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Mariacristina Piva, Massimiliano Tani and Marco Vivarelli

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Maastricht Economic and social Research institute on Innovation and Technology (UNU-MERIT)
email: **info@merit.unu.edu** | website: **http://www.merit.unu.edu**

Boschstraat 24, 6211 AX Maastricht, The Netherlands
Tel: (31) (43) 388 44 00

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The productivity impact of business visits across industries

Mariacristina Piva
Department of Economic Policy, Università Cattolica del Sacro Cuore, Piacenza, Italy

Massimiliano Tani
UNSW Canberra, Australia and IZA, Bonn, Germany

Marco Vivarelli
Department of Economic Policy, Università Cattolica del Sacro Cuore, Milano, Italy; UNU-MERIT, Maastricht, The Netherlands and IZA, Bonn, Germany

Abstract

This paper builds on and considerably extends Piva, Tani and Vivarelli (2018), confirming the key role of Business Visits as a productivity enhancing channel of technology transfer.
Our analysis is based on a unique database on business visits sourced from the U.S. National Business Travel Association, merged with OECD and World Bank data and resulting in an unbalanced panel covering 33 sectors and 14 countries over the period 1998-2013 (3,574 longitudinal observations).
We find evidence that BVs contribute to fostering labour productivity in a significant way. While this is consistent with what found by the previous (scant) empirical literature on the subject, we also find that short-term mobility exhibits decreasing returns, being more crucial in those sectors characterized by less mobility and by lower productivity performances.

Keywords: Business visits· Labour mobility · Knowledge diffusion· R&D · Productivity

JEL classification: J61 **,** O33

Corresponding Author:

Prof. Marco Vivarelli
Department of Economic Policy
Università Cattolica del Sacro Cuore
Largo Gemelli 1
20123 Milano
Italy
marco.vivarelli@unicatt.it

1 Introduction

Over the past decades new decentralised models of innovation have emerged alongside the global economy, expanding the range of innovation sources. Multinational enterprises (MNE) have progressively moved away from the post-WWII model of centralised R&D activity to take advantage of *open innovation* as an effective model to tap resources, expertise, and service markets, located around the world (Criscuolo, 2005; Baldwin and von Hippel, 2011). Other firms and nations have benefited from collaborations involving temporary exchanges of experts (Edler, Fier and Grimpe, 2011), and externalities from returning entrepreneurs (Filatotchev *et al.*, 2011), researchers (Kogut and Macpherson, 2011; Jonkers and Cruz-Castro, 2013) and scientists (Gibson and McKenzie, 2014). Moreover, some firms have sourced innovation by improving communication and interaction with customers (Crescenzi and Gagliardi, 2018), often within a supply chain relation (Roy, Sivakumar and Wilkinson, 2004; Roper, Du and Love, 2008), or enhanced internal communication via new organisational practices (Foss, Laursen and Pedersen, 2011).

These new sources of innovation have shed light on the important role played by short-term labour mobility as a channel through which technological transfers as well as tacit knowledge can be exchanged and created, with substantive positive effects on patenting (Hovhannisyan and Keller, 2015), productivity (Dowrick and Tani, 2011; Piva, Tani and Vivarelli, 2018) and economic growth (Andersen and Dalgaard, 2011). Indeed, when mobility is restricted, growth and innovation are negatively affected (Orazbayev, 2017).

Yet, despite the growing literature on its positive economic effects, short-term mobility remains an over-looked topic in innovation policy discussions and in strategic studies of organizational practice and management. The main reason behind this status quo is likely to be the general lack of data on the phenomenon: short-term movements are not captured by the Community Innovation Surveys (CIS), and aggregate data cannot be disentangled in national

and international statistics about people's flows. In addition, at the firm level, mobility-related expenditures are merged with other administrative and general expenses. In this context, without precise information, it is challenging to understand whether short-term mobility is mere consumption, which simply raises the utility of the individuals practicing it (Anderson, Tang and Wood, 2006), or an investment to reach and absorb innovation-enhancing knowledge. This uncertainty has an opportunity cost, as it prevents clarifying whether short-term mobility is a strategic resource to gain an edge over competitors and overcome disadvantages due to unfavourable geography or size. As a result, managerial and budget decisions about mobility are dispersed across several local functional and administrative areas rather than being taken 'holistically' with the viewpoint of the entire organisation in mind, contributing to possible duplications, inaction, and wastage (Welch, Welch and Worm, 2007).

