

ECONOMIC AND BUSINESS REVIEW

VOLUME 20 | NUMBER 2 | 2018 | ISSN 1580 0466

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PUBLISHERS:

Faculty of Economics,

Kardeljeva ploščad 17, SI-1001 Ljubljana, Slovenia.

The review is co-financed by Slovenian Research Agency.

URL: <http://www.ebrjournal.net>

THE REVIEW'S OFFICE:

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Bound by Birografika Bori d.o.o., Ljubljana

Printed by Copis d.o.o., Ljubljana

Economic and Business Review is indexed in: AJG, Cabell's Directory of Open Access Journals Publishing Opportunities, DOAJ, Ebsco, Econlit, IBSS and ProQuest

ISSN 1580-0466

e-ISSN 2335-4216

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A REVIEW OF THE EMPIRICAL EVIDENCE ON PWYW PRICING

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Received: March 15, 2017
Accepted: January 8, 2018

ABSTRACT: *The purpose of the paper is to review recent studies on Pay-What-You-Want (PWYW) pricing and to identify research gaps in the recently mushrooming literature on the topic. We examine a total of 53 empirical studies published between 2009 and 2016. In contrast to previous reviews we classify the research according to the type of study, i.e., the applied research methodology. That is why we discuss separately laboratory experiments, field experiments, survey experiments and case studies. Based on this descriptive review we identify the following two gaps in the study on PWYW pricing: (1) studies on PWYW pricing for high cost goods, and (2) studies on the long-term effects of PWYW pricing.*

Keywords: *Pay-What-You-Want, PWYW, pricing mechanism, review, empirical studies*

JEL: C90, D12, D49, M21, M30

DOI: 10.15458/85451.64

1. INTRODUCTION

Pay-What-You-Want (PWYW) is a participative pricing mechanism (Chandran and Morwitz 2005, Natter and Kaufmann 2015), which leaves the pricing decision with the buyer. In contrast to other participative pricing mechanisms, like name-your-own-price (NYOP, see Spann, Skiera and Schäfers 2004, Spann and Tellis 2006), a buyer can choose any price (including zero) and the seller has to accept this price.

PWYW can be considered as a special form of voluntary market payments, which have been discussed before (e.g., the literature on tipping, Azar 2004, 2007). What distinguishes PWYW from other forms of voluntary market payments is that PWYW is used for goods and services, which are usually sold employing fixed or posted prices (e.g., music, restaurant meals, drinks, entertainment activities), and that the sellers who use PWYW compete with sellers who use fixed pricing (Chao, Fernandez and Nahata 2015; Gerpott and Schneider 2016).

PWYW pricing has recently received considerable attention in the management, business, and economics literature. There have been a sizeable number of empirical studies on

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PWYW pricing, and in this paper, we present a review of empirical studies on PWYW pricing published between 2009 and October 2016. In particular, we review empirical studies on PWYW pricing which report data generated in laboratory experiments, field experiments, survey experiments and case studies (see additionally Krzyżanowska and Tkaczyk 2016). In contrast to other recent reviews (Gerpott 2017), we include also studies that report findings from experimental settings.

The primary purpose of the paper is to structure recent research with respect to the different types of studies conducted. We thus distinguish between four methodological approaches: laboratory experiments, field experiments, survey experiments, and case studies. We differentiate between these four types of studies because results of PWYW mechanisms depend on the applied methodology, hence also the subjects on which data has been gathered. The result from our systematic comparison of 53 studies allows us to learn which effects are robust. Furthermore, certain authors report on different types of studies and apply different methodologies in one paper. So the descriptive review helps to disentangle these peculiarities. The second aim of the paper is to identify gaps in recent studies on PWYW pricing that are independent from the type of methodology, i.e. to identify topics that require additional research in order to obtain a more comprehensive answer to the question when PWYW is a suitable pricing mechanism and when it is not.

We find that (1) PWYW is used almost exclusively for low-cost goods, experience goods, and for bundles of goods and services, and that (2) almost all empirical studies focus on relatively short time periods. Based on our review, we identify some unanswered questions and suggest directions for further research.

This paper is structured as follows. In section 2, we review the empirical literature on PWYW pricing and summarize our findings in four tables. In section 3 we address topics which have not been dealt with in detail but which are relevant for sellers if PWYW is put into practice. In section 4, we conclude.

2. THE EMPIRICAL LITERATURE ON PWYW PRICING

2.1 Categorization of Empirical Studies

The first paper that explicitly addresses PWYW pricing, to our knowledge, is Kim, Natter and Spann (2009). Since this publication, the literature on PWYW has received considerable attention. In Tables 1 to 4 we summarize the results of the empirical studies on PWYW pricing published in the English language in journals in Economics and Business Administration between 2009 and October 2016. These studies have been collected from various scientific databases, such as JSTOR, EconLit, EBSCO, Scopus, Science Direct, ResearchGate and Google Scholar. We selected papers that included the keywords or acronyms such as Pay-What-You-Want, PWYW, Pay Your Own Price, voluntary pricing and that were empirical in nature. We excluded the related but distinguished topic of voluntary contributions to public good provisions because our focus is on private not on

public goods. An initial search was conducted in 2014, followed by repeated sampling in 2015 and finally in October 2016. The advantage of this repeated sampling was that papers which were initially identified as working papers could be included in this review in their form as published journal articles. To avoid publication bias, we also include relevant working papers that have not been published as journal articles yet.

In contrast to another recent review (Gerpott 2017), we decided to look at individual studies (case studies, experiments, etc.) instead of papers. This is because several papers report results from more than one study. We classify the empirical studies into four categories: laboratory experiments, field experiments, survey experiments, and case studies. We include in the review 5 laboratory experiments, 16 field experiments, 26 survey experiments and 6 case studies. We exclude in this review recent experiments in neuroscience that record functional magnetic resonance imaging data in a PWYW decision (Waskow et al. 2016). In laboratory, field and survey experiments the researcher has full control over the design of the experiment and makes use of random assignment of individual subjects to one or more treatments.

Laboratory experiments take place in an environment over which the researchers has complete control (e.g., a university's laboratory). All laboratory experiments on PWYW pricing are incentivized, i.e., the subject's compensation depends on her choices. In all laboratory experiments the subjects are students.

Field experiments are similar to laboratory experiments, except that they are run in the field. An example is Kim, Kaufmann and Stegemann (2014), who have designed an intervention in the field and ran their treatments at two comparable shopping malls. Hence, in field experiments in contrast to laboratory experiments, the researcher has less control. A survey experiment embeds the experimental design within a survey (e.g., a factorial survey or a survey based on vignettes). Usually, the survey consists of hypothetical purchase scenarios, and each subject responds to one or more scenarios. Survey experiments are easy to administer and, usually, they are computer or internet-based. This allows the researcher to generate a large number of observations within a short period of time. In contrast to laboratory and field experiments, in survey experiments there is no strategic interaction between subjects and the researcher has no control once the experiment has started. Involvement might not be as emotionally intense as it is the case in laboratory and field experiments (Collett and Childs 2011), and, usually, there are no financial incentives linked to the subjects' decisions. In most survey experiments, the subjects are undergraduate students who complete the survey for partial or extra course credit.

In a case study, there is no controlled intervention by the researcher since a case study is an observational study. While in field experiments, the researcher chooses the intervention (i.e., use of PWYW pricing), in case studies the seller choose PWYW pricing and allows the researcher to use the data on sales, revenue, prices, etc. Self-selection is an issue because unsuccessful sellers are driven out of the market (see Kim, Natter and Spann 2010, 152) so that only sellers who use PWYW for short periods and sellers who use PWYW successfully over longer periods are observed.

2.2 Main Results from our Review

Table 1 summarizes the laboratory experiments. For each laboratory experiment, we sketch the design and summarize the main findings. In one of the studies (Machado and Sinha 2013), real products were sold to students and the latter had to fill out a questionnaire regarding their payment motivations. We decided to categorize this experiment as laboratory experiment because the context in which the purchase took place was controlled by the researchers. Although subjects can differ in their valuations for the products, this should not bias the results because subjects are randomly allocated to the different conditions. In the other four laboratory experiments, subjects trade hypothetical goods, for which the value is induced (see Smith 1976), so that, in contrast to Machado and Sinha's laboratory experiment, students' true valuations are controlled. The goal of these studies is not to identify the motives that drive payments. Rather, the goal is to investigate the effect of market structure (Krämer et al. 2015, Schmidt, Spann and Zeithammer 2014, also Tudon 2015) and the strategic interaction between multiple buyers and a seller (Mak et al. 2015).

Table 2 summarizes the field experiments. For each field experiment, we present the experimental design, type of product, payments, duration of the PWYW intervention and the main findings. We use the following acronyms for referring to the types of products most frequently investigated: experience goods (EG), digital goods (DG) which always have quasi zero marginal cost, goods with low marginal cost (LMC). If not indicated otherwise, payments refer to mean PWYW payments. What sticks out is that in the field experiments, PWYW is applied to low-value items and over short periods of time. The highest PWYW payments are payments for a day at a golf resort (\$22.95, Machado and Sinha 2013), and payments for a photo portrait (€16.12 » \$17.40, Kim, Natter and Spann 2014). In all other field experiments, average PWYW payments are below \$10, and in many cases they are even lower than one dollar.

Gautier and van der Klaauw (2012) provide interesting results because they find evidence for self-selection. Guests, who booked a hotel stay under PWYW pricing in advance, pay significantly less in comparison to hotel guests, who have booked the hotel stay at regular conditions, but whom are given the chance to PWYW. A convincing interpretation is that PWYW campaigns of hotels attract buyers whose willingness to pay (WTP) is comparatively low. However, Gautier and van der Klaauw (2012) also report that while the campaign is successful in the sense of increasing capacity utilization for unfavorable days, PWYW is not a feasible long-term strategy as the share of those guests who have little concern to pay anything may increase.

Most field experiments last only for a couple of days. Schons et al. (2013) and Gravert (2014) stick out because they analyze repeated purchases. In Schons et al. (2013), buyers' repeated purchases are observed over 8 weeks, and it is found that, at the individual level, prices decrease over time. Similarly, Gravert (2014) finds that payments decrease from the first to the second purchase.

Table 3 summarizes the survey experiments. For each survey experiment, we summarize data on payments, type of product, experimental design and main findings. In comparison with the field experiments, it becomes apparent that in survey experiments, PWYW payments for higher-value products are also analyzed. The most expensive product is a mobile phone, with estimated production cost of \$472 (according to subjects' estimations).

It should be noted that most survey experiments are based on hypothetical decisions, which might result in subjects overstating the prices they would pay (Harrison and Rutström 2008, Murphy et al. 2005). Such a hypothetical bias might not be a problem if one only looks at treatment differences to see whether a specific variable (like the availability of a suggested price, for example) affects prices that subjects are willing to pay. Exceptions are studies 3 and 4 in Kunter (2015) and Regner (2015), where subjects are surveyed after they have made a real PWYW purchase.

Most survey experiments identify variables that influence PWYW payments. Variables that positively affect payments are fairness, buyers' satisfaction (product quality, service quality), social norms, information about prices paid by other buyers and information about cost. Variables that negatively affect payments are social distance and anonymity. The effect of external reference prices is ambiguous and seems to depend on whether the reference price is perceived as reasonable or too high.

Another pattern that emerges from Table 3 concerns the types of products. Many products are experience goods, like tickets for sauna, cinema, concert, zoo or museum, or drinks or meals at restaurants, where quality is known only after consuming the product. In line with this is study 1 in Machado and Sinha (2013) in which subjects pay what they want for a dinner in an upscale restaurant. Subjects buy a bundle consisting of (at least) the dinner and the quality of service. Both parts of the bundle are experience goods, and it is found that the quality of the service has the largest effect on payments.³

Table 4 summarizes the case studies. For each case study, we summarize data on payments, type of product, duration and main findings. All products investigated are experience goods, and some of them are digital goods (e.g., e-books and music) with almost zero marginal cost. There are three case studies which report payments over longer time horizons: The e-book seller in Krawczyk, Kukla-Gryz and Tyrowicz (2015), the seller of music downloads in Regner and Barria (2009), and the restaurant in Riener and Traxler (2012) report results from environments where PWYW has been used for 18 months or more.

The study by León, Noguera and Tena-Sánchez (2012) stands out because in this study holiday packages with regular prices between \$40 and \$2,938 are offered under PWYW

³ There are numerous empirical studies on voluntary contributions to public goods, which do not explicitly refer to PWYW. One study, which is noteworthy because of its similarity to PWYW is Borck et al. (2006). They conducted a survey among readers of an online newsletter. The newsletter is available free of charge but subscribers are asked for voluntary donations. Borck et al. find evidence of conditional cooperation: subjects state that they give more if they expect others to give more.

pricing. León, Noguera, and Tena-Sánchez (2012) show that holiday packages with a market value of more than €137,000 earned slightly more than €7,000 under PWYW pricing. For the seller, the use of PWYW was everything but a success because 46.5% of buyers paid nothing, and only 3.3% paid more than 40% of the regular price. Based on the comments in the seller's blog, the authors argue that buyers chose low prices because they perceived reference prices as too high, and because they thought that marginal costs were low. Also, cannibalizing effects might be at work: For example, if subjects buy one part of a bundle (e.g., a flight) under PWYW and buy another part (e.g., dinner) at regular pricing, but have to pay the flight after they have paid the dinner, they might pay less because their budget for the bundle is already depleted.

Table 1: *Laboratory Experiments*

Reference	Experimental Design	Main Findings
1 Krämer et al. (2015)	subjects' risk aversions and social preferences were measured; several treatments in which sellers with various pricing mechanisms competed, focus on sellers' choices of pricing mechanism, resulting market structure, prices and profits	compared to name-your-own-price (NYOP), PWYW achieves higher market penetration but lower profit; sellers choose PWYW if costs are low; PWYW prices depend on buyers social preferences
2 Machado and Sinha (2013) (Study 2)	subjects were told to watch and evaluate a movie, before that they could buy a snack; contextual factors (seller type, payment time, payment appeal, payment visibility) were varied	average payments were \$0.30, 60% paid nothing, possibly because subjects felt entitled to consume the snack for free; buyers paid more for local products if payment is made after the snack is consumed, buyers paid more if buyers were satisfied with quality; no evidence for image concerns
3 Mak et al. (2015) (Experiment 1)	PWYW as a threshold public good game; seller was simulated; an infinitely repeated game; 8 buyers with high or low valuation; if revenue falls below a known threshold the seller switches from PWYW to fixed pricing; market information was provided (i.e., buyers' valuations were common knowledge); each period buyers chose prices; full feedback (i.e., after each period buyers are informed about other buyers' prices and the earnings from previous period); treatments different by framing and by communication (no communication, suggested payments, chat)	no effect of framing, average number of periods was around 190, mean number of periods for which PWYW was sustained is 10.50 (no communication), 35.88 (suggestion) and 167.50 (chat); results are driven by buyers with high valuations for the good; these buyers pay significantly more in chat-treatment; in chat-treatment subjects often coordinate on prices resulting in equal earnings
4 Mak et al. (2015) (Experiment 2)	similar to experiment 1 but all treatments with chat, with or without market information and with or without full feedback	the possibility to communicate via chat facilitates the sustainability of PWYW pricing even if buyers have less than full information about other buyers' valuations and prices paid by other buyers; chat helps to establish a "social contract" about appropriate prices
5 Schmidt et al. (2014)	effect of competition is analyzed in two sets of treatments: (i) no competition treatments: repeated game with 1 seller and 3 buyers, seller chooses whether to enter the market or not, seller could invest in quality; (ii) competition treatments: 2 sellers and 6 buyers	buyers are motivated by outcome-based social preferences and strategic concerns (keeping the seller in the market); no evidence for intention-based social preferences; with competition prices are lower; sellers who invest in quality made positive profits on average in all treatments

Table 2: *Field Experiments*

Reference	Experimental Design	Product Type	Payments	Duration	Main Finding
1 Gautier and van der Klaauw (2012)	hotel stays are sold via a promotional campaign in 36 hotels	EG, LMC	involuntary participants: €48 voluntary participants: €24 regular prices are €80, €120, or €150	2 days	promotional campaigns with PWYW attracts customers with few pro-social reputational concerns
2 Gerpott and Schneider (2016)	waffles and crêpes at a university campus are sold with a posted price or under PWYW	EG, LMC	posted price: € 0.50 PWYW waffles: € 0.67 PWYW crêpes: € 0.61	2 days	customers who decided themselves to purchase via PWYW paid on average higher unit prices than posted prices; offering a product via PWYW does not increase demand in case close substitutes are available
3 Gneezy et al. (2010)	photos in amusement park are sold under fixed price or PWYW, in 2 out of 4 treatments half the revenue is donated to charity	LMC	merchandise revenue per individual p=\$12.95: \$0.40 p=\$12.95 + charity: \$0.40 PWYW: \$0.42 PWYW + charity: \$0.45	2 days per treatment	merchandise revenue per individual is highest when part of the PWYW price is donated to charity
4 Gneezy et al. (2012)	in three treatments subjects could buy photos in amusement park at different fixed prices (\$5 or \$15) or under PWYW pricing	LMC	ratio of individuals who bought product/average profit p=\$15: 23% / \$3.45 p=\$5: 64% / \$3.20 PWYW: 55% / \$3.50	boat tour: data from 20 cruises per treatment	in PWYW fewer individuals buy compared with \$5; this opting-out is driven by image-concerns (not knowing the appropriate price)
5 Gravert (2014), published as Gravert (2017)	books at charitable bookstore are sold under PWYW; two treatments depend on whether subjects are reminded of their membership status	EG, LMC	\$1.50 (pooled over treatments)	2 months	members of the bookstore paid 75 cents more when reminded of their membership; members pay less when they purchase a second book
6 Jang and Chu (2012) (Study 5)	subjects buy canned coffee, information about cost and reference price (i.e., prices paid by previous buyers) are provided	EG, LMC	\$0.37 information about cost \$0.42 reference price > cost \$0.30 reference price = 0	3 days	on average, buyers paid less when informed that 72% of previous buyers paid nothing

Reference	Experimental Design	Product Type	Payments	Duration	Main Finding
7 Kim, Kaufmann and Stegemann (2014) (Field Exp. 1)	restaurant meals in high-priced restaurant (drinks excluded) were sold, external reference price (i.e., information about regular price) and social distance regarding payment (personal interaction with waiter or anonymity) were varied	EG, LMC	€4.20 for products with regular price < €5.00 €7.63 for pr. w. € 5.00 < regular price. < €10.00 €10.29 for products with regular price > €10.00	3 weeks	external reference price and reputation of seller (quality of the good) have positive effect on PWYW prices; product value has negative effect
8 Kim, Kaufmann and Stegemann (2014) (Field Exp. 2)	sandwiches were sold, external reference price (i.e., information about regular price) and social distance regarding payment (personal interaction with waiter or anonymity) were varied	EG, LMC	€1.19	two days per week at lunchtime, for 4 weeks	see above
9 Kim, Natter and Spann (2009)	buffet lunch cinema ticket (regular) cinema ticket (discount) deli	EG, LMC	€6.44 €4.87 €3.11 €1.94	2 weeks 2 days 1 day 2 weeks	face-to-face interaction, fairness considerations and reciprocity increase PWYW payments; at the restaurant loyalty, price consciousness and income drive payments
10 Kim, Natter and Spann (2014) (Exp. 1)	comparison of free sampling and PWYW for Gillette razors; participants were surveyed 5 weeks and 1 year later		€1.41	2 days (promotional campaign)	PWYW yields higher repeat purchases and is more entertaining than free sampling
11 Kim, Natter and Spann (2014) (Exp. 2)	comparison of free sampling, 40% discount and PWYW for photo portraits	LMC	PWYW: €16.12 sampling: €0.00 discount: €26.00	3 weeks (promotional campaign)	compared to the discount treatment, the PWYW treatment attracted more buyers and resulted in higher revenue

Reference	Experimental Design	Product Type	Payments	Duration	Main Finding
12 Kunter (2015) (Study 5)	potential buyers had to fill out a questionnaire before they purchased a zoo ticket; 5 treatments varied textual cues in the questionnaire	EG, LMC	control: €5.75 economic: €5.51 avoid neg. feelings: €5.69 pro-social behavior: €5.98 making excuses: €5.91	10 days	pro-social cues yield significantly higher payments than economic cues; avoiding feelings of guilt is an important factor
13 Machado and Sinha (2013) (Study 3)	payments are made after playing golf	EG, LMC	PWYW: \$22.95 fixed price: \$31.07	6 Saturdays	with PWYW average payments are lower; in combination with fixed pricing PWYW attracts more buyers and increases revenue
14 Schons et al. (2014)	during the 8 weeks buyers made 1-4 purchases of iced coffee	EG	first purchase: €0.88-0.99 second purchase: €0.62-0.88 third purchase: €0.50-0.76	8 weeks	in aggregate, prices do not decline over time but decline on the individual level until the 4th transaction; buyers have difficulties determining seller's cost
15 Park, Nam and Lee (2017)	best-selling beverage items are sold in 5 treatments: (i) traditional PWYW; (ii) PWYW with charitable giving (PWYW-C), (iii) PWYW with charitable giving plus a suggested price (PWYW-CS); benchmarks (iv) fixed price scheme with (FP-C) and without (FP) charitable giving	EG	recorded revenues/net revenues (revenues minus charity) per customer in \$ (n=928) FP: 5.62/5.62 FP-C: 5.61/4.77 PWYW: 4.59/4.59 PWYW-C: 5.04/4.30 PWYW-CS 6.46/5.44	5days	PWYW and PWYW-C attracts slightly more customers than FP; revenues are highest under PWYW-CS, however net revenues are highest under fixed prices and lowest under PWYW-C; suggested prices are important for the profitability of PWYW pricing schemes
16 Schröder, Lüter and Sadrieh (2015)	in 2 treatments buyers of soft drinks either paid via PWYW or reduced a given price by as much as they want (mark-of-your-own price, MOYOP)	EG	PWYW: €0.90 MOYOP: €0.69	4 x 40 min. per treatment	prices are significantly lower with MOYOP

DG = digital good, EG = experience good, LMC = good with low marginal cost.

Table 3: *Survey Experiments*

Reference	Experimental Design	Product Type	Payment	Main Finding
1 Armstrong Soule and Madrigal (2015) (Study 1)	subjects are presented with a hypothetical online concert ticket purchase scenario; treatments differed as to the level of external reference prices (\$10 or \$25) and whether they are presented as a descriptive norm ("what others have paid") or injunctive norm ("what you should pay")	EG, LMC	\$17.44 low ref. price and descriptive norm \$25.06 high ref. price and descriptive norm \$21.21 low ref. price and injunctive norm \$36.76 high ref. price and injunctive norm	in situations without social pressure payments are influenced by norms and reference prices; when reference prices are high, payments are closer to the reference price when the norm is framed as a descriptive norm
2 Armstrong Soule and Madrigal (2015) (Study 2)	a pretest was used to determine the expected price for a concert ticket; treatments differed as to the level of external reference prices and as to whether they are presented as a descriptive or injunctive norm	EG, LMC	reference price = \$20 < expected price \$21.44 descriptive / \$23.06 injunctive reference price = \$45 = expected price \$34.18 descriptive / \$42.09 injunctive reference price = \$70 > expected price \$52.93 descriptive / \$53.59 injunctive	when reference prices are equal to the expected price, payments are closer to the reference price when the norm is framed as injunctive norm (in contrast to the results of study 1)
3 Dorn and Suessmair (2016)	McDonald's Big Mac, in a within-subjects design each subject is presented with three scenarios which differ in the level of social presence and observation, first scenario was anonymous payment, second scenario was direct contact with seller, third scenario was being observed by third party, after each scenario subjects were asked to rank factors that influenced their price	low cost	not reported	social agreeableness was more important in scenarios with high social presence and observation, willingness to pay (WTP) increases from scenario 1 to scenario 2 to scenario 3
4 Hilbert and Suessmair (2015)	in a 3 (social interaction: low, medium, high) x 3 (norm compliance: low, medium, high) factorial design subjects indicated their WTP for a travel mug	low cost	€12.80 high social interaction €11.92 medium social interaction €9.15 low social interaction (regular price €17.95)	with high and medium social interaction subjects' WTP are higher as compared to low social interaction; norm compliance is not significant
5 Jang and Chu (2012) (Study 1)	for four products (recording album, mobile phone, cake, DVD), 70 subjects were asked about their WTP and the price they would pay under PWYW	varying	not reported	the distribution of the ratio price-paid/WTP is similar to the distribution of offer/ endowment in dictator games

Reference	Experimental Design	Product Type	Payment	Main Finding
6 Jang and Chu (2012) (Study 2a)	for recording album and mobile phone 60 subjects were asked about their WTP and the price they would pay under PWYW; half of the students had information about cost	varying	not reported	price-paid/WTP ratio is higher in cost provision treatment
7 Jang and Chu (2012) (Study 2b)	in a pretest, subjects estimated the cost of the mobile phone; average estimated cost was \$470; in three treatments 120 students were asked about their WTP and the price they would pay under PWYW; treatments differed according to information about cost (\$260, \$470, \$680). Subjects in a control treatment received no information	high cost	price-paid/WTP ratios 40.23% control 73.18% (cost inf. \$260) 72.00% (cost inf. \$470) 48.48% (cost inf. \$680)	the relation between price-paid and cost information is interpreted as buyers signaling fairness; buyers pay less if signaling fairness is more costly
8 Jang and Chu (2012) (Study 3)	in three treatments subjects were asked about their WTP and the price they would pay under PWYW for a mobile phone; treatment variation with respect to information: (i) none, (ii) information about cost, \$180, (iii) information about cost together with information that most subjects would pay nothing	high cost	price-paid/WTP ratios 40.00% (i) 60.00% (ii) 34.00% (iii)	when injunctive norm (information about cost) and descriptive norm (most subjects pay would nothing) are in conflict, subjects react stronger to the descriptive norm
9 Jang and Chu (2012) (Study 4)	PWYW for Starbucks coffee; treatments differed according to the information subjects received: (i) fair price is \$4.00-4.50, (ii) fair price is \$4.00-4.50 but most subjects would pay nothing, (iii) fair price is \$4.00-4.50 and most subjects would pay fair price	EG, LMC	price-paid/WTP ratios 72.00% (i) 46.00% (ii) 70.00% (iii)	the influence of an injunctive norm (information about fair price) is not enhanced by the descriptive norm

Reference	Experimental Design	Product Type	Payment	Main Finding
10 Johnson and Cui (2013) (Study 1)	PWYW for concert tickets in four treatments; treatments differed according to the information subjects received: (i) no reference price, (ii) minimum price = \$20, (iii) maximum price = \$50, (iv) suggested price \$35	EG, LMC	\$45.80 (i) \$34.45 (ii) \$29.67 (iii) \$34.31 (iv)	reference price has negative effect and reduces variance
11 Johnson and Cui (2013) (Study 2)	PWYW for concert tickets in a 2 (minimum price present or absent) x 2 (maximum price: present or absent) x 2 (suggested price: present or absent) design	EG, LMC	\$43.77 (no information) \$49.90 (suggested price only) \$47.00 (minimum price only) \$35.77 (maximum price only) \$32.11 (minimum and maximum) \$42.67 (suggested and minimum) \$39.53 (suggested and maximum) \$34.06 (minimum, maximum, suggested)	external reference prices have negative effect on prices paid; if external reference price is provided, prices paid are closer to the reference price (less variance)
12a Johnson and Cui (2013) (Study 3)	PWYW for concert tickets, in a 2 (minimum price \$10 or \$20) x 2 (maximum price: \$50 or \$60) x 2 (suggested price: present or absent) design	EG, LMC	\$33.04 (minimum price = \$10) \$38.25 (minimum price = \$20) \$33.30 (maximum price = \$50) \$37.99 (maximum price = \$60)	significant effect of minimum and maximum price but no effect of suggested price; the extremity of anchors influences buyers' chosen prices
12b Johnson and Cui (2013) (Study 4)	PWYW for concert tickets; in all three treatments minimum price = \$20 and maximum price = \$60; treatments differed according to the suggested price: (i) \$30, (ii) \$40, (iii) \$50	EG, LMC	\$32.62 (i) \$33.58 (ii) \$37.56 (iii)	suggested price affects prices buyers actually pay
13 Kim, Kaufmann and Stegemann (2014)	PWYW for several products (cinema tickets, DVD, digital album, flight tickets, hotel, rental car, opera, wine), online survey which varied social distance, product value, external reference price, seller's reputation and sales promotion; subjects were asked for the price they would pay under PWYW, their WTP and the regular price	different	subjects paid 65.85% of the regular price and 77% of their WTP with respect to all products	PWYW prices increase with lower social distance, low value products and external reference prices; seller's reputation and sales promotions had no significant effect

Reference	Experimental Design	Product Type	Payment	Main Finding
14 Kunter (2015) (Study 1)	PWYW for tickets to animal park (sold in lecture); real payments but subjects received €11.50 show-up fee; study explores "motivation-related payment factors"	EG, LMC	PWYW prices not reported; regular price € 4.00	three most frequent answers: fairness (58%), reference prices (46%), customer satisfaction (31%)
15 Kunter (2015) (Study 2)	PWYW for day ticket for wellness and sauna, survey and interview with 91 subjects	EG, LMC	PWYW prices not reported; regular price €20-25	most frequent answers: reference prices (71%), customer satisfaction (47%), fairness (37%)
16 Kunter (2015) (Studies 3 and 4)	survey with 153 and 205 subjects; survey with paired comparisons took place in museum or zoo after subjects purchased tickets, in contrast to other surveys prices paid are not hypothetical; prices are not recorded	EG, LMC	not applicable regular prices: €4.50 museum €14.00 zoo	most important motives for making positive payments: customer satisfaction, fairness, income
17 Machado and Sinha (2013) (Study 1)*	PWYW for dinner in an upscale restaurant, in a conjoint analysis, 258 subjects ranked 12 different profiles; profiles differed in characteristics of the meal, quality of service, pricing (fixed or PWYW) and price paid	EG, LMC	not applicable	quality of service and fairness have significant effect; reciprocity is not significant; the effect of quality of service is largest
18 Maretti, Pearson and Moore (2012)	buyers downloaded projects for an app (iProduct) from iTunes App Store, made their PWYW payments and completed a survey	DG, LMC	\$0.43	structural equation modeling is used; loyalty influences buyers' WTP; price consciousness and usage affect the price actually paid
19 Regner (2015)	227 frequent customers (ten or more purchases) of an online music label are asked in a survey about their payments and motives; survey answers are compared with the purchases of these subjects in the past to control for self-serving biases	DG, LMC	recommended price \$8.00	three types of customers are found: those who pay the minimum price, the recommended price and above the average price; customers more inclined to follow social norms are more likely to pay the recommended price; the possibility to try the product (listen to the music) before the purchase positively affects prices and is interpreted as evidence for reciprocity

Reference	Experimental Design	Product Type	Payment	Main Finding
20 Roy (2015)	paper and pencil survey on a hypothetical restaurant visit with 300 students; willingness to pay (WTP), internal reference price (IRP), product involvement and price consciousness of subjects are recorded	EG, LMC	WTP: AU\$ 22.9 IRP: AU\$ 22.3	IRP has the strongest influence on WTP; subjects with high product involvement pay lower prices compared to subjects with low involvement; highly price-conscious subjects pay lower prices
21 Santana and Morwitz (2013) (Study 2)*	PWYW for 16-ounce cup of fresh-squeezed lemonade, online survey with 205 M-Turk subjects; social value orientation (SVO) was measured and the survey primed the norm: (i) communal norm in which all profits go to charity, and (ii) exchange norm	EG, LMC	\$2.81 (i) \$1.52 (ii)	subjects pay more when profits go to charity; effect of social norm depends on SVO: with exchange norm pro-socials pay more than pro-selves, with communal norm pro-socials and pro-selves pay the same
22 Santana and Morwitz (2013) (Study 3)*	PWYW for 16-ounce cup of coffee, online survey with 546 M-Turk subjects; social value orientation (SVO) was measured and the survey primed the norm: (i) communal relationship norm, the description focuses on social aspects (e.g., "very warm interaction"), and (ii) exchange relationship norm focusing on economic aspects	EG, LMC	\$2.71 (i) \$2.22 (ii)	situational relationship norms lead to higher prices, even if profits do not go to charity (cf. Study 2); pro-socials (\$2.62) pay more than pro-selves (\$2.31)
23 Santana and Morwitz (2013) (Study 4)*	PWYW for coffee plus bagel, online survey with 339 M-Turk subjects; social value orientation (SVO) was measured and the survey primed the norm: (i) communal norm, and (ii) exchange norm; priming took place in an unrelated task	EG, LMC	\$3.37 (i) \$3.04 (ii) (suggested price \$3.00)	subjects primed with communal norm paid significantly more than subjects primed with exchange norm; priming effect carries over; pro-selves react stronger to priming

Reference	Experimental Design	Product Type	Payment	Main Finding
24 Thomas and Gierl (2014)	WTP for pizza and hotel room is elicited, 2 (perspective) × 3 (reference-price information) × 3 (profit orientation) within subjects design	EG, LMC	€ 11.03 pizza € 62.13 hotel room	reference prices (inform. about what others paid before or minimum prices) have negative effects, no sign. difference between profit and nonprofit sellers
25 Weisstein, Kukar-Kinney and Monroe (2016) (Study 1)	DVD movies, survey study of online purchase scenarios, 2 (familiar or unfamiliar brand) × 2 (product video present or absent) between subjects design, experiment tests how brand familiarity and virtual product experience (potentially reducing uncertainty) affects perceived product knowledge, perceived quality, purchase intentions and PWYW prices	DG, EG	DVD retail price \$ 19.99 \$ 12.03 (unfamiliar brand, video present) \$ 7.86 (unfamiliar brand, video absent) \$ 9.84 (familiar brand, video present) \$ 9.51 (familiar brand, video absent)	only for the unfamiliar brand the perceived product knowledge, perceived quality, purchase intentions and prices are positively affected by availability of the product video
26 Weisstein, Kukar-Kinney and Monroe (2016) (Study 2)	16 GB USB flash drive, survey study of online purchase scenarios, 2 (familiar or unfamiliar brand) × 2 (suggested price present or absent) between subjects design, experiment tests how brand familiarity and suggested price affects perceived product knowledge, perceived quality, purchase intentions and PWYW prices	LMC	USB flash drive: suggested price \$ 17.99 \$ 6.53 (unfamiliar brand, suggested price) \$ 10.37 (unfamiliar brand, no price sugg.) \$ 9.59 (familiar brand, suggested price) \$ 9.01 (familiar brand, no price sugg.)	USB flash drive: suggested price for goods with an unfamiliar brand reduces perceived product knowledge, perceived quality, purchase intentions and PWYW payments; for goods with familiar brand the suggested price has no effect on purchase intentions and the PWYW price

DG = digital good, EG = experience good, IRP = internal reference price, LMC = good with low marginal cost, SVO = social value orientation, WTP = willingness to pay.
Additional results to Santana and Morwitz (2013) are reported by Santana and Morwitz (2015) in a comprehensive form.

Table 4: Case Studies

Reference	Description	Product Type	Payments	Duration	Main Findings
1 Krawczyk, Kukla-Gryz and Tyrowicz* (2015)	PWYW for bundles of about 5 e-books, each bundle is sold in a 7 or 14 days campaign, the mean price and the eight buyers who paid the highest prices are listed on the seller's website	DG, EG, LMC	€5.00	about two years	buyers try to match the mean price; due to information about payments of others a social norm may drive payment behavior
2 León, Noguera and Tena-Sánchez (2012)	holiday packages and services (flights, hotel stays) of different price categories	EG, high cost	total payment €7,011, i.e., 5.1% of total value, €137,066	2 weeks	overall very low contributions with 46% of customers who paid zero; explanations for low payment are a framing effect and a cannibalizing effect caused by complementary goods
3 Regner and Barria (2009)	music downloads or CDs are sold, buyers can choose any price between \$5 and \$18, CD costs additional \$4.97 for physical costs	DG, EG, LMC	\$8.20 (\$8.00 recommended price)	18 months (September 2003 – January 2005)	on average payments are considerably higher than the minimum price of \$5 and higher than a recommended price of \$8; reciprocity as the driver for voluntary payments is not confirmed; instead warm glow and guilt seem to be motives that drive behavior
4 Regner and Riener* (2012)	as above, but for two weeks, the seller changed its policy so that the artist was informed about buyers' names and prices paid;	DG, EG, LMC	\$7.99 with anonymity \$8.05 without anonymity	4 months (September – December 2005)	reduced privacy increases payments, but effect is not significant; reduced privacy decreases buyers by 20% per day and decreases revenues by 25% per day
5 Riener and Traxler (2012)	lunch or dinner at a restaurant	EG, LMC	€5.26	2 years	average payments modestly declined since the start of the restaurant but PWYW payments stabilized at about 5€ per meal on average; revenues increased due to more customers; restaurant has been operating for two years in a competitive market with PWYW pricing
6 Santana and Morwitz* (2013) (Study 1)	adoption fee at animal shelter	EG	\$110.38 (reference adoption fee is \$150)	1 month	buyers consider transaction in PWYW as socially interdependent; outcomes of sellers are considered; communal or exchange norms drive payment decisions

DG = digital good, EG = experience good, LMC = good with low marginal cost

* Working paper

3. GAPS IN CURRENT RESEARCH

The main results of the studies surveyed above can be summarized as follows. PWYW pricing has the potential to increase revenue, even if each single buyer pays less than she would pay under traditional pricing. This is because PWYW can be used as a marketing instrument to attract additional buyers.

