisation (Potrafke, 2015). It has the usual cons of composite indicators but conveniently, it covers all social capital dimensions.

We bring our model to the data on 28 EU countries complemented by 2 EFTA countries (Norway, Switzerland) and 3 EU candidates (Iceland, Macedonia, Turkey). We run the estimations separately for Western European Countries (west) and Eastern EU (east) in order to compare the path dependencies that might still be traced in post-communist countries. The rest of the variability in countries' formal institutions and capital markets shall be captured by constant terms, random or fixed-effects estimator.

III. RESULTS

All estimations were performed using Stata package for panel data estimation. Following Table 1, our estimations lend support to rather large role of social capital for cross-country and yearly differences in total factor productivities across Europe. Our results adhere to the magnitude and direction of earlier estimates on the impact of imports and foreign direct investments on TFP (Krammer, 2014; Puškárová and Gurníková, 2013). The impact of human capital is positive and sizeable. The impact of domestic research and development expenditures appears negligible what might come as no surprise considering that the return to research and development investments is volatile and stretches over time.

In order to shed more light on the role of social capital, we introduced also the interaction terms of social capital with the other explanatory variables. Our results suggest that the impact of social capital is to significant extent subject to foreign investments – the impact increases from 0.58 to 0.846. That comes as no surprise. In reality, investments are prompted by trust and communication, and knowledge formation is dependent on investments.

Table 1. Baseline model estimation, EU+ countries, 1995-2010, 2SLS

	model-1	model-2	model-3	model-4	model-5
SC	**0.587*** **	**0.586*** **	**0.584*** **	**0.582*** **	**0.846*** **
	(9.66)	**(9.72)**	**(9.75)**	**(9.80)**	**(9.03)**
FDI	*0.0703*** **	*0.0790*** **	*0.0679*** **	*0.0765*** **	*0.546*** **
	(8.81)	*(9.42)*	*(8.63)*	*(9.27)*	*(4.19)*
IMP	0.198*** **	0.205*** **	0.186*** **	0.194*** **	0.200*** **
	(6.16)	(6.23)	(5.88)	(6.03)	(6.28)
HC			0.0949*** **	0.0933*** **	0.0982*** **
			(3.59)	(3.61)	(3.84)

RD			-0.0007*** (-4.76)	-0.0007*** (-5.10)	-0.0006*** (-4.04)
SC x FDI					***-0.109*** (-3.61)***
C	-0.617* (-2.43)	-0.568* (-2.23)	-0.823*** (-3.14)	-0.758*** (-2.90)	-1.911*** (-12.90)
N	485	449	483	447	447

Notes: the dependant variable is TFP. *, **, and *** indicate parameters that are significant at 10%, 5% and 1% level respectively; standard errors are reported in parentheses, all estimated models contain random effects and use white standard errors; C denotes constant; robustness checks available on demand.

Table 2. Baseline model estimation, Western vs.Eastern EU+countries, 1995-2010, 2SLS

	all	*east*	*west*	*all*	*east*	*west*	*all*	*east*	*west*	*all*	*east*	*west*	*all*	*east*	*west*
FDI	0.0703*** (8.81)	0.0997*** (7.57)	0.0454*** (7.17)	0.0790*** (9.42)	0.106*** (7.61)	0.0528*** (8.08)	0.0679*** (8.63)	0.0953*** (7.46)	0.0432*** (6.82)	0.0765*** (9.27)	0.102*** (7.49)	0.0513*** (7.86)	0.0409*** (3.62)	-0.0210 (-1.42)	0.0168* (2.05)
IMP	0.198*** (6.16)	0.378*** (7.50)	0.0830** (3.11)	0.205*** (6.23)	0.329*** (6.52)	0.114*** (4.20)	0.186*** (5.88)	0.361*** (7.41)	0.0811*** (3.07)	0.194*** (6.03)	0.318*** (6.47)	0.111*** (4.08)	0.0919* (2.42)	0.0591 (1.30)	0.00382 (0.13)
RD				-0.0007*** (-4.76)	-0.00004 (-0.15)	-0.0006*** (-4.50)				-0.0008*** (-5.10)	-0.0002 (-0.68)	-0.0006*** (-4.47)	-0.0009*** (-5.76)	-0.0006** (-3.15)	-0.0004** (-3.43)
HC							0.0949*** (3.59)	0.154*** (4.00)	0.0583* (2.47)	0.0933*** (3.61)	0.130*** (3.45)	0.0489* (2.09)	0.0710** (2.75)	0.0618* (2.17)	0.0361 (1.72)
SC	**0.587*** (9.66)**	**0.503*** (5.35)**	**0.204*** (3.53)**	**0.586*** (9.72)**	**0.561*** (6.17)**	**0.206** (3.25)**	**0.584*** (9.75)**	**0.532*** (5.81)**	**0.195*** (3.39)**	**0.582*** (9.80)**	**0.572*** (6.45)**	**0.200** (3.17)**	**0.476*** (7.66)**	**0.248*** (3.36)**	**-0.0824 (-1.32)**
SC '96													-0.0098	0.0095	0.019
SC '97													0.0147	0.0661*	0.0388***
SC '98													0.0109	0.0925***	0.0538***
SC '99													0.0241	0.1160***	0.0701***
SC '00													0.0313	0.1550***	0.0882***
SC '01													0.0368	0.1860***	0.0790***
SC '02													0.0610**	0.2390***	0.0860***
SC '03													0.0744***	0.2640***	0.0943***
SC '04													0.0874***	0.3060***	0.1060***
SC '05													0.0991***	0.3320***	0.1210***
SC '06													0.1110***	0.3750***	0.1280***
SC '07													0.1150***	0.3950***	0.1370***
SC '08													0.1120***	0.3900***	0.1220***
SC '09													0.0700**	0.3420***	0.0787***
SC '10													0.0783**	0.3580***	0.0967***
C	-0.617* (-2.43)	-0.524 (-1.40)	1.267***(4.94)	-0.568* (-2.23)	-0.822* (-2.25)	1.352*** (4.87)	-0.823** (-3.14)	-0.994* (-2.58)	1.180*** (4.60)	-0.463 (-1.24)	-1.152** (-3.09)	1.266*** (4.55)	-0.259 (-0.92)	0.406 (1.27)	2.446*** (8.68)
N	485	213	272	449	203	246	483	211	272	447	201	246	447	201	246
R^2	0.6235	0.7506	0.4736	0.6504	0.7660	0.5270	0.6278	0.7635	0.4861	0.6542	0.7738	0.5361	0.7002	0.8955	0.7008