In order to fill these gaps in the available knowledge, this paper aims to assess the relevance of business visits (BVs) for productivity, by using comprehensive commercial information on short-term mobility expenditures by sector and country, which we combine with public OECD and WORLD BANK data on productivity, R&D expenditures, and international trade for the period 1998-2013. In this way, we are able to test the relative contribution of each prospective knowledge-enhancing channel to labor productivity for 33 sectors (manufacturing and service) in 14 countries (European nations and United States) and to analyze the role of short-term mobility in promoting productivity across different industries.

We find evidence that BVs contribute to fostering productivity (measured as value added per employee) in a significant way. While this is consistent with what found by the previous (scant) literature on the subject (see next section), we also find that short-term mobility exhibits decreasing returns, being more crucial in those sectors characterized by less mobility and by lower productivity performances.

The rest of the paper is organized as follows: Section 2 reviews the literature. Section 3 discusses the empirical strategy. Section 4 presents the data. Section 5 illustrates the results. Section 6 concludes and discusses some managerial and policy implications.

2 Literature review

Mobility is not a new phenomenon[1], though its spread has historically been constrained by technology and other factors, such as transport costs and institutional barriers. Positive technological shocks leading to better and cheaper transportation and communication have typically lifted the number of people using mobility to take up economic opportunities around the globe without having to permanently migrate. For example, the advent of steamships in the 19th century encouraged seasonal migration, as agricultural workers became able to be employed throughout the year following different harvest seasons in North and South hemispheres (Piore, 1979). The arrival of commercial jet flights, in 1959, made long-distance short-term mobility easier, enabling firms to enter new markets by temporarily deploying key personnel without having to reproduce structure, functions, and positions of the head company in each location (Ohmae, 1990; Salt, 1992; Moss-Kanter, 1995; Rogers, 1995). Short-term mobility nowadays is shared by a large portion of the labour force, especially if highly educated, contributing to 'grease the wheels' of global supply chains to serve customers all over the world (Roy, Sivakumar and Wilkinson, 2004; Roper, Du and Love,

[1] Throughout history, people living in settled societies have been moving around the globe for economic reasons. At times these movements consisted of relocating from one area to another, typically after environmental, health, and man-made events that disrupted economic activity, such as droughts, plagues, and wars and persecutions. More generally they involved returning to the place of origin where consumption or revenue generation would ultimately materialise. Examples of this form of movement, which is referred to as mobility, include travelling in search of, or to supply, tradable commodities or services, information, and employment. There is evidence of Greek merchants from the cities of Attica trading with remote regions in the 3rd century BC, of managers of the Medici's bank travelling across cities in Northern Europe to keep in touch with business conditions in the 14th century, and of Marco Polo's travels to and then throughout China to inform the Khan about business environment within his empire (http://www.let.leidenuniv.nl/history/migration/index.html).

2008).

Short-term mobility however has not only changed the way in which goods and services are produced and delivered: key has been and remains its influence on how these are developed. Interacting through short-term mobility establishes opportunities of knowledge exchange between individuals within and across firms, enabling them, crucially, to form new links between what one already knows and what one learns as a result of the interaction and the steps leading to it. These novel linkages expand problem-solving capabilities and skills within individuals and organisations, raising at once the efficient absorption of new information (Cohen and Levinthal, 1989; Teece, Pisano and Shuen, 1997; Crescenzi and Gagliardi, 2018), and the stimulation of creativity (Shalley, Zhou and Oldham, 2004) and learning capabilities (McCoombs, 1991). Recognising useful external knowledge and exploiting it can give firms an edge over their competitors, and new products have been shown to incorporate knowledge that exists or was originally produced outside the successful innovator (March and Simon, 1958; Mueller, 1962; Mansfield, 1968; Rosenberg and Steinmuller, 1988).

As knowledge is not uniformly distributed in space, mobility solves the strategic need to access it, either by co-locating in certain places (von Hippel, 1987; Florida, 2002; Howells, 2002; Bathelt, Malmberg and Maskell, 2004; Torre and Rallet, 2005) or interacting, often face-to-face[2], with the individuals holding valuable embodied knowledge (Polanyi, 1966; Franco and Filson, 2000; Zellner, 2003; Dahl and Pedersen, 2004; Boschma, 2005; Singh, 2005; Hamermesh, 2006; Bathelt and Schuldt, 2008).