With regard to the motives behind buyers' payments the following regularities emerge. Prices paid under PWYW pricing are positively influenced by social distance, social preferences, fairness, strategic considerations like loyalty, price consciousness and product quality. With regard to reciprocity and the availability of reference prices the evidence is mixed. Several studies (e.g., Regner and Barria 2009, Machado and Sinha 2013) do not find evidence for reciprocity as a driver of buyers' payments. Regner (2015), however, concludes that reciprocity drives higher payments in a setting where buyers have the opportunity to test the product before deciding about the payment. This suggests that information about a product's quality matters. Also, the effect of reference prices is ambiguous and seems to depend on whether the reference price is perceived as reasonable or too high.

It is interesting to see for which goods PWYW pricing is used. Results from our review suggest that PWYW pricing is used mainly for low-price goods, and most of these goods are experience goods. Moreover, from the review it is apparent that the vast majority of empirical studies is confined to short-term observations. These two insights are related to the following unanswered questions: (1) What conditions are required so that a seller applies PWYW pricing to high-cost goods without making a loss? (2) What are the conditions under which sellers can apply PWYW pricing in the long run?

In the following, we address the two gaps stated previously. Since the results from our review provide only limited insights with respect to the gaps, the discussion is partly speculative. However, we think that the discussion provides fruitful guidance in research since the answers are of central importance for theoretical as well as applied studies on PWYW. On the theoretical level, the answers will contribute to the literature on behavioral pricing (for a game theoretical perspective see Greiff and Egbert 2017). On the applied level, the answers to question (1) are of interest for sellers who want to use PWYW pricing as a short-term or long-term strategy, and the answers to question (2) are of interest for sellers who want to use PWYW pricing in the long run.

3.1 PWYW and High-Cost Goods

If we consider the perspective of a seller, PWYW can, firstly, be considered as a marketing strategy with the goal of creating awareness for a new product. Long term considerations, such as future market penetration, can be reasons for choosing PWYW pricing in the short run. Secondly, in the long term, PWYW can be a viable profit-enhancing pricing strategy for experience goods with low marginal costs, such as services, music downloads or e-books.

As a marketing strategy, PWYW can be successful in the short run because it attracts new buyers and increases sales. Many buyers might be attracted by the innovative character of PWYW pricing (Kim, Natter and Spann 2014), or by the option of making a ‘good’ bargain (Shampanier, Mazar and Ariely 2007). Another reason why buyers might be attracted by PWYW pricing is the reduced risk of paying too much for a low quality product. This holds especially true for experience goods whose quality is only known after consumption (Nelson 1970). A buyer, who pays before consumption, is at risk to pay a price she would not pay if she knew the quality of the good in advance. This may lead to abstaining from purchasing the good at a fixed price. Egbert, Greiff and Xhangolli (2015) point out that PWYW-ex-post-consumption can be a viable strategy to reduce information asymmetries and to increase sales. This is confirmed in several field and survey experiments, showing that PWYW payments increase with the quality of the good provided (Kim, Kaufmann and Stegemann 2014, Kim, Natter and Spann 2014, Kunter 2015 and Study 1 in Machado and Sinha 2013).

Only a small number of studies examine goods which have relatively high cost and which are normally sold at higher fixed prices (e.g., more than 200 USD per unit). Exceptions are the sales of holiday packages reported by León, Noguera and Tena-Sánchez (2012), with sales between €40 (hotel room for two persons, one night) and €2,938 (a seven-night holiday for two persons in Egypt), the hotel stays reported by Gautier and van der Klaauw (2012), with regular sales between €80 and €160 and, very recently, the study of Stangl, Kastner and Prayag (2017) for dance courses at a dance festival.

To see the relation between PWYW pricing and profits, consider the ratio of average PWYW payment, \bar{p} , to average cost, \bar{c} , $r = \frac{\bar{p}}{\bar{c}}$. If $r > 1$, a seller makes positive profits, and if $r < 1$, a seller makes a loss. Based on the results summarized in the previous section, it seems that r is smaller for goods that have higher costs.

If applied to goods with a low average cost, PWYW pricing can, in the worst case, lead to minimal losses because \bar{c} is small. For goods with a higher average cost, the risk of making a loss is larger, because buyers have a stronger incentive to free-ride by paying a low price. Although the empirical results show that buyers are sensitive to reference prices and cost information, and that buyers are willing to pay higher prices for goods that come with higher costs, it is unclear from the reviewed studies whether sellers can apply PWYW to high-cost goods without making losses. The results from León, Noguera and Tena-Sánchez (2012) and Gautier and van der Klaauw (2012) provide a pessimistic outlook, but it appears premature to draw any generalized conclusion based on two studies only. Firstly, in both studies, social distance between buyers and seller is rather high and this might lead to reduced payments. Secondly, it is possible that buyers make small payments because they underestimate production costs (Greiff, Egbert and Xhangolli 2014). And, thirdly, buyers might perceive the use of PWYW as a marketing campaign in which they are entitled to make payments below cost.

For the field experiment by Gautier and van der Klaauw (2012), the third explanation seems plausible because PWYW was used as part of a promotional campaign. If buyers

know that a seller does not use PWYW as a short-run marketing strategy, buyers might recognize that the seller will stay in business only if payments are high enough, and hence, they might be willing to pay higher prices in order to keep the seller in business.

Although commonsense might suggest that PWYW cannot be successful for high cost goods because buyers will take advantage of the opportunity to pay low prices, there is no clear evidence for this. Many studies on PWYW pricing suggest that positive payments are driven by social preferences, in particular by fairness and reciprocity. Results from laboratory experiments show that fairness considerations and reciprocity (List and Cherry 2008; Fehr, Fischbacher and Tougareva 2002) are not weakened by higher stakes, suggesting that sellers do not necessarily make losses when offering high cost products at PWYW pricing.

3.2 PWYW in the Long-Run

Our review reveals that most field experiments rely on data that covers comparatively short periods of time – at best several months but mostly only a few days. This is different as with case studies. Three case studies (Krawczyk, Kukla-Gryz and Tyrowicz 2015, Regner and Barria 2009, Riener and Traxler 2012) are based on data about PWYW transaction collected over a period of more than a year.

In these case studies, goods with low marginal costs are sold. It is plausible that for these goods average payments exceed marginal cost. It seems that for goods with a low marginal cost, PWYW can increase profitability by attracting buyers at times when production operates below full capacity utilization. With regard to profitability this makes sense if there are economies of scale (e.g., due to high fix cost) so that average cost decreases with a higher capacity utilization. Digital goods are a specific case because marginal costs are zero and a capacity constraint does not exist. For these goods any additional unit sold at an arbitrary small but positive price increases profit.

The above literature review finds that PWYW can be successfully applied over long periods of time if products have low marginal cost, as in the mentioned case studies. However, based on our review, it is an open question whether PWYW can be successfully applied over longer periods for goods which have comparatively high marginal costs.

Another important factor which could influence the success of PWYW in the long run is the degree of substitutability, which depends on market structure. For instance, if buyers prefer the good a seller offers under PWYW and if substitutes are available, buyers have an incentive to free-ride under PWYW pricing by buying the good at a low price. The seller makes a loss and, eventually, is driven out of business. This is not a problem for buyers because substitutes are available. However, if no perfect substitutes are available, the incentive to free-ride under PWYW is weaker since driving the seller out of the market cannot be in the interest of the buyer.

An example for this situation can be lunch or dinner at a restaurant. Riener and Traxler find that 81% of the customers of the restaurant studied are regular customers who eat there at least once a month, and 50% of customers eat there at least twice per month (Riener and Traxler 2012, 477). These regular customers might be an important factor driving the success of PWYW at this particular restaurant because they are willing to pay prices that cover costs in order to keep the restaurant in business. Arguably, this would be different if there were an exact replica of the restaurant which sells at fixed prices (i.e., a restaurant where customers could eat exactly the same meals in exactly the same atmosphere). Hence, we postulate that over longer time spans, the success of PWYW pricing will depend on the availability of substitutes and, therefore, on market structure. This is a hypothesis right now and further research into this direction is needed. For example, one could design a LE (similar to Mak et al. 2015) in which buyers choose between two goods, one being sold under PWYW pricing and the other one being sold under fixed pricing. Across treatments one could vary the degree of substitutability between the two goods in order to explore how this affects PWYW payments.

Closely related to the discussion of the long run is the question of how buyers' payments develop over time in repeated purchases. Schons et al. (2013) and Gravert (2014) show that prices decrease when purchases are repeated. Decreasing prices do not imply that the seller will eventually realize losses. In fact, Riener and Traxler (2012) find that a slow decrease in average PWYW payments goes hand in hand with an increase in buyers so that revenue increases in total.

4. CONCLUSION

In this paper, we provide a review of the fast growing literature on PWYW pricing. We review empirical studies on PWYW pricing which report data generated in laboratory experiments, field experiments, survey experiments and case studies. We find that PWYW pricing is almost exclusively used in very small segments of consumer goods, mostly for low-cost goods, experience goods, or for bundles of goods and services. Moreover, almost all empirical studies focus on relatively short time periods.

Furthermore, with respect to the four types of studies (Tables 1 to 4) we conclude that the findings are not consistent as regards the identified variables that seem to have an influence on payments in PWYW settings. Future research will be needed for the examined low-price goods due to conflicting results.

With reference to the discussed studies it is also striking that nearly all of those which are documented have been conducted in a few rather developed European and Asian countries and North America, and that studies related to India, China or Africa have not been conducted. This may hint that the level of economic development of a country and cultural aspects play also a role in the feasibility of PWYW pricing. Related to this is the observation that PWYW is applied only in B2C contexts but that results from B2B contexts have not been reported yet.

Our review shows that despite the current fashion to investigate PWYW, there are still several unanswered questions. In particular, it is not clear if sellers can successfully apply PWYW to high cost goods, or over longer time periods. To address these issues, we provided some tentative answers in the previous section. However, so far, the amount of goods sold via PWYW pricing in comparison to other pricing mechanisms is nothing more than marginal.

Acknowledgements: For helpful comments on earlier drafts we thank two anonymous reviewers of this journal. An early version of this text was published under the title “A Survey of the Empirical Evidence on PWYW Pricing” as a working paper in *Bulgarian Economic Papers* (BEP 02-2016). The present text is substantially different from the working paper and reviews more studies. The usual disclaimer applies.

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THE INTERPLAY OF EXPATRIATES' PSYCHOLOGICAL AND SOCIAL CAPITAL FOR KNOWLEDGE TRANSFER¹

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Received: June 27, 2017
Accepted: November 11, 2017

ABSTRACT: *Expatriate managers are recognised as fundamentally important stakeholders in the process of transferring knowledge between headquarters and subsidiaries in multinational corporations (MNCs). This paper's goal is to determine how expatriates' personal capital (i.e. positive psychological capital and social capital) facilitates conventional and reverse knowledge transfer where there are language, cultural and geographical differences between headquarters and subsidiaries. A qualitative multiple case study approach was used to analyse the data, obtained by in-depth interviews with expatriates and managers from three MNCs. The findings suggest that psychological capital supports knowledge transfers in MNCs in two ways: first, directly and, second, through the creation of expatriates' social capital. This study shows that positive psychological capital dimensions of expatriates (efficacy, resilience and optimism) represent individual level antecedents of knowledge transfer between HQ and subsidiaries, thereby contributing to the literature on expatriates' boundary spanning role in MNCs. The results also indicate that psychological capital dimensions support creation of structural and relational dimensions of social capital, further enhancing knowledge transfer in MNCs, thereby advancing the literature on the role of expatriates' social capital in knowledge flows. By observing the relationships in different subsidiary types, this study also provides valuable implications for international knowledge management.*

Keywords: *knowledge transfer, expatriates, psychological capital, social capital, multinational companies*

JEL: M1, M12

DOI: 10.15458/85451.65

1 INTRODUCTION

Knowledge transfer is the primary source of competitive advantage in MNCs (Gupta & Govindarajan, 2000; Kogut & Zander, 2003; Michailova & Mustafa, 2012) where it is also particularly challenging since headquarters (HQ) and subsidiaries usually operate in dissimilar cultural contexts (Ambos & Ambos, 2009; Mäkelä et al., 2007). Therefore, the international knowledge management literature extensively investigates the conditions

1 Acknowledgments: The authors would like to thank Matevž Raškovič, the editor Matej Černe and two anonymous reviewers for their valuable comments on the earlier versions of the manuscript.

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enabling the transfer of knowledge within MNCs (Michailova & Mustafa, 2012; Yang et al., 2008). The research has shifted from the firm level to highlighting the role of individuals at the subsidiary level (Israilidis et al., 2015), especially expatriate managers ('expatriates') (Chang et al., 2012; Harzing et al., 2015). As boundary spanners, expatriates are recognised for ensuring continuous knowledge flows and minimising knowledge losses (Schotter & Beamish, 2011; Tippmann et al., 2013) by facilitating the connections for knowledge transfer between HQ and subsidiaries across a range of geographic, organisational and other contexts (Hocking et al., 2007). Expatriates with close relationships to HQ are the main facilitators and coordinators of knowledge transfer processes (Ambos et al., 2006; Miao et al., 2011; Mudambi et al., 2014; Rabbiosi, 2011).

The literature establishes that knowledge transfer decisions taken by expatriates are strongly influenced by their personal relationships (Mudambi et al., 2014) and their social capital (Mäkelä et al., 2012), conceptualised as a set of social resources embedded in relationships (Tsai & Ghoshal, 1998). But the decision to share knowledge is also very personal, thus depending on the personal characteristics of individuals (S. Wang & Noe, 2010). Surprisingly little is known about individual characteristics that tap into the personality of an expatriate. The few existing studies in this area investigated how willingness (Minbaeva & Michailova, 2004) and emotional intelligence (Magnini, 2008) impact knowledge sharing. Yet not much is known about how psychological capital affects knowledge transfer, although it has been theorised to be important for successful leadership in MNCs and for overcoming cross-cultural barriers (Youssef-Morgan & Luthans, 2013) as well as physical and language distance (Mäkelä et al., 2012; Youssef-Morgan & Luthans, 2013; Youssef & Luthans, 2012). This individual factor is important because, together with social and intellectual/human capital, it constitutes the intangible resources employees accumulate to advance their careers (Direnzo et al., 2015), which is of particular importance in a global environment (Javidan & Teagarden, 2011). Further, leaders with high levels of positive psychological capital have also been found to be better at communicating across cultures and building effective leader–follower relationships (Story et al., 2013). However, this indicates that positive individual characteristics might be enhancing the relationship-building capacity of expatriates, helping them build up their social capital, a necessary condition for successful knowledge transfer in MNCs (Mäkelä et al., 2012). Thus, there might be an interplay of the social and psychological capital dimensions, which has so far not been addressed in the research.

The purpose of the study is to explore the role played by expatriates' psychological capital and its relationship to social capital in the process of knowledge transfer (KT) and reverse knowledge transfer (RKT) between HQ and subsidiaries by adopting an inductive, qualitative and multiple case study approach that has been used extensively in previous studies on KT in MNCs (Rugman & Verbeke, 2001). The study is situated in China where three Slovenian manufacturing companies have established subsidiaries. In this context, it is particularly challenging to determine knowledge transfer due to several barriers: the diversity of the cultural contexts, the language barriers, and the physical distance between HQ and the subsidiaries (Huang et al., 2008; Michailova & Hutchings, 2006).

This study intends to make various advances regarding the existing theory on the role of expatriates in KT and RKT between HQ and subsidiaries, an important area of research in the international management literature (Kostova et al., 2016). First, it aims to contribute to the literature on the role of expatriates' boundary spanning (K. L. Johnson & Duxbury, 2010; Mäkelä, 2007; Reiche et al., 2009) by clarifying the relationship between three positive individual characteristics and expatriates' knowledge flows between HQ and different types of subsidiaries. Second, it intends to add to the global leadership literature, which has established the influence of an expatriate's psychological capital on his/her cross-cultural adjustment and competencies (Vogelgesang et al., 2014; Youssef & Luthans, 2012) by demonstrating its importance also for KT and RKT, thereby helping us better understand the individual factors impacting expatriates' performance. Third, by addressing the role of the various dimensions of psychological capital as antecedents of social capital, this study also aims to complement the literature on expatriates' social capital, which shows the positive impact of the high social capital available through strong and trusting KT relationships in MNCs (Mäkelä, 2007; Nahapiet & Ghoshal, 1998). By revealing the impact certain dimensions of psychological capital have on building social capital, thereby facilitating actual knowledge flows, the study provides valuable implications for international knowledge management and talent management.

2 THEORETICAL BACKGROUND

2.1 Knowledge transfer in MNCs

Multinational corporations (MNCs) have been viewed as knowledge-creating, knowledge-diffusing and knowledge-integrating entities (Ambos et al., 2006; Fey & Furu, 2008) for which knowledge transfer represents the primary source of their competitive advantage (Gupta & Govindarajan, 2000; Kogut & Zander, 2003; Michailova & Mustaffa, 2012). It is conceptualised as the process through which actors in an organisation receive, exchange knowledge and are impacted by this experience (van Wijk et al., 2008). This is quite challenging in MNCs where HQ and subsidiaries operate in dissimilar cultural contexts (Ambos & Ambos, 2009; Mäkelä et al., 2007).

MNCs can benefit from knowledge transfer if they can, firstly, successfully transfer knowledge from HQ to its subsidiaries, referred to as KT (Monteiro et al., 2008; Noorderhaven & Harzing, 2009) and, secondly, integrate knowledge and best practices learned in subsidiaries into organisation-wide solutions, referred to as RKT (Ambos et al., 2006; Miao et al., 2011). KT assures the transfer of firm-specific advantages, the alignment of goals, strategies and values (Rugman & Verbeke, 2001), whereas RKT may help improve business processes in HQ and other subsidiaries by rapidly disseminating innovative solutions, referred to as subsidiary-specific advantage, throughout the global network as well as contribute to a re-evaluation of the global strategy (Ambos et al., 2006; Rugman & Verbeke, 2001). Regarding their strategic role, Bartlett and Ghoshal (1986) distinguish four types of subsidiaries: a Strategic Leader has high competencies in an important market, therefore low KT and high RKT; a Contributor has high competencies

but in an unimportant market, therefore high KT and high RKT; an Implementer has low competencies in an unimportant market, therefore high KT and low RKT; and a Black Hole has low competencies in an important market, and is characterised by low KT and low RKT.

Organisations use different channels, tools, technologies or media to transfer knowledge (Rasula et al., 2012), whereas knowledge is usually best shared directly by individuals (Davenport & Prusak, 1998). Even in MNCs, where direct, face-to-face communication is difficult to establish across geographically dispersed locations, it is still considered the crucial way to transfer knowledge (Argote & Ingram, 2008).

The literature addresses various factors influencing KT and RKT (Michailova & Mustafa, 2012; S. Wang & Noe, 2010): organisational (organisational structure, rewards system, management support etc.), team-related (team composition and cohesion, social networks etc.), cultural (collectivism and other cultural contexts) and individual (personality). As these factors can both stimulate or impede knowledge sharing, each can present a distinct enabler or barrier to knowledge sharing. Two groups of barriers have attracted considerable attention: individual and organisational (Riege, 2005; Sharma et al., 2012). In addition, intercultural barriers emerge in MNCs due to cultural differences, geographical distance and language differences (Huang et al., 2008; Michailova & Hutchings, 2006). Geographical dispersion leads to cultural and linguistic barriers, resulting in communication difficulties and difficulties in establishing trust in relationships (Mäkelä et al., 2012). Differences are acknowledged in communication styles, demographic differences, differences in skills, values and language (Lauring & Selmer, 2011). Differences in social categories (race, religious belief), language differences (level of knowledge, fluency, accents), differences in knowledge and cognitive decision-making schemes, differences in national cultures (values, norms, implicit rules regarding knowledge sharing) can all limit the interaction and thereby knowledge sharing (Chow et al., 2000).

2.2 The role of expatriates' personal capital

Expatriates with close relationships to HQ are the primary stakeholders for overcoming barriers to KT and RKT in the first ten years of a subsidiary's formation as transfer facilitators or boundary spanners and also as knowledge carriers (Fang et al., 2010). They enable the transfer of tacit knowledge over geographical boundaries (Argote & Ingram, 2008). They provide access to knowledge and communicate it through network channels (Hocking et al., 2007). Further, they are responsible for so-called knowledge translation whereby knowledge is modified while being transferred from one cultural and institutional context to another (Choi & Johanson, 2012).

In addition, scholars have identified expatriates' personal resources that are critical for KT and RKT. Social capital as reflected in the number of work group contacts and the proportion of trusted ties within the host unit positively impacts the continued transfer of and access to host-unit knowledge (Reiche, 2012). Existing evidence shows that

managers' social capital (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998) impacts firm performance (Westlund & Adam, 2010) and facilitates the transfer of knowledge (Mäkelä et al., 2012; Reiche, 2012; J. Yang et al., 2011). Social capital enables expatriates to perform a boundary spanning role between organisational units to support knowledge transfer (Barner-Rasmussen et al., 2010).

The literature recognises three dimensions of individual social capital: structural, relational and cognitive. The structural dimension comprises the number of expatriates' relationships in terms of with whom they are connected and the intensity and frequency of their communication flows, reflecting the depth and quality of their relationships. It refers to the ability to develop long-term, lasting relationships with host-country nationals (Barner-Rasmussen et al., 2010; Mendenhall & Oddou, 1985). Social interaction ties, reciprocity and identification were found to increase the quantity of individuals' knowledge transfer (Chiu et al., 2006). The relational dimension involves interpersonal trust as behavioural assets and obligations build up in their relationships (Adlesic & Slavec, 2012; Mäkelä et al., 2012). Trust is based on the rule of reciprocity and encompasses expectations that employees will fulfil their working duties and provide help when needed (Cook & Wall, 1980). People in trusting relationships are more inclined to interact with others (Barner-Rasmussen et al., 2010). Previously, social interaction and trust were found to significantly relate to the extent of inter-unit resource exchange (Tsai & Ghoshal, 1998). The cognitive dimension refers to the contextual, cultural and linguistic skills of expatriates (Barner-Rasmussen et al., 2010) that empower them to establish shared goals, codes of conduct, and systems of meaning (Mäkelä et al., 2012). It contains knowledge of values, norms and business conduct of foreign cultures, knowledge of foreign languages as well as the ability to connect and interact with others easily (Mendenhall & Oddou, 1985). Based on the extensive research presented above, expatriates' social capital facilitates the transfer of knowledge within MNCs.

Apart from social capital, we posit that psychological capital may affect knowledge transfer in MNCs by enabling the proactive sharing of information, skills and competencies as it has been theorised to be important for successful leadership in MNCs (Youssef-Morgan & Luthans, 2013). Psychological capital comprises four personality traits – efficacy, hope, optimism and resilience – which positively impact job attitudes and on-the-job behaviour (Avey et al., 2011) as well as individual performance (Peterson et al., 2011). The argument for the relationship between psychological capital and knowledge transfer is developed on recent findings which highlight the importance of individual characteristics for the transfer of knowledge (S. Wang & Noe, 2010). It can be assumed that the different personality traits represented by psychological capital may be relevant to managers' performance in international assignments since they are conducive of the individual's cross-cultural adjustment (Peltokorpi & Froese, 2012). In particular, different personality traits of the individual can either facilitate or hinder the learning of cross-cultural competencies (J. P. Johnson et al., 2006), which are important for performing abroad.

Perceived self-efficacy reflects the beliefs of individuals about what they can do with what they (in terms of competencies) possess in different circumstances. People with strong beliefs in their skill set view difficult tasks as challenges rather than as threats

which need to be avoided (Bandura, 2003). Thus far, self-efficacy has not been linked with the process of knowledge transfer in cross-cultural relationships, although it was associated with cross-cultural adjustment (Harrison et al., 1996). Further, Early et al. (2006) suggested that an expatriate's self-efficacy should lead to improved effectiveness. In order for hopeful thinking to occur (i.e. the second dimension of psychological capital), two elements need to be present: first, the perceived ability to generate pathways to a goal and, second, the perceived determination to follow those pathways. While routes serve as a connection between the present time and an imagined future, agency is the motivational component, which involves affirming self-statements (Snyder, 2002). Optimistic people have positive expectations for the future and, when faced with challenges, such people tend to be persistent and confident (Scheier & Carver, 1992). In the wake of cross-cultural misunderstandings (which are likely to arise due to profound cultural, societal and historical differences), optimistic expatriates may expect good outcomes. Resilience is defined as "the capacity of the individual to effectively modulate and monitor an ever changing complex of desires and reality constraints" (Block & Kremen, 1996). There is considerable evidence that resilience, once believed to be a rare dispositional trait, is open to change and development (Bonanno, 2004; Masten & Reed, 2002). Resilient expatriates may have a staunch sense of reality. Due to cultural differences and challenges related to cultural adjustment, expatriate jobs are stressful and so resilience may help in alleviating stressful situations (Luthans et al., 2010) when transferring knowledge.

Recent studies have started to relate various individual's resources – psychological capital, social capital and intellectual/human capital (Hmieleski et al., 2015) – as constituents of an individual's global mindset, comprising the knowledge, cognitive and psychological attributes of expatriates (Javidan & Teagarden, 2011) and were found to advance the individual's career (Direnzo et al., 2015). A level of interdependence between these different forms of capital was also suggested by studies relating certain expatriates' personality traits (e.g. Big Five personality dimensions, agreeableness, hedonism, sensory processing sensitivity) with the network structure of their relationships and social capital (Andresen et al., 2017; Klein et al., 2004; Osman-Gani & Rockstuhl, 2008) in support of their adjustment and performance in overseas assignments. Specifically, positive individual characteristics were found to enable effective leader–follower relationships across cultures in support of leader–member exchange (Story et al., 2013). This suggests that positive individual characteristics might be enhancing the relationship-building capacity of expatriates, helping them accumulate social capital and thus further enable KT and RKT within MNCs.

With regard to the above reasoning, it is proposed that expatriates' positive psychological capital could play an important role in supporting knowledge flows in MNCs, similarly to social capital. Moreover, there might be an interplay of the social and psychological capital dimensions, which has not been addressed in the existing literature. The following research questions are thus posed:

RQ1: *How does an expatriate's psychological capital facilitate KT and RKT in MNCs?*

RQ2: *How does the interplay of an expatriate's psychological capital and social capital facilitate KT and RKT in MNCs?*

3 METHODOLOGY

3.1 Study design

As the present study is exploratory in nature, a qualitative approach was chosen (Yin, 1993) to capture the challenges of transferring knowledge across culturally dissimilar societies and assess the role of psychological and social capital in KT and RKT. This approach is appropriate for investigating novel contexts, providing insights into relationships, underlying mechanisms and 'how things get done' (Anteby et al., 2014). A multiple case study design was used to answer the research questions. This approach has been recommended (Rugman & Verbeke, 2001) and used extensively in the MNC knowledge transfer context (Fletcher & Prashantham, 2011; Mäkelä et al., 2007). Further, cross-case analysis contributes to the greater generalisability of research findings (Eisenhardt, 2014; Eisenhardt & Graebner, 2007).

3.2 Research setting and selection of the cases

Three Slovenian companies known for their successful internationalisation strategy with well-established subsidiaries in China (but not for more than ten years) were chosen as the focus of the study. The Slovenian-Chinese context was selected due to cultural, geographic and language differences between Slovenia and China, because KT is particularly difficult in conditions of great language, cultural and geographical barriers between HQ and subsidiaries (Lauring & Selmer, 2011; Mäkelä et al., 2012). Further, due to the *guanxi* culture, it is especially difficult for Slovenian expatriates to develop social ties (Tsang, 1998) since only a handful of Slovenian companies are already present in China, making this a unique setting to explore factors influencing knowledge flows in unfamiliar international settings. The selection of companies was made according to two criteria. First, the company should have at least a production plant in China, reflecting a richer transfer of knowledge compared to that of a representative office and, second, the subsidiary should be established for up to ten years, allowing for an expatriate's positive impact on KT to take place (Fang et al., 2010). Eight Slovenian companies fitted both criteria. The selection of the cases was further guided by the Bartlett-Ghoshal (1986) typology of subsidiaries to capture the various types of subsidiaries and corresponding knowledge flows. Five companies were contacted. Three companies agreed to participate in the study, representing three different types of subsidiaries. The selected cases are two large and one medium-sized international company, operating in other countries as well, but with their largest foreign production facility in China (see Table 1 for background information on the companies). To assure anonymity, the companies are referred to as company A, company B and company C.

Table 1: *Background information on the cases and profile of the interviewees*

	Company A	Company B	Company C
Industry	Starters, alternators, electric drive and mechatronic systems	Serge protective devices	Electric motors
MNC type	International	International	International
No. of offshore production subsidiaries	4	2	1
No. of employees	2600	120	1025
Of these, those in China	250–260	20–40	100
No. of expatriates in China	5–6	2	1
Subsidiary role in China (Bartlett&Ghoshal, 1986)	Strategic Leader	Contributor	Implementer
Founding year of Chinese subsidiary	2005	2009	2006
Position of HQ manager	Global Operations Manager	IT & Quality Manager	Head of Assembly Process Engineering
Position of expatriate in China	CEO	Sales manager	CEO
Years in China	7	5	7
Knowledge of Mandarin	No	Yes	No

Based on its company characteristics, the subsidiary of company A, subsidiary A, was classified as a Strategic Leader with low KT and high RKT of technological and R&D knowledge and skills in the segment relevant to the Chinese market. Subsidiary B was a Contributor, with high KT and high RKT of technological knowledge and skills. Subsidiary C corresponded to the Implementer type with high KT and low RKT of technological knowledge and skills.

3.3 Data collection

The data were collected via six in-depth, semi-structured interviews with managers who are directly involved in KT and RKT between HQ and the subsidiaries. In each of the three cases, two managers were selected for the interviews: a senior manager from the HQ responsible for co-ordinating with subsidiaries and overseeing knowledge flows from the HQ to the Chinese subsidiary; and the expatriate (subsidiary manager) located in China initiating RKT back to HQ. As the majority of KT and RKT go through expatriate managers, they were selected as the primary informants from the subsidiaries. In HQ, the managers in most frequent contact with subsidiaries, most knowledgeable of KT and RKT from the perspective of HQ, and aware of the transfer problems as well as the attention HQ pays its Chinese subsidiary were interviewed. This dual perspective enabled us to thoroughly explore the perceptions of knowledge flows and the relevance

of individual capital in KT. Further, it allowed us to obtain the HQ perspective on the role of the expatriate's capital in enabling and nurturing KT. Since all of the interviewed senior managers from HQ had been overseeing Chinese subsidiaries from their very establishment and the expatriates had occupied the managerial position from the outset, they were all aware of the progress made in knowledge flows over the years (see Table 1 for more information on the interviewees' profile). Five interviews were carried out at the HQ premises and one interview via Skype (each lasting approximately 90 minutes). The interviewees were informed about the purpose of the research and requested anonymity.

The data were gathered in two steps. In the first step, the HQ managers (managers A, B and C) were interviewed and the interviews unfolded over three phases. First, general questions about the company and the subsidiary were asked. Second, inquiry was made about knowledge flows with a focus on the ways knowledge is being transferred between HQ and the subsidiary, types of knowledge being transferred and to what extent (conventionally and/or reverse). Third, barriers to knowledge transfer on the individual and organisational level, mitigating strategies, and cultural differences were addressed. The interviewees were asked about specific situations when knowledge was transferred, their personal experience as well as to reflect on the conditions that enabled KT; the manager's perception of the expatriate's characteristics and his capital characteristics.

In the second step, the expatriates in the Chinese subsidiaries (expatriates A, B and C) were interviewed. Open-ended questions enabled us to obtain data about unique, individual experiences and attitudes. The interview questions focused on knowledge flows between HQ and the subsidiaries with an emphasis on the expatriates' role in facilitating this process and shedding light on the capital dimensions. The importance of social capital was established via questions relating indirectly to the three dimensions looking at the social ties, communication styles, trust-building strategies, and perceptions of adjustment to the cultural character (Cook & Wall, 1980; Eisenberger et al., 2001). First, their capital characteristics were generally explored and, second, the specific accounts during the KT process where the capital was relevant. The expatriates described how the situations unfolded and where their personal characteristics proved to be crucial. Based on the existing literature (Block & Kremen, 1996; Luthans & Youssef, 2004), psychological capital dimensions were revealed through questions about behavioural responses in challenging and stressful situations, strategies used to achieve desired goals, and ways of dealing with failures, thereby helping to determine the expatriate's personality characteristics.

3.4 Data analysis, validity and reliability

Data were analysed according to the guidelines of qualitative research and several steps were taken to assure the validity and reliability of the findings (Myers, 2013; Schreier, 2012). An interview guide based on the literature review was prepared prior to the conversations. All interviews were recorded and the data were transcribed. The transcripts were reviewed by the respective executives. Following the guidelines for case study research (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 1993), in the first phase

of the data analysis the authors read the material multiple times to identify terms and categories within each case indicating specific patterns of thought, then independently analysed the data and, finally, compared their findings. This phase included becoming familiar with the contents and writing observations. During the process, the authors listened to the recorded conversations several times to reveal any additional information (e.g. laughter, pauses in thinking, sequencing of the information given, and the richness of the examples). The authors sorted the data according to pre-assigned categories (e.g. general information related to knowledge, directions of knowledge transfer, challenges related to cultural differences, the role of expatriates in knowledge transfer). In the second phase, the specific examples of the theoretical dimensions of an expatriate's capitals were accounted for in the texts and the patterns of relationships between an expatriate's capitals and KT and RKT were revealed. Finally, the transcripts of the different interviews were compared to shed light on similarities and differences in the responses. The within-case analysis uncovered the relationships between constructs within a single case as well as supporting and contrasting views on the relationships between HQ and the subsidiaries, whereas the between-case analysis revealed similarities and differences among the cases.

4 RESULTS

Results of the interview analysis showed that the key channels for KT and RKT in all three cases are expatriates since the majority of knowledge is transferred through them, approximately 80%–90% on a daily basis. We organise our findings to determine first the role of psychological capital in enabling KT, comparing all three cases. We then investigate the relationship between psychological and social capital in enabling KT and RKT, taking different subsidiary types into consideration.

4.1 The relationship between psychological capital and KT

In all three cases, managers from HQ emphasised that for knowledge to transfer to China expatriates need specific personal characteristics (for examples of statements, see Table 2). Manager A stressed self-efficacy, resilience and optimism as being important expatriate personal characteristics needed for effective KT. Manager B explained that expats in China need specific energy, stamina and grit to face the difficulties. He also indicated self-efficacy, resilience and optimism as particular expatriate characteristics being conducive to KT. Manager C further clarified the personal characteristics that he believed are valuable for an expatriate to successfully transfer knowledge, thereby explicitly referring to three components of psychological capital – self-efficacy, resilience and optimism – as being important for KT, whereas hope was not mentioned at all.

When the expatriates from all three companies explained how they assured the transfer of knowledge, they all pointed to specific personal characteristics (for examples of their statements, see Table 2). Expatriate A stated that his personal characteristics are important for enabling KT, namely, being persistent, optimistic, trustworthy, displaying high self-

efficacy, and resilience. Expatriate B also explained which personal characteristics in his view are important for expatriates to enable KT, stressing self-confidence and resilience. He admitted being an extreme pessimist in private life, suggesting his levels of psychological capital were lower than he would have desired, which might be limiting KT to Chinese subordinates. He mentioned missing the things needed to succeed (e.g. resources, the ability to give employees a higher salary) and difficulties in KT on several occasions during the interview. With respect to expatriate C, we were able to estimate his psychological capital through his reflections on everyday experiences he made in the interview. We concluded he is positive, self-confident, stubborn, fair, respectful, displaying self-efficacy, optimism and resilience.

In all three cases, managers in HQ expressed that the personal characteristics of self-efficacy, optimism and resilience (pertaining to psychological capital) are important for successful KT. The fourth component of hope was not brought up during the interviews, and was thus explicitly not seen as important. The findings suggest that not all components of psychological capital are equally important and that some personal characteristics of expatriates are more important than others. The expatriates in all three cases pointed to self-efficacy, optimism and resilience as being important and never referred to hope as important, confirming the view of the HQ managers.