Notes: the dependant variable is TFP; eastdenotes eastern EU countries, west denotes western EU countries; *, **, and * indicate parameters that are significant at 10%, 5% and 1% level respectively; standard errors reported in parentheses below the coefficients, all estimated models contain random effects and use robust standard errors; robustness checks on demand.**

We further decided to limit our estimations to western countries of the European Union being those who entered the EU up till 2004, and the rest EU+ members. Table 2 suggests that the impact of social capital in the eastern part of the EU is much larger – almost triple – the impact in the western part. Moreover, from the last column in Table 2 we read that the impact of social capital has increased sizeably over the years what corresponds with the accelerating pace of globalization and booming impact of knowledge transmission through networks. The estimations were subject to various robustness checks (on demand).

Further, we tested the reliability of our measure of social capital against alternatives, namely trust, number of network connections, and number of phone lines. The results are listed in Table 3.It appears that the volume of internet connections as well as trust work quite well for our model even though the average impact is rather limited compared to the estimates of KOFsoc estimated effects. Phone lines turn out insignificant. It comes clear that productivity-relevant communication runs nowadays online rather than on the phone. Drawing upon assumption that social capital is closely linked to social regime (Esping-Andersen, 1990) and social inequality, we re-estimated the model also with Gini coefficient, and the results suggest that, in fact, social capital generated through equal distribution of income might contribute to TFP formation quite extensively – 0.142. Our measure of social capital – kofsoc appears to explain the variation in TFP the best out of all the measures taken.

Table 3. Model estimation using fixed effects, EU+ countries, 1995-2010, 2SLS estimator

	model-6	model-7	model-8	model-9	model-10	model-11	model-12
SC - trust	**.0333*** **						
	(9.69)						
SC - phone		**0.0198**	**0.0049**				
		(0.71)	**(0.18)**				
SC - net				**0.0488*** **	**0.0492*** **		
				(10.56)	**(10.98)**		
SC - gini						**0.170** **	**0.142** **
						(3.19)	**(2.62)**
IMP	.1479***	0.194***	0.223***	0.0802*	0.0981**	0.138***	0.155***
	(6.98)	(5.47)	(6.16)	(2.42)	(2.95)	(4.04)	(4.44)
FDI	.1397***	0.108***	0.114***	0.0302**	0.0361***	0.0673***	0.0766***
	(15.15)	(14.26)	(13.63)	(3.11)	(3.67)	(7.14)	(7.15)
HC		0.0751*	0.0742*	0.0312	0.0353	0.0596	0.0524
		(2.55)	(2.57)	(1.19)	(1.41)	(1.83)	(1.63)
RD	-.0008***		-0.0008***		-0.0009***		-0.0005**
	(-9.56)		(-4.86)		(-6.11)		(-2.90)
C	1.614***	0.935*	1.686***	1.751***	1.821***	1.223***	1.360***
	(13.45)	(2.49)	(12.16)	(23.65)	(25.03)	(6.25)	(6.85)
N	298	239	438	237	436	336	325
R^2	.6813	0.5724	0.5755	0.6442	0.6662	0.4000	0.4255