Despite its theoretical and anecdotal importance, empirical research on short-term mobility is

[2] Face-to-face interaction is the most effective form of inter-personal communication because it makes participants decide immediately whether to trust each other (Gambetta, 1988; Storper and Venables, 2004). If mutual trust is established, then reciprocal understanding and cooperation behaviours raise, as the transaction costs and uncertainty associated with sharing knowledge decrease. This facilitates exchanges of know-how and experiences (Hansen, 1999; Amin and Cohendet, 2004), promotes learning, and creates 'social capital' and networks (Burt, 1997; Portes, 1998; Dosi, Marengo and Nuvolari, 2019). Once trust is established, the range of communication means used can expand, and interacting face-to-face is no longer critical, though it can reinforce existing personal links, especially in certain cultures.

dampened by the lack of data. Innovation surveys, the primary source of innovation statistics, do not include short-term mobility as a possible category among the sources contributing to product or process innovations (OECD, 2005). Short-term movements are merged within the definition of 'international visits'[3] followed by the United Nations (UN, 1998), but these figures are highly aggregated[4]. Data from passenger surveys and tourism statistics are also too aggregate to inform beyond major airport destinations, average length of stay and expenditure (e.g. IATA, 2007; ONS, 2001; ABS various years). Primary data collected through in-depth interviews are highly informative and support the hypothesis that mobility is mostly carried out to exchange knowledge (Tani, 2014), but their results are typically based on too few observations to be generalised or merged with official data on productivity at sectoral or firm level. Even financial statistics from public and private database, such as Dun & Bradstreet[5], do not disentangle expenditures for short-term mobility from other general expenses.

Facing these constraints the empirical literature has used proxies of short-term mobility, such as tourist (Andersen and Dalgaard, 2011; Hovhannisyan and Keller, 2015) or migration flows (Dowrick and Tani, 2011; Rogers, 1995) as well as primary data (Salt, 1992; Moss-Kanter,

[3] An *international visitor* is defined by the UN as "any person who travels to a country other than that in which he/she has his/her usual residence but outside his/her usual environment for a period not exceeding 12 months and whose main purpose of visit is other than the exercise of an activity remunerated from within the country visited" (UN, 1998 - para. 29). The category of international visitors includes tourists (overnight visitors) and same-day visitors (also known as "excursionists") (UN, 1998 - para. 30).

[4] Data on movements at international level reflects an anachronistic convention to classify movements between two countries according to the length of stay (UN, 1998): movements can be either 'visits' if they involve a change in the 'usual residence' for less than 12 months and no payment is received from the host country, or 'migrations' if they last for over one year. Migration in turn is divided into 'long-term' if there is a change of usual residence longer than 12 months and 'short-term' when the change of residence lasts between 3 and 12 months. 'Temporary migration' is also used at times to define particular categories of stays that grant employment rights and last a number of years (typically up to four), depending on the host country's regulations. These nevertheless are reclassified as visits or migrations in international statistics depending on their length of stay. This classification tends to be followed by national statistical offices, although this is not always the case making is challenging to obtain consistent historical series (e.g. Salt, Singleton and Hogarth, 1994; OECD, 2008). As some visits allow recipients to subsequently apply for permanent visa, since 2006 the OECD (SOPEMI reports) has reclassified a number of visits into permanent movements if the underlying entry visa had either no expiry date, could be renewed indefinitely, or allowed recipients to apply for permanent residence in the host country.

[5] Dun & Bradstreet is a US-based private corporation that offers credit and financial information (including accounts), on more than 300 million businesses around the world: https://www.dnb.com/.

1995; Tani, 2014), but each of these carries significant limitations.

Turning the attention to the aim of this study, we will now focus on the sole three articles dealing with the impact of BVs on productivity, so summarizing the main results of the extant empirical literature on the subject.

In their pioneering study, Andersen and Dalgaard (2011) used travel data for 72 countries over two years (120 observations in total) sourced from the World Tourism Organization (UNWTO) to link international arrivals plus departures to total factor productivity (TFP) and showed that travel intensity accounts for almost 50% of the variation in aggregate TFP (OLS estimates). Furthermore, they addressed the possible endogeneity of travel intensity by using predicted travel shares as instruments; in particular, their 2SLS estimates imply that an increase of 10% in the travel share leads to a 0.2% increase in the level of TFP.