Table 2: *Statements supporting the relationship between expatriates' psychological capital and KT*

Psychological capital dimensions	Examples of statements from the interviews
self-efficacy	<i>"For an expat, it is most important that he is competent for KT and that he is self-confident and decisive.... He has to be positive, has to possess knowledge ... Chinese employees expect he will transfer knowledge from HQ." (Manager A)</i>
self-efficacy, resilience, optimism	<i>"You should be persistent, trust you own abilities, optimistic ... constantly look for ways to achieve goals... Expats working in China have a certain style, energy ... every day is a challenge, this challenge has to drive you, it gives you energy." (Manager B)</i>
self-efficacy, resilience, optimism	<i>"An expat has to be optimistic, positive ... convinced of his own abilities ... persistent, he mustn't get scared." (Manager C)</i>
self-efficacy	<i>"You have to be superior, good at several things, then they respect you ... you are like a father figure to them. Then they look up to you and listen to your advice." (Expatriate A)</i>
self-efficacy, resilience, optimism/pessimism	<i>"You have to be an optimist, a merry person, like a colleague to the employees and business-savvy, knowledgeable, very structured... I believe in winning ... I am convinced I have the abilities to succeed ... if we have managed so far, we will solve this problem too... In my private life, I am an extreme pessimist..." (Expatriate B)</i>
self-efficacy, resilience, optimism	<i>"In the beginning, it was difficult, but I was stubborn... when problems appear, it is always better to be in a good mood, not worried, I say to myself, if we have come so far, and solved so many things, we will solve this one too. ... Here, I know I depend on myself, success depends on me ... I am glad I came to China, it is such a powerful experience" (Expatriate C)</i>

4.2 The relationship between psychological capital and social capital facilitating KT and RKT

When discussing the barriers to KT, the interviewees said that relationships with their subordinates are important for successful KT, confirming the role of social capital. Managers in all three companies stated there are substantial limitations on building up social capital in the particular Chinese context (for examples of statements, see Table 3). Manager A expressed several concerns about building social capital with Chinese employees, directly referring to limitations on building structural and relational types of social capital. The cognitive dimension was not regarded as crucial. Manager B also recognised limitations on building all dimensions of social capital with Chinese employees and directly referred to social capital as being important for KT. Manager C outlined several limitations on social capital building specific to China, noting they rely extensively on the expatriate to transfer knowledge. Barriers to building structural social capital and relational social capital were recognised during the interview, as well as limitations on building cognitive social capital.

Expatriates revealed a different view on social capital building with Chinese employees. In fact, throughout the interviews, expatriate A and C did not express any particular difficulties with relationship building. Expatriate A referred to his relationships with the Chinese subordinates as friendly, trusting, thus expressing a high level of structural and relational social capital. Also from the interview with expatriate C, no particular problems were noted in respect of social capital building. The answers of expatriate C indicate high structural and relational social capital, whereas cognitive social capital was not referred to as being crucial. On the other hand, when asked about relationships with Chinese employees, expatriate B expressed difficulties establishing structural and relational social capital. Expatriate B specifically associated relationship-building problems with the KT problems occurring on a daily basis. However, on the cognitive dimension of social capital he demonstrated a high level of cognitive social capital. Expatriate B explained that Chinese employees do not accept knowledge from him without close relationships (structural social capital) and trust (relational social capital) first having been established, and despite the fact that knowledge is highly explicit, with everything being written or even recorded, it does not seem to stick with the employees. Further, the expatriate expressed substantial problems with KT despite having a high level of cognitive social capital, leading us to conclude that cognitive social capital is insufficient for successful KT and that the dimensions of social capital vary in importance.

Table 3: *Statements expressing the level of difficulty in building social capital and its impact on KT and RKT and the impact of psychological capital on social capital in support of KT*

Difficulties in social capital building for KT and RKT and impact of psychological capital on social capital	Examples of statements from the interviews
Difficulties to build structural and relational social capital, cognitive not important	<i>"The Chinese will never let you into their families, the family is important for them ... You can never trust them completely, you have to monitor their work constantly ... For a leader, adjusting to the Chinese culture is not critical, though... They don't expect you to speak Mandarin."</i> (Manager A)
Difficulties to build structural, relational, and cognitive social capital, causing difficulties in KT	<i>"Socialising with Chinese employees is uncommon ... I only meet with two Chinese for drinks after work ... but I never meet with their families ... Chinese employees don't particularly respect foreign managers ... You have to be careful not to offend them ... You can't trust them completely ... When going to China, you have to accept their culture, the customs, food, there are several things about the culture you have to grow fond of ... Knowledge of language is sometimes a problem as a lot of understanding and knowledge gets lost in translations from Slovenian, first to English, and then to Mandarin, due to specific technical terms. Sometimes, due to English technical terms we do not understand each other, even though we think we are pretty good at English. It takes a lot of communication to sort out what everyone thought and what was then the end result.... In communication, it leads to situations where we don't understand each other. It takes hours to resolve the issue."</i> (Manager B)
Difficulties to build structural, relational, and cognitive social capital	<i>"It is more difficult to establish close personal relationships ... The Chinese strictly separate personal and business life ... they never invite me home ... even expats socialise more with other Slovenian and European expats.... You can't trust the Chinese, you have to oversee their work all the time.... It is important to know the appropriate behaviour and language ... it is difficult for an expatriate to learn Mandarin."</i> (Manager C)
No difficulties to build structural and relational social capital, in support of KT and RKT, cognitive not important	<i>"We have friendly relationships ... they talk to me about their families ... they invited me to their weddings ... I can trust them ... I trusted them from the very beginning... I am a very trusting person. And they trust me ... I don't speak Mandarin ... I don't think there are cultural differences really... they work for money to feed their families like we do.... Good, warm and close relationships with people at HQ are important for sharing knowledge. I can get in touch with them quickly."</i> (Expatriate A)
No difficulties to build structural and relational social capital, in support of KT, cognitive not important	<i>"I am communicating a lot with my co-workers ... we go together for lunch, communication is friendly, open ... I can trust them, and they trust me ... I tried to learn Mandarin, but it is difficult to learn ... it is good to know the Chinese customs, but that is not vital ...if you are fair and respectful, they accept you and respect you."</i> (Expatriate C)
Difficulties to build structural, relational social capital, causing difficulties in KT, but high level of cognitive social capital, no difficulties in RKT	<i>"Close and friendly relationships are rare; only possible with a few Chinese Employees need an authoritative leader, which is due to their culture ... I can trust just one Chinese manager, for the rest, you have to monitor their work closely and give explicit and detailed instructions. They follow your guidelines for a day, but then return to the way they worked before ... they adjust the work according to how it suits them best.... You have to build a team that is better than you, but you need to have the resources to do that, which some MNCs have, but we don't... I have been married to China for the last 15 years, so to speak ... I speak Mandarin."</i> (Expatriate B)

Personality helps to build trust in support of KT	<i>"An expatriate builds trust in his subordinates when they see he is decisive and can quickly provide a solution when needed. If he is not decisive, he is not trustworthy..."</i> (Manager A)
Personality helps to build trust in support of KT	<i>"You have to trust yourself that with your personal characteristics you will find a way to build relationships with Chinese employees."</i> (Expatriate C)

For RKT, which is important in company A with subsidiary A in the role of Strategic leader, and in company B with subsidiary B in the role of Contributor, the expatriates emphasised the role of their social capital vis-à-vis HQ (for examples of statements, see Table 3). Expatriate A stated that close relationships with HQ are important. He explained that nurturing relationships when meeting in person in China, taking care of people, when they come for a visit, and building trust is of the greatest importance for subsequent RKT, addressing the relevance of social capital for HQ. Expatriate B explained the importance of raising HQ awareness of the value of the subsidiary's knowledge through relational and structural social capital. This was confirmed in the interview with manager B, who recognised expatriates' frequent communication with HQ to enable RKT. The results indicate that the focus of social capital building is following the direction of knowledge flows. In the case of KT, expatriates focus on building relationships with Chinese employees, whereas for RKT expatriates have to maintain close relationships with HQ. The level of intercultural barriers inhibiting social capital varies for two reasons, first in the case of KT, expatriates are building social capital, whereas for RKT they are maintaining already established social capital and, second, intercultural and language differences are not present as the expatriate is transferring knowledge to HQ, with geographical distance remaining relevant.

Further, in the interviews the managers implicitly stated that personal characteristics help expatriates overcome the cultural differences and build relationships (for examples of statements, see Table 3). Manager A sees expatriate A's personality as helping him to build relational social capital to facilitate the transfer of knowledge. Similarly, expatriate A explained that perseverance (a concept similar to resilience) and a positive attitude (optimism) enable him to maintain high structural and relational social capital with HQ for RKT. During the interview, expatriate C also explained that Chinese employees trust him for his positive characteristics, directly linking psychological capital to relational social capital. Although Manager B indicated that self-efficacy and resilience help an expatriate build up trust, when recognising the actual dimensions of his psychological capital expatriate B talked about pessimism in his private life, leading us to conclude that a lack of psychological capital dimensions might also be detrimental to his ability to build structural and relational social capital.

For the expatriates, asking them about their everyday challenges and experiences allowed us to assess how much of particular psychological and social capital dimensions they themselves display, enabling potential problems in psychological and social capital impacting KT and RKT to be uncovered. Expatriates A and C demonstrated no problems in building structural and relational social capital, further indicating that cognitive social capital was not particularly relevant for KT and RKT. While expatriate B expressed a high

level of cognitive social capital, he nonetheless indicated problems in building the structural and relational dimensions of social capital. Interestingly, in terms of psychological capital, expatriates A and C demonstrated high levels of self-efficacy, resilience and optimism, whereas expatriate B showed a lower level of self-efficacy, and higher pessimism. Further, in the interview expatriate B directly related problems with structural and relational social capital to problems in KT, whereas expatriates A and C attributed no problems to the social capital dimensions. Expatriates A and C related personal characteristics to their capability to build trust with their subordinates.

In addition, only the interviewees in company B stated that cultural barriers are importantly inhibiting KT and RKT⁴, allowing us to conclude that a lack of positive psychological capital leads to limited social capital, which is necessary for overcoming cultural barriers. Expatriates with a higher level of positive psychological are thus better at building social capital and therefore better at overcoming the barriers pertaining to the different cultural contexts of the HQ and the subsidiaries.

5 DISCUSSION

The present study employed a qualitative approach to investigate the role of personal capital (i.e. positive psychological and social capital) in facilitating KT and RKT within MNCs. The analysis revealed that psychological capital might better equip expatriates to overcome barriers to KT. Our results indicate that three dimensions are particularly relevant; self-efficacy, optimism and resilience. Expatriates with a higher level of psychological capital dimensions enable KT since employees look to them for advice, guidelines and solutions to problems. The reasons this may occur is that they believe a positive, optimistic leader is more likely to help them achieve positive individual outcomes like satisfied goals or increased job satisfaction, well-being or salary (Newman et al., 2014). This provides an interesting avenue for future research.

Further, the analysis revealed the impact of psychological capital and social capital on KT and RKT should be addressed simultaneously because psychological capital was found to influence the creation of social capital. The indirect impact of psychological capital on KT and RKT through social capital has previously not been explored in the literature, although some recent studies suggested that positive correlations between social and psychological capital exist (Hmieleski et al., 2015; Javidan & Teagarden, 2011). The literature predominantly treats different personal capitals as unrelated, albeit the findings are inconclusive (Luthans et al., 2004) as social capital was found to be dependent on the

⁴ The interviewees all agreed that multicultural barriers were experienced in all three cases, but the level to which they are present varies, proving that the cases are ideal settings for the research. In company A, geographical distance between HQ and the Chinese subsidiary was reported as an important barrier, although other multicultural barriers were not found to be very present. In company B, besides geographical distance between HQ and the Chinese subsidiary language barriers and differences in national culture were found to be very present. For company C, besides geographical distance between HQ and the Chinese subsidiary, language was expressed as the greatest challenge to sharing knowledge.

motivation and characteristics of individuals (Kwon & Adler, 2014) and, together with psychological and human capital, constitutes the individual's global mindset (Javidan & Teagarden, 2011). In our study, expatriates who expressed higher psychological capital reported fewer limitations on their social capital building than the one with a lower level of psychological capital. Certain personality characteristics such as agreeableness and hedonism have already been recognised as antecedents of individuals' social capital (Klein et al., 2004). In addition, positive individual characteristics were found to enable effective leader–follower relationships across cultures in support of leader–member exchange (Story et al., 2013). Research thus indicates that employees with higher positive psychological capital are better at building relationships in a global context (Youssef-Morgan & Luthans, 2013). Therefore, based on both previous research findings and our study we suggest that positive psychological capital can lead to a greater relationship creation and increased social capital. In fact, one's positive psychological characteristics help their social capital to grow, as the managers in the interviews expressed. However, the impact of psychological capital on social capital may go well beyond KT and RKT processes as social capital also affects other employees' outcomes like performance, creativity, job satisfaction, happiness, health and well-being (Borgatti & Foster, 2003), which are all understudied in the literature and thus in need of further research.

Another important observation from our study is that different types of social capital might vary in importance for KT vs. RKT. Our research findings suggest that, in the case of RKT, expatriates who focus on maintaining high social capital with the employees in HQ to assure knowledge inflows to the parent company are relevant in subsidiaries that play the role of a Strategic leader (Company A). For KT, developing relationships with employees within the Chinese subsidiary is vital for assuring inflows from the parent company to the subsidiary playing the role of an Implementer (Company C). For a subsidiary in the role of Contributor (Company B), both types of social capital are important. The findings complement previous research which found that level of social capital needed and its forms depend on the relationship between HQ and the subsidiaries (Kostova & Roth, 2003). Other types of social capital may also be important in MNCs, like relationships with other subsidiaries to enable KT within the whole MNC network. Further, relationships with external stakeholders in the host country are valuable for enabling knowledge spillover effects to the broader community (Golob, 2017). A typology of social capital could provide a fresh lens for social capital research, as already mentioned in the literature, in relation to different forms of communities (Kwon & Adler, 2014), different levels of social capital ownership (Kostova & Roth, 2003) etc.

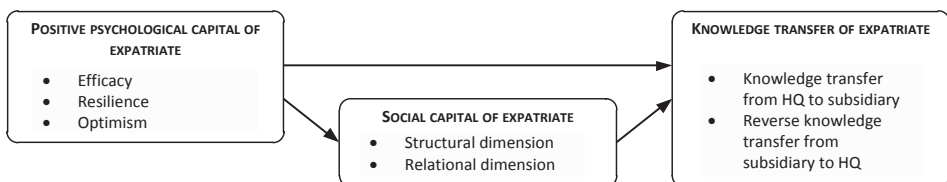
The results further showed that not all dimensions of psychological and social capital are equally important, suggesting they should be investigated separately. In fact, Vogelgesang and co-authors (2014) in their study on psychological capital as part of a global mindset called for future research to investigate whether certain dimensions of psychological capital are more relevant in the global context. In our research, the dimensions of self-efficacy, resilience and optimism were found to enhance the creation of structural and relational social capital. Further, the hope component of psychological capital was never mentioned during the interviews as being an important characteristic for supporting KT

or RKT. This might be due to expatriates who work in the volatile and highly competitive Chinese environment demanding prompt responses to current challenges and because relying extensively on outside help erodes their value as a leader in the eyes of Chinese employees. Another explanation might be that hope suggests adopting a more long-term view of the subsidiary's performance. Yet, in our cases all of the expatriates view their jobs as temporary, lasting only for a few more years.

Similarly, the cognitive dimension of social capital, reflecting knowledge of Chinese business customs, behaviours and the Mandarin language, was regarded as less important for enabling KT and RKT. In fact, the expatriate with the highest dimension of cognitive social capital and knowledge of Mandarin reported several problems related to KT and RKT. As for building relationships with external stakeholders like local officials and business partners, cognitive social capital along with structural and relational social capital were found to be most important. Previous research recognised that different dimensions of social capital hold varying importance when comparing inter- and intra-organisational KT in MNCs, finding that a lack of the cognitive dimension is more detrimental to internal KT than external KT in conditions of high cultural distance (van Wijk et al., 2008). In our research, the cognitive dimension was determined to be less important in enabling KT and RKT between HQ and the subsidiary, whereas in relationships with customers and other external stakeholders it was recognised as crucial for establishing relationships. This might be due to Chinese employees not expecting expatriates to adjust to the local customs, but to exercise leadership abilities and use positive psychological capital, which entails an interesting question for future research. Future research should address whether different dimensions of social capital have different levels of importance for building specific types of relationships and which dimension dominates when creating a certain type of social capital.

Based on the research results and the above reasoning, the proposed relationships between positive psychological and social capital dimensions and their impact on KT and RKT are summarised in the model shown in Figure 1.

Figure 1: *Graphical representation of the relationships between personal capital and knowledge transfer*



6 CONCLUSIONS

6.1 Theoretical contributions

The present study makes the following contributions to the existing body of knowledge. First, it contributes to the literature on the expatriate's boundary spanning role (K. L. Johnson & Duxbury, 2010; Mäkelä, 2007; Reiche et al., 2009) by introducing three positive individual characteristics (self-efficacy, optimism, resilience) comprising the expatriate's psychological capital as individual-level antecedents of knowledge sharing. To the best of the authors' knowledge, this is the first study to integrate psychological capital and its dimensions as antecedents of an expatriate's KT and RKT between HQ and subsidiaries abroad. In this sense, it advances the global leadership literature on the influence of the expatriate's psychological capital on his/her cross-cultural adjustment and competencies (Vogelgesang et al., 2014; Youssef & Luthans, 2012). Our findings complement the literature on the expatriate's social capital, which shows the positive impact high social capital available through strong, trusting relationships has on KT in MNCs (Mäkelä, 2007; Nahapiet & Ghoshal, 1998). The integration of positive psychological capital, rooted in positive psychology, in the expatriate literature is timely due to the increasing demands imposed on expatriates to combat the fierce competition in the diverse global market (Horak & Yang, 2016).

The study also advances the literature on international knowledge management in MNCs by showing how the relevance of different forms of capital differs based on subsidiary types and the nature of knowledge flows. Building on the Bartlett-Ghoshal (1986) typology of subsidiaries, it reveals how in the case of the Implementer type (company C) psychological capital helps build social capital with host-country nationals to enable a high level of KT. A Contributor (company B) focuses on KT and RKT and here psychological capital aids in attracting attention and making HQ aware of the newly created knowledge. For a Strategic Leader (company A), psychological capital is important to sustain sufficient attention in HQ for RKT as KT diminishes, and to maintain sufficiently high social capital with HQ to support RKT.

An empirical contribution arises from the use of a qualitative research design. The qualitative multiple case study approach enabled us to investigate psychological capital in a novel context, providing insights into the relationship between different individual capital dimensions as underlying mechanisms behind KT and RKT within MNCs. It enabled us to uncover 'how things really get done' (Anteby et al., 2014). It allowed us to gain an in-depth understanding of the positive individual characteristics behind the capacity of individuals to build relationships that stimulate KT behaviour, thereby obtaining a richer comprehension of the studied phenomena.

6.2 Practical implications

The study shows that expatriates' personal characteristics and capabilities for developing trusting relationships are crucial for KT, both conventional and reverse. Important

questions arise for human resource and talent management in organisations: how to recruit people with high psychological and social capital, whether to recruit them or develop them internally. In the recruitment phase, companies should carefully select managers for offshore assignments (Tsang, 1999), particularly focusing on their personal characteristics: self-efficacy, resilience and optimism already during the selection stage. Psychological tests should be used to establish the levels of relevant capitals and determine the appropriateness of a certain candidate for positions abroad to increase the probability of the expatriate being successful, which would benefit the exchange of resources, specifically knowledge.

As both social and positive psychological capital are open to development, it is also beneficial for talent managers to ask how to develop personal capital internally. Further development of an expatriate's social and psychological capital is in the company's interest because it facilitates KT. Therefore, HRM departments could develop trainings to recognise deficiencies in capital dimensions and formal programmes in which an expatriate would work with a professional to try to increase specific capital dimensions. The introduction of capital development programmes would also help ensure a pool of candidates eligible for expatriate jobs. Social capital development programmes should include workshops on cross-cultural sensitivity, formally building and supporting communities of practice, organising informal meetings, and sending potential candidates out on short-term assignments.

In management development programmes, greater attention should also be paid to the development of psychological capital among managers chosen for foreign assignments as such capital helps and a lack of it hinders the development of social capital and can limit the transfer of knowledge. Psychological capital is developable through different strategies (Luthans et al., 2007), particularly experiences gained, training and development, learning from positive situations, feedback, an ethical and trustworthy culture as well as managing negative situations to become developmental experiences (Luthans et al., 2006; Reichard et al., 2013). This might be especially relevant for expatriates on first offshore assignments in situations of no previous relationships in place to build on, and in cultures like the Chinese where *guanxi* guides the personal and professional life of Chinese employees and is quite challenging for expatriates to develop (Buckley et al., 2006).

6.3 Limitations

Like all research, the present study is not without limitations. The first concerns the small sample size which limits the generalisability of the findings. Nonetheless, it represents 40 per cent of the whole population, where all companies fit the following criteria: a fairly developed internationalisation strategy (i.e. a production plant in China); up to 10 years of the expatriate's presence in China. From the study's standpoint, this is important because it allowed us an insight into expatriates' perceptions of knowledge flows and culture that were created over a longer time. In addition, the small sample enabled a thorough exploration of the concepts, complementing the few existing studies that employed a

case study approach (J. Y. Yang et al., 2011). Second, the sample is limited to Slovenian companies and therefore only Slovenian perceptions and experiences were accounted for. In the future, researchers could consider expatriates from different countries to account for differences across cultural contexts (Michailova & Mustafa, 2012). A comparison of the responses of managers with a global career with managers who have a single foreign country experience could provide greater insights into the role of specific capital dimensions. Fourth, the research documents two types of knowledge transfer: from HQ to Chinese subsidiaries, and vice versa. Scholars may want to explore the flows between Chinese subsidiaries and subsidiaries in other locations as well (Buckley et al., 2003; P. Wang et al., 2004). Finally, as the Bartlett-Ghoshal typology (1986) of subsidiaries provided the sampling framework, it needs to be mentioned that one type of subsidiary, the Black Hole, was not included, since none of the companies fitted the criteria.

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COHESION POLICY AND DEVELOPMENT PRIORITIES IN SLOVENIA

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Received: November 13, 2016

Accepted: August 1, 2017

ABSTRACT: *Slovenian Smart Specialization Strategy was adopted in 2015, identifying key priority areas of the country's future Research, Technology Development and Innovation (RTDI) policy. The aim of this paper is to find how well these areas correspond to the past development priorities in Slovenia. Since they have never been explicitly determined before, this paper seeks to identify them ex-post, based on the analysis of sectoral distribution of firm-level data on cohesion policy subsidies, distributed to firms for R&D activities between 2004 and 2011. We find that as high as 76% of subsidies going to manufacturing firms were concentrated in only seven sectors, which are in fact consistent with the recently defined future RTDI priority areas. This contributes to our understanding of cohesion policy in practice by recognizing that despite no explicitly identified priority sectors before 2015, cohesion R&D support in Slovenia has in the past been successful in identifying and promoting sectors which have later proved to be the most dynamic and promising parts of the Slovenian economy, and which still form the backbone of its current RTDI strategy.*

Keywords: *RTDI Policy, smart specialization, sectoral analysis, priority sectors, European Cohesion Policy*

JEL classification: E61, O25, R58

DOI: 10.15458/85451.63

1. INTRODUCTION

Slovenia has recently identified key priority areas for its Research, Technology Development and Innovation (RTDI) policy as part of the preparation of the Slovenian Smart Specialization Strategy² (also named S4). They were based on two comprehensive empirical studies³, which focused on the international competitiveness of specific economic activities and product groups. The studies took into account several aspects of competitiveness to determine key economic activities in Slovenia: technological specialization, analysis of comparative export-related advantages, the attractiveness of a specific area in terms of foreign investments, and dynamic analysis of performance in terms of productivity growth and export performance, as well as the untapped export-related potential at the level of products in comparison to the best performing EU Member States (GODC, 2015, p. 9). Based on the obtained data, key areas of the Slovenian economy were identified, forming

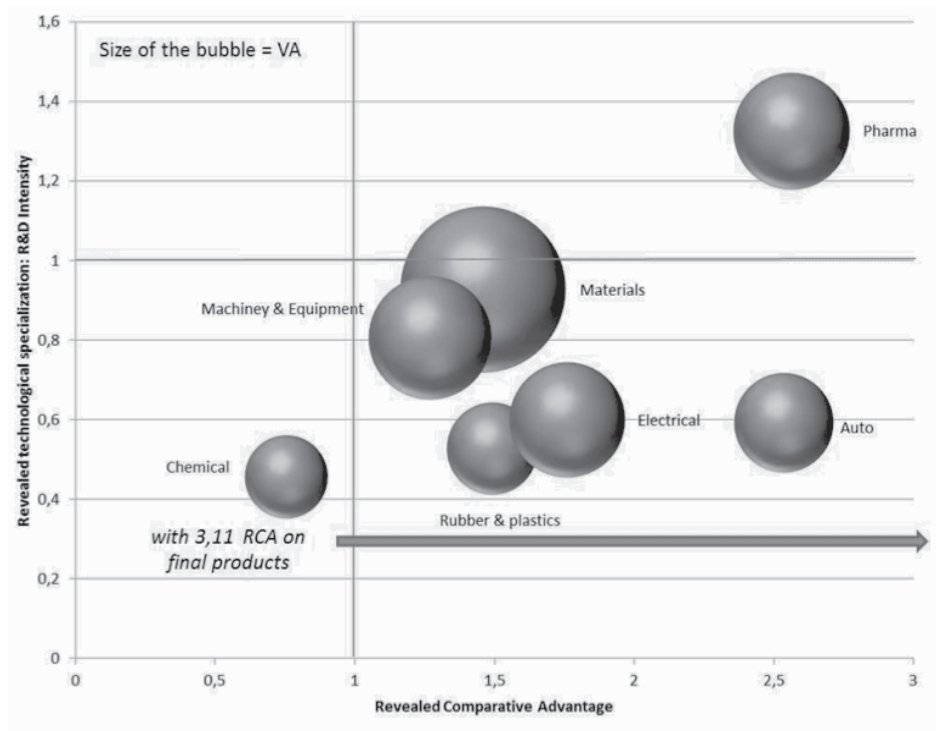
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² "Smart specialisation is a platform for concentrating development investments in areas where Slovenia has the critical mass of knowledge, capacities and competences and where there is innovation potential for placing Slovenia within global markets and thus enhancing its recognisability." (GODC, 2015, p.5)

³ Burger and Kotnik, 2014 and FIDEA, 2014.

“the backbone underpinning S4”. (ibid, p. 10). They are displayed in Figure 1 as economic activities with revealed comparative advantages in export (RCA⁴ above 1): Manufacture of Chemicals, Materials, Machinery and Equipment, Rubber&Plastic Products, Electrical Equipment, Automobile Industry, and Pharmaceuticals. The figure also demonstrates that all areas, with the exception of pharmacy, are technology-wise lagging behind the leading European countries.

Figure 1: Revealed comparative and technological advantage of key priority areas of RTDI policy, identified in Slovenian Smart Specialization Strategy (S4)



Source: GODC, 2015, p10

In view of the recently defined key areas of the S4, this paper seeks to find how they are aligned to development priorities of the Slovenian past RTDI policy. Has the ball game changed now that the priority sectors have been explicitly identified for the first time or has the policy focus proven to be consistent in the long term? The first question to ask is if such a focused approach to supporting RTDI existed at all in the past, or was it carried out on a purely horizontal basis.

⁴ RCA is a measure of revealed comparative advantage in export, calculated as $RCA = (EXP_{ij} / EXP_{it}) / (EXP_{nj} / EXP_{nt})$ where i is country index, n stands for set of countries, j is commodity index and t stands for the set of commodities.

The paper is organized as follows: section 2 presents cohesion policy support for firm R&D in Slovenia during 2004 and 2011, by introducing data, summary statistics and basic recipient firm characteristics. Since S4 is a platform for the placement of EU cohesion funds in the 2014-20 programming period, and these funds have also been used (in part) to stimulate the development potentials of Slovenia since its accession to the EU in June 2004, data on cohesion policy subsidies for firm R&D have been chosen for the empirical part of the analysis. Section 3 presents the sectoral distribution of these funds to find whether data on R&D support in Slovenia reveal a specific sectoral pattern which could be used to identify its past priority areas. In section 4 we address the question of a long-term consistency of Slovenian RTDI policy by comparing its priorities over an extended time frame. The last section concludes.

2. COHESION POLICY FOR FIRM R&D IN SLOVENIA

Cohesion policy aims to promote productivity and economic growth, stimulate the creation of jobs and promote investment in the EU regions, with the objective to stimulate a reduction in development disparities and at the same time to promote growth across the European Union. Slovenia has gained full access to cohesion policy after full membership, in the 2004-2006 period, for which €458 was negotiated. In the Financial Perspective 2007-2013, Slovenia was still considered as one region and since its development level was just below the 75% of EU average, it managed to negotiate €4.2 billion of cohesion funds (Kumar, Šlander, 2014). €1.7 billion of these funds have financed activities under the Operational programme »Enhancing the regional development potentials«, from which €402 million were distributed to finance productive investments to increase the competitiveness of Slovenian economy (by financing activities such as research investments, centers of excellence, subsidies and other means of finance for the small and medium sized companies, especially for the acquisition of technological equipment etc.).

Our analysis uses data on a large portion of these funds: cohesion policy subsidies for firm R&D in the period 2004-11 (combined payments from the EU+national co-financing). Table 1 presents basic summary statistics.

Table 1: *Cohesion policy subsidies for firm R&D (EU+national co-financing) in Slovenia between 2004 and 2011 (EUR); number of recipient firms*

Year	Number of recipients/ firms*	Total CP R&D subsidies,paid out to firms (EUR)	Average subsidy (EUR)
2004	9	726,919.47	80,768.83
2005	119	16,346,199.38	137,363.02
2006	255	30,631,232.40	120,122.48
2007	68	13,196,489.80	194,066.03
2008	324	44,745,381.72	138,103.03
2009	283	50,673,385.32	179,057.90
2010	233	81,260,547.68	348,757.72
2011	166	52,754,214.87	317,796.48
Total	1,457	290,334,371.00	199,268.61

Source: data provided by Government Office for Development and Cohesion Policy; own calculation

* A firm winning funds in multiple tenders in the same year is counted once for each tender.

As shown above, a total of €290 million R&D subsidies was paid out to 1457 firms in the 2004-11 period with an average subsidy of €199,269, showing a generally increasing trend since 2004.

Cohesion policy for firm R&D in Slovenia followed two broad goals in the past two programming periods (basic statistics shown in Table 2):

1. Heading / Priority theme 1.1 is dedicated to “*stimulating the development of innovation environment*” in financial perspective 2004-06, renamed to “*firm competitiveness and research excellence*” during 2007-13. During 2004-2011, 184 firms have received subsidies under this priority, in total value of €161 mio, with the overall average subsidy of €873,254. The average subsidy has doubled from the first to the second financial perspective to €1,1 mio as also the cumulative value funds available has increased. Substantial subsidies along with data on average firm size (cca 370 employees) also reveal that relatively large firms with larger projects have been selected to follow this goal. The largest recipient firm had almost 6,000 employees in the year of winning the tender.

2. Heading 1.3/Priority theme 1.2 allocates funds for “*stimulating entrepreneurship in firms*”. Between June 2004 and the end of 2011, a total of 1,015 firms received subsidies in

the total amount of €130 mio. The average subsidy here is substantially smaller, €127,740 for the entire period (though it has increased from €93,243 in 2004-06 period to €146,699 in 2007-11) but also smaller firms were selected in tenders, with an average size of approx. 36 employees. The largest company under this heading had 256 employees in the year of winning the tender.

Table 2: *Cohesion policy subsidies for R&D in Slovenia, paid-out directly to firms (EU+national co-financing), by priority theme in the period 2004-2006 and 2007-2011*

Priority theme	1.1 Development of innovation environment		1.3/1.2 Stimulating entrepreneurship in firms	
	2004-06	2007-11	2004-06	2007-11
Financial perspective				
Number of recipients	51	133	360	655
Subsidies, total (EUR)	27,539,598	133,139,136	33,567,434	96,088,205
Average subsidy per firm (EUR)	539,992	1,101,146	93,243	146,699
Average firm size (nr. of employees)	371.9	367.7	36.0	36.4

Source: data provided by Government Office for Development and Cohesion Policy (GODC); own calculation

To further analyse the characteristics of recipient firms, we merged data on subsidies with firm financial data, which is collected annually by Slovenian Agency for Public Evidence (AJPEŠ) for the entire population of Slovenian firms. 1-person entrepreneurs were omitted from the analysis due to unreliable data reporting and some firms were lost from the database via the data-merging process. This left us with 1,048 cohesion R&D subsidy recipients for which the relevant financial data are available. This number represents 72% of all recipient firms, but they account for €272.4 mio of subsidies, which is 94% of all cohesion R&D subsidies paid out to firms in the period under consideration. Table 3 presents relevant recipient firms' characteristics.

Table 3: Average absolute (in EUR) and relative* (in %) values of selected characteristics for recipients of cohesion policy subsidies for firm R&D one year before receiving funds

Priority	1.1 Development of innovation environment		1.3/1.2 Stimulating entrepreneurship in firms		Cohesion Policy R&D total
	Absolute values	Relative to sector	Absolute values	Relative to sector	Relative to sector
Number of firms	180	180	868	868	1048
Sales	49,350,153	15.32	3,845,845	2.37	4.6
Employment	369	11.69	36.28	2.41	4
Value added	13,478,771	12.63	1,078,511	2.65	3.78
Labour productivity	40,843	1.27	35,307	1.28	1.2
Profit/employment	7,348	2.08	7,099	2.17	2.17
Wages	18,116	1.25	14,266	1.11	1.14
K intensity (Capital/employment)	83,551	1.63	71,051	1.61	1.61
Energy intensity	0.02	0.72	0.02	0.75	0.74
Export share	0.54	2.92	0.33	2.02	2.17
Debt/capital		0.50		0.48	0.49

Source: own calculations based on GODC and AJPES data

* Relative values are based on comparing the characteristics of CP recipients to their sectoral averages, based on 2-digit NACE Rev.2 (similar results are obtained by comparison with 3-digit sectors, see also Jaklič et al., 2012). Value 1 means that the average performance of CP recipients corresponds to that of their respective sector.

Table 3 shows (column “CP R&D total”) how the recipients of cohesion policy R&D support compare to other, non-recipient firms in their respective sector on average (one year before actually receiving cohesion funding to avoid the possible effect of funds on the selected firm characteristics). Data reveals substantial differences: firms winning the cohesion R&D tenders were on average larger (by a factor of around 4), more productive, more profitable (by 2-fold), paid higher wages (by 14%), were more capital intensive (by 60%), significantly more export-oriented (by a factor of 2), less energy-intensive (by a quarter) and substantially less indebted (by a half) than the average firm in their respective sector. **This means that firms receiving cohesion policy support for their R&D activities were above-average performers in their respective sectors even before obtaining subsidies.**

In the same table we also compared characteristics of recipient firms under both priority themes (columns 2-5). There is a notable difference in absolute values of their selected characteristics: firms, funded under priority “1.1. Development of innovation environment” were not only much larger (in terms of sales, employment and value added), but also more productive, more profitable, more capital intensive, paid higher wages on average and exported a larger share of their income.

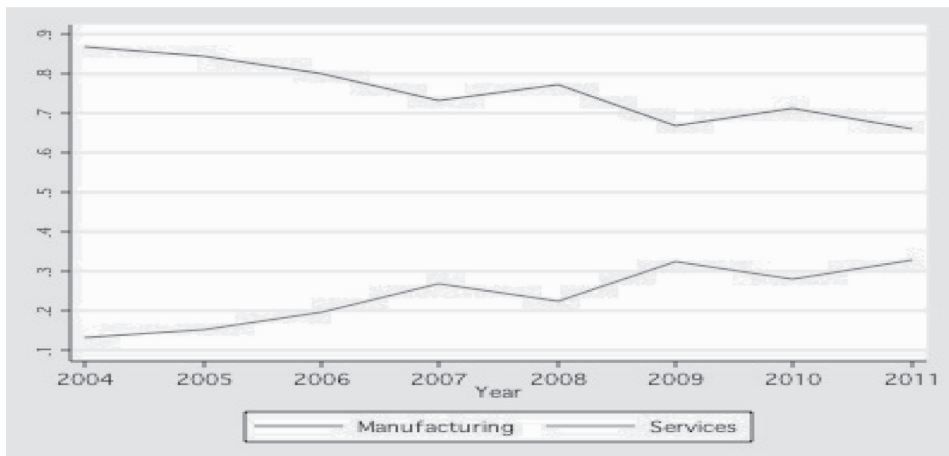
On the other hand, comparing their relative-to-sector results, apart from the relative size dominance and relative-to-sector export advantage of firms funded under priority 1.1 (Development of innovation environment), most of their relative-to-sector results are comparable between firms from both priorities.

3. IDENTIFYING PRIORITY AREAS FOR THE PERIOD 2004-11

This section is focused on identifying the possible sectoral focus of cohesion policy R&D support in the period 2004-11. The allocation of subsidies to sectors (2-digit NACE Rev.2 classification was used in the analysis) was calculated to find whether data reveal a specific sectoral pattern which could identify priority areas of the past RTDI policy in Slovenia or, conversely, to find that it has in the past been carried out as a purely horizontal policy.