Notes: the dependant variable is TFP. *, **, and * indicate parameters that are significant at 10%, 5% and 1% level respectively; standard errors are reported in parentheses below the coefficients, all estimated models contain random effects and use white standard errors; C denotes constant term; robustness checks available on demand.**

Concluding remarks

Our estimations shed new light on the role of social capital in endogenous growth in general and knowledge formation in particular. The effects of social capital are clearly subject to measures taken for a particular study. Traditionally employed indicators of trust or network communication appear to represent social capital insufficiently. Our approach to take a composite indicator of social effects of globalization renders estimates of higher magnitude, particularly for Eastern European countries where the domestic knowledge formation through patenting is low. In fact, social capital appears to be the key essence of catch-up trajectories of Eastern EU countries towards the Western. Thus, our study calls for reinforcement of strategies supporting social capital, but more so the combination of social capital and participation in global value chains as it is the combination of the two that might unfold far larger positive effects on local economies.

Our estimations adhere also to the long list of evidence on knowledge spillovers channelled through imports and foreign direct investments that stand behind most of the total factor productivity increases in the "new" EU countries.

REFERENCES

[1] ACEMOGLU, D.; GALLEGO, F.; ROBINSON, J.A. 2014. Institutions, Human Capital and Development. NBER Working Paper No. 19933, February 2014. Available at:<http://www.nber.org/papers/w19933>.

[2] Akçomak, I.S.;Ter Weel, B. 2009. Social capital, innovation and growth: Evidence from Europe. European Economic Review,Vol. 53, Iss. 5, pp. 544-567.

[3] BOTTAZZI, L.; PERI, G. 2003. Innovation Spillovers in Regions: Evidence from European Patent Data. European Economic Review, Vol. 47, No. 4, pp. 687-710.

[4] DE NONI, I.; GANZAROLI, A.; ORSI, L. 2017. The impact of intra- and inter-regional knowledge collaboration and technological variety on the knowledge productivity of European regions. Technological Forecasting and Social Change, Vol. 117, pp. 108-118.

[5] ESPING-ANDERSEN, G. 1990. The three worlds of welfare capitalism. Princeton University Press. ISBN 978-0-691-02857-6.

[6] FAGERBERG, J.; SRHOLEC, M.; VERSPAGEN, B. 2010. Innovation and Economic Development. In

HALL, B.; ROSENBERG, N. (Eds). Handbook of the Economics of Innovation – Volume 2. North-Holland: Elsevier, pp. 833-872. ISBN 978-0-444-53609-9.

[7] FISCHER, M.M.; SCHERNGELL, T.; REISMANN, M. 2009. Total factor productivity effects of interregional knowledge spillovers in manufacturing industries across Europe. Geographical Analysis, Vol. 41, pp. 204-220.

[8] GRILICHES, Z. 1979. R&D and the productivity slowdown. American Economic Review, Vol. 70, pp. 343-348.

[9] HALL, S.G.; AHMAD, M. 2013. Can Trust Explain Social Capital Effect on Property Rights and Growth? Procedia Economics and Finance,Vol. 7, pp. 55-64.

[10] ISHISE, H.; SAWADA, Y. 2009. Aggregate returns to social capital: Estimates based on the augmented augmented-Solow model. Journal of Macroeconomics, Vol. 31, No. 3, pp. 376-393.

[11] JAFFE, A.B. 1986. Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits, and market value. American Economic Review, Vol. 76, Iss. 5, pp. 984-1001.

[12] JONES, C.I. 1995. R&D-Based Models of Economic Growth. Journal of Political Economy, Vol. 103, Iss. 4, pp. 759-784.

[13] KEMENY, T. 2010. Does Foreign Direct Investment Drive Technological Upgrading? World Development, Vol. 38, Iss. 11, pp. 1543–1554.

[14] KRAMMER, S. 2014. Assessing the relative importance of multiple channels for embodied and disembodied technological spillovers. Technological Forecasting and Social Change, Vol. 81, pp. 272-286.

[15] POTRAFKE, N. 2015. The Evidence on Globalization, The World Economy, Vol. 38, Iss. 3, pp. 509-552.

[16] PUŠKÁROVÁ, P.; GURNÍKOVÁ, J. 2013. The research and development performance of various EU social regimes. Comparative Economic Research, Vol. 4, pp. 23-38.

[17] PUŠKÁROVÁ, P.; PIRIBAUER, P. 2016. The impact of knowledge spillovers on total factor productivity revisited: New evidence from selected European capital regions. Economic Systems,Vol. 40, Iss. 3, pp. 335-344.

[18] PUTNAM, R.D. 1993. The Prosperous Community: Social Capital and Public Life. The American Prospect, Vol. 13, pp. 35-42.

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