To start in broad classification terms, there was a strong focus given to firms in manufacturing sectors (sectors C10-C33) - 72% of subsidies went to 727 manufacturing firms, while 28% of funds went to 322 service firms (sectors D34-S96). Nevertheless, a stable upward trend towards financing R&D activities of firms in the services sector is visible from Figure 2. **The share of funds paid out to services firms has increased from 13% in 2004 to almost 1/3 in 2011, at the expense of a declining share of cohesion R&D funds paid out to manufacturing firms.**

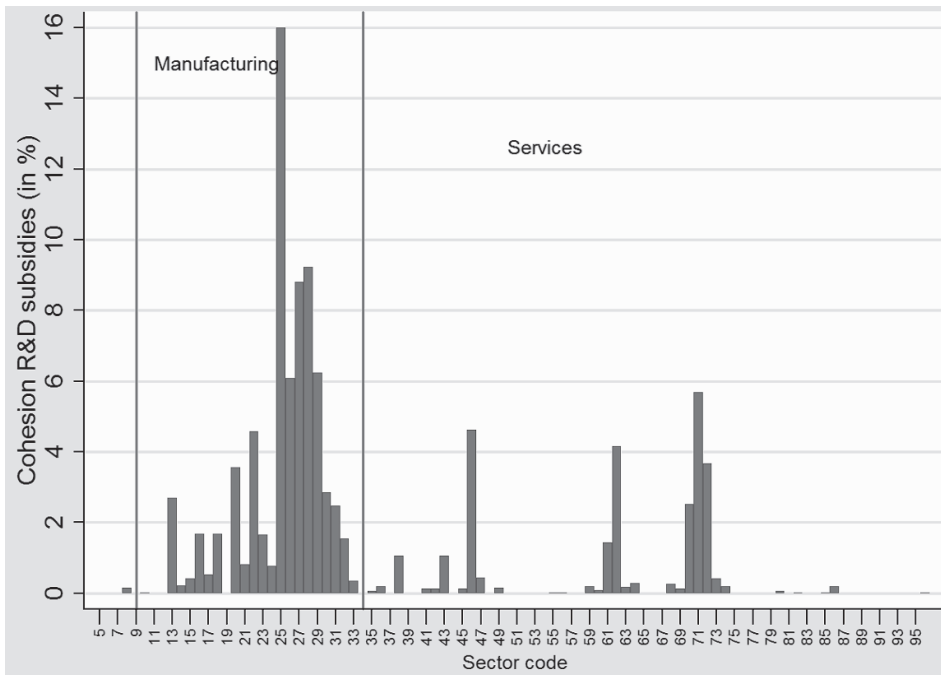
Figure 2: *Distribution of cohesion policy subsidies for R&D in Slovenia, paid out to firms in manufacturing and services sectors in the period 2004 - 2011*



Source: own calculations based on GODC and AJPES data

Further, Figure 3 reveals a more detailed picture of the sectoral distribution of cohesion R&D subsidies. 53 sectors have been funded altogether in the period 2004-11, but the variation of the intensity of subsidies is large and only **11 sectors received more than 3% of the total sum of funds**. Moreover, there is a visible sectoral policy focus here where firms in the 10 most strongly financed sectors received 69% of these funds.

Figure 3: *Distribution of cohesion R&D subsidies paid out to firms between 2004-11 by sector (2-digit NACE Rev.2)*



Source: own presentation based on GODC and AJPES data

The analysis presented in Table 4 shows that although cohesion policy for firm R&D in Slovenia during 2004-11 displayed a horizontal nature (most of the manufacturing sectors - 21 out of 24 - have received some level of financing), there is a visible cluster of sectors with a higher concentration of subsidized firms: as high as **76% of subsidies going to manufacturing** (and 46% of total cohesion policy R&D subsidies) **was distributed to firms in only seven sectors, which we identified as revealed priority areas of the past RTDI policy in Slovenia:**

- Manufacture of fabricated metal products, excl. machinery and equipment (sector C25)
- Manufacture of machinery and equipment (C28)
- Manufacture of electrical equipment (C27)
- Manufacture of motor vehicles (C29)
- Manufacture of computer, electronic and optical products (C26)
- Manufacture of chemicals (C20)
- Manufacture of rubber and plastic products (C22)

Among the services firms, the largest share (close to 6%) of total cohesion R&D subsidies went to firms in Architectural and engineering activities (sector code M71), followed by firms in Wholesale trade (4.6%, G46), Information technology (4%, J62) while 3.7% of total R&D funds went to firms classified in Scientific research and development sector (M72).

Table 4: *Distribution of cohesion R&D subsidies paid out to firms in the 2004-06 and 2007-11 programming periods under priorities 1.1 and 1.3/1.2 by sector (2-digit level NACE Rev.2)*

NACE Rev.2	Priority	1.1 Development of innovation environment		1.3/1.2 Stimulating entrepreneurship in firms		Total cohesion R&D funds
		2004-06	2007-11	2004-06	2007-11	
C10	Food products	0%	0%	0%	0%	0.02%
C13	Textiles	15%	2%	1%	1%	2.69%
C14	Wearing apparel	0%	0%	1%	0%	0.21%
C15	Leather and related products	0%	0%	1%	0%	0.42%
C16	Woods, products of wood and cork	0%	0%	4%	4%	1.69%
C17	Paper products	0%	0%	2%	1%	0.52%
C18	Printing	0%	0%	3%	4%	1.67%
C20	Chemicals, chemical products	3%	5%	1%	2%	3.55%
C21	Pharmaceutical products	0%	2%	0%	0%	0.81%
C22	Rubber and plastic products	2%	1%	8%	10%	4.58%
C23	Other non-metallic mineral products	0%	1%	3%	3%	1.65%
C24	Basic metals	0%	1%	1%	1%	0.76%
C25	Fabricated metal products	6%	11%	19%	26%	16.00%

C26	Computer, electronic and optical products	3%	9%	2%	3%	6.07%
C27	Electrical equipment	5%	14%	6%	2%	8.80%
C28	Machinery and equipment	12%	7%	13%	10%	9.23%
C29	Motor vehicles, trailers and semi-trailers	28%	6%	4%	2%	6.24%
C30	Other transport equipment	6%	4%	1%	1%	2.85%
C31	Furniture	0%	1%	7%	3%	2.47%
C32	Other manufacturing	0%	2%	2%	1%	1.54%
C33	Repair and installation of machinery and equipment	1%	0%	0%	1%	0.34%
D35	Electricity, gas, steam and air conditioning supply	0%	0%	0%	0%	0.06%
E36	Water collection, treatment and supply	2%	0%	0%	0%	0.20%
E38	Waste collection etc	0%	2%	1%	0%	1.05%
F41	Construction of buildings	0%	0%	1%	0%	0.12%
F42	Civil engineering	0%	0%	0%	0%	0.12%
F43	Specialized construction activities	0%	0%	2%	3%	1.06%
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	0%	0%	1%	0%	0.13%
G46	Wholesale trade, except of motor vehicles and motorcycles	0%	5%	4%	6%	4.63%
G47	Retail trade, except of motor vehicles and motorcycles	0%	0%	1%	1%	0.43%
G49	Land transport and transport via pipelines	0%	0%	0%	0%	0.14%
I55	Accommodation	0%	0%	0%	0%	0.01%
I56	Food and beverage service activities	0%	0%	0%	0%	0.01%
J59	Motion picture, video and television programme production, sound recording and music publishing activities	0%	0%	1%	0%	0.19%

J60	Programming and broadcasting activities	0%	0%	0%	0%	0.09%
J61	Telecommunications	0%	1%	2%	2%	1.43%
J62	Information technology service activities	3%	6%	2%	2%	4.15%
J63	Information service activities	0%	0%	0%	0%	0.17%
K64	Financial intermediation, except insurance and pension funding	3%	0%	0%	0%	0.29%
L68	Real estate activities	3%	0%	0%	0%	0.27%
M69	Legal and accounting activities	0%	0%	0%	0%	0.12%
M70	Activities of head offices; management consultancy activities	2%	4%	0%	1%	2.52%
M71	Architectural and engineering activities	4%	7%	4%	4%	5.67%
M72	Scientific research and development	2%	6%	1%	1%	3.67%
M73	Advertising and market research	0%	1%	0%	0%	0.42%
M74	Other professional, scientific and technical activities	0%	0%	1%	0%	0.19%
N80	Security and investigation activities	0%	0%	0%	0%	0.05%
N82	Office administrative, office support and other business support activities	0%	0%	0%	0%	0.02%
P85	Education	0%	0%	0%	0%	0.02%
Q86	Human health activities	0%	0%	0%	1%	0.20%
S96	Other personal service activities	0%	0%	0%	0%	0.00%
	Total	100%	100%	100%	100%	100%
Total	Cohesion R&D funds (mio EUR)	24,992	132,503	29,343	85,554	272,392

Source: own calculations based on GODC and AJPES data

*Sectors receiving more than 3% of total funds are highlighted

A further examination of data shows that **the focus of cohesion R&D policy on the seven key sectors highlighted above was consistent between both priority axis** (they received 78% of manufacturing funds in priority axis 1.1. and 72% in 1.3/1.2 priority axis) despite the fact that they tended to target firms with very different characteristics (see Table 3 for details). Further, **the consistency of priority areas also applies to both programming periods** – 70% of funds in 2004-06 and 77% in the 2007-11 period were paid out to firms in these seven sectors, which means that the sectoral focus of the R&D policy has even increased in the last programming period.

4. ASSESSING LONG-TERM CONSISTENCY OF PRIORITY AREAS OF SLOVENIAN RTDI POLICY

To assess the long-term consistency of priority areas of Slovenian RTDI policy we compared the revealed sectors most heavily supported in the past (identified in the previous section) with the seven future priority areas, defined recently in the Slovenian Smart specialisation strategy (S4) as:

- Materials, composed of: Manufacture of other non-metallic mineral products (C23), Manufacture of basic metals (C24) and Manufacture of fabricated metal products (C25)
- Manufacture of chemicals and chemical products (C20)
- Manufacture of rubber and plastic products (C22)
- Machinery and equipment C28+C33
- Manufacture of motor vehicles, trailers and semi-trailers (C29)
- M. of electrical equipment (C27)
- M. of basic pharmaceutical products and pharmaceutical preparations (C21)

Table 5 sets out a presentation of the alignment of past and future key priorities of RTDI policy in Slovenia and shows that as high as 72% of cohesion R&D subsidies for manufacturing (52% of total R&D subsidies) in the period 2004-11 were paid out to firms belonging to the seven future priority areas. **This indicates that the consistency criteria for RTDI policy in Slovenia has been met and means that despite the fact there were no explicitly identified priority sectors before 2015, the cohesion policy for R&D has in the past been successful in identifying and promoting sectors which have later proved to be the most dynamic and promising parts of the Slovenian economy⁵.**

⁵ To say whether the cohesion policy has also contributed to the successful development of the sectors under consideration, a further analysis on its effectiveness is needed.

Table 5: *Presentation of the alignment of key priority areas of Slovenian development policy 2004-11 and future RTDI policy (set out in S4)*

Key priority areas of future RTDI policy	Key priority areas of past RTDI policy	Subsidies 2004-11 (as share in total cohesion R&D subsidies for manufacturing)going to future key priority areas defined in S4
Defined ex-ante in Smart specialization strategy	Identified ex-post based on empirical evidence in Section 3	
Materials , composed of: C23, C24 C25	C25	25.5%
Chemicals (C20)	C20	5%
Manufacture of rubber and plastic products (C22)	C22	6.3%
Machinery and equipment C28+C33	C28	13.3%
Manufacture of motor vehicles, trailers and semi-trailers (C29)	C29	8.7%
M. of electrical equipment (C27)	C27	12.2%
M. of basic pharmaceutical products and pharmaceutical preparations (C21)	/	1.1%

Source: own calculations

Further, there is only one future priority area – Pharmaceutical industry – which has not been seen substantial R&D support in the 2004-11 period. Considering that this is the only industry in the Slovenian economy which reveals both comparative and technological advantage over their European counterparts, the case of Pharmaceutical industry seems to indicate that, at least in this case, Slovenia was able to avoid the danger of a deadweight effect of funding firms with sufficient own resources.

Besides evidence of consistency at the level of sectors, supported in the past and identified presently, there also seems to be consistency at the level of types for recipient firms within those sectors. As presented in Section 2, Slovenian RTDI policy in the 2004-2011 period supported above-average performers (even before receiving R&D subsidies) within sectors, which might imply that this funding has contributed towards greater specialization within diversified economic structure.

5. CONCLUSION

Slovenian Smart Specialization Strategy (S4), approved by the European Commission in autumn 2015, identified seven key economic areas of the future Slovenian Research, technology development and innovation (RTDI) policy: Manufacture of chemicals,

Materials, Machinery and equipment, Rubber&plastic products, Electrical equipment, Automobile industry, and Pharmaceuticals. Since this is the first time that Slovenia has explicitly defined its priority sectors, the question arises of their alignment with the country's RTDI activities in the past.

This paper seeks to find whether there is a long-term consistency of priority areas in Slovenian RTDI policy. Since they have not been defined in the past, we first sought to confirm whether they existed in the first place, as opposed to financing R&D as a purely horizontal measure.

Since RTDI policy in Slovenia has and will continue to be largely financed by the European cohesion policy, we based our empirical analysis on firm-level data for cohesion policy R&D subsidies between 2004 and 2011. €290 million has been distributed to 1,457 firms in this period under two headings: "*Stimulating the development of innovation environment*" and "*Stimulating entrepreneurship in firms*". Analysis of the recipient firm characteristics shows that they were above-average performers in their respective sectors in terms of size, productivity, profitability, export intensity and capital intensity even before receiving subsidies. They were also less energy intensive and less indebted.

An extensive empirical analysis of the sectoral distribution of subsidies between 2004 and 2011 has then been carried out to find whether the data reveal a specific sectoral pattern which could be used to identify priority areas of the past RTDI policy in Slovenia. First, we found that although there was a strong focus of funds given to firms in manufacturing sectors (72% of subsidies in the entire period), there was also a stable upward trend towards financing the services sector, which ended up to account for almost one third of R&D subsidies in 2011 (up from 13% in 2004). Second, even though cohesion R&D policy during 2004-11 was characterized by a horizontal nature (most of the manufacturing sectors - 21 out of 24 - have received some level of financing), as high as 76% of subsidies to manufacturing were distributed to firms in only seven sectors, which we identified as priority areas of the past RTDI policy in Slovenia: Manufacture of fabricated metal products (C25), Machinery and equipment (C28), Electrical equipment (C27), Motor vehicles (C29), Computer, electronic and optical products (C26), Chemicals (C20) and Rubber and plastic products (C22).

Finally, comparison of the revealed priority sectors supported in the past and those identified for the future (by Slovenian Smart specialization strategy – S4) led us to conclude that the consistency criteria for RTDI policy in Slovenia has been met and that despite the fact that there were no explicitly identified priority sectors before 2015, the cohesion policy for R&D has in the past been successful in identifying and promoting sectors which have later proved to be the most dynamic and promising parts of the Slovenian economy. In fact, there is only one area – pharmaceutical industry – which is amongst future priority areas but has not been heavily subsidized for R&D in the 2004-11 period. Considering that this is the only industry in the Slovenian economy which reveals both comparative and technological advantage over their European counterparts, this is a positive signal that, at least in the pharmaceuticals case, Slovenia was able to avoid the danger of a deadweight effect of funding firms with sufficient own resources.

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GLOBAL SUPPLY CHAINS AT WORK IN CENTRAL AND EASTERN EUROPEAN COUNTRIES: IMPACT OF FOREIGN DIRECT INVESTMENT ON EXPORT RESTRUCTURING AND PRODUCTIVITY GROWTH¹

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Received: April 11, 2017
Accepted: August 1, 2017

ABSTRACT: *Based on the global supply chains' economics the objective of the paper is to ascertain to what extent FDI has been a factor of structural change and productivity growth in Central and Eastern European Countries' (CEECs) manufacturing. By applying the empirical model that accounts for the impact of FDI on export restructuring (controlling for export demand, imports and intra-industry intensity of trade) and standard growth accounting approach to capture the effect of export restructuring on industry productivity growth we empirically accounts for the importance of the 'global supply chains' concept for export restructuring and productivity growth in CEECs in the period 1995-2007. Using industry-level data and accounting for technology intensity, we show that FDI has significantly contributed to export restructuring in the CEECs. The effects of FDI are, however, heterogeneous across countries. While more advanced core CEECs succeeded in boosting exports in higher-end technology industries, non-core CEECs stuck with export specialization in lower-end technology industries. This suggests that in what kind of industries FDI flows have been directed is of key importance. The paper adds to the relevant literature by explaining the mechanism through which FDI contributed to economic and technological restructuring in CEECs.*

Keywords: *foreign direct investment, global supply chain, Central and Eastern European countries, export, productivity*

JEL classification: F210, F230, L600, O140

DOI: 10.15458/85451.66

1 This research was supported by the European Commission, Research Directorate General as part of the 7th Framework Programme, Grant Agreement no. 290657 (GRINCOH), and by the Slovenian Research Agency, Basic Research Project no. ARRS: J5-6815 (Determinants and effects of Slovenian firms' positioning in global value chains). This publication reflects the views of the authors and not those of the institutions they are affiliated with. The European Commission and the Slovenian Research Agency are not liable for any use that may be made of the information contained therein.

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1. INTRODUCTION

Inward foreign direct investment (FDI) has traditionally been treated as an important means of structural upgrading and productivity growth in Central and Eastern European countries (CEECs), in particular in the new member states of the EU. Endogenous growth theory suggests that FDI is an important channel of technology transfer to host countries (see Findlay, 1978, Wang, 1998; De Mello, 1997; Borensztein, De Gregorio and Lee, 1998; Carkovic and Levine, 2005; Barba Navaretti and Venables. 2004; Contessi and Weinberger, 2009). On the other side, international business theory emphasizes the interplay of factors within the OLI (ownership-location-internalization advantages) paradigm, where technology is also the main ownership-specific advantage of foreign investors transferred to host countries (Dunning and Lundan, 2008). In the context of development economics and based on the *flying geese model* (FGM) tradition, Ozawa (1992, 2000, 2012) proposes a dynamic paradigm of multinational enterprises-assisted development. He identifies three principles that govern the process of rapid growth in the labour-driven stage of economic development, i.e. trade augmentation through FDI, increasing factor incongruity, and localized but increasingly internationalized learning and technological accumulation. Common feature of these theoretical approaches is that FDI positively impacts development of host countries through the technology transferred by multinational enterprises (MNEs). The positive outcome, however, is far from granted and it crucially depends on host countries' absorption capacity.⁵

Yet, in a recent theoretical approach on *global supply chain* (GSC) *economics*, Baldwin (2011, 2012) seems to be less optimistic about technology transfer via FDI. He claims that within the 'vertical specialization' pattern, which is typical for the offshoring of labour-intensive stages from headquarter to factory economies, one cannot really refer to technology transfer but should think more of a technology lending. Investing firms tend to avoid real technology transfer and have due to the ICT revolution better means to ensure this (Baldwin, 2012). With the ICT revolution it became increasingly economical to geographically separate manufacturing stages, i.e. to unbundle the factories. This was, in Baldwin's words, "*globalization's 2nd unbundling*", where production stages previously performed in close proximity were dispersed to reduce production costs, whereby ICT enabled control over the dispersed manufacturing processes. Economics of GVC unbundling is in fact adjustment of the FGM to the circumstances of 21st century, i.e. to the fact that globalization's 2nd unbundling means offshoring of production stages and not of industries as in the case of FGM. The fact "*that Korea eventually managed to start exporting domestically-designed car engines was testimony to its rich-nation status. Now, exporting sophisticated manufactured goods is no longer the hallmark of having arrived. It may simply reflect a nation's position in a global value chain*" (Baldwin, 2012: 19). This, however, suggests that the development impact of FDI on host countries may be limited.

While there emerged evident and clear pattern of technological upgrading and catching-up in terms of productivity of CEECs during the last two decades, the mechanisms of the underlying economic and technological restructuring in CEECs have not been studied in great detail. For what seems to be indisputable, this process of economic restructuring was

⁵ For a comprehensive overview of the benefits and costs of FDI for host countries see OECD (2002).

related to the inflow of FDI. But what is the exact mechanism by which the FDI impact the development of host economies? This paper aims to fill the gap in the literature by explaining the mechanism through which FDI contributed to economic and technological restructuring in CEECs. We build on the idea that during the last two decades CEECs were used as an export platform for advanced EU countries, which enabled them to relocate lower technology intensive stages of production to the next-door lower-wages countries. This idea fits well into the global value chain concept developed by Baldwin (2011, 2012).

There are a number of studies on productivity spillovers from FDI for CEECs at the firm or sector level, whereby they are inconclusive on whether the spillovers are positive, negative or insignificant.⁶ Surprisingly, though, studies that specifically analyse the impact of FDI on structural changes in CEECs' economies are quite scarce. They mostly notify different (superior) sectoral breakdown of foreign subsidiaries as compared to domestic firms, thus generating a positive restructuring impact of FDI to a host economy. Notable exceptions are WIIW (2000), RWI (2001), Hunya (2000a), Landesmann (2003), Damijan and Rojec (2007) and Kalotay (2010). They all confirm a positive impact of FDI on manufacturing restructuring of CEECs, but much less if at all of other transition countries which lag behind or are outside the EU accession processes. WIIW (2000) and RWI (2001) claim that in the early stage of transition and during the era of mass privatization programs, FDI did not bring immediate changes to the structure of manufacturing sectors. Notably, this is due to the fact that it mostly came via foreign privatizations of existing firms and capacities in well established industries and was primarily motivated by getting access to the local markets. However, higher rate of foreign penetration in individual industries gradually intensified its impact on the pattern of structural change in manufacturing sectors of these countries due to faster growth of foreign subsidiaries as compared to domestic firms. In the next stage of transition, FDI tended to have a stronger impact on restructuring as it has been more concentrated on new and growing industries (automotive industry, for instance) and filling gaps in the production portfolio (RWI, 2001). According to Hunya (2000a), structural change in CEECs' manufacturing is closely linked to the penetration of foreign capital, as the foreign owned firms specialized in industries of higher technology intensity and in export-oriented industries, while domestic firms remained in low-tech and domestic-market-oriented industries. The deeper the foreign penetration, the faster was the speed of structural change (Hunya, 2000b).

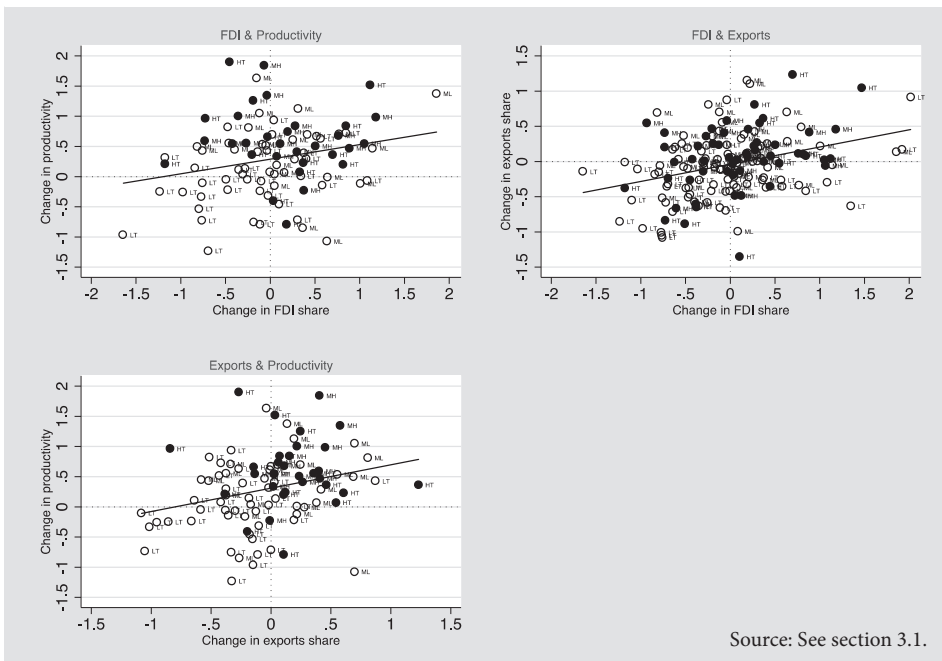
Along the same lines, Landesmann (2003) finds that in the Czech Republic, Hungary, Poland and Slovenia, foreign subsidiaries account for a higher share of sales in the medium and high-tech than in the low-tech or the resource-intensive branches, while the presence of FDI across other CEECs is very uneven and so is its role in facilitating the upgrading of the CEECs' industrial structures. For six CEECs,⁷ Damijan and Rojec (2007) show that in the first decade of transition, in the period 1993-2001, productivity growth was generally positively correlated with foreign penetration.

6 Compare Konings, 2001; Djankov and Hoekman, 2000; Kinoshita, 2000; Damijan, Rojec, Knell, Majcen, 2003a, 2003b, 2013; Smarzynska Javorcik and Spatareanu, 2002, 2009; Tytell and Yudaeva, 2005; Nicolini and Resmini, 2006, 2010; Arnold and Smarzynska-Javorcik, 2005; Gorodnichenko, Svejnar and Terrell, 2006; Halpern and Murakozy, 2006; Schoors and van der Tol, 2001; Sgard, 2001; Toth and Semjen, 1999; Torlak, 2004.

7 Czech Republic, Estonia, Hungary, Poland, Slovenia and Slovakia.

Figure 1 provides some useful stylized facts regarding the economic restructuring and technology upgrading through FDI and trade in 14 CEECs (see Table 1 for the list of countries) over the period 1995-2007. Upper left panel indicates that long-run productivity growth in particular industry is weakly, but positively, associated with the changed importance of FDI in that particular industry. A closer look shows that it was most likely low-tech (LT) and medium-low tech (ML) industries that suffered relative productivity declines. These industries have also mostly lost their importance in terms of FDI shares (relative to total manufacturing) over the period. Yet, also in the case when they retained or increased their FDI shares their productivity increases remained very modest and well below the productivity growth of medium-high (MH) and high-tech (HT) industries. The superior performance of the latter, however, is not necessarily associated with their increased FDI shares. What matters might be how successful were industries in boosting exports. Upper right panel of Figure 1 demonstrates that FDI had a strong impact on export restructuring of CEECs' economies. Winners again are industries of higher technology intensity, but there are also some "outliers" to be found among low and medium-low tech industries that made it to boost exports substantially. This picture is further diversified when observing the lower panel of Figure 1, which shows a positive relationship between the export growth and productivity increases. However, one cannot find many low-tech and medium-low tech industries in the top right quadrant, i.e. among the top performers in terms of productivity. There are quite a few that succeeded in substantial export increases, but only few matched this with comparable productivity increases.

Figure 1: Correlation between FDI, exports and productivity in 14 CEE countries, total change between 1995 and 2007



^a Data for 14 CEECs for Nace Rev. 1 2-digit industries. Upper figures depict relationship between total change in share of FDI of industry j in total manufacturing over 1995-2007 on total change in labour productivity (measured with value added per employee) in industry j and total change in share of exports of industry j in total manufacturing over the same period, respectively. Lower figure shows relationship between total change in share of exports of industry j in total manufacturing and total change in labour productivity in the same industry over 1995-2007. Value of change on the axes from 0 to 1 indicates a 100% change of particular variable relative to the initial value in 1995. Industries are assigned labels according to their technology intensity, where LT, ML, MH and HT refer to low-tech, medium-low tech, medium-high tech and high-tech based on OECD classification. Black dots denote MH and HT industries, while white dots denote LT and ML industries.

This suggests that FDI had a quite heterogeneous impact on productivity growth in CEECs. No doubt, winners in the transition process were countries that succeeded in attracting FDI into industries of higher technology intensity since this resulted both in increased exports and productivity levels. The question whether in general, industries that were successful in attracting FDI also succeeded in boosting productivity along the increased export performance is, however, less clear. The Figure 1 implies that FDI inflow and export growth do not necessarily translate into higher productivity growth. What seems to be important is not the quantity, but the 'content of exports'. To put it in the words of Hausmann, Hwang and Rodrik (2007) – what countries export seems to matter. One needs to account for heterogeneity among the industries (as well as among particular product groups) to be able to evaluate how induced technological change through both FDI and exports changed the landscape in the CEECs in terms of technology upgrading and aggregate productivity growth.

In attempting to explain the mechanisms through which FDI contributed to economic and technological restructuring in CEECs, our prior is that – while the mechanism of economic restructuring through FDI and exports may be similar in different countries – it is the industry and technology segment within the industries picked by MNEs that matters in the long-run for relative performance of industries and overall productivity growth. In other words, relative performance of industries may depend on their positioning within the global value chains of MNEs. Firms in industries at either technology level are likely to increase their export performance if they succeeded in attracting FDI. Yet, technology upgrading and productivity growth took place only if they were plugged into 'right' specific production stages of – regionally or globally – dispersed production processes of MNEs. To demonstrate this fact it is useful to take an example of Apple's iPhone global value chain. A teardown analysis by Rassweiler (2012) shows that Apple's implied margin with the entry model of iPhone 5 sold at \$649 peaks at 68% (and even more with high-end models), while total value of material inputs, such as semiconductors, processors, displays, etc., provided by dozens of Korean, Japanese, Taiwanese, German and U.S. firms totals to only \$199 (less than 31 %). The final assembly cost by the Chinese Foxconn, however, equals a meagre \$8 (1.2%), whereby Foxconn itself is owned by a Taiwanese firm.

This suggests the importance of industry, technology segment and production stage to which FDI has been attracted. One can talk about so-called 'implanted economic restructuring' through FDI. The higher the technology intensity of the implanted industries and products the higher will be the benefits of the host country, but then again

simple assembling process will generate fewer benefits than engagement in design of components. It is difficult to account for the whole complexity of 'implanted economic restructuring' through FDI due to the lack of very detailed data, but we aim to study the impact of FDI on CEECs performance by accounting for the technology intensity of sectors and the trade structure of imported and exported products.

Along the lines of the GSC economics, we will study to what extent FDI has been a factor bringing about structural change and productivity growth in CEECs' manufacturing. We expect a positive contribution of FDI to restructuring and aggregate productivity growth of CEECs, but not necessarily a positive direct effect of FDI on productivity growth of individual industries. We will study to what extent this effect works through 'quality' of the investment in terms of differential technology intensity and through imposed trade specialization. More precisely, we will analyse how FDI has triggered changes in import and export structures across and within industries and how this in turn contributed to productivity growth of industries.

In the paper, by using the industry-level data for the period 1995-2007, we first estimate the extent of structural change in CEECs in terms of export and employment restructuring as well as productivity growth brought about by massive inflows of FDI. Next, we estimate the impact of FDI on export restructuring and how much of this economic restructuring is in line with technology upgrading. And finally, we check how export restructuring promoted by FDI inflows translated into industries' productivity growth. More specifically, we will test whether structure of exports in terms of technology intensity of industries matters for long-run productivity growth.

Our results show that FDI has indeed significantly contributed to export restructuring in the CEECs, whereby the effects are found to be heterogeneous across countries. We find that more advanced core CEECs succeeded at boosting exports in higher-end technology industries, while non-core CEECs stuck to export growth in lower-end technology industries. We find that this dichotomous export restructuring in both groups of CEECs might have played a crucial role in determining their potential for long-run productivity growth. Countries attracting FDI to industries of higher-end technology intensity have consequently succeeded in substantially higher productivity growth.

The outline of the paper is as follows. Next section reviews the related literature and section 3 accounts for the overall structural change in CEECs. In section 4 we estimate the impact of FDI on export restructuring and section 5 tests the impact of changed export structure on industries' total factor productivity growth. Final section concludes.

2. UNDERLYING THEORETICAL CONCEPT

The impact of FDI on the restructuring and productivity growth of host country's manufacturing sector has traditionally been dealt with within the Flying Geese Model (FGM) (Kojima and Ozawa, 1985; Ozawa, 1992; Kojima, 2000). The FGM aims to explain

the catching-up process in the industrial sector in emergent open economies. The model argues that a lesser developed country is able to catch up, depending on the upgrading process in the lead country. The catching-up process is furthered via trade and FDI, the latter being pro-trade (i.e. trade-creating) in character (Bellak, 2003). According to Ozawa (1992, 2000), the FGM describes the links between various stages of industrial upgrading and related phases of FDI. As the lead country moves on up the technology ladder, it relocates via FDI industries at a lower level of technology to lesser developed countries. Based on the requirements of the differing stages of technology, MNEs shift their manufacturing activities to various developing countries and/or transition economies. Yet, the FGM is suited to explaining the simple (initial) catching-up process as an outcome of the relocation of labour-intensive industries but less so when it comes to the relocation of medium-high and high-tech industries. As developed in Ozawa's structural upgrading model, the FGM does not seem to take into account the fact that as the leader moves up the ladder, it becomes increasingly difficult to recycle comparative advantage, as the latter now differs from the early stages when it was based on low-cost unskilled labour (Ozawa 2003). In other words, the flying geese pattern of catching-up might mean that as a means of upgrading structures and enhancing productivity growth in host countries, FDI is a powerful factor in industries at the lower end of technology scale, but (much) less so in the industries at the upper end of that same scale.

This is when global supply chains (GSCs) economics comes into play as it seems to better fit into the present-day offshoring of production stages than FGM. Namely, GSCs economics claims to explain offshoring of stages and not industries and goes beyond the labour intensive stages as it explains vertical as well as horizontal specializations. The economics and functioning of global supply chains has been conceptualized by Baldwin (2011, 2012). The starting point of the GSCs economics is the so called globalization's 2nd unbundling which shifted the locus of globalization from sectors to stages of production. According to Baldwin, this requires an analytical focus on fractionalization and dispersion as the very nucleus of supply chains. Fractionalization concerns the functional unbundling of production processes into finer stages of production, dispersion concerns the geographic unbundling of stages of production. Fractionalization is governed by a trade-off between specialization and coordination costs and dispersion is governed by a balance between dispersion forces and agglomeration forces. The dispersion forces that encourage geographic unbundling include wage gaps (fostering North-South offshoring) and firm-level excellence (fostering North-North and South-South offshoring). Since mid 1980s, the ICT revolution enabled certain stages of production, previously performed in close proximity, to be dispersed geographically, offshored and performed at distant locations as it made possible to coordinate complexity at distance and, thus, to reduce the costs and risks of combining developed economy technology with developing economy labour. This is the very essence of global supply chains. ICT made the 2nd unbundling possible and wage differences made it profitable.

FDI is the crucial integral part of the global supply chains. Within the global supply chains trade is not limited to goods, but is an 'intertwining of: (i) trade in goods, especially parts and components, (ii) international investment in production facilities, training,

technology and long term business relationships, (iii) the use of infrastructure services to coordinate the dispersed production, (iv) cross border flows of know-how' Baldwin (2012: 8) calls this trade-investment-services-IP nexus.

In the global supply chains there are 'headquarter' and 'factory' economies. Comparison of supply chain trade between headquarters and factory economies exhibit important differences. The first is that supply chain trade between 'headquarter' and 'factory' economies is dominated by vertical specialization based on wage differences, while supply chain trade between 'headquarter' economies, which is even more intensive, is based on horizontal specialization and firm specific advantages.⁸ The second difference relates to the fact that exports of 'headquarter' economies contain relatively little imported intermediates, while exports of 'factory' economies contain a large share of imported intermediates (Baldwin, 2012). Gonzales (2012) finds that as nations get richer they use imported intermediates ('backward' supply chain trade) more intensively in their exports. But only up to a certain point; beyond a threshold of per capita income of about \$25,000 the imports intensity diminishes. For the supply of intermediates to others ('forward' supply-chain trade) the relationship is vice versa. It is low for low income levels but rises beyond a point near \$15,000. The above pattern leads to a hub-and-spoke asymmetry in the dependence of 'factory' economies on 'headquarter' economies; exports of 'headquarter' economies contain relatively little imported intermediates, while exports of 'factory' economies contain a large share of imported intermediates. Global supply chains also show strong regional concentration, what Baldwin (2012) calls Factory Asia, Factory North America and Factory Europe. Germany is the hub of Factory Europe, CEECs obviously being factory economies.

What do GSCs economics tell to 'factory' economies? Joining supply chains makes the industrialization process and inclusion in international trade very fast but, as put by Baldwin (2012), industrialization became less meaningful for the same reasons. The 'factory' economies have lots of industry and rapidly growing exports of manufactured goods, but they cannot ensure their place in the supply chain is not supplanted by the next low-wage country. This relates to the application of offshoring firm's technology and know-how in a low wage country. The internationalization of supply chains involves cross-border applications of very specific slices of the parent company's know-how and keeping control over the use of this know-how is of critical importance to the offshoring firms. The result is that there is no proper process of technology transfer of a broad range of productivity enhancing techniques but more of technology lending. A related issue is the pattern exhibited by the so called smile curve, i.e. the fact that lower value added stages of production (assembly, fabrication stages) are offshored while high value added stages (product concept, design, R&D, sales, marketing and after sales services) are kept at home, i.e. stage's shares of product's total value added seemed to shift away from the offshored stages. The conclusion is that fabrication stages in manufacturing may not be the development panacea as they once were (Baldwin, 2012: 17-18).

⁸ This is also reflected in different supply chain business models of firms from new and old EU member states (Szasz and Demeter, 2015).

In principle, countries cannot ensure that their place in the supply chain is not supplanted by the next low-wage country. Following the work of Puga and Venables (1996), Baldwin (2012) claims that productivity/wage growth induces firms to move offshore to a second location once a threshold wage is reached. The key points here are that the spread is not even – the departing industry does not spread out evenly, it concentrates in just one new location to benefit from agglomeration rents. Moreover, the relocation does not empty out the first location/nation but rather slows the growth of new manufacturing activity. As the second location's wages are driven up, a third location/nation emerges for offshoring. This is in fact the FGM pattern.

At the next level, the convergent wages and income level between 'factory' economies and 'headquarter' economies need not reduce the extent of supply-chain trade among them. Indeed, the intensity of such trade among developed nations exceeds that between developed and developing economies since the gains from specialization driven by firm-level excellence is even more important than the gains from specialization due to large wage gaps. According to Baldwin (2012), such a pattern of development logically follows from the trade theory claiming that nations trade more – not less – as their economies get larger and more similar. In other words, countries develop to a stage when their inclusion in global supply chains will be based on horizontal rather than vertical specialization and will be included more via forward than backward supply chain trade. Theory tends to suggest that income convergence will gradually boost supply-chain trade in that the extra horizontally specialization will more than compensate any reduction in wage-driven, vertical specialization (Baldwin, 2012). GSCs economics, thus, claim to explain the structural and productivity development of 'factory' economies' manufacturing beyond the labour intensive stages but the mechanism of this catch-up is not really obvious as global supply chains promote more technology lending than technology transfer and when the higher value added stages of production remain in 'headquarter' economies.

Based on the FGM and GSCs economics we will test the proposition that CEECs' accession to the EU has not resulted only in the increase of FDI inflows in the new member countries, but also in a structural, export competitiveness and productivity upgrading contribution of FDI. Structural change, export competitiveness and productivity growth in CEECs manufacturing sectors during the pre- and post-accession period is importantly accounted for by FDI because FDI is directed into higher technology intensive industries than domestic firms, because foreign subsidiaries within the same industries exhibit higher export propensity and productivity growth, and because a considerable part of FDI is based on vertical specialization. Still, the fact that an important part of FDI in CEECs' manufacturing is based on vertical specialization and on the offshoring of lower value added production stages may limit the positive impact of FDI. In this regard, one may expect considerable heterogeneity among host countries.

In our analysis we will use two approaches to account for the impact of FDI on the catching-up process along the lines of FGM and GSCs economics. First, we will follow the spirit of the approach by Cutler, Berri and Ozawa (2003) who look at changes/trends in main markets' market shares of individual manufacturing industries of catching-up

countries. This eventually indicates the structural changes/trends in their comparative advantages. We modify this approach in the sense that we look for the changes in shares of individual industries in total exports to the main market of CEECs, i.e. OECD countries. However, in order to account for the within changes in the manufacturing comparative advantage, we calculate the shares of individual industries in total manufacturing exports of individual CEECs to the OECD countries. In addition, we will put these trends in export restructuring into the perspective of the changes in the level of FDI penetration in individual industries, as proposed by Dowling and Cheang (2000).

Second, to account for the impact of FDI on catching-up of industries along the concept of GSC, we will test how changes in export structure impacted at the relative industry performance measured by TFP. Specifically, we will test how changes in export shares of three groups of products (capital, intermediate and consumer goods) and changes in the intra-industry specialization affect productivity growth of industries. We will also test whether changes in exports of industries of different technology intensity affect industry performance differently.

3. STYLIZED FACTS ON RESTRUCTURING ALONG THE GSC CONCEPT

3.1. Data

To perform our analysis we combine several databases available at the industry level for CEEC countries. The bottleneck data in our case are the data for FDI inflows/stocks and data for productivity, capital and labour. For most of the countries, the availability of FDI data is at the NACE Rev. 1 2-letter level, which comprises 14 industries in the manufacturing sector. This also provided the major limitation to the construction of the dataset as all other data had to be provided at the same level of aggregation or had to be aggregated to 14 NACE Rev. 1 2-letter industries. Data on inward FDI stocks for 14 CEECs⁹ is taken mostly from the WIIW Database on Foreign Direct Investment (2012) and combined with the UNCTAD data. FDI data is mainly available between 1995 and 2007, while for a few countries there is also data available back to 1994.

Data for labour productivity is available for 12 out of the 14 countries. Data sources are WIIW Industrial Database Eastern Europe (2010), which was combined with the EU-Klems data (provided by the University of Groningen). Productivity data spans the period 1995-2007. There was bigger problem of gathering data for capital variable. The only consistent data for capital is provided by the EU-Klems. Unfortunately, EU-Klems covers only 8 CEEC countries, i.e. the new EU member states. This limits the empirical tests on catching-up of industries along the concept of GSC in terms of productivity to these 8 countries only.

9 Albania (AL), Bosnia and Herzegovina (BA), Bulgaria (BG), Czech republic (CZ), Estonia (EE), Croatia (HR), Hungary (HU), Latvia (LV), Lithuania (LT), Macedonia (MK), Poland (PL), Romania (RO), Slovakia (SK), Slovenia (SI).

Data on foreign trade of CEECs was less of a problem, since there is good coverage of trade statistics at any level of aggregation at the Eurostat. In several aspects we also combined these data with the OECD data.

To sum up, due to the data limitations our analysis was carried out for the sample of 8 to 12 CEEC countries in the period 1995-2007 with the data aggregated to 14 NACE Rev. 1 2-letter industries.

3.2. Restructuring along the GSC concept

3.2.1. FDI and trade restructuring

CEECs experienced enormous increases in FDI inflows since the early 1990s. These inflows expanded along with the accession process to the EU. Table 1 shows an obvious 'correlation' of inward FDI inflows and EU accession process, with gradually increasing relative position of CEECs as recipients of FDI (relative to the total of EU-27) in the pre-accession period, its peak in the accession year (2004), and decrease in the post-accession period. After the accession, CEECs' relative position remains on a much higher level than in the pre-accession period. Countries of the Southern and Eastern Europe (SEE-6) follow similar pattern as CEECs in the pre-accession period. Improved relative position of CEECs as investment location is in line, first, with the general theoretical premise saying that economic integration leads to increasing FDI inflows in member countries and changed perception of member countries in foreign investors' strategy (Dunning, 1993; Baldwin, Francois and Portes, 1997; Rosati, 1998). And, second, it is in line with the transition countries and EU specific premise predicting that attractiveness of a country for inward FDI is co-determined by the quality of business and investment environment in the broadest sense which, in the context of CEECs, means nothing else but a successful accomplishment of transition reforms. Important here is that transition and EU accession processes are two sides of the same coin. The decision for EU accession, more or less also means a decision for specific concept of transition reforms, legal and institutional system. Thus, EU accession process has sped up and converged transition reforms in the candidate countries as opposed to other transition countries. This makes the former more attractive location for FDI than the latter.

Table 1: *FDI inflows in CEECs and SEE-6 as percentage of total FDI inflows in EU-27 in 1998-2010; sub-period averages (in %)*

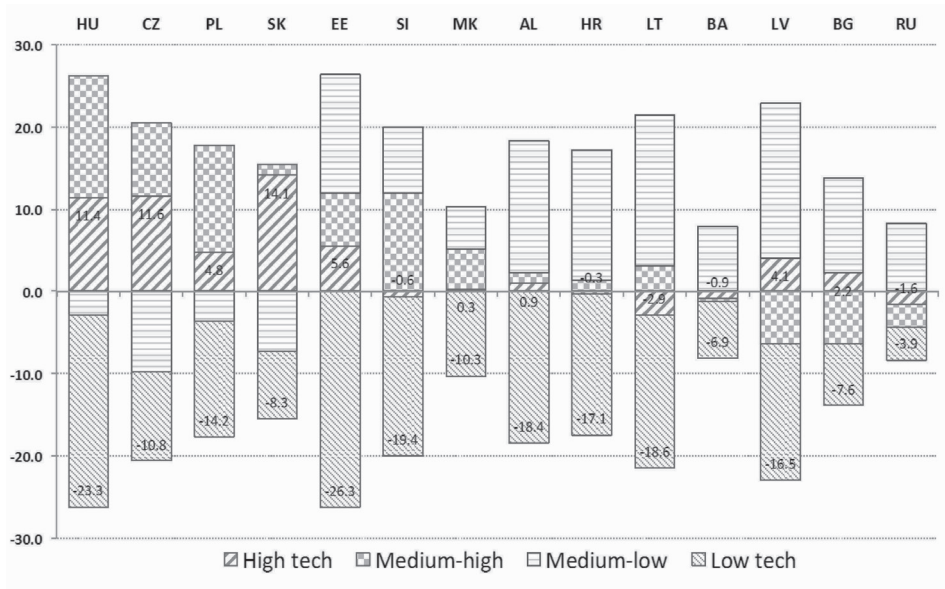
	1998-2000	2001-2003	2004	2005-2007	2008-2010
Bulgaria	0.16	0.40	1.53	1.25	1.35
Czech Republic	1.01	1.69	2.23	1.43	1.42
Estonia	0.09	0.18	0.43	0.38	0.45
Hungary	0.63	0.94	1.92	0.96	1.04
Latvia	0.08	0.07	0.29	0.24	0.15
Lithuania	0.12	0.14	0.35	0.25	0.25
Poland	1.55	1.50	5.78	2.77	3.35
Romania	0.28	0.47	2.89	1.44	1.96
Slovakia	0.21	0.82	1.36	0.55	0.45
Slovenia	0.03	0.24	0.37	0.14	0.19
CEECs	4.15	6.46	17.15	9.43	10.61
Albania	0.02	0.05	0.16	0.06	0.27
Bosnia and Herzegovina	0.03	0.08	0.32	0.18	0.11
Croatia	0.23	0.46	0.53	0.54	0.85
Macedonia	0.03	0.07	0.15	0.06	0.09
Montenegro	0.00	0.01	0.03	0.11	0.29
Serbia	0.02	0.22	0.43	0.48	0.55
SEE-6	0.32	0.89	1.61	1.43	2.16

Source: Calculated from UNCTAD, World Investment Report 2011, Annex Table 1: FDI inflows by region and economy, 1990-2010; <http://archive.unctad.org/Templates/Page.asp?intItemID=5823&lang=1>.

In the course of the accession process, which for some countries started as early as 1991, CEECs have also intensified trade flows with the EU-15 as their main trading partner. In most of the countries, the share of EU in exports increased well above 70% of total exports. At the same time, in line with the GSC concept, increased FDI inflows were also paralleled with extensive trade restructuring. There was immense trade restructuring both across industries as well as within industries that completely displaced the old trade structures inherited from the communist era. One of the key changes was the move from exports in the lower-end technology intensive sectors and product groups towards higher technology intensity of exports. As shown by Figure 2, all of the CEECs have significantly reduced their export shares in low-tech industries. One can, however, spot the difference in export restructuring across countries. Most of the CEECs have moved only one rung up the product ladder from low tech to medium-low tech sectors, while only a group of

four core-CEECs (Czech Rep., Hungary, Poland and Slovakia) have shifted their exports to mainly medium-high and high tech sectors.

Figure 2: *Changes in export shares by technology groups between 1995 and 2009*



^a Average over industries of total changes of export shares in total manufacturing exports between 1995 and 2007.

To calculate the extent of overall changes in FDI and export restructuring across technology groups by estimating over the whole period, we estimate the following model:

$$\Delta Y_{ij} = \alpha + \beta_1 ML_{ij} + \beta_2 MH_{ij} + \beta_3 HT_{ij} + \eta_i + \varepsilon_{ij}, \tag{1}$$

where ΔY_{ij} is a change in share of exports and FDI, respectively, of particular industry j in total manufacturing of country i between 1995 and 2007. Explanatory variables include dummy variables for technology groups, whereby ML, MH and HT denote medium-low, medium-high and high-tech industries. Control group is low-tech industries (LT). The model is estimated by OLS, whereby we control for country fixed effects. The coefficients β_1 , β_2 and β_3 , hence indicate conditional average long-run changes in ML, MH and HT shares of FDI and exports, respectively, relative to the low technology industries.

Table 2a: Average total increase in FDI share and export share in total manufacturing by technology groups, 1995-2007

	All CEE countries (13)		Non-core CEE countries (9)		Core CEE countries (4)	
	FDI	Exports	FDI	Exports	FDI	Exports
	(1)	(2)	(3)	(4)	(5)	(6)
High-tech	0.112 [0.80]	0.235** [2.46]	0.044 [0.26]	0.125 [1.10]	0.300 [1.45]	0.483** [2.67]
Medium-high	0.243* [1.74]	0.317*** [3.32]	0.146 [0.85]	0.249** [2.18]	0.505** [2.45]	0.462** [2.56]
Medium-low	0.318** [2.60]	0.348*** [4.10]	0.288* [1.92]	0.410*** [4.05]	0.402** [2.17]	0.190 [1.17]
Constant	-0.043 [-0.23]	-0.253* [-1.97]	-0.121 [-1.39]	-0.188*** [-3.04]	-0.133 [-0.81]	-0.279* [-1.94]
Observations	182	162	134	117	45	45
R-squared	0.075	0.211	0.029	0.134	0.196	0.225

^a Dep. variable: change in share of exports and FDI, respectively, of particular industry j in total manufacturing between 1995 and 2007. Explanatory variables: dummy variables for technology groups. Control group is low-tech industries. Regressions include country fixed effects. Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: AL, BG, EE, HR, LT, LV, MK, SI, RO. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2a shows that the changes in export shares across technology groups in CEECs in the period 1995-2007 went hand-in-hand with the changes in FDI shares. On average of all CEECs (see columns 1 and 2), largest gain is recorded in medium-low tech industries by increasing their shares of FDI in total manufacturing by 32 percentage points relative to the low-tech industries. This was matched with a relative increase of medium-high tech industries' export shares by 35 percentage points. The move towards medium-high tech industries was substantial as well, but to a lesser extent, whereby FDI and export shares increased by 24 and 32 percentage points, respectively. On average, CEECs also increased export shares of high-tech industries by 24 percentage points, but this was not accompanied by corresponding increases in FDI shares (the coefficient on FDI is low and insignificant).

As indicated by Figure 2, there is a lot of heterogeneity among CEECs, where four core-CEECs (Czech Rep., Hungary, Poland and Slovakia) seem to distinguish from the rest of the CEECs. In the subsequent analysis, we will hence differentiate between the group of core-CEECs and rest of the CEECs. Separate results for core and non-core CEECs in Table 2a confirm the differences between the groups. The group of non-core CEECs seems to have attracted most of FDI into the medium-low tech industries, which was matched with corresponding increases in export shares, but less so into medium-high tech industries. The group of core CEECs, however, attracted FDI mainly into medium-high tech sectors (increases by 50 percentage points), which was accompanied by the increased export shares of these industries by 46 percentage points. Core CEECs also increased export shares of high-tech industries by a slightly bigger margin (48 percentage points), which was accompanied by somehow lower and not significant increases in the FDI shares.

Table 2b: *Average total increase in export shares by BEC product groups and technology groups, 1995-2007*

	Non-core CEE countries (9)			Core CEE countries (4)		
	Capital (1)	Intermed. (2)	Consumer (3)	Capital (4)	Intermed. (5)	Consumer (6)
High-tech	0.049 [0.83]	0.080 [0.67]	0.140 [1.49]	0.181** [2.47]	0.140 [0.91]	1.021*** [4.77]
Medium-high	-0.021 [-0.35]	0.211* [1.76]	0.267*** [2.86]	-0.098 [-1.34]	0.482*** [3.12]	0.332 [1.55]
Medium-low	0.000 [0.00]	0.409*** [3.86]	0.153* [1.85]	-0.020 [-0.31]	0.108 [0.78]	0.229 [1.19]
Constant	-0.179** [-2.40]	-0.640*** [-4.24]	-0.127 [-1.07]	0.001 [0.02]	-0.214* [-1.74]	-0.234 [-1.38]
Observations	117	117	117	45	45	45
R-squared	0.165	0.264	0.114	0.238	0.230	0.392

^a Dep. variable: change in share of exports of particular industry j in total manufacturing exports between 1995 and 2007. Explanatory variables: dummy variables for technology groups. Control group is low-tech industries. Regressions include country fixed effects. Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: AL, BG, EE, HR, LT, LV, MK, SI, RO. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. BEC is Classification by Broad Economic Categories which distinguish among capital, intermediate and consumer goods.

Table 2c: *Average total increase in import shares by BEC product groups and technology groups, 1995-2007*

	Non-core CEE countries (9)			Core CEE countries (4)		
	Capital (1)	Intermed. (2)	Consumer (3)	Capital (4)	Intermed. (5)	Consumer (6)
High-tech	-0.164** [-2.26]	-0.100 [-1.02]	0.088 [1.45]	0.028 [0.35]	0.393*** [2.91]	0.088 [0.90]
Medium-high	-0.203*** [-2.80]	0.080 [0.81]	0.003 [0.05]	-0.371*** [-4.64]	0.311** [2.30]	-0.139 [-1.43]
Medium-low	0.012 [0.18]	0.082 [0.95]	0.015 [0.28]	-0.071 [-1.00]	0.270** [2.23]	-0.042 [-0.48]
Constant	0.238** [2.59]	-0.189 [-1.53]	-0.044 [-0.57]	-0.027 [-0.42]	-0.237** [-2.21]	0.078 [1.01]
Observations	117	117	117	45	45	45
R-squared	0.176	0.068	0.062	0.424	0.245	0.115

^a Dep. variable: change in share of imports of particular industry j in total manufacturing imports between 1995 and 2007. Explanatory variables: dummy variables for technology groups. Control group is low-tech industries. Regressions include country fixed effects. Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: AL, BG, EE, HR, LT, LV, MK, SI, RO. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

According to the GSC concept, FDI is supposed to facilitate the trade of the recipient countries, but not of any kind of trade. By being included in the global supply chains, firms (foreign subsidiaries) in the CEECs are supposed to increase imports of mainly intermediate goods and increase exports of either processed intermediates or assembled final consumer goods. Tables 2b and 2c reveal these patterns by showing the increases of export and import shares by the three product groups. Table 2b shows that non-core CEECs have increased exports mainly in intermediate and consumer product groups of medium-low and medium-high technology industries. On the other side, core CEECs mostly engaged in exports of intermediates in medium-high tech industries, but also succeeded to significantly increase exports of capital and consumer goods in high-tech industries. On the importing side, Table 2c does not reveal a clear pattern of changed structure in the group of non-core CEECs, indicating a lot of heterogeneity within this group of countries. The pattern, however, is much clearer in the group of four core CEECs, where imports of intermediates of all three technology groups have increased by large margins, but not in the groups of capital and consumer goods. This supports the GSC concept of increased imports of intermediate goods, followed by increased exports of processed intermediates or assembled final consumer goods.

3.2.2. Productivity growth and employment restructuring

Finally, we also account for the long-run changes in labour productivity and employment across the technology groups. Along with the GSC concept, CEECs are expected to increase productivity and employment shares in industries that attracted most of the FDI and that have restructured the most in terms of exports.

Table 2d. Average total increase in labour productivity and employment by technology groups, 1995-2007.

	Non-core CEE countries (6)		Core CEE countries (4)	
	VA/Emp (1)	Empl. (2)	VA/Emp (3)	Empl. (4)
High-tech	0.637*** [2.84]	-0.066 [-0.37]	0.684* [1.89]	0.173 [0.91]
Medium-high	0.642*** [2.86]	-0.245 [-1.37]	1.054*** [2.91]	0.319* [1.67]
Medium-low	0.405** [2.07]	0.501*** [3.20]	0.639* [1.96]	0.328* [1.92]
Constant	-0.312* [-1.74]	-1.236*** [-8.58]	0.838*** [2.90]	-0.143 [-0.94]
Observations	48	48	45	45
R-squared	0.372	0.310	0.219	0.170

^a Dep. variable: long difference in log value added per employee and log employment, respectively, of particular industry *j* between 1995 and 2007. Explanatory variables: dummy variables for technology groups. Control

group is low-tech industries. Regressions include country fixed effects. Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: BG, EE, LT, LV, SI, RO. Robust t-statistics in brackets; *** p<0.01, ** p<0.05, * p<0.1

We account for these changes by estimating the model (1). As shown by Table 2d, labour productivity in the period 1995-2007 has increased in all industries of higher technology intensity relative to the low-tech industries. In non-core CEECs, relative increases of productivity vary between 40 and 64 percentage points in real terms as compared to the low-tech industries. The extent of the productivity increases seems to be correlated with the technology intensity. In four core CEECs, the relative productivity increases were higher by about 50 per cent relative to the group of non-core CEECs. The highest productivity gain was obtained by the group of medium-high tech industries (by about 100 percentage points more than in the low-tech industries).

Economic restructuring in terms of employment did follow the general pattern of export restructuring and productivity growth, but not fully. Non-core CEECs have experienced employment growth mostly in the medium-low tech industries (by 50 percentage points more than in the low-tech industries), while four core CEECs managed to increase employment shares in the medium-high tech industries as well. The extent of increases of employment shares in the latter group, however, is smaller than for the export shares. This suggests increases in capital- and technology intensity within industry groups along with the inflow of FDI and export restructuring.

4. IMPACT OF FDI ON TRADE RESTRUCTURING ALONG THE GSC CONCEPT

Previous section provided some stylized facts on how FDI inflows might have changed the landscape of the economies of CEECs. What appears to be undisputable is that FDI played a significant role in this restructuring. In this section we will shed more lights on the underlying mechanism.

In the 1990s, CEECs seemed to be a natural choice of advanced EU countries to relocate parts of the production processes towards cost-efficient economies in the region. Cost-effective manufacturing of intermediates or assembly of final consumer goods from the intermediates produced locally in particular CEECs or imported from headquarters or other subsidiaries was in the forefront of the strategy of Western MNEs. This strategy involves increased trade flows both between CEECs and advanced EU countries as well as among the CEECs themselves. Partly because capital and intermediate goods were imported to set up local production and to support manufacturing of new intermediates or for assembly processes, and partly because produced intermediates or assembled final consumer goods were exported to other CEECs or advanced EU countries. Baldwin (2011, 2012) asserts that a large fraction of these trade flows occurs within the same industry (i.e. intra-industry trade, IIT). Furthermore, he predicts a rise in the vertical intra-industry trade as imported intermediate goods might after processing be shipped back to the headquarters or other subsidiaries in the network of a MNE.

To our opinion, vertical intra-industry trade is not a very likely outcome of specialization along the global supply chains. A strict definition of the vertical IIT (see Greenaway, Hine, and Milner, 1995; Fontagné, Freudenberg, and Péridy, 1997; and Aturupane, Djankov, and Hoekman, 1999) requires substantial quality and hence price differentiation between the same imported and exported product variety. Usually, a 15 per cent threshold (a difference of ± 15 per cent) between export/import unit values is required, whereby – to ensure the comparability of the imported/exported products – product varieties are defined at the highest possible trade disaggregation level, i.e. at 8-digit Harmonized System (HS) classification. At this level of disaggregation, however, it is difficult to imagine that imported variety can be significantly processed and upgraded, but not to change its nature in the process and to fall into a different HS 8-digit product when being exported. Importing a set of components in order to assemble them into a more complex intermediate good or into a final good does not meet the requirements of the vertical IIT.

The only way how FDI in the process of the GSC could lead to vertical IIT is importing varieties from the affiliate, relabeling them by the headquarter's brand name and then re-exporting with a substantial mark-up. Certainly, part of the trade flows between affiliates and headquarters may consist of this type of 'pass-on trade' (see Damijan, Konings and Polanec, 2013), but this is not at the heart of the GSC concept. Similarly, one could "overcome" this problem by accounting for vertical IIT at a higher level of aggregation, such as 6- or 4-digit HS classification, which would allow for comparing import/export unit values of aggregated products. This, however, has nothing to do with the true concept of the vertical IIT. Based on this, we will account for the intra-industry pattern of trade of CEECs by sticking to the overall measure of the IIT, which comprises both horizontal and vertical IIT.

To test whether the GSC concept was at work in the CEECs we estimate the empirical model that accounts for the impact of FDI on export restructuring by controlling for export demand, imports and intra-industry intensity of trade. We estimate a version of the following model:

$$\Delta X_{ijt}^k = \alpha + \beta_1 \Delta FDI_{ijt} + \beta_2 shM_{ijt}^k + \beta_3 IIT_{ijt}^k + \beta_4 Q_{ijt} + \beta_5 M_{jt}^{EU} + \beta_6 EU_i + \eta_i + \delta T + \rho C + \varepsilon_{ijt}, \quad (2)$$

where ΔX_{ijt}^k is an annual change in share of exports of type k products to OECD countries of particular industry j in total manufacturing of country i . ΔFDI_{ijt} denotes annual change in share of FDI stock of industry j in total manufacturing FDI stocks. shM_{ijt}^k is a log share of imports of type k products from OECD countries of industry j in total manufacturing, while IIT_{ijt}^k is a log of Grubel-Lloyd index of intra-industry trade of type k products in industry j (calculated at the HS 6-digit product aggregation). Q_{ijt} denotes industry's output, M_{jt}^{EU} is total imports of industry j in OECD countries, and EU_i is a dummy variable for EU accession taking value of 0 before accession and 1 afterwards. The model is estimated by OLS, whereby we control for country fixed effects (C) and industry (η_i) fixed effects as well as for time effects (T). The latter controls for common external shocks. Note, however, that we estimate (2) for the period 1995-2007, which spans after the common transition shock (1989-1994) and before the recent great recession (starting in 2009).

Key coefficients in estimating model (2) are β_1 , β_2 and β_3 , whereby the former indicates whether trade restructuring occurred along the inflow of FDI, and the latter two capture the mechanism of the GSC.

Table 3: *Impact of FDI on export restructuring by type of products, first differences*

	Non-core CEE countries (6)			Core CEE-4 countries		
	Capital	Intermed.	Consumer	Capital	Intermed.	Consumer
	(1)	(2)	(3)	(4)	(5)	(6)
ΔFDI_j	-0.007 [-0.50]	-0.012 [-0.69]	0.031 [1.65]	-0.000 [-0.00]	0.037* [1.80]	0.037** [2.09]
Share Im_Cap _j	0.018* [1.90]	0.006 [0.51]	-0.012 [-1.18]	0.010** [2.00]	0.011* [1.87]	0.030*** [3.60]
Share Im_Inter _j	0.006 [0.77]	0.024 [1.61]	-0.013 [-1.13]	0.005 [1.31]	-0.008 [-0.90]	0.016* [1.70]
Share IIT _{jk}	0.002 [0.33]	-0.016 [-1.28]	-0.009 [-0.87]	-0.012 [-0.92]	0.022 [1.33]	-0.000 [-0.02]
$\Delta Output_j$	0.004 [0.84]	-0.012 [-1.31]	-0.002 [-0.19]	-0.002 [-0.65]	-0.002 [-0.25]	0.001 [0.19]
$\Delta EU\text{-imports}_j$	-0.011* [-1.91]	-0.010 [-0.78]	0.015 [1.48]	-0.006 [-1.34]	0.011 [1.61]	-0.006 [-0.71]
EU accession	-0.015 [-0.45]	-0.027 [-0.36]	0.042 [0.63]	-0.017 [-0.62]	-0.044* [-1.81]	0.013 [0.61]
Constant	0.063 [0.90]	0.104 [0.62]	-0.214 [-1.41]	0.151* [1.78]	-0.195* [-1.83]	0.013 [0.11]
Observations	718	718	718	547	547	547
R-squared	0.046	0.047	0.065	0.053	0.087	0.161

^a Dep. variable: annual growth of share exports of type k of products of particular industry j in total manufacturing exports. Regressions control for country, industry and time fixed effects. Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: BG, EE, LT, LV, SI, RO. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3 shows results of estimating the model (2) by disaggregating the exports into three BEC groups (capital, intermediate and consumer goods). Results show that GSC concept is hardly able to explain the pattern of export restructuring in non-core CEE countries. The FDI variable is insignificant for all three wide product groups, though only marginally so for final consumer goods. Increased exports also do not seem to be determined by higher shares of imports of capital and intermediate group, the only exception being the imports of capital goods generating higher exports of capital goods as well (at 10% significance level). This suggests that FDI in non-core CEECs was probably not intended to serve as an export platform, at least not generally.

On the other side, GSC concept seems to be well suitable to explain the pattern of export restructuring in four core CEE countries. Increases in annual FDI stocks by industries

can explain increases in the relative exports of intermediate and capital goods. Moreover, increasing shares of imports of capital goods are significantly associated with the export growth of all three types of goods, while increasing shares of intermediates seems to drive the exports of final consumer goods only. This implies that FDI in core CEECs has been used to set up the production of local affiliates involving increasing imports of capital goods (i.e. production lines and equipment). The mechanism of the GSC concept in the core CEECs, however, seem to be mainly working through imports of intermediates used in the assembly processes and exports of assembled final consumer goods. Another mechanism of the GSC at work might also involve exports of intermediates, but this does not seem to be associated with the previous imports of intermediates. This is confirmed by insignificant coefficients on IIT shares in all specifications indicating that increased exports of particular product group are not associated with the simultaneous imports and exports of very similar product varieties within the industry. While IIT shares in all of the countries have increased substantially over the period under examination, this is apparently not due to the working of the GSC. It might have to do with larger general competition within product groups, but apparently not with the exchange of similar product varieties within the network of the MNEs.

Other included variables in the model, such as industry output or industry's imports from the OECD countries do not seem to affect the export growth. The same is true for the EU accession (2004 for most of the countries), which returns mostly insignificant or even negative results for some specifications. This suggests that most of the trade restructuring has occurred before 2004.

Next, to account for further heterogeneity within manufacturing sector, we also estimate model (2) by grouping industries into four technology intensity groups. Unfortunately, due to the small number of observations, we had to give up on disaggregating the trade flows into three BEC groups.

Table 4a: *Impact of FDI on export restructuring by technology groups, first differences*

	Non-core CEE countries (6)				
	All	High-tech	Med-high	Med-low	Low-tech
	(1)	(2)	(3)	(4)	(5)
ΔFDI_j	-0.005 [-0.25]	-0.026 [-0.60]	0.046 [0.87]	-0.082** [-2.28]	0.007 [0.24]
Share Im_Cap _j	-0.002 [-0.21]	-0.043 [-1.13]	0.022 [0.40]	-0.117** [-2.31]	-0.173*** [-3.50]
Share Im_Inter _j	0.010 [1.03]	0.166*** [3.27]	-0.080 [-1.14]	0.044 [1.28]	-0.080*** [-4.79]
Share IIT _{jk}	-0.014 [-1.55]	-0.033 [-1.13]	0.024 [0.38]	-0.007 [-0.21]	-0.024 [-1.61]
$\Delta Output_j$	-0.009 [-1.09]	-0.014 [-0.25]	0.007 [0.07]	0.005 [0.17]	-0.027* [-1.96]

Δ EU-imports _j	0.003 [0.31]	0.377* [1.93]	-0.031 [-0.15]	0.028 [1.12]	0.025* [1.76]
EU accession	-0.003 [-0.10]	0.081 [0.93]	-0.002 [-0.01]	-0.040 [-0.62]	0.019 [0.45]
Constant	-0.064 [-0.52]	-5.125** [-2.01]	0.221 [0.08]	-0.291 [-1.06]	-0.060 [-0.39]
Observations	718	123	118	176	301
R-squared	0.052	0.332	0.208	0.299	0.238

^a Dep. variable: annual growth of share of exports of particular industry j in total manufacturing exports. Regressions control for country, industry and time fixed effects. Non-core CEE countries: BG, EE, LT, LV, SI, RO. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4b: *Impact of FDI on export restructuring by technology groups, first differences*

	Core CEE countries (4)				
	All	High-tech	Med-high	Med-low	Low-tech
Δ FDI _j	0.051*** [2.95]	0.078* [1.68]	0.102 [1.29]	0.050** [2.04]	0.010 [0.44]
Share Im_Cap _j	0.019*** [2.63]	0.052 [1.44]	0.017 [0.26]	-0.250*** [-3.19]	0.157* [1.66]
Share Im_Inter _j	-0.004 [-0.51]	-0.014 [-0.22]	0.049 [0.47]	0.112** [2.01]	-0.009 [-0.46]
Share IIT _{jk}	0.021 [1.16]	-0.020 [-0.24]	-0.036 [-0.42]	-0.051 [-1.03]	0.019 [0.72]
Δ Output _j	0.003 [0.51]	-0.019 [-0.34]	-0.007 [-0.08]	0.000 [0.01]	0.023** [2.30]
Δ EU-imports _j	0.005 [0.70]	0.042 [0.37]	-0.135 [-0.25]	-0.021 [-0.75]	-0.016 [-1.19]
EU accession	-0.031 [-1.53]	-0.061 [-0.46]	0.315 [0.96]	-0.052 [-0.99]	-0.121* [-1.93]
Constant	-0.172 [-1.43]	-0.228 [-0.16]	1.499 [0.22]	0.336 [0.73]	-0.014 [-0.09]
Observations	547	98	98	134	217
R-squared	0.093	0.394	0.304	0.374	0.259

^a Dep. variable: annual growth of share of exports of particular industry j in total manufacturing exports. Regressions control for country, industry and time fixed effects. Core CEE countries: CZ, HU, SK, PL. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Results for six non-core countries (see Table 4a) are somewhat discouraging, showing no correlation between relative growth of industries' FDI and export shares. Results even suggest a negative correlation between the variables for the group of medium-low tech industries. In addition, imports of capital and intermediate goods are shown either not

to be correlated with the export growth or even significantly negatively associated for the groups of medium-low and low-tech industries, which indicates that GSC mechanism may be poorly suited for explaining the trade dynamics of the six non-core economies. It is only the group of high-tech industries where export growth is positively associated with the share of imported intermediates.

Situation, however, is different for a group of core CEECs. Results in Table 4b reveal that increased relative exports of high-tech and medium-low tech industries are positively correlated with increased industries' FDI stocks. Mechanism of the GSC seems to work the best in the medium-low and low-tech industries where export growth is associated with either increased shares of imported capital or intermediate goods. Results are marginally insignificant in the high tech industries. Admittedly, these results are less conclusive than results presented in Table 3, arguably due to using aggregated trade data, which hide a lot of heterogeneity between different groups of products. There is a sacrifice to be made when estimating the model by the technology intensity groups as the number of observations per sample is further reduced.

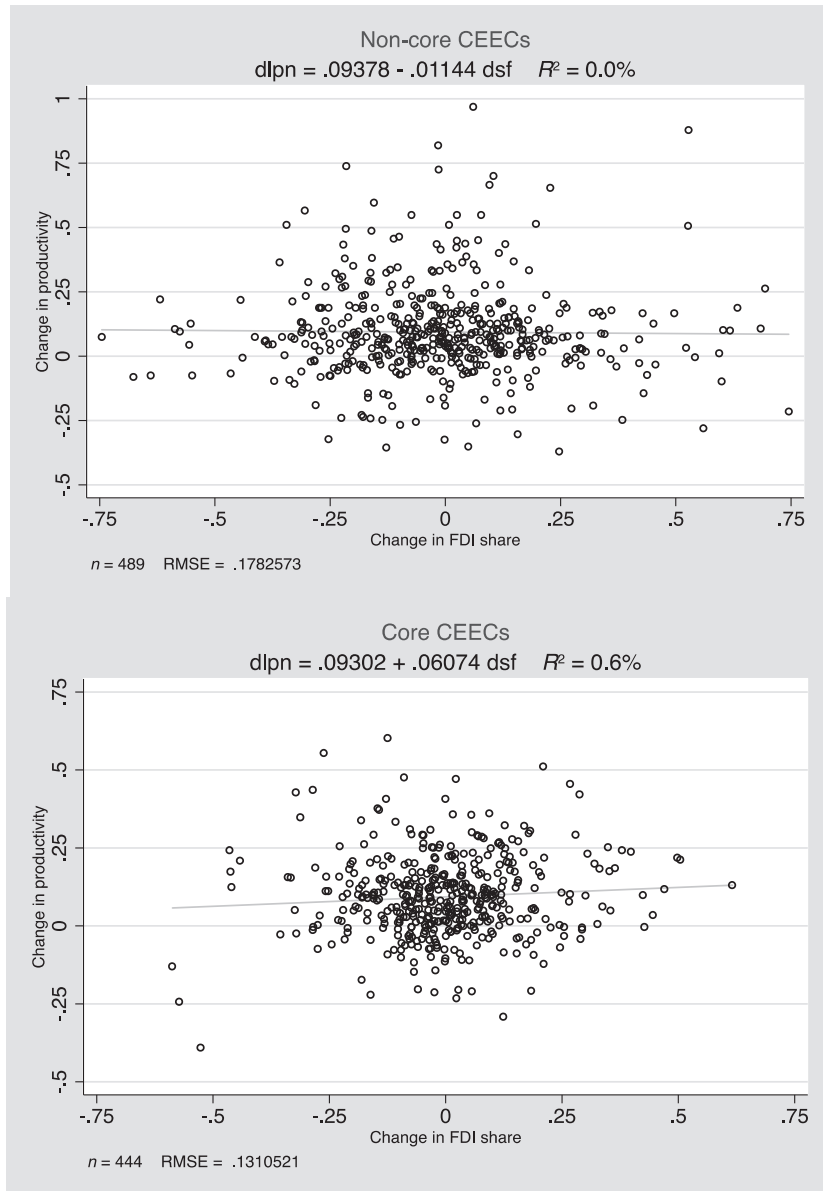
To sum up, the global supply chains concept seems to be suitable to explain the pattern of export restructuring in four core CEE countries, but less so for non-core CEECs. An explanation for this, first, might lie in higher advancement of the core CEECs in terms of their inherited economic structure and, second, in their proximity to the core investing countries with larger industrial base, i.e. Germany. For the other countries, MNEs might had different objectives when investing there. One possible explanation is that MNEs have set up affiliates in individual countries mainly to supply the local and adjacent markets with final consumer goods, but they did not really integrate them into their global supply chains.

It remains to be seen how FDI and export restructuring have affected productivity growth of industries. We account for this in the next section.

5. IMPACT OF TRADE RESTRUCTURING ALONG THE GSC CONCEPT

As argued in the introductory section, large inflows of FDI do not necessarily translate into higher productivity growth. It is essential to note which industries have been attracting the majority of FDI flows. Figure 3 demonstrates that labour productivity growth at the industry level is not correlated with changes in industries' FDI stocks. This holds for both, non-core as well as core CEECs.

Figure 3: Correlation between FDI and labour productivity in 10 CEE countries in the period 1995-2007, annual growth rates



^a Data for 10 CEECs for Nace Rev. 1 2-digit industries. Figures depict relationship between annual growth of share of FDI of industry j in total manufacturing and annual growth of labour productivity in industry j (measured with value added per employee). Core CEE countries: CZ, HU, SK, PL; non-core CEE countries: BG, EE, LT, LV, SI, RO.

Previous section has shown that in non-core CEECs FDI did not have a significant effect on export restructuring, while in core CEECs FDI has contributed to faster export growth in high-tech and medium-high tech industries. This distinction between the two groups of countries and industries might be essential for understanding the impact of FDI on aggregate productivity. As industries characterized by higher-end technology tend to grow faster as compared to low and medium-low tech industries, this may imply that countries increasing exports in industries with higher-end technology will experience higher aggregate productivity growth. To put it differently, in line with Hausmann, Hwang and Rodrik (2007), it seems to matter a lot what countries export. In this section, we test this proposition by accounting for differences in technology intensity of industries.

To capture the effect of export restructuring on industry productivity growth, we use the standard growth accounting approach. In the first stage we estimate a production function at the industry level to obtain industries' capital and labour shares:

$$VA_{ijt} = \phi + \alpha L_{ijt} + \beta K_{ijt} + \eta_i + \delta T + \rho C + \varepsilon_{ijt} . \quad (3)$$

This enables us to obtain industries' total factor productivity (TFP) as a residual from (3):

$$TFP_{ijt} = VA_{ijt} - \alpha L_{ijt} - \beta K_{ijt} . \quad (4)$$

Finally, to capture the impact of export restructuring on industry TFP growth we estimate the following model:

$$\Delta TFP_{ijt} = \alpha + \beta_1 \Delta X_{ijt}^k + \beta_2 EU_i + \eta_i + \delta T + \rho C + \varepsilon_{ijt} , \quad (5)$$

where ΔX_{ijt}^k is an annual change in share of exports of type k products to OECD countries of particular industry j in total manufacturing of country i and EU_i is a dummy variable for EU accession taking value of 0 before accession and 1 afterwards. The model (5) is estimated by OLS, whereby we control for country fixed effects (C) and industry (η_i) fixed effects as well as for time effects (T). The latter controls for common external shocks. We estimate (5) for the period 1995-2007 and hence avoid the common transition shock (1989-1994) and the recent great recession (starting in 2009).

To capture a differential effect of varying technology intensity, we estimate (5) by segmenting industries into four technology groups. First, we present results obtained with aggregate industry exports and then proceed with results for exports disaggregated into the three BEC groups.

Table 5a: *Impact of export restructuring on industry productivity growth by technology groups, non-core CEE countries (4)*

	All	High-tech	Med-high	Med-low	Low-tech
	(1)	(2)	(3)	(4)	(5)
Δ Exports _{<i>j</i>}	0.158*** [3.76]	0.171 [1.28]	-0.100 [-1.30]	0.201 [1.56]	0.156*** [3.09]
EU accession	-0.050** [-2.05]	0.029 [1.09]	0.047** [2.05]	-0.003 [-0.10]	-0.011 [-0.88]
Constant	0.065*** [3.52]	0.059** [2.29]	0.050** [2.41]	0.117*** [4.52]	0.066*** [5.38]
Observations	540	90	84	138	228
R-squared	0.657	0.659	0.766	0.606	0.642

^a Dep. variable: annual growth of total factor productivity in particular industry *j*. Regressions control for country, industry and time fixed effects. Non-core CEE countries: EE, LT, LV, SI. Robust t-statistics in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 5b: *Impact of export restructuring on industry productivity growth by technology groups, core CEE countries (4)*

	All	High-tech	Med-high	Med-low	Low-tech
Δ Exports _{<i>j</i>}	0.231*** [5.61]	0.176* [1.74]	0.297*** [3.52]	0.175 [1.47]	0.052 [0.68]
EU accession	-0.024 [-1.05]	0.024 [1.16]	0.022 [0.85]	0.006 [0.41]	0.011 [0.78]
Constant	0.089*** [5.42]	0.050** [2.30]	0.079*** [2.94]	0.069*** [4.51]	0.038*** [2.62]
Observations	538	90	90	133	225
R-squared	0.316	0.333	0.353	0.345	0.238

^a Dep. variable: annual growth of total factor productivity in particular industry *j*. Regressions control for country, industry and time fixed effects. Core CEE countries: CZ, HU, PL, SK. Robust t-statistics in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 5a shows that increased exports have contributed to TFP growth in four non-core CEE countries. A closer look, however, reveals that this is exclusively due to the export growth in low-tech and medium-low tech industries (the coefficient for the latter is marginally insignificant, but positive). On the other side, as shown by Table 5b, TFP growth in four core CEE countries is correlated with the growth of exports in the high-tech and medium-high tech industries, but not with the exports in industries with lower-end technology intensity.

Another point of interest is to compare the average effects of exports on TFP growth across country groups. While in core CEE countries each 1 percentage point in growth of exports translates into TFP growth of 0.23 percentage points, this effect is more meagre in non-core CEECs – only about 0.16 percentage points. As revealed by Tables 5a and 5b, this is due to the fact that pro-growth effects of exports in higher-end technology industries are bigger than in industries with lower-end technology. This confirms that it matters a lot what countries export.

Table 6a: *Impact of export restructuring on industry productivity growth by type of products and technology groups, non-core CEE countries (4)*

	All	High-tech	Med-high	Med-low	Low-tech
	(1)	(2)	(3)	(4)	(5)
$\Delta \text{Exp_Capital}_j$	0.016 [0.31]	0.109 [0.79]	-0.050 [-0.89]	-0.204 [-0.57]	0.093 [0.66]
$\Delta \text{Exp_Interm}_j$	0.175*** [4.04]	0.163 [1.41]	-0.141 [-1.02]	0.183 [1.48]	0.094* [1.84]
$\Delta \text{Exp_Cons}_j$	0.043 [0.92]	-0.052 [-0.57]	0.192 [1.33]	0.142 [0.52]	0.073 [1.33]
EU accession	-0.052** [-2.09]	0.032 [1.17]	0.062** [2.54]	-0.002 [-0.08]	-0.013 [-1.05]
Constant	0.065*** [3.51]	0.058** [2.22]	0.048** [2.28]	0.120*** [4.53]	0.067*** [5.36]
Observations	540	90	84	138	228
R-squared	0.659	0.665	0.773	0.606	0.637

^a Dep. variable: annual growth of total factor productivity in particular industry j . Regressions control for country, industry and time fixed effects. Non-core CEE countries: EE, LT, LV, SI. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6b: *Impact of export restructuring on industry productivity growth by type of products and technology groups, core CEE countries (4)*

	All	High-tech	Med-high	Med-low	Low-tech
$\Delta \text{Exp_Capital}_j$	0.084 [1.61]	0.273** [2.08]	0.024 [0.33]	0.079 [0.22]	0.285 [0.76]
$\Delta \text{Exp_Interm}_j$	0.173*** [4.26]	0.083 [0.75]	0.349*** [4.15]	0.152 [1.22]	-0.037 [-0.52]
$\Delta \text{Exp_Cons}_j$	0.069 [1.61]	-0.079 [-1.10]	0.401* [1.96]	0.153 [0.85]	0.104 [1.50]
EU accession	-0.022 [-0.94]	0.034 [1.61]	0.038 [1.46]	0.008 [0.52]	0.009 [0.63]
Constant	0.085*** [5.18]	0.044** [1.99]	0.067** [2.51]	0.070*** [4.53]	0.037** [2.58]
Observations	538	90	90	133	225
R-squared	0.312	0.357	0.398	0.348	0.245

^a Dep. variable: annual growth of total factor productivity in particular industry j . Regressions control for country, industry and time fixed effects. Core CEE countries: CZ, HU, PL, SK. Robust t-statistics in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Tables 6a and 6b present results for growth effects of exports disaggregated to three BEC groups. Table 6a reveals that, in non-core CEE countries, the positive growth effect of exports on TFP growth in the low-tech industries is due to growth of exports of intermediates. In core CEECs, however, impact of exports on TFP growth seems to be confined to exports of high-tech capital goods and to exports of medium-tech intermediate and consumer goods. Results also show that pro-growth effects of exports of consumer goods are bigger than those of intermediate goods and capital goods. This suggests that margins in exporting final consumer goods might be bigger than in exporting intermediates or capital goods.

To sum up, the results show that export restructuring and economic specialization brought about by FDI during the last two decades in the CEE countries might matter for long-run productivity growth. Countries attracting FDI to industries of higher-end technology intensity have boosted exports relatively more and consequently succeeded in higher productivity growth.

6. CONCLUSIONS

This paper studies the contribution of FDI to structural change in the Central and Eastern European Countries (CEECs) by verifying the mechanism of the global supply chain (GSC) concept as developed by Baldwin (2011, 2012). Specifically, we account for the importance of industry and technology segment to which FDI has been attracted. We argue that the higher the technology intensity of the ‘implanted’ industries and products through FDI the higher will be benefits for the host country.

We tackle the complexity of the GSC concept by accounting for the technology intensity of industries and trade structure of imported and exported products. We employ industry-level data for 8 to 12 CEECs for the period 1995-2007. By accounting for technology intensity we show that FDI has significantly contributed to export restructuring in the CEECs, whereby the effects are shown to be heterogeneous across countries. We find that more advanced core CEECs succeeded in increasing exports predominantly in higher-end technology industries, while non-core remain to specialize in exports of lower-end technology industries. This dichotomous export restructuring between both groups of CEE countries is shown to have played a crucial role in determining their potential for long-run productivity growth. Countries attracting FDI to industries of higher-end technology intensity have consequently succeeded in substantially higher productivity growth.

As noted by Baldwin (2012), these productivity improvements due to inflow of FDI may not necessarily predestine countries more lucky in attracting FDI to higher-end technology industries for long-run higher development levels. FDI may easily pull out of the countries leaving them without much home-grown economic foundations. Yet, so far FDI certainly helped the CEECs over the last decade and a half to grow faster in terms of TFP and to increase employment in higher-end technology industries. How sound and stable is this specialization in the long run, however, remains to be seen.

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SLOPOL10: A MACROECONOMETRIC MODEL FOR SLOVENIA

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Received: September 26, 2017
Accepted: January 22, 2018

ABSTRACT: *This paper describes the SLOPOL10 model, a quarterly macroeconomic model of the Slovenian economy to be used for forecasting macroeconomic development and simulating alternative policy measures. The model is of the Cowles Commission type and is estimated using the cointegration approach, thus combining the long-run equilibrium and the short-run adjustment mechanism. It contains behavioural equations and identities for the goods market, the labour market, the foreign exchange market, the money market, and the government sector. Estimation of behavioural equations for Slovenian aggregates is based on data starting in 1995. The model combines Keynesian and neoclassical elements. The Keynesian elements determine the short and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. The supply side incorporates neoclassical features. Static and dynamic ex-post simulations show that the model can reasonably reproduce past development and is therefore suited for prediction and policy evaluation, especially for fiscal policy design and optimal control experiments.*

Keywords: *SLOPOL10 model, macroeconomic models, fiscal policy design, optimal control experiments, Slovenia*

JEL Classification: E01, B23

DOI: 10.15458/85451.62

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1. INTRODUCTION

This paper presents SLOPOL10, a medium-sized macroeconometric model for the small open economy of Slovenia. We document the theory behind the model blocks, the equations, and formal tests of the ability of the model to replicate the trajectories of the endogenous variables in an ex-post simulation.

The Slovenian economy, although small, is of interest for the following reasons: First, it was part of the Yugoslav economy, a centrally planned economy with a unique system of workers' self-management, until the dissolution of Yugoslavia. Second, Slovenia has developed towards a parliamentary democracy and a capitalist economy much faster than any other of the successor states of Yugoslavia. In particular, it became a member of the European Union in 2004 and, as the first former communist country, joined the Euro Area in 2007, which at the time was regarded as a major achievement. Third, the Slovenian economy is one of the small open economies within the Euro Area; hence its economic policy problems may also be of interest to other economies of that type. For example, difficulties resulting from the particular policy architecture of supranational monetary policy versus a national fiscal policy occur not only in Slovenia but also in several other members of the Euro Area. Finally, Slovenia was hit very hard by the Great Recession and the ensuing sovereign debt crisis but managed to return to satisfactory growth relatively fast recently, so it can be regarded as a model for dealing with business cycles.

If we want to explain economic developments in a country like Slovenia, and even more so if we want to design economic policies for such a country, a model of the Slovenian economy is required. Such a model shall serve as a tool for forecasting macroeconomic developments over the short and medium run and for evaluating alternative policies aimed at influencing the business cycle, stabilizing unemployment and inflation, and enhancing growth and employment in Slovenia. Several modelling strategies are available for building a macroeconomic model which can fulfil these requirements. If a model builder believes in neoclassical or New Keynesian macroeconomic theory, a Dynamic Stochastic General Equilibrium (DSGE) model will be his/her choice. If, on the other hand, theories are distrusted and a "data-only" approach is preferred, a vector autoregression (VAR) model will be chosen. Here we follow a more traditional modelling approach and opt for an econometric model of the Cowles Commission type. These models compromise between the theory-first and the empirics-first approaches; they must be based on sound theoretical foundations and estimated using real data of the economy under consideration. Several models of this type have been estimated before by members of the present team of authors (Verbič 2005, 2006, Weyerstrass et al. 2007); here we follow this tradition.

To build such a model, it is important to have available a data base with sufficiently long time series to provide reliable estimates. For former communist countries like Slovenia, this poses a problem: data before 1991, when the country gained independence, are based on communist accounting rules and are not comparable to those of later years. Even for the early years of the transition process many data (especially those from national income accounting) are of dubious quality. Therefore estimation of behavioural

equations for Slovenian aggregates has to be based on data starting in 1995 or later. In order to obtain estimations with sufficient degrees of freedom, an econometric model for Slovenia has to use quarterly or – where available – monthly or even higher-frequency data. Here we describe a quarterly macroeconometric model called SLOPOL10, which is a revised and updated version of a series of models which we have built since the late 1990s, with increasing degrees of sophistication and reliability. These models have been used for various purposes of forecasting and especially evaluating alternative policies, where simulation and optimization experiments were conducted to arrive at politically relevant insights and policy recommendations (see, e.g., Neck et al. 2011). Of particular importance with respect to Slovenia's position in the European Union are evaluations of its fiscal policies as the country has to fulfil the requirements of the EU Stability and Growth Pact (see Blueschke et al. 2016).

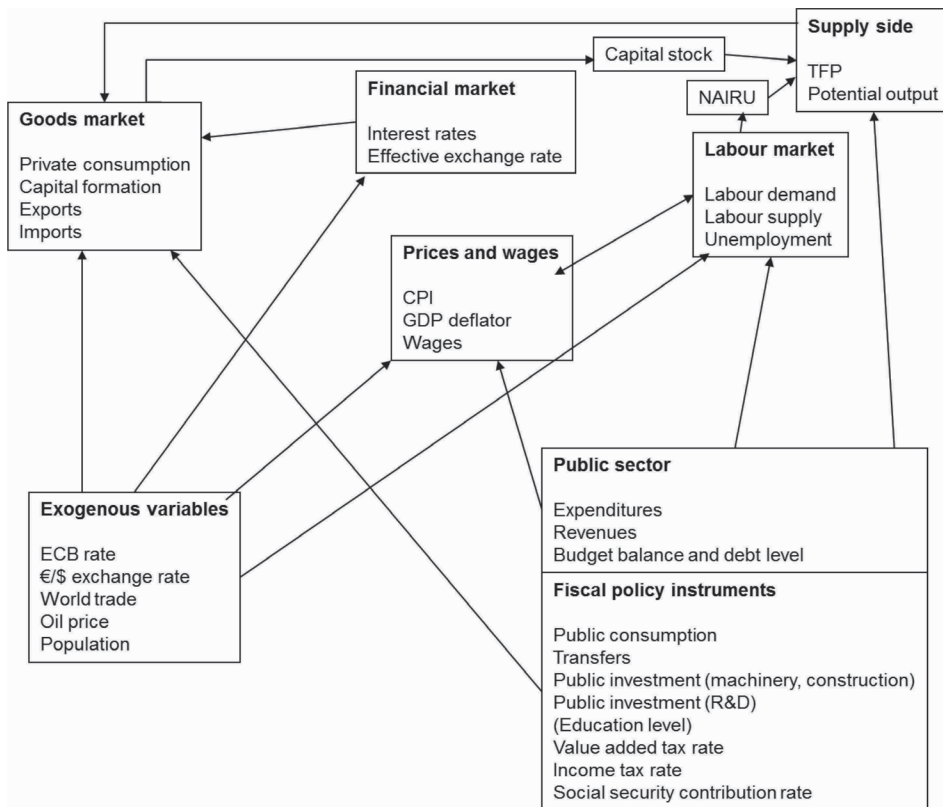
Like every structural econometric model, the SLOPOL10 model may be subject to the famous Lucas critique. Lucas (1976) argued that the relations between macroeconomic aggregates in an econometric model should differ according to the macroeconomic policy regime in place. In this case, the effects of a new policy regime cannot be predicted using an empirical model based on data from previous periods when that policy regime was not in place. Sargent (1981) argues that the Lucas critique is partly based on the notion that the parameters of an observed decision rule should not be viewed as structural. Instead, structural parameters in Sargent's conception are just "deep parameters", such as preferences and technologies. These parameters would be invariant, even under changing policy regimes. Providing for such "deep parameters" requires a different class of macroeconomic models, namely Computable General Equilibrium (CGE) or DSGE models. We take the Lucas critique into account to a certain extent by following the so-called London School of Economics tradition initiated by Sargan (1964). According to this approach, economic theory guides the determination of the underlying long-run specification while the dynamic adjustment process is derived from an analysis of the time series properties of the data series. Error correction models involving cointegrated variables combine the long-run equilibrium and the short-run adjustment mechanism.

2. MODEL DESCRIPTION

SLOPOL10 (SLOvenian economic POLicy model, version no. 10) is a medium-sized macroeconometric model of the Slovenian economy. In its current version, SLOPOL10 consists of 75 equations, 23 of which are behavioural equations and 52 identities. In addition to the 75 endogenous variables, the model contains 41 exogenous variables. A list of the variables used in the SLOPOL10 model can be found in Table A1 in the Appendix. The model is constructed in order to allow for forecasts and policy simulations over the near future. Statistical tests will be presented that show the performance of the model in the past. In our view, these tests show that the model exhibits acceptable quality for such uses. Improvements in the light of new data will be continually made when using the model for these purposes.

The behavioural equations were estimated with the software program EViews, using quarterly data for the period 1995q1 to 2015q4. Data for Slovenia and for Euro Area aggregates as well as the oil price were taken from the Eurostat database, and those for world trade came from the CPB Netherlands Bureau for Economic Policy Analyses. The model contains behavioural equations and identities for the goods market, the labour market, the foreign exchange market, the money market, and the government sector. Rigidities of wages and prices are taken into account. The model combines Keynesian and neoclassical elements, the former determining the short and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. In the following, the model equations are described verbally. A diagram of the building blocks of the model is given in Figure 1.

Figure 1: SLOPOL10 – Building Blocks



The supply side incorporates neoclassical features. In accordance with the approach applied by the European Commission for all EU Member States (Havik et al. 2014), potential output is determined by a Cobb-Douglas production function with constant returns to scale. It depends on trend employment, capital stock and autonomous technical

progress. Trend employment is defined as the labour force minus natural unemployment, the latter being defined via the non-accelerating inflation rate of unemployment (NAIRU). In line with the literature on production functions as well as international practice in macroeconomic modelling, the elasticities of labour and capital were set at 0.65 and 0.35 respectively. These elasticities correspond approximately to the shares of wages and profits respectively in national income. The NAIRU, which approximates structural unemployment, is estimated by applying the Hodrick-Prescott (HP) filter to the actual unemployment rate. For forecasts and simulations, the structural unemployment rate is then extrapolated with an autoregressive (AR) process. Capital stock enters the determination of potential GDP not with its trend level but with its actual one.

Several steps are required to determine technical progress. First, ex-post total factor productivity (TFP) is calculated as the Solow residual, i.e. that part of the change in GDP that is not attributable to change in the production factors of labour and capital, weighted with their corresponding production elasticities. In a second step, the trend of technical progress is then determined by applying the HP filter, in a procedure similar to the NAIRU. For simulations and forecasts, the trend of the TFP is explained in a behavioural equation. In accordance with the endogenous growth literature, technical progress is influenced by the share of people with tertiary education in the labour force. In addition, trend TFP is influenced by the real investment ratio, i.e. gross fixed capital formation over GDP. As a third factor, lagged real government spending on research and development (R&D) is included in the TFP equation.

On the demand side, the consumption of private households is explained by a combination of a Keynesian consumption function and a function in accordance with the permanent income hypothesis and the life cycle hypothesis. Thus, private consumption depends on current disposable income and on the long-term real interest rate, the latter entering the consumption equation with a negative sign. Real gross fixed capital formation is influenced by the change in real disposable income (more or less in accordance with the accelerator hypothesis) and by the user cost of capital, where the latter is defined as the real interest rate plus the depreciation rate of capital stock. Changes in inventories are treated as exogenous in the SLOPOL model, as in many macroeconomic models in use around the world.

Real exports of goods and services are a function of the real exchange rate and foreign demand for Slovenian goods and services. Foreign demand is approximated by the volume of world trade. The real exchange rate is meant to capture the competitiveness of Slovenian companies on the world market. Real imports of goods and services depend on domestic final demand and on the real exchange rate. A real appreciation of the Slovenian currency (the Slovenian tolar until the end of 2006 and the euro following Slovenia's entry into the Euro Area on 1 January 2007) makes Slovenian goods and services more expensive on the world markets. On the other hand, foreign products become relatively cheaper; hence domestic production is substituted by imports. Thus a real appreciation stimulates imports while having a negative effect on exports. Even when Slovenia is part of the Euro Area, its real exchange rate can, of course, still appreciate or depreciate, not only against

other currencies but also against other Euro Area countries due to inflation differentials. On the labour market, both labour demand and supply are divided into the main age group (15 to 64 years) and older people (65 years and above). The labour demand of companies (actual employment) is modelled via the employment rates of the two age groups, i.e. employment as a share of the relevant age group in the total population. Both equations were estimated as Tobit models, the employment rates being limited to lying between 0 and 0.9 (15 to 64 years) and between 0 and 0.5 (65 years and above). Both employment rates are influenced positively by real GDP and negatively by the real net wage and additionally by the wedge between the gross and the net wage. The idea behind the latter is that increases in the tax wedge are borne partly by employers and partly by employees. Rising income tax rates or social security contribution rates increase the production wage, to which employers react by reducing their employment demand. Labour supply is modelled via the share of the labour force of the two age groups in the total population. These equations have also been estimated as Tobit models, with the restrictions of being positive but below 0.9 and 0.5 respectively. Labour supply depends positively on the real net wage and, as employment, negatively on the wedge between the gross and the net wage.

In the wage-price system, gross wages, the consumer price index CPI (to be precise, the harmonised index of consumer prices HICP for Slovenia), and various deflators are determined. The gross wage rate depends on the price level, labour productivity and the unemployment rate. This equation is based on a bargaining model of the labour market, where the relative bargaining power of the employees (or the trade unions) is negatively affected by unemployment. The consumer price index is linked to the private consumption deflator. The latter depends on domestic and international factors. Domestic cost factors comprise unit labour costs and the capacity utilisation rate. The inclusion of the capacity utilisation rate in the price equation represents a channel for closing an output gap by increasing prices in the case of over-utilisation of capacities and by decreasing prices if actual production falls behind potential GDP. Foreign influences on Slovenian consumer prices are approximated by the import deflator. The public consumption deflator is linked to the most important cost factor of the public sector, which is public consumption. Public consumption includes purchases of goods and services and the wage costs of public employees. Similarly to consumer prices, both the investment and the export deflators are influenced by domestic and imported cost elements. The former are approximated by the unit labour costs while the latter are captured by the import deflator. Finally, the import deflator is influenced by the oil price in euro as a proxy for international raw material prices, which constitute an important determinant of the price level in a small open economy like Slovenia.

On the money market, the short-term interest rate is linked to its Euro Area counterpart so as to capture Slovenia's Euro Area membership and the resulting gradual adjustment of interest rates in Slovenia towards the Euro Area average. In the same vein, the long-term Euro Area interest rate is included in the equation determining the long-term interest rate in Slovenia. In addition, the long-term interest rate is linked to the short-term rate, representing the term structure of interest rates. Furthermore, the long-term interest rate is influenced by the debt to GDP ratio, representing a risk premium that rises with

the debt ratio. The foreign exchange market is modelled by the real effective exchange rate against a group of 41 countries. Due to Slovenia's membership of the Euro Area, the nominal exchange rate is exogenous for Slovenia. However, the real exchange rate is still endogenous, even for the Euro Area countries, since it also depends on domestic price developments. Furthermore, the real effective exchange rate is an important determinant of exports and imports. When determining the effective exchange rate for Slovenia, it has to be taken into account that the country has only been a Euro Area member state since 2007. As the time series on which the estimations of the behavioural equations are based include the period before Slovenia's Euro Area accession in 2007, the bilateral exchange rate between the Slovenian tolar and the euro is included as one of the explanatory variables in the real effective exchange rate equation. In addition, the exchange rate between the euro and the US dollar is considered. Furthermore, inflation in Slovenia is a regressor. To be theoretically consistent, the inflation differential between Slovenia and the group of countries forming the base for the real effective exchange rate should have been taken. However, this would have involved information about price developments in 41 countries, and for these exogenous variables assumptions had to be made for ex-post simulations.

In the government sector of the model, the most important expenditure and revenue items of the Slovenian budget are determined. Social security contributions by employees are calculated by multiplying the average social security contribution rate by the gross wage rate and the number of employees. In the same vein, income tax payments by employees are determined by multiplying the average income tax rate by the gross wage rate and the number of employees. In a behavioural equation, social security payments by companies are linked to social security contributions by employees. Profit tax payments by companies are explained by GDP as an indicator for the economic situation, taking account of the fact that profits and hence profit tax payments display a strongly pro-cyclical behaviour. Value added tax revenues depend on the value added tax rate and on private consumption. Other direct and indirect taxes are determined via their relation to nominal GDP, which is exogenous and has to be extrapolated in ex ante simulations, as for all other exogenous variables. Interest payments on public debt depend on the lagged debt level and on the long-term interest rate. Public consumption and transfer payments to private households as well as the remaining public expenditures and revenues are exogenous. By definition, the budget balance is given by the difference between total government revenues and expenditures. The public debt level is extrapolated using the budget balance equation. The model is closed by a number of identities and definition equations.

3. TESTS FOR STATIONARITY OF THE TIME SERIES

As can be seen from Table A2 in the Appendix, it turns out that most level variables are I(1). Only a few variables are stationary in levels. These are the output gap (be construction, this variable should be stationary), the real interest rate, the real GDP growth rate, the labour force and employment of older people (very small numbers), the user cost of capital, and changes in inventories (as expected). For the budget balance in relation to GDP, the stationarity tests are inconclusive, although in the longer term this

variable should be stationary. Also for the average real gross and net wage, the stationarity results are inconclusive, although one would expect these variables to increase over time. However, according to the data in our database, the average real wage per employee declined between 1996 and 2003, then rose until 2011, before decreasing again somewhat.

We also tested for cointegration between those time series where we suspected long-run relations to hold. In those cases where cointegration seemed to be present, we used error-correction models as dynamic specifications for these relations while estimations in levels or first differences were tried when tests indicated the absence of long-run relations between stationary or between I(1) variables. The tests support our suspicion of cointegration between the variables we included in the behavioural equations. The detailed results can be found in Table A3 in the Appendix.

4. MODEL EQUATIONS

In this section, the model equations are listed in detail, starting with the behavioural equations and then presenting the model identities.

4.1. Behavioural Equations

Hereinafter, R^2 is the adjusted coefficient of determination, BG(p) is the Breusch-Godfrey Lagrange Multiplier statistic, a test for serial correlation up to lag p; * , ** , *** denote rejection of the null hypothesis of no serial correlation at the 10, 5, 1 percent significance level respectively; t-statistics are given in parentheses below coefficients.

Trend TFP

$$\begin{aligned} \text{LOG}(\text{TRENDTFP}) = & -4.588302 + 0.009127 * \text{LOG}(\text{GERDR}(-1)) + 0.384806 * \text{LOG}(\text{LFTERSARE}) \\ & (-145.3956) \quad (3.105505) \quad (28.58483) \\ & + 0.309750 * \text{LOG}(\text{INVR/GDPR}) \\ & (15.03015) \end{aligned}$$

$$\text{Adj. } R^2 = 0.923320 \quad \text{F-stat} = 318.0849 \quad \text{BG}(2) = 40.364^{***}$$

Private Consumption

$$\begin{aligned} \text{LOG}(\text{CR/CR}(-4)) = & 0.321936 + 0.282529 * \text{LOG}(\text{INCOMER/INCOMER}(-4)) \\ & (1.108405) \quad (5.481512) \\ & - 0.121486 * \text{LOG}(\text{CR}(-4)) + 0.081661 * \text{LOG}(\text{INCOMER}(-4)) \\ & (-7.369967) \quad (2.362665) \\ & - 0.006417 * \text{GOV10YR} - 0.062606 \text{D2013q1} \\ & (-5.068519) \quad (-3.531924) \end{aligned}$$

$$\text{Adj. } R^2 = 0.612852 \quad \text{F-stat} = 24.74484 \quad \text{BG}(2) = 6.503145^{**}$$

Private Gross Fixed Capital Formation

$$\begin{aligned} \text{LOG}(PRINVR/PRINVR(-4)) = & -0.000824 + 0.542725 * \text{LOG}(PRINVR(-1)/PRINVR(-5)) \\ & (-0.106209) \quad (6.891356) \\ & + 0.404963 * \text{LOG}(INCOMER/INCOMER(-4)) \\ & (2.163258) \\ & - 0.018054 * (UCC(-1) - UCC(-5)) - 0.163850 * D2010q3 \\ & (-4.114459) \quad (-2.41256) \\ & - 0.141658 * D2014q4 \\ & (-2.174659) \end{aligned}$$

Adj. R² = 0.672624

F-stat = 29.76431

BG(2) = 3.772958

Exports

$$\begin{aligned} \text{LOG}(EXR/EXR(-4)) = & 0.549852 + 0.277227 * \text{LOG}(EXR(-1)/EXR(-5)) \\ & (4.119548) \quad (5.136417) \\ & + 0.815406 * \text{LOG}(WTRADE/WTRADE(-4)) \\ & (13.78450) \\ & - 0.321950 * \text{LOG}(REER(-4)/REER(-8)) - 0.287643 * \text{LOG}(EXR(-4)) \\ & (-3.401803) \quad (-4.888083) \\ & + 0.411336 * \text{LOG}(WTRADE(-4)) + 0.033620 D2007 - 0.026177 (D2013+D2013) \\ & (4.991134) \quad (2.831993) \quad (-2.808663) \end{aligned}$$

Adj. R² = 0.917547

F-stat = 120.2305

BG(2) = 3.249562

Imports

$$\begin{aligned} \text{LOG}(IMPR/IMPR(-4)) = & -5.038052 + 1.315281 * \text{LOG}(DEMAND(-1)/DEMAND(-5)) \\ & (-3.231196) \quad (9.747473) \\ & + 0.801468 * \text{LOG}(REER(-2)/REER(-6)) \\ & (2.011144) \\ & - 0.831232 * \text{LOG}(REER(-3)/REER(-7)) - 0.480082 * \text{LOG}(IMPR(-4)) \\ & (-2.024690) \quad (-2.652671) \\ & + 0.649493 * \text{LOG}(DEMAND(-4)) + 0.642609 * \text{LOG}(REER(-4)) \\ & (2.294327) \quad (1.909966) \\ & + 0.090691 * D1998q1 - 0.200624 * D2009q1 \\ & (1.739119) \quad (-4.110804) \end{aligned}$$

Adj. R² = 0.684522

F-stat = 21.61303

BG(2) = 1.195105

Employment 15 to 64

$$\begin{aligned} \text{EMP1564/POP1564} = & -0.617752 + 0.473440 * \text{EMP1564}(-4)/\text{POP1564}(-4) + 0.200109 * \text{LOG}(GDPR) \\ & (-3.013194) \quad (5.660659) \quad (7.137335) \\ & - 0.044223 * \text{LOG}(NETWAGER) - 0.071028 * \text{LOG}(WEDGE) \\ & (-1.931810) \quad (-5.892452) \end{aligned}$$

Employment 65+

$$\begin{aligned}
 EMP65PLUS/POP65PLUS = & -0.088596 + 0.601889 * EMP65PLUS(-1)/POP65PLUS(-1) \\
 & (-0.684680) \quad (6.271412) \\
 & + 0.057105 * LOG(GDPR) - 0.048881 * LOG(NETWAGEN+WEDGE) \\
 & (1.928939) \quad (-2.436480)
 \end{aligned}$$

Labour Supply 15 to 64

$$\begin{aligned}
 LF1564/POP1564 = & 0.216732 + 0.694325 * LF1564(-4)/POP1564(-4) \\
 & (4.602100) \quad (10.31312) \\
 & + 0.145252 * LOG(NETWAGER/NETWAGER(-4)) \\
 & (4.829452)
 \end{aligned}$$

Labour Supply 65+

$$\begin{aligned}
 LF65PLUS/POP65PLUS = & -0.170715 + 0.380958 * LF65PLUS(-1)/POP65PLUS(-1) \\
 & (-1.207595) \quad (3.843020) \\
 & + 0.036490 * LOG(NETWAGER) - 0.018406 * D2015 \\
 & (2.213463) \quad (-3.537480) \\
 & - 0.010935 * LOG(WEDGE) - 0.011630 * (D2012+D2013) \\
 & (-2.216665) \quad (-2.812858)
 \end{aligned}$$

Average Gross Wage

$$\begin{aligned}
 LOG(AGWN/AGWN(-4)) = & 0.238652 + 0.599927 * LOG(AGWN(-1)/AGWN(-5)) \\
 & (2.517697) \quad (7.324412) \\
 & + 0.133776 * LOG(CPI/CPI(-4)) + 0.114755 * LOG(PROD/PROD(-4)) \\
 & (2.223294) \quad (2.480250) \\
 & - 0.003440 * UR - 0.055291 * LOG(AGWN(-4)/CPI(-4)) \\
 & (-2.503514) \quad (-2.175832) \\
 & - 0.030158 * D2012q2 \\
 & (-2.402247)
 \end{aligned}$$

Adj. R² = 0.828677

F-stat = 61.46166

BG(2) = 2.439687

CPI

$$\begin{aligned}
 LOG(CPI/CPI(-4)) = & -0.000764 + 0.860254 * LOG(CPI(-1)/CPI(-5)) \\
 & (-0.520422) \quad (16.41307) \\
 & + 0.119368 * LOG(CDEF/CDEF(-4)) \\
 & (2.347029) \\
 & - 0.024320 * LOG(CPI(-4))-LOG(CDEF(-4)) - 0.024477 * D2008q4 \\
 & (-2.247985) \quad (-3.425420)
 \end{aligned}$$

Adj. R² = 0.942442

F-stat = 303.9159

BG(2) = 7.259309**

Private Consumption Deflator

$$\begin{aligned} \text{LOG}(CDEF/CDEF(-4)) = & -0.635911 + 0.270101 * \text{LOG}(AGWN/AGWN(-4)) \\ & (-2.801746) \quad (2.994393) \\ & + 0.129630 * \text{LOG}(IMPDEF(-6)/IMPDEF(-10)) \\ & (2.534036) \\ & - 0.268560 * \text{LOG}(CDEF(-4)) + 0.101022 * \text{LOG}(AGWN(-4)) \\ & (-3.637782) \quad (3.249838) \\ & + 0.133540 * \text{LOG}(UTIL(-1)) + 0.091529 * \text{LOG}(IMPDEF(-4)) \\ & (2.641737) \quad (1.854469) \end{aligned}$$

Adj. R² = 0.571235 F-stat = 17.20944 BG(2) = 16.17359***

Public Consumption Deflator

$$\begin{aligned} \text{LOG}(GDEF/GDEF(-4)) = & 0.119450 + 0.544327 * \text{LOG}(GDEF(-1)/GDEF(-5)) \\ & (1.851414) \quad (6.264521) \\ & + 0.090745 * \text{LOG}(GNFIN/GNFIN(-4)) - 0.086096 * \text{LOG}(GDEF(-4)) \\ & (2.283731) \quad (-3.041525) \\ & + 0.038165 * \text{LOG}(GNFIN(-4)) \\ & (3.062869) \end{aligned}$$

Adj. R² = 0.680608 F-stat = 42.55355 BG(2) = 1.793151

Investment Deflator

$$\begin{aligned} \text{LOG}(INVDEF/INVDEF(-4)) = & 0.010428 + 0.216076 * \text{LOG}(ULC/ULC(-4)) \\ & (5.262049) \quad (4.098676) \\ & + 0.141856 * \text{LOG}(IMPDEF/IMPDEF(-4)) \\ & (2.601534) \\ & + 0.042883 * D1997q1 + 0.046206 * D1998q4 \\ & (2.655108) \quad (2.855100) \\ & - 0.052778 * D2000q4 \\ & (-3.160315) \end{aligned}$$

Adj. R² = 0.342428 F-stat = 9.227795 BG(2) = 31.20401

Export Deflator

$$\begin{aligned} \text{LOG}(EXPDEF/EXPDEF(-4)) = & 0.691182 + 0.477104 * \text{LOG}(IMPDEF/IMPDEF(-4)) \\ & (5.368551) \quad (13.53162) \\ & - 0.636126 * \text{LOG}(EXPDEF(-4)) + 0.403268 * \text{LOG}(IMPDEF(-4)) \\ & (-6.693435) \quad (6.843747) \\ & + 0.046780 * \text{LOG}(AGWN(-4)) \\ & (3.329078) \end{aligned}$$

Adj. R² = 0.785893 F-stat = 73.49374 BG(2) = 10.24065***

Import Deflator

$$\begin{aligned} \text{LOG}(\text{IMPDEF}/\text{IMPDEF}(-4)) = & 1.688217 + 0.064189 * \text{LOG}(\text{OILEUR}/\text{OILEUR}(-4)) \\ & (6.514300) \quad (8.883464) \\ & - 0.427363 * \text{LOG}(\text{IMPDEF}(-4)) + 0.070433 * \text{LOG}(\text{OILEUR}(-4)) \\ & (-6.675438) \quad (7.561347) \\ & - 0.040262 * D2009 + 0.028375 * D2010 \\ & (-3.950683) \quad (2.861353) \end{aligned}$$

$$\text{Adj. } R^2 = 0.698642 \quad \text{F-stat} = 37.62936 \quad \text{BG}(2) = 28.40523***$$

Short-term Interest Rate

$$\begin{aligned} \text{SITBOR3M}-\text{SITBOR3M}(-4) = & 0.072921 + 0.583728 * (\text{SITBOR3M}(-1) - \text{SITBOR3M}(-5)) \\ & (1.110144) \quad (10.69963) \\ & + 0.510182 * (\text{EUR3M}-\text{EUR3M}(-4)) \\ & (7.271125) \\ & - 0.453068 * (\text{SITBOR3M}(-4) - \text{EUR3M}(-4)) \\ & (-6.395199) \end{aligned}$$

$$\text{Adj. } R^2 = 0.859096 \quad \text{F-stat} = 159.5222 \quad \text{BG}(2) = 23.92325***$$

Long-term Interest Rate

$$\begin{aligned} \text{GOV10Y}-\text{GOV10Y}(-4) = & -0.116529 + 0.218874 * (\text{SITBOR3M}-\text{SITBOR3M}(-4)) \\ & (-0.780286) \quad (2.522239) \\ & + 2.021775 * (\text{EUR10Y}-\text{EUR10Y}(-4)) \\ & (10.71268) \\ & + 1.694831 * \text{LOG}(\text{DEBTGDP}/\text{DEBTGDP}(-4)) - 1.856888 * D2004 \\ & (1.704599) \quad (-3.693687) \\ & + 1.992136 * D2012 + 1.624226 * D2013 \\ & (4.029161) \quad (3.083994) \end{aligned}$$

$$\text{Adj. } R^2 = 0.679935 \quad \text{F-stat} = 23.30579 \quad \text{BG}(2) = 17.72585***$$

Real Effective Exchange Rate

$$\begin{aligned} \text{LOG}(\text{REER}/\text{REER}(-4)) = & -0.007941 + 0.084268 * \text{LOG}(\text{EURUSD}/\text{EURUSD}(-4)) \\ & (-2.789133) \quad (4.503065) \\ & + 0.280321 * \text{LOG}(\text{SITEUR}/\text{SITEUR}(-4)) \\ & (4.729566) \\ & + 0.678165 * \text{LOG}(\text{GDPDEF}/\text{GDPDEF}(-4)) + 0.037226 * D1998 \\ & (6.623438) \quad (4.447943) \\ & + 0.031405 * D1999 \\ & (3.946994) \end{aligned}$$

$$\text{Adj. } R^2 = 0.701605 \quad \text{F-stat} = 38.14987 \quad \text{BG}(2) = 31.90596***$$

Employers' Social Security Contributions

$$\begin{aligned} \text{LOG}(\text{SOCCOMP}/\text{SOCCOMP}(-4)) &= -0.418600 + 0.941308 * \text{LOG}(\text{SOCEMP}/\text{SOCEMP}(-4)) \\ &\quad (-7.290584) \quad (14.45902) \\ &\quad - 0.646844 * \text{LOG}(\text{SOCCOMP}(-4)) \\ &\quad (-17.69022) \\ &\quad + 0.682561 * \text{LOG}(\text{SOCEMP}(-4)) \\ &\quad (19.67186) \end{aligned}$$

Adj. R² = 0.888454 F-stat = 210.7419 BG(2) = 3.277950

Corporate Income Tax Payments

$$\begin{aligned} \text{INCTAXCORP}-\text{INCTAXCORP}(-4) &= -1717.275 + 1168.325 * \text{LOG}(\text{GDPR}/\text{GDPR}(-4)) \\ &\quad (-3.778722) \quad (5.918436) \\ &\quad - 0.341519 * \text{INCTAXCORP}(-4) + 193.6532 * \text{LOG}(\text{GDPR}(-4)) \\ &\quad (-4.077339) \quad (3.780993) \end{aligned}$$

Adj. R² = 0.421035 F-stat = 20.15009 BG(2) = 0.591128

Value Added Tax Revenues

$$\begin{aligned} \text{LOG}(\text{VAT}) &= -5.491826 + 1.054549 * \text{LOG}(\text{CN}) + 1.054032 * \text{LOG}(\text{VATAXRATE}) \\ &\quad (-7.238066) \quad (19.42491) \quad (4.267224) \\ &\quad - 0.336750 * D2000q1 - 0.630827 D2001q1 - 0.926044 D2002q1 \\ &\quad (-2.658629) \quad (-4.981327) \quad (-7.337844) \end{aligned}$$

Adj. R² = 0.883668 F-stat = 127.0950 BG(2) = 4.614928*

Interest Payments on Public Debt

$$\begin{aligned} \text{LOG}(\text{INTEREST}) &= -1.966945 + 0.832199 * \text{LOG}(\text{INTEREST}(-4)) \\ &\quad (-1.894332) \quad (17.18193) \\ &\quad + 0.242440 * \text{LOG}(\text{DEBT}(-4) * \text{GOV10Y}) \\ &\quad (2.378300) \\ &\quad + 1.454346 * (D2010q2 + D2010q3) + 0.2866858 * q1 \\ &\quad (5.976520) \quad (3.071885) \end{aligned}$$

Adj. R² = 0.859831 F-stat = 122.1512 BG(2) = 1.288664

4.2. Identities

AGWR	= AGWN / CPI * 100
BALANCE	= TGRN - TGEN
BALANCEGDP	= BALANCE / GDPN * 100
CAGDP	= CAN / GDPN * 100
CAN	= EXR * EXPDEF / 100 - IMPR * IMPDEF / 100
CAPR	= (1 - DEPR / 100) * CAPR(-1) + INVNR
CN	= CR * CDEF / 100
DEBT	= DEBT(-1) - BALANCE + BANKCAP + DEBTADJ
DEBTGDP	= DEBT / (GDPN + GDPN(-1) + GDPN(-2) + GDPN(-3)) * 100
DEMAND	= INVNR + CR + GR + EXR
EMP	= EMP1564 + EMP65PLUS
GAP	= (GDPR - YPOT) / YPOT * 100
GDPDEF	= GDPN / GDPR * 100
GDPN	= CN + GN + (INVNR + INVENTR) * INVDEF / 100 + CAN
GDPR	= CR + GR + INVNR + INVENTR + EXR - IMPR
GERDR	= GERD / INVDEF * 100
GINVR	= GINVN / INVDEF * 100
GN	= GNFIN + GN_REST
GOV10YR	= GOV10Y - INFL
GR	= GN / GDEF * 100
GRGDPR	= GDPR / GDPR(-4) * 100 - 100
GRYPOT	= (YPOT / YPOT(-4) - 1) * 100
INCOME	= GDPN+TRANSFERSN-SOCTOTAL-INCTAX-VAT-TAXDIRREST-TAXINDIRREST
INCOMER	= INCOME / CPI * 100
INCTAX	= INCTAXPERS + INCTAXCORP
INCTAXPERS	= INCTAXRATE * (AGWN * EMP / 1000) / 1000
INFL	= (CPI / CPI(-4) - 1) * 100
INVN	= INVNR * INVDEF / 100
INVNR	= PRINVR + GINVR + GERDR
LF	= LF1564 + LF65PLUS
LOG(YPOT)	= 0.65 * LOG(TRENDEMP) + (1 - 0.65) * LOG(CAPR) + LOG(TRENDTFP)
NETWAGEN	= AGWN - WEDGE
NETWAGER	= NETWAGEN / CPI * 100
OILEUR	= OIL / EURUSD
PRIMBALANCE	= BALANCE + INTEREST
PRIMBALANCEGDP	= PRIMBALANCE / GDPN * 100
PROD	= GDPR / EMP * 100
SOCEMP	= SOCEMPRATE * (AGWN * EMP / 1000) / 1000
SOCTOTAL	= SOCCOMP + SOCEMP
TAXDIRREST	= TAXDIRRATE * GDPN / 100
TAXINDIRREST	= TAXINDIRRATE * GDPN / 100

<i>TGEN</i>	= <i>GNFIN</i> + <i>GINVN</i> + <i>TRANSFERSN</i> + <i>INTEREST</i> + <i>EXPREST</i>
<i>TGRN</i>	= <i>VAT</i> + <i>SOCTOTAL</i> + <i>INCTAX</i> + <i>TAXDIRREST</i> + <i>TAXINDIRREST</i> + <i>REVREST</i>
<i>TRENDEMP</i>	= <i>LF</i> * (1 - <i>NAIRU_EU</i> / 100)
<i>UCC</i>	= <i>GOV10YR</i> + <i>DEPR</i>
<i>ULC</i>	= <i>AGWN</i> / <i>PROD</i>
<i>UN</i>	= <i>LF</i> - <i>EMP</i>
<i>UN1564</i>	= <i>LF1564</i> - <i>EMP1564</i>
<i>UR</i>	= <i>UN</i> / <i>LF</i> * 100
<i>UR1564</i>	= <i>UN1564</i> / <i>LF1564</i> * 100
<i>UTIL</i>	= <i>GDPR</i> / <i>YPOT</i> * 100
<i>WEDGE</i>	= <i>AGWN</i> * (<i>INCTAXRATE</i> + <i>SOCEMPRATE</i>)

5. EX-POST SIMULATION

Figures A1–A12 in the Appendix show the results of a dynamic ex-post simulation of the model over the period 1999 to 2015 for the key macroeconomic variables. In addition to the visual inspection, we tested the quality of the ex-post forecasting performance of the model formally. As quality criteria we chose the root mean squared error (RMSE) or the root mean squared percent error (RMSPE), the mean absolute percent error (MAPE) or the mean absolute error (MAE), and Theil's inequality coefficient (THEIL).

Regarding the Theil coefficient, we chose the U2 coefficient, defined by the following formula:

$$\text{THEIL} = \frac{\sqrt{\sum_{i=1}^n (F_i - A_i)^2}}{\sqrt{\sum_{i=1}^n A_i^2}}$$

where A_i and F_i denote the actual realisations and forecasts of changes in the underlying variables. The benchmark is the no-change forecast. In this case, THEIL will take the value 1. Values below 1 show an improvement over the simple no-change forecast (Theil 1966).

The RMSE, the RMSPE, the MAE and the MAPE are defined as follows (Shcherbakov et al., 2013):

$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{i=1}^n (F_i - A_i)^2}$$

$$\text{RMSPE} = \sqrt{\frac{1}{n} \sum_{i=1}^n \left[100 * \left(\frac{(F_i - A_i)}{A_i} \right)^2 \right]}$$

$$\text{MAE} = \frac{1}{n} \sum_{i=1}^n |F_i - A_i|$$

$$\text{MAPE} = \frac{1}{n} \sum_{i=1}^n 100 * \frac{|F_i - A_i|}{F_i}$$

We took the RMSE and the MAE for interest rates, ratios (net exports, budget balance and public debt in relation to GDP), growth rates, interest rates, the inflation rate and the unemployment rate, and the RMSPE and the MAPE for all other variables.

The results of these tests ascertaining the quality of the ex-post simulation are shown in Table A4 in the Appendix. Overall, the results are quite promising. The high values of the error statistics for the budget balance and net exports can be explained by the fact that in some cases the simulation misses the correct sign, leading to large errors. Among the demand components, for investment and imports the model simulation is worse than for the other GDP components. Employment and unemployment are in general tracked satisfactorily, with the exception of the labour market indicators of the older people, which is due to the very small absolute numbers of these variables.

6. CONCLUDING REMARKS

The SLOPOL10 model as described above was obtained after a series of steps, following the general-to-specific methodology initiated by David Hendry and associates (see, e.g., Hendry 1995). We also conducted simulations of the model (both static and dynamic) with historical values of (non-controllable and policy) exogenous variables over the period of estimation and found reasonable tracking quality for most variables with respect to trends and turning points. This encourages us to use the model for policy analysis. Among these, policy simulations for fiscal policy design and optimal control experiments for determining optimal budgetary policies will be prominent.

ACKNOWLEDGMENT

The authors gratefully acknowledge financial support from the Slovenian Research Agency ARRS (contract no. 630-31/2016-1) and the Austrian Science Foundation FWF (project no. I 2764-G27). Helpful suggestions from two anonymous referees are gratefully acknowledged. The usual caveat applies.

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Appendix

Table A1: *List of Variables*

Endogenous Variables

AGWN	Average gross wage, euro per employee
AGWR	Average gross wage real
BALANCE	Budget balance
BALANCEGDP	Budget balance in relation to GDP
CAGDP	Current account balance in percent of GDP
CAN	Current account balance
CAPR	Real capital stock
CDEF	Private consumption deflator
CN	Private consumption, nominal
CPI	Consumer price index
CR	Private consumption, real
DEBT	Public debt stock
DEBTGDP	Debt level in relation to GDP
DEMAND	Final demand, real
EMP	Total number of employees
EMP1564	Employment, 15 to 64 years
EMP65PLUS	Employment, 65 years or older
EXPDEF	Export deflator
EXR	Exports of goods and services, real
GAP	Output gap in percent of potential GDP
GDEF	Public consumption deflator
GDPDEF	GDP deflator
GDPN	Nominal GDP
GDPR	Real GDP
GERDR	Real government R&D expenditures
GINVR	Real government investment
GN	Public consumption, national accounts, nominal
GOV10Y	10 year government bond yield
GOV10YR	Real government bond yield
GR	Public consumption, real
GRGDPR	Real GDP growth rate
GRYPOT	Growth rate of potential GDP
IMPDEF	Import deflator
IMPR	Imports of goods and services, real
INCOME	Disposable income of private households, nominal
INCOMER	Disposable income of private households, real
INCTAX	Total income tax revenues
INCTAXCORP	Corporate income tax revenues
INCTAXPERS	Personal income tax revenues
INFL	Inflation rate

<i>INTEREST</i>	Interest payments on public debt
<i>INVDEF</i>	Investment deflator
<i>INVN</i>	Gross fixed capital formation, nominal
<i>INVR</i>	Gross fixed capital formation, real
<i>LF</i>	Total labour force
<i>LF1564</i>	Labour force, 15 to 64 years
<i>LF65PLUS</i>	Labour force, 65 years or older
<i>NETWAGEN</i>	Net wage, nominal
<i>NETWAGER</i>	Average net wage, real
<i>OILEUR</i>	Oil price in euro
<i>PRIMBALANCE</i>	Primary budget balance
<i>PRIMBALANCEGDP</i>	Primary budget balance in relation to GDP
<i>PRINVR</i>	Real private investment
<i>PROD</i>	Labour productivity
<i>REER</i>	Real effective exchange rate (deflator: consumer price indices, 42 trading partners)
<i>SITBOR3M</i>	3 month interest rate before 2007, EURIBOR from 2007 onwards
<i>SOCCOMP</i>	Social security contributions by employers
<i>SOCEMP</i>	Social security contributions by employees
<i>SOCTOTAL</i>	Total social security contributions
<i>TAXDIRECT</i>	Other direct taxes
<i>TAXINDIRECT</i>	Other indirect taxes
<i>TGEN</i>	Total government expenditures
<i>TGRN</i>	Total government revenues
<i>TRENDEMP</i>	Trend of employment
<i>TRENDTFP</i>	Trend of total factor productivity
<i>UCC</i>	User cost of capital
<i>ULC</i>	Unit labour cost
<i>UN</i>	Total number of unemployed persons
<i>UN1564</i>	Unemployment, 15 to 64 years
<i>UR</i>	Unemployment rate
<i>UR1564</i>	Unemployment rate, 15 to 64 years
<i>UTIL</i>	Capacity utilisation rate
<i>VAT</i>	Value added tax revenues
<i>WEDGE</i>	Tax wedge on gross wages
<i>YPOT</i>	Potential output

Exogenous Variables not Controllable by Slovenian Policy Makers

<i>BANKCAP</i>	Capital injections into the banking sector, mill. euro
<i>D1997</i>	Dummy, 1 in 1997, 0 else
<i>D1998</i>	Dummy, 1 in 1998, 0 else
<i>D1999</i>	Dummy, 1 in 1999, 0 else
<i>D2000</i>	Dummy, 1 in 2000, 0 else
<i>D2001</i>	Dummy, 1 in 2001, 0 else

<i>D2002</i>	Dummy, 1 in 2002, 0 else
<i>D2003</i>	Dummy, 1 in 2003, 0 else
<i>D2004</i>	Dummy, 1 in 2004, 0 else
<i>D2005</i>	Dummy, 1 in 2005, 0 else
<i>D2008</i>	Dummy, 1 in 2008, 0 else
<i>D2009</i>	Dummy, 1 in 2009, 0 else
<i>D2010</i>	Dummy, 1 in 2010, 0 else
<i>D2012</i>	Dummy, 1 in 2012, 0 else
<i>D2013</i>	Dummy, 1 in 2013, 0 else
<i>D2014</i>	Dummy, 1 in 2014, 0 else
<i>D199xQi</i>	Dummy, 1 in quarter <i>i</i> of year 199 <i>x</i> , 0 else
<i>D200xQi</i>	Dummy, 1 in quarter <i>i</i> of year 200 <i>x</i> , 0 else
<i>DEBTADJ</i>	Change in debt level, not due to budget balance or bank capitalisation
<i>DEPR</i>	Capital stock depreciation rate
<i>EUR10Y</i>	10 year government bond yield, Euro Area average
<i>EUR3M</i>	3-month EURIBOR
<i>EURUSD</i>	Exchange rate, US dollar per euro
<i>EXPREST</i>	Remaining government expenditures
<i>GN_REST</i>	Public consumption, diff. between national account and fiscal stat.
<i>INVENTR</i>	Real changes in inventories
<i>OIL</i>	Oil price, USD per barrel Brent
<i>NAIRU_EU</i>	Non-accelerating inflation rate of unemployment, published by the EU Commission
<i>POP1564</i>	Population, 15 to 64 years
<i>POP65PLUS</i>	Population, 65 years or older
<i>q1</i>	Dummy, 1 in the first quarter of each year, 0 else
<i>REVREST</i>	Remaining government revenues
<i>SITEUR</i>	Exchange rate, euro per Slovenian tolar
<i>TAXDIRRATE</i>	Other direct taxes in relation to nominal GDP
<i>TAXINDIRRATE</i>	Other indirect taxes in relation to nominal GDP
<i>WTRADE</i>	World trade, CPB

Policy Instruments

<i>GERD</i>	Public expenditures, Research & Development
<i>GINVN</i>	Public investment, nominal
<i>GNFIN</i>	Public consumption according to fiscal statistics, nominal
<i>INCTAXRATE</i>	Average personal income tax rate
<i>LFTERS SHARE</i>	Active working population with tertiary education, % of total
<i>SOCEMPRATE</i>	Average social security contribution rate
<i>TRANSFERSN</i>	Transfers to individuals and households
<i>VATAXRATE</i>	Value added tax rate

The following table shows the detailed results of the stationarity tests. We report the results of Augmented Dickey-Fuller tests (ADF), Phillips-Perron tests (PP) and Kwiatkowski-Phillips-Schmidt-Shin tests (KPSS) for stationarity. The decision on lag length was based on the Schwarz information criterion (SIC). The bandwidth was automatically selected using the Newey-West (1994) approach. We used the test model with a constant and without a deterministic trend. *, **, *** denote rejection of the null hypothesis of a unit root at the 10, 5, 1 percent level of significance respectively. +, ++, +++ denote rejection of the null hypothesis of no unit root at the 10, 5, 1 percent level of significance respectively.

Table A2: *Results of Tests for Stationarity***Levels**

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
AGWN	-1.773	4	-1.406	13	1.127+++	7
AGWR	-3.043**	4	-5.638***	2	0.174	6
BALANCE	-1.499	3	-5.872***	2	0.789+++	6
BALANCEGDP	-1.734	3	-6.893***	3	0.782+++	5
CAGDP	0.899	3	-2.588*	7	0.949+++	6
CAN	2.07	3	-2.632*	23	0.873+++	6
CAPR	-1.547	5	-1.463	6	1.115+++	7
CDEF	-1.358	4	-1.237	15	1.134+++	7
CN	-1.173	4	-1.598	14	1.121+++	7
CPI	-2.596*	5	-3.661***	8	1.218+++	6
CR	-1.747	8	-2.995*	19	1.199+++	6
DEBT	3.494	0	3.778	1	0.971+++	7
DEBTGDP	2.321	0	2.086	3	0.927+++	6
DEMAND	-1.437	5	-1.404	16	1.079+++	7
EMP	-1.656	4	-2.915*	16	0.348+	6
EMP1564	-2.134	4	-2.111	21	0.367+	6
EMP65PLUS	-3.523***	0	-3.573***	1	0.418+	5
EXPDEF	-0.651	4	-0.887	6	1.115+++	7
EXR	-0.446	5	-0.134	14	1.128+++	7
GAP	-5.023***	4	-8.500***	2	0.134	3
GDEF	-1.808	4	-1.259	14	1.127+++	7
GDPDEF	-1.286	4	-1.36	16	1.138+++	7
GDPN	-1.146	6	-1.281	14	1.113+++	7
G DPR	-1.645	6	-1.762	16	1.041+++	7
GERDR	-1.581	3	-8.808***	20	0.474++	10
GINVR	0.121	3	-7.910***	2	1.882+++	0
GN	-1.183	8	-1.097	14	1.112+++	7
GOV10Y	-1.384	1	-3.932***	3	1.014+++	6
GOV10YR	-4.225***	1	-3.109**	2	0.224	5
GR	-1.970	4	-1.625	14	1.063+++	7
GRGDPR	-3.556***	2	-2.789*	4	0.428+	6
GRYPOT	-2.189	0	-2.172	2	0.846+++	6
IMPDEF	-0.7	0	-0.78	3	1.051+++	7

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
IMPR	-1.314	4	-1.006	59	1.072+++	7
INCOME	-1.318	5	-1.3	14	1.127+++	7
INCOMER	-2.268	5	-4.746***	5	0.231	6
INCTAX	-1.636	3	-4.629***	22	1.04+++	6
INCTAXCORP	-1.52	3	-4.783***	2	0.616++	6
INCTAXPERS	-2.021	3	-5.053***	29	1.196+++	6
INFL	-0.944	4	-1.205	3	1.032+++	6
INTEREST	0.21	11	-7.885***	1	1.338+++	4
INVDEF	0.35	2	-0.343	21	1.125+++	7
INVN	-2.369	4	-2.098	82	0.74+++	6
INVR	-2.381	4	-2.181	82	0.433+	6
LF	-1.427	4	-2.934**	17	0.716++	6
LF1564	-1.396	2	-1.903	26	0.752+++	6
LF65PLUS	-3.523***	0	-3.573***	1	0.418+	5
NETWAGEN	-1.533	5	-1.479	14	1.113+++	7
NETWAGER	-2.988**	4	-3.233**	49	0.458+	6
OILEUR	-1.505	0	-1.505	0	0.977+++	7
PRIMBALANCE	-1.912	3	-5.552***	3	0.549++	6
PRIMBALANCEGDP	-2.03	3	-6.633***	3	0.557++	5
PRINVR	-2.124	4	-2.041	60	0.332	6
PROD	-2.189	7	-2.083	16	1.241+++	6
REER	-1.949	0	-2.121	1	0.741+++	6
SITBOR3M	-2.687*	1	-2.103	4	0.86+++	6
SOCCOMP	-0.961	4	-1.017	15	1.107+++	7
SOCEMP	-1.721	4	-1.415	14	1.119+++	7
SOCTOTAL	-1.378	4	-1.221	14	1.116+++	7
TAXDIRREST	-2.534	4	-2.988**	20	0.629++	6
TAXINDIRREST	-1.138	3	-1.752	26	1.134+++	7
TGEN	-1.692	5	-1.343	14	1.125+++	7
TGRN	-1.822	4	-1.786	15	1.114+++	7
TRENDEMP	-1.568	4	-3.151**	13	0.575++	6
TRENDTFP	-1.877	8	-5.521***	6	1.009+++	7
UCC	-4.266***	1	-3.154**	2	0.216	5
ULC	-1.500	4	-1.549	19	1.033+++	7
UN	-2.472	8	-1.639	5	0.483++	7
UN1564	-2.306	8	-1.505	5	0.553++	6
UR	-2.406	8	-1.717	7	0.408+	7
UR1564	-2.472	8	-1.611	6	0.464++	6
UTIL	-5.023***	4	-8.500***	2	0.134	3
VAT	-1.399	3	-4.813***	12	1.251+++	6
WEDGE	-2.666*	3	-2.025	16	1.127+++	7
YPOT	-2.068	4	-2.094	14	1.085+++	7
DEBTADJ	-13.689***	0	-13.711***	3	0.147	0
DEPR	-0.415	4	-0.319	85	0.449+	6
EUR10Y	-2.193	1	-2.336	4	1.067+++	6

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
EUR3M	-2.414	1	-1.855	4	0.988+++	6
EURUSD	-2.035	1	-1.624	2	0.382+	6
EXPREST	-0.89	4	-2.477	19	1.147+++	7
GERD	-1.504	3	-8.284***	7	1.362+++	0
GINVN	0.469	3	-7.201***	0	1.552+++	3
GN_REST	-0.316	3	-4.877***	4	0.565++	6
GNFIN	-2.125	4	-1.784	15	1.09+++	7
INCTAXRATE	-3.075**	3	-7.214***	1	0.942+++	5
INVENTR	-3.137**	4	-5.843***	1	0.228	5
LFTERSHARE	2.803	4	3.037	4	1.123+++	6
NAIRU_EU	-0.733	9	-0.807	4	1.164+++	7
OIL	-1.557	2	-1.616	3	0.863+++	7
POP1564	-0.521	5	-0.133	4	0.287	6
POP65PLUS	0.112	1	2.799	30	1.189+++	6
REVREST	-0.709	3	-4.133***	13	1.336+++	6
SITEUR	-2.689*	8	-7.179***	9	0.901+++	7
SOCEMPRATE	-3.082**	4	-5.357***	42	1.108+++	6
TAXDIRRATE	-1.929	4	-2.733**	36	0.249	6
TAXINDIRRATE	-1.487	3	-3.223**	8	0.954+++	6
TRANSFERSN	-2.19	4	-1.663	14	1.175+++	7
VATAXRATE	-1.729	3	-11.539***	2	0.656+++	27
WTRADE	-1.029	2	-0.938	1	1.185+++	7
YPOT	-2.068	4	-2.094	14	1.085+++	7

First Differences

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
AGWN	-2.312	3	-33.323***	47	0.254	13
AGWR	-2.334	3	-31.946***	28	0.096	13
BALANCE	-13.39***	2	-28.624***	17	0.109	15
BALANCEGDP	-14.273***	2	-30.893***	16	0.104	15
CAGDP	-11.625***	2	-22.159***	19	0.303	18
CAN	-5.417***	3	-15.823***	17	0.338	16
CAPR	-1.864	4	-2.287	51	0.398+	6
CDEF	-3.172**	3	-11.877***	14	0.192	14
CN	-2.898**	3	-21.676***	13	0.142	13
CPI	-0.838	3	-8.512***	2	1.28+++	2
CR	-2.123	7	-28.605***	14	0.218	13
DEBT	-4.499***	1	-8.642***	4	0.709++	5
DEBTGDP	-4.478***	1	-8.394***	4	0.495++	5
DEMAND	-3.641***	4	-21.409***	42	0.185	15
EMP	-3.816***	3	-10.045***	26	0.128	25
EMP1564	-3.727***	3	-9.087***	27	0.165	29
EMP65PLUS	-9.544***	0	-12.997***	14	0.157	17

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
EXPDEF	-3.273**	3	-9.309***	7	0.072	7
EXR	-4.754***	4	-9.687***	12	0.098	15
GAP	-5.356***	6	-42.042***	23	0.128	13
GDEF	-2.872*	3	-21.594***	27	0.176	14
GDPDEF	-3.353**	3	-13.965***	17	0.221	15
GDPN	-3.437**	5	-17.76***	16	0.148	13
GDPR	-4.001***	5	-19.49***	33	0.216	14
GERDR	-28.757***	2	-20.675***	13	0.091	12
GINVR	-40.618***	2	-24.808***	13	0.16	13
GN	-1.841	7	-27.178***	4	0.151	13
GOV10Y	-2.888*	10	-12.684***	3	0.333	8
GOV10YR	-7.119***	0	-7.091***	3	0.089	3
GR	-2.279	3	-29.073***	2	0.195	14
GRGDPR	-5.946***	3	-8.009***	3	0.037	3
GRYPOT	-9.439***	0	-9.449***	2	0.037	2
IMPDEF	-8.791***	0	-8.840***	3	0.084	3
IMPR	-3.214**	3	-13.062***	10	0.23	37
INCOME	-2.802*	4	-14.353***	14	0.14	13
INCOMER	-2.717**	4	-14.622***	14	0.079	14
INCTAX	-12.354***	2	-31.134***	19	0.165	13
INCTAXCORP	-13.754***	2	-25.119***	16	0.113	14
INCTAXPERS	-15.093***	2	-44.113***	17	0.175	13
INFL	-6.092***	3	-6.855***	3	0.036	3
INTEREST	-3.058**	10	-29.74***	13	0.101	13
INVDEF	-12.284***	1	-9.487***	27	0.11	20
INVN	-2.602*	3	-12.377***	18	0.246	23
INVR	-2.753*	3	-13.303***	46	0.272	19
LF	-11.16***	1	-10.608***	26	0.15	25
LF1564	-10.165***	1	-10.062***	27	0.164	29
LF65PLUS	-9.544***	0	-12.997***	14	0.157	17
NETWAGEN	-2.883*	4	-20.567***	14	0.156	13
NETWAGER	-3.306**	3	-16.111***	14	0.124	13
OILEUR	-7.438***	0	-7.351***	3	0.179	0
PRIMBALANCE	-10.064***	2	-37.165***	40	0.149	20
PRIMBALANCEGDP	-11.229***	2	-35.294***	25	0.131	18
PRINVR	-2.938**	3	-10.627***	19	0.358+	18
PROD	-5.074***	6	-24.469***	25	0.287	14
REER	-7.864***	0	-7.904***	1	0.047	1
SITBOR3M	-6.426***	0	-6.414***	1	0.083	4
SOCCOMP	-4.44***	3	-22.854***	26	0.124	14
SOCEMP	-2.726	4	-23.800***	23	0.199	13
SOCTOTAL	-3.8	3	-23.724***	23	0.169	13
TAXDIRREST	-3.387	3	-14.619***	15	0.328	14

Variable	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
<i>TAXINDIRREST</i>	-15.542	2	-29.294***	17	0.19	15
<i>TGEN</i>	-2.794	4	-33.417***	14	0.116	13
<i>TGRN</i>	-5.585	3	-41.022***	15	0.166	13
<i>TRENDEMP</i>	-11.161	1	-10.692***	26	0.15	25
<i>TRENDTFP</i>	-1.712***	7	-1.668	6	0.767+++	7
<i>UCC</i>	-7.164***	0	-7.137***	3	0.085	3
<i>ULC</i>	-2.849*	3	-17.118***	32	0.163	15
<i>UN</i>	-1.853	7	-9.096***	9	0.082	10
<i>UN1564</i>	-2.713*	3	-8.385***	8	0.11	9
<i>UR</i>	-2.029	7	-9.325***	12	0.086	14
<i>UR1564</i>	-1.572	7	-8.359***	11	0.112	13
<i>UTIL</i>	-5.356***	6	-42.042***	23	0.128	13
<i>VAT</i>	-19.866***	2	-42.366***	14	0.094	13
<i>WEDGE</i>	-5.984***	3	-42.232***	15	0.197	13
<i>YPOT</i>	-2.609*	3	-8.314***	8	0.555++	6
<i>DEBTADJ</i>	-8.254	5	-36.099***	5	0.114	17
<i>DEPR</i>	-9.447	3	-9.466***	26	0.361+	19
<i>EUR10Y</i>	-6.358	0	-6.291***	2	0.207	4
<i>EUR3M</i>	-5.024	0	-5.099***	1	0.063	4
<i>EURUSD</i>	-6.762	1	-6.323***	8	0.131	3
<i>EXPREST</i>	-6.328	3	-25.289***	13	0.084	13
<i>GERD</i>	-28.241	2	-21.678***	13	0.063	13
<i>GINVN</i>	-44.566	2	-27.355***	13	0.175	13
<i>GN_REST</i>	-22.335	2	-24.487***	14	0.237	13
<i>GFIN</i>	-2.573	3	-29.785***	55	0.213	13
<i>INCTAXRATE</i>	-22.203	2	-37.677***	14	0.187	13
<i>INVENTR</i>	-4.443	3	-24.159***	22	0.108	15
<i>LFTERSHARE</i>	-2.365	3	-7.962***	1	0.909+++	3
<i>NAIRU_EU</i>	-3.005	8	-4.262***	2	0.062	4
<i>OIL</i>	-7.291	1	-6.852***	9	0.159	4
<i>POP1564</i>	-2.873	4	-8.365***	4	0.508++	4
<i>POP65PLUS</i>	-13.868	0	-14.307***	8	0.489++	47
<i>REVREST</i>	-17.644	2	-38.455***	14	0.082	14
<i>SITEUR</i>	-2.372	7	-6.142***	4	1.02+++	5
<i>SOCEMPRATE</i>	-3.622	3	-25.702***	13	0.252	13
<i>TAXDIRRATE</i>	-2.925	3	-10.84***	28	0.277	18
<i>TAXINDIRRATE</i>	-14.309	2	-27.146***	20	0.131	15
<i>TRANSFERSN</i>	-3.346	4	-26.334***	17	0.346	13
<i>VATAXRATE</i>	-19.501	2	-50.457***	14	0.098	13
<i>WTRADE</i>	-5.956	1	-4.453***	9	0.061	1

The following table shows the results of the cointegration tests for the behavioural equations finally adopted. *, **, *** means that the null hypothesis (ADF and Phillips-Perron: no stationarity of the residuals; KPSS: stationarity of the residuals) can be rejected at the 10, 5, 1 percent level of significance respectively. Similarly to the tests for stationarity, we chose the models with a constant, but without a trend. As before, the decision on lag length was based on the Schwarz information criterion. The bandwidth was selected automatically using the Newey-West (1994) approach.

Table A3: *Tests for Cointegration – Tests for Stationarity of Residuals of the Equations*

Equation	ADF	Lags	PP	Bandwidth	KPSS	Bandwidth
Trend TFP	-2.012	4	-3.872***	5	0.176	6
Consumption	-6.536***	0	-6.546***	3	0.065	2
Investment	-7.636***	0	-7.913***	5	0.195	5
Exports	-7.243***	0	-7.267***	1	0.092	1
Imports	-9.165***	0	-9.156***	4	0.124	4
Employment 15-64	-4.250***	0	-4.250***	0	0.184	4
Employment 65+	-7.983***	0	-7.984***	1	0.109	2
Labour supply 15-64	-5.241***	0	-5.260***	1	0.264	3
Labour supply 65+	-7.965***	0	-7.965***	1	0.098	1
Wage rate	-8.002***	0	-7.999***	1	0.060	0
CPI	-6.739***	0	-6.806***	2	0.048	3
Cons. Deflator	-5.007***	0	-5.039***	2	0.082	3
Gov. cons. deflator	-8.062***	0	-8.062***	0	0.093	1
Investment deflator	-4.739***	0	-4.739***	0	0.217	4
Export deflator	-6.105***	1	-6.288***	4	0.074	2
Import deflator	-5.127***	3	-4.563***	5	0.124	5
Short-term int. rate	-5.080***	0	-5.080***	0	0.086	4
Long-term int. rate	-3.865***	5	-4.357***	4	0.205	4
Real eff. exch. rate	-4.592***	0	-4.550***	2	0.131	5
Soc. sec. revenues	-7.798***	0	-7.869***	3	0.130	4
Company taxes	-9.062***	0	-9.161***	5	0.105	5
VAT revenues	-2.920**	3	-8.474***	8	0.175	3
Interest payments	-9.239***	0	-9.244***	2	0.216	2

Table A4: Results of Ex-post Model Evaluation

Variables in levels

Variable	RMSPE	Theil	MAPE	Variable	RMSPE	Theil	MAPE
AGWN	4.1	0.359	3.6	INTEREST	9,463.4	0.660	18.1
AGWR	2.0	0.516	1.8	INVDEF	1.8	0.459	1.2
BALANCE	247.8	0.689	293.7	INVN	10.6	0.814	8.6
CAN	467.9	1.062	447.9	INVR	11.0	0.838	9.2
CAPR	7.2	0.373	6.5	LF	0.9	0.767	0.7
CDEF	2.0	0.570	1.5	LF1564	0.9	0.795	0.6
CN	5.1	0.543	4.2	LF65PLUS	9.4	0.726	7.2
CPI	4.4	0.436	3.3	NETWAGEN	4.1	0.369	3.6
CR	3.2	0.557	2.7	NETWAGER	2.0	0.381	1.8
DEBT	22.8	0.160	21.1	OILEUR	0.0	0.000	0.0
DEMAND	2.0	0.328	1.6	PRIMBALANCE	9,081.8	0.679	339.0
EMP	1.4	0.787	1.3	PRINVR	12.3	0.854	10.4
EMP1564	1.3	0.778	1.2	PROD	2.0	0.610	1.7
EMP65PLUS	16.2	1.034	12.2	REER	2.2	0.697	1.9
EXPDEF	0.8	0.484	0.7	SOCCOMP	5.2	0.430	4.6
EXR	2.1	0.197	1.7	SOCEMP	4.5	0.387	3.9
GDEF	2.0	0.431	1.7	SOCTOTAL	4.8	0.392	4.2
GDPDEF	8.2	0.366	0.8	TAXDIRREST	2.9	0.257	2.5
GDPN	2.8	0.513	2.4	TAXINDIRREST	3.0	0.366	2.6
GDPR	2.3	0.525	1.9	TGEN	0.5	0.056	0.4
GERDR	1.6	0.054	1.2	TGRN	3.8	0.458	3.0
GINVR	1.8	0.080	1.4	TRENDEMP	0.9	0.759	0.7
GN	0.0	0.000	0.0	TRENDTFP	3.8	1.164	0.0
GR	1.9	0.532	1.6	UCC	49.4	1.134	40.9
IMPDEF	1.7	0.451	1.5	ULC	3.6	0.682	3.0
IMPR	4.4	0.418	3.8	UN	18.7	1.044	15.9
INCOME	2.5	0.463	2.1	UN1564	17.1	0.896	14.9
INCOMER	5.2	0.621	3.8	VAT	7.2	0.653	5.7
INCTAX	8.8	0.699	7.4	WEDGE	4.1	0.250	3.6
INCTAXCORP	32.4	0.955	27.0	YPOT	5.8	0.639	5.5
INCTAXPERS	4.6	0.296	4.0				

Variables in percent

Variable	RMSE	Theil	MAE
BALANCEGDP	1.4	0.777	1.0
CAGDP	1.7	1.121	1.4
DEBTGDP	7.8	0.324	7.3
GAP	5.7	0.971	4.9
GOV10Y	0.6	0.471	0.5
GOV10YR	1.8	1.140	1.5
GRGDPR	2.1	0.695	1.6
GRYPOT	1.9	1.706	1.5
INFL	1.9	0.862	1.6
PRIMBALANCEGDP	1.5	0.758	1.2
SITBOR3M	1.0	0.828	0.7
UR	1.3	1.030	1.1
UR1564	1.2	0.892	1.0
UTIL	5.7	0.969	4.9

Figure A1: *Real GDP*

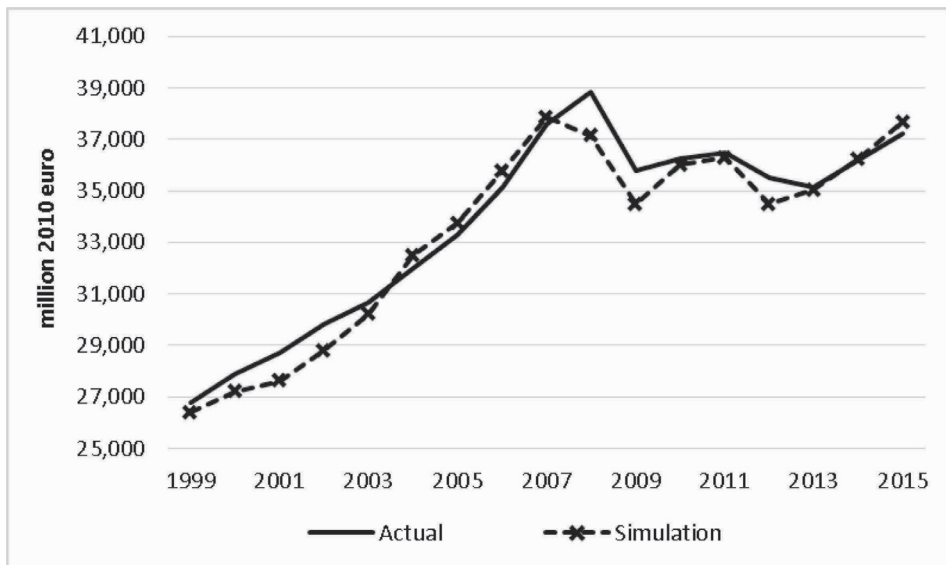


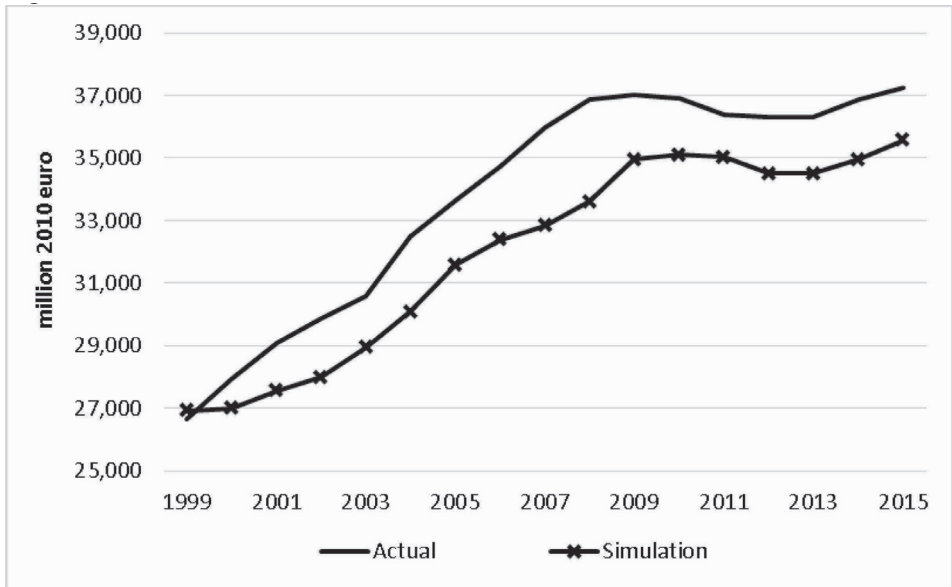
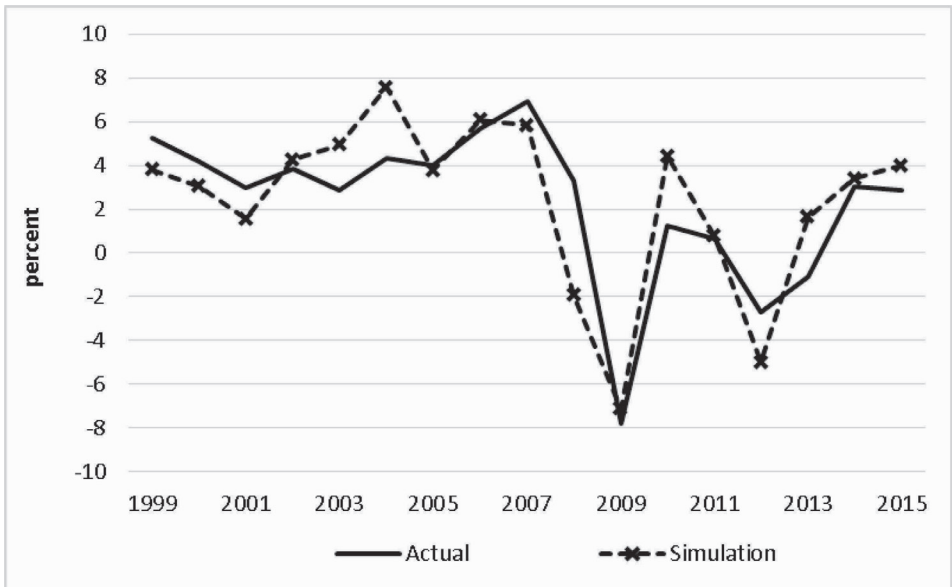
Figure A2: *Potential GDP*Figure A3: *Real GDP Growth*

Figure A4: *Real private consumption*

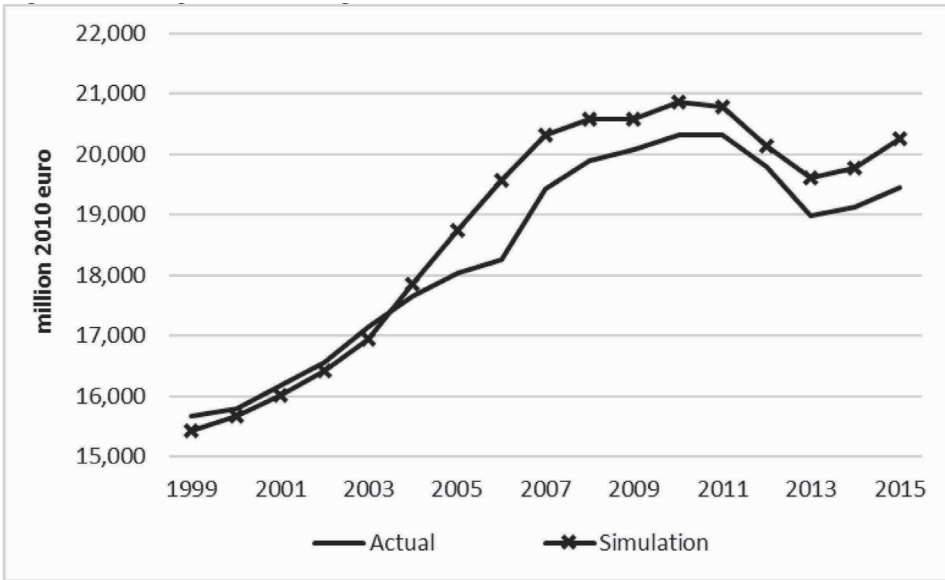


Figure A5: *Real investment*

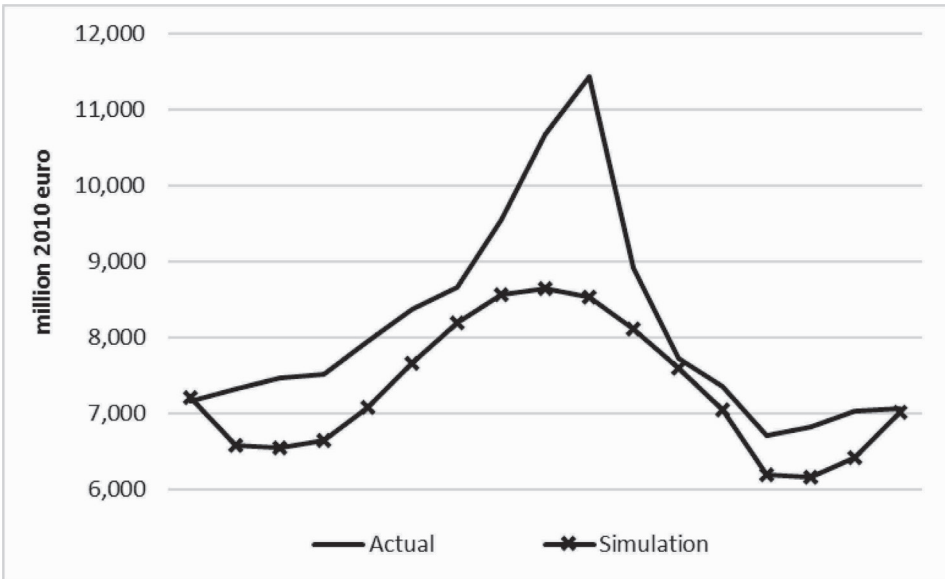


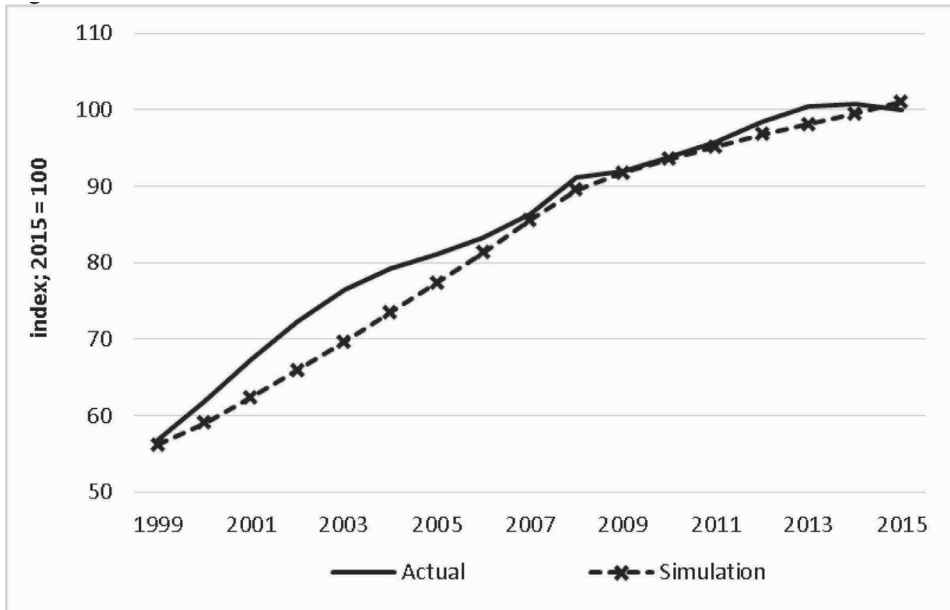
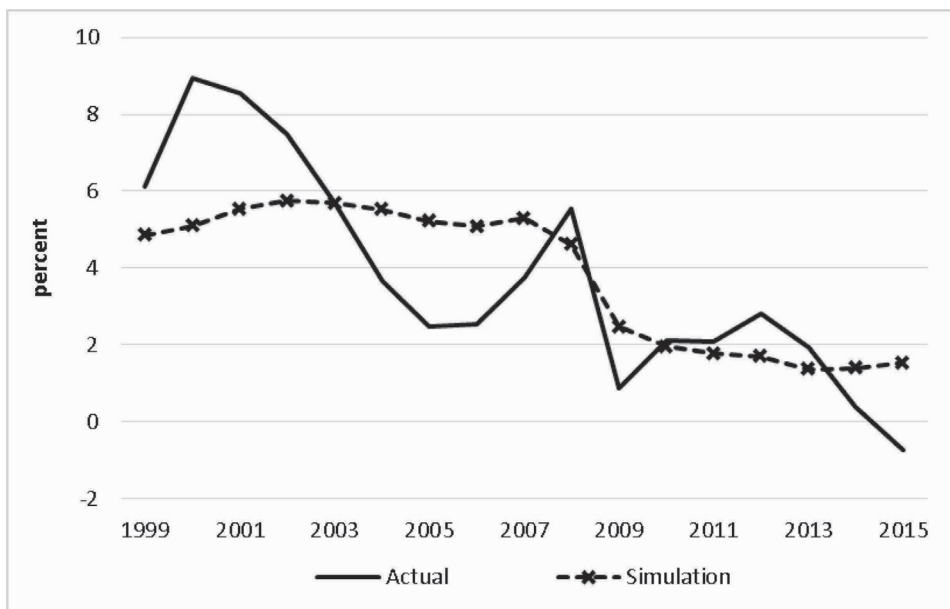
Figure A6: *Consumer Price Index*Figure A7: *Inflation Rate*

Figure A8: *Employment*

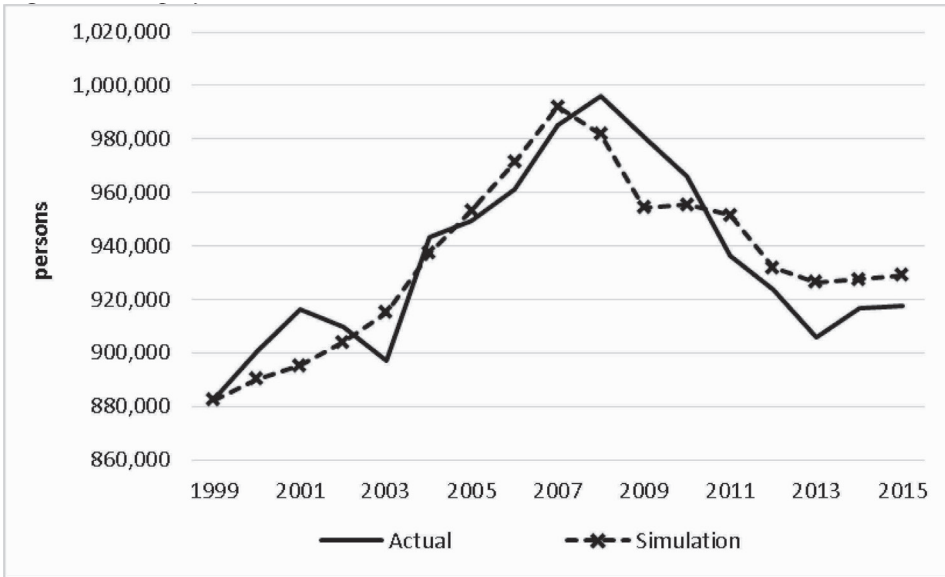


Figure A9: *Unemployment Rate*

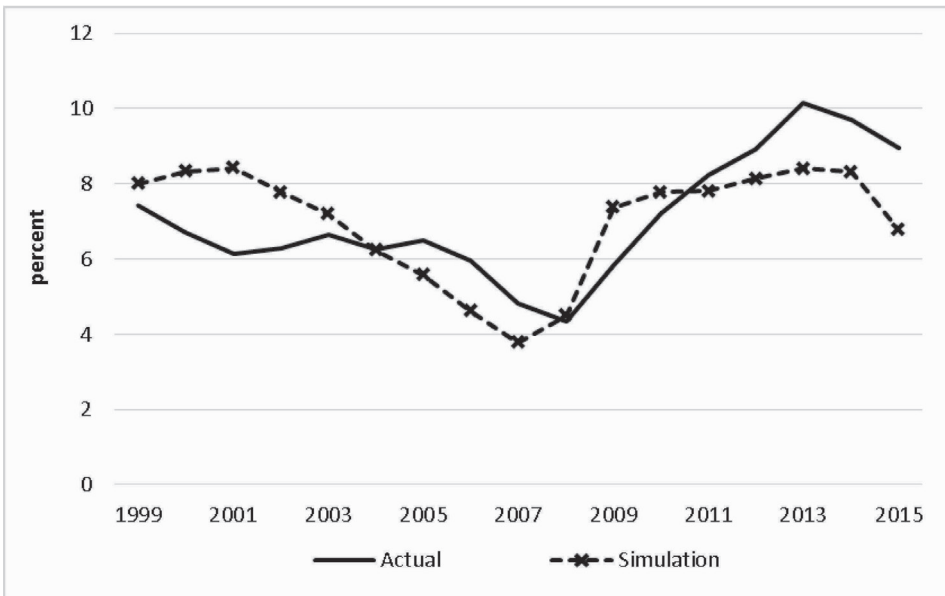


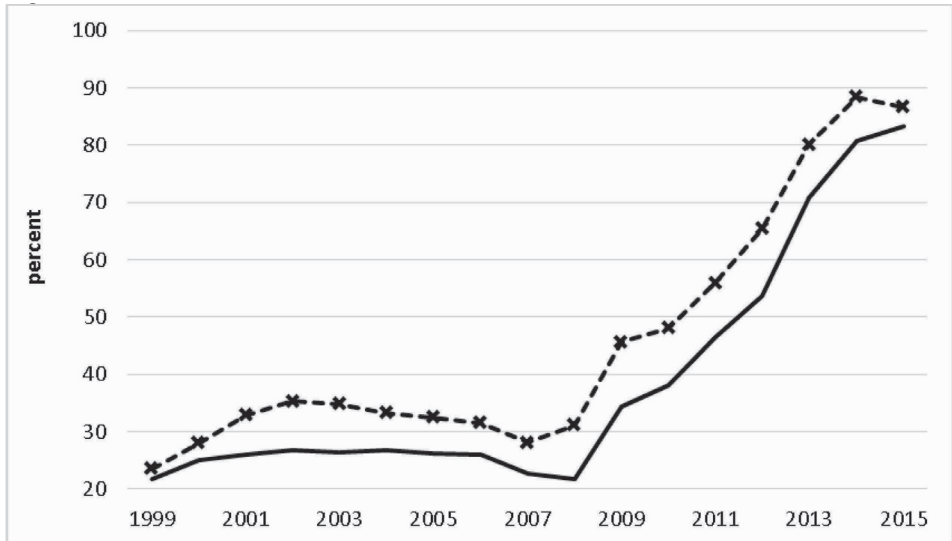
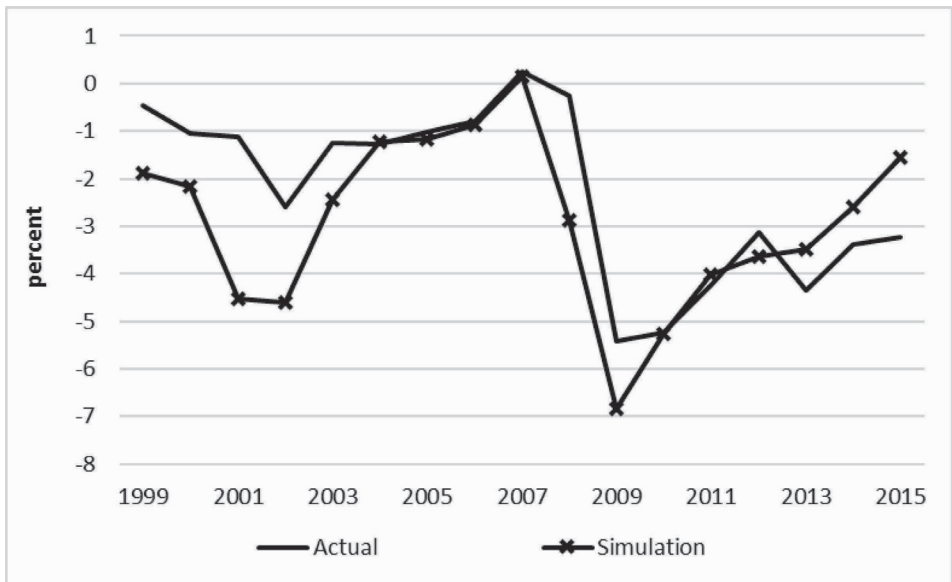
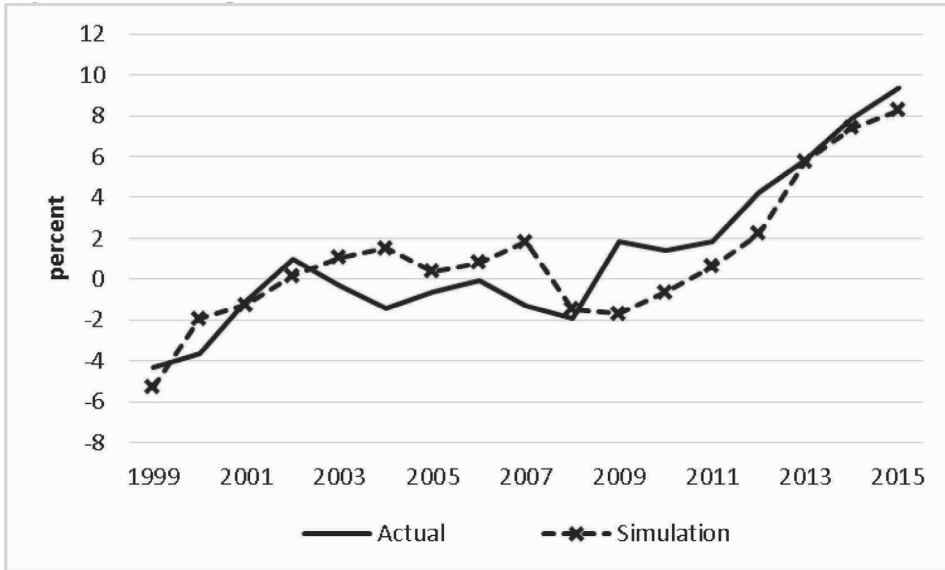
Figure A10: *Public Debt in relation to Nominal GDP*Figure A11: *Budget balance in relation to Nominal GDP*

Figure A12: *Net Exports in relation to Nominal GDP*



E / B / R

**POVZETKI V
SLOVENSKEM JEZIKU**

A REVIEW OF THE EMPIRICAL EVIDENCE ON PWYW PRICING

PREGLED RAZISKAV S PODROČJA MEHANIZMA ZA DOLOČANJE CEN »PAY-WHAT-YOU-WANT (PWYW)«

MATTHIAS GREIFF, HENRIK EGBERT

POVZETEK: V članku avtorji sistematično analizirajo literaturo s področja teorije oblikovanja cen, in sicer »Pay-What-You-Want (PWYW)« mehanizma za določanje cen. Cilj preglednega članka je identifikacija morebitnih raziskovalnih vrzeli na sicer hitro rastočem področju. Metodološko članek temelji na analizi 53 člankov iz obdobja med 2009 in 2016, literaturo pa klasificira na podlagi uporabljene metode analize. Tako ločeno obravnava eksperimente v nadzorovanem okolju, eksperimente na terenu ter študije primerov. Na podlagi pregleda literature avtorji identificirajo dve temeljni vrzeli na področju PWYW določanja cen: (1) določanje cen za proizvode z visokimi proizvodnimi stroški ter (2) analize dolgoročnih posledic PWYW določanja cen.

Ključne besede: mehanizmi za določanje cen, Pay-What-You-Want (PWYW), empirične študije

THE INTERPLAY OF EXPATRIATES' PSYCHOLOGICAL AND SOCIAL CAPITAL FOR KNOWLEDGE TRANSFER

VZAJEMNI VPLIV PSIHOLOŠKEGA IN SOCIALNEGA KAPITALA EKSPATRIIRANCEV NA PRENOS ZNANJA

ALEŠA SAŠA SITAR, KATARINA KATJA MIHELIC

POVZETEK: Literatura izpostavlja zaposlene, ki prihajajo v podružnice v tujini iz centrale podjetja (ekspatriirance) kot glavne deležnike v procesu prenosa znanja med centralo in podružnicami v multinacionalnih podjetjih. Cilj članka je preučiti vlogo managerjevega osebnega kapitala (pozitivnega psihološkega kapitala in socialnega kapitala) pri prenosu znanja iz centrale v podružnico in nazaj, iz podružnice v centralo, v pogojih jezikovnih razlik, razlik v nacionalnih kulturah in geografske oddaljenosti med centralo in podružnico. Kvalitativna analiza treh poslovnih primerov slovenskih podjetij s podružnicami na Kitajskem je pokazala, da psihološki kapital pomembno vpliva na prenos znanja v multinacionalnih podjetjih in sicer na dva načina: prvič, neposredno in drugič, posredno preko vplivanja na socialni kapital. Raziskava pokaže, da imajo dimenzije pozitivnega psihološkega kapitala ekspatriirancev (samoučinkovitost, trdoživost in optimizem) vpliv na prenos znanja med centralo in podružnico, s čimer prispeva k literaturi o povezovalni vlogi ekspatriirancev v multinacionalnih podjetjih. Rezultati nadalje kažejo, da dimenzije psihološkega kapitala podpirajo razvoj strukturne in razmernostne dimenzije social-

nega kapitala, kar dodatno krepi prenos znanja v multinacionalnih podjetjih. Tako raziskava prispeva k literaturi o vlogi socialnega kapitala ekspatriirancev v tokovih znanja. Z opazovanjem razmerij v različnih vrstah podružnic v tujini raziskava nudi še koristne napotke za management znanja v mednarodnem kontekstu.

Ključne besede: prenos znanja, ekspatriiranci, psihološki kapital, socialnih kapital, multinacionalna podjetja

COHESION POLICY AND DEVELOPMENT PRIORITIES IN SLOVENIA

KOHEZIJSKA POLITIKA IN RAZVOJNE PRIORITETE V SLOVENIJI

SONJA ŠLANDER WOSTNER

POVZETEK: Slovenija je v letu 2015 sprejela nacionalno Strategijo pametne specializacije, v kateri je določila ključna prednostna področja svoje prihodnje nacionalne politike raziskav, razvoja in inovacij (RRI). Namen članka je ugotoviti, v kolikšni meri so ta področja usklajena s panogami, ki so bila na področju RRI spodbujana v preteklosti. Ker pa le-te do sedaj niso bila eksplicitno definirane, jih v članku identificiramo ex-post, in sicer na podlagi analize panožne porazdelitve subvencij kohezijske politike, izplačanih podjetjem za aktivnosti raziskav in razvoja (RR) med leti 2004 in 2011. Rezultati kažejo, da je bilo v tem obdobju 76% subvencij za RR, izplačanih podjetjem v predelovalnih panogah, namenjenih podjetjem v samo sedmih panogah, in da le-te skoraj v celoti ustrezajo v letu 2015 opredeljenim prednostnim panogam slovenske politike RRI. Članek s tem prispeva k razumevanju pomena in delovanja kohezijske politike v Sloveniji, saj ugotavlja, da je, kljub temu, da do leta 2015 Slovenija ni eksplicitno definirala svojih prednostnih razvojnih področij, kohezijska politika kljub temu uspešno identificirala in spodbujala panoge, ki so pozneje postale najbolj dinamični in perspektivni del slovenskega gospodarstva, in ki še vedno predstavljajo najpomembnejši del nacionalne strategije RRI.

Ključne besede: PRI, Strategija pametne specializacije, kohezijska politika, Slovenija

GLOBAL SUPPLY CHAINS AT WORK IN CENTRAL AND EASTERN EUROPEAN COUNTRIES: IMPACT OF FOREIGN DIRECT INVESTMENT ON EXPORT RESTRUCTURING AND PRODUCTIVITY GROWTH

EKONOMIKA GLOBALNIH DOBAVITELJSKIH VERIG V DRŽAVAH SREDNJE IN VZHODNE EVROPE: NEPOSREDNE TUJE INVESTICIJE KOT DEJAVNIK IZVOZNEGA PRESTRUKTURIRANJA IN RASTI PRODUKTIVNOSTI

JOŽE DAMIJAN, ČRT KOSTEVC, MATIJA ROJEC

POVZETEK: Izhajajoč iz ekonomike globalnih dobaviteljskih verig, je cilj prispevka oceniti, v kolikšni meri so vhodne neposredne tuje investicije (NTI) dejavnik strukturnih sprememb in rasti produktivnosti v predelovalni dejavnosti držav srednje in vzhodne Evrope (DSVE). Z uporabo empiričnega modela, ki ocenjuje učinek NTI na izvozno prestrukturiranje (pri čemer kontroliramo za izvozno povpraševanje, uvoz in intra-industrijsko intenzivnost trgovine) in standardnega modela rasti zajamemo učinek prestrukturiranja izvoza na rast industrijske produktivnosti ter empirično ocenimo pomen globalnih dobaviteljskih verig za izvozno prestrukturiranje in rast produktivnosti predelovalne dejavnosti DSVE v razdobju 1995-2007. Z uporabo panožnih podatkov in upoštevajoč tehnološko intenzivnost industrij pokažemo, da so NTI signifikantno prispevale k prestrukturiranju izvoza DSVE, vendar pa se učinki po državah razlikujejo. Medtem ko so bolj napredne DSVE uspele povečati izvoz v bolj tehnološko zahtevnih industrijah, so preostale DSVE ostale specializirane v tehnološko nižje intenzivnih industrijah. To kaže, da je ključnega pomena, v kakšne industrije se usmerjajo vhodne NTI. Članek prispeva k relevantni literaturi s tem, da pojasnjuje mehanizem, s katerim NTI prispevajo k ekonomskemu in tehnološkemu prestrukturiranju DSVE.

Ključne besede: neposredne tuje investicije, globalne dobaviteljske verige, Srednja in Vzhodna Evropa, izvoz, produktivnost

SLOPOL10: A MACROECONOMETRIC MODEL FOR SLOVENIA

SLOPOL10: KVARTALNI MAKROEKONOMETRIČNI MODEL SLOVENSKEGA GOSPODARSTVA

KLAUS WEYERSTRASS, REINHARD NECK, DMITRI BLUESCHKE,
BORIS MAJČEN, ANDREJ SRAKAR, MIROSLAV VERBIČ

POVZETEK: Članek predstavlja model SLOPOL10, ki je kvartalni makroekonometrični model slovenskega gospodarstva, uporaben za makroekonomske napovedi in simulacije alternativnih ukrepov ekonomske politike. Model je tipa Cowlesove komisije in se ga ocenjuje prek pristopa kointegracije, kar omogoča upoštevanje tako dolgoročnega ravnovesja, kot tudi kratkoročnih mehanizmov prilagajanja. Vsebuje vedenjske enačbe in identitete za trg dobrin, trg dela, trg mednarodne menjave, trg denarja in javni sektor. Ocene vedenjskih enačb za slovenske makroekonomske agregate temeljijo na podatkih od vključno leta 1995 naprej. Model kombinira keynesijanske in neoklasične elemente. Keynesianski elementi določajo kratkoročne in srednjeročne rešitve v smislu, da je model opredeljen s povpraševanjem ter so možna trajajoča neravnovesja na trgih dobrin in dela. Ponudbena stran vključuje neoklasične elemente. Statične in dinamične simulacije modela kažejo, da lahko le-ta ustrezno reproducira pretekla gibanja in je zato uporaben za napovedovanje in vrednotenje ukrepov ekonomske politike, še posebej za oblikovanje fiskalne politike in eksperimente optimalne kontrole.

Ključne besede: SLOPOL10 model, makroekonometrični modeli, oblikovanje fiskalne politike, eksperimenti optimalne kontrole, Slovenija

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PUBLISHERS:

Faculty of Economics,
Kardeljeva ploščad 17, SI-1001 Ljubljana,
Slovenia.

The review is co-financed by Slovenian Research Agency.

URL: <http://www.ebrjournal.net>

THE REVIEW'S OFFICE:

Economic and Business Review
Faculty of Economics,
Kardeljeva ploščad 17, SI-1001 Ljubljana,
Slovenia
tel: + 386 1 58 92 607, fax: + 386 1 58 92 698,
email: ebr.editors@ef.uni-lj.si

Bound by Birografika Bori d.o.o., Ljubljana
Printed by Copis d.o.o., Ljubljana

Economic and Business Review is indexed in:
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Econlit, IBSS and ProQuest

ISSN 1580-0466
e-ISSN 2335-4216

ISSN 1580 0466



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