While the previous study was cross-countries and using general travel data (this being the main limitation of Andersen and Dalgaard, 2011), Dowrick and Tani (2011) used cross-sectoral data within one country (Australia) measuring the specific number of business visits, as reported by arrival and departure cards over the period 1991-2005 (143 observations). In their short-term panel estimations they found that a 10% rise in the gross flows of BVs in an industry increases multifactor productivity in that industry by about 0.1%. They also find that the productivity effect of outgoing BV is about double those of incoming BV (0.2% vs. 0.1%).

A common main limitation of both the previous studies is the small number of observations used in their panels, which obviously constrains the power of the statistical tests performed and the reliability of the results obtained.

The third study, by ourselves (Piva, Tani and Vivarelli, 2018), used the data described in the following Section 4, at that time covering on average 16 sectors per year in 10 countries during the period 1998-2011 (2,262 observations). Our fixed-effect results suggested that mobility through BVs was indeed an effective mechanism to improve labour productivity, the

estimated elasticity (0.053) being about half as large as investing in R&D, which researchers and policy-makers alike generally see as the prime mechanism to foster productivity.

The present study builds on Piva, Tani and Vivarelli (2018) with the following substantial extensions. First, dealing with an extended longitudinal dataset, we have increased the number of the available observations to 3,574. Second, in this study we control for the role of capital formation, R&D expenditures and also for the possible role of trade as a channel of knowledge diffusion. Third, we dig into the investigation of the nature of the productivity impact of BVs, looking for the possibility of decreasing returns both in terms of business visit intensity and in terms of productivity performance (see next sections).

3 Empirical specification

We put forward and test a simple model of knowledge transfer, based on Hall and Mairesse (1995); consider industry *i* of country *j*, which at time *t* produces value added Y_{ijt} according to the production function (1):

$$(1) \qquad Y_{ijt} = AC_{ijt}^{\alpha} L_{ijt}^{\beta} \left(\sum_r K_{rijt}^{\gamma_r}\right) e^{b_{ij0}+\lambda_i t+\varepsilon_{ijt}}$$

where C_{ijt} and L_{ijt} are the industry input of physical capital and labour, respectively, and $K_{rijt}^{g_r}$ represents the level of productive knowledge available to the industry via activity *r*: K_{rijt} includes knowledge-enhancing activities like R&D expenditures, spending on short-term labour movements, and international trade in goods and services; the parameter γ_r represents the proportional increase in productive knowledge resulting from the r^{th} activity ($r = 1, 2, \ldots$). Finally, the last factor captures other productivity drivers, including an initial industry-and country-specific level of value added b_{ij0}, a deterministic time trend $\lambda_i t$ representing the exogenous growth of the global technological frontier in a given industry (λ_i being the rate of disembodied technical change) and an idiosyncratic error term ε_{ijt}.

Transforming (1) in logarithmic form, and rearranging it to measure value added per employee yields the following (2):

$$(2) \qquad y_{ijt} - l_{ijt} = a + a(c_{ijt} - l_{ijt}) + g_1(k_{1ijt} - l_{ijt}) + g_2(k_{2ijt} - l_{ijt}) + \ldots + (a + b + g_1 + g_2 + \ldots g_{r-1} - 1)l_{ijt} + g_r k_{rijt} + \ldots + b_{ij0} + l_i t + e_{ijt}$$

Where: y, l, a, c and k_r represent natural logarithms of Y, L, A, C, and K_r.

Empirically, we focus on the estimates of the parameters $\sum_r g_r$ to assess the role of the alternative channels affecting labour productivity (value added per employee); this means to estimate the following testable specification (3):

$$(3) \qquad \ln\left(\frac{VA}{E}\right)_{ijt} = constant + \alpha \ln\left(\frac{C}{E}\right)_{ijt} + \gamma_1 \ln\left(\frac{K}{E}\right)_{ijt} + \gamma_2 ln\left(\frac{BV}{E}\right)_{ijt} + (a + b + g_1 + g_2 - 1)\ln(E)_{ijt} + \gamma_3 \ln\left(\frac{X + M}{GDP}\right)_{ijt} + b_{ij0} + l_i t + \varepsilon_{ijt}$$

with: i (sector) = 1,…, 33; j (country) = 1,…, 14; t (time) = 1998,…, 2013;

ln = natural logarithm.

Productivity is measured by labour productivity (Value Added, VA, over total Employment, E), while our control impact variables are the physical capital stock (C) per employee, the R&D stock (K, for knowledge) per employee and the trade intensity (import plus export over

GDP[6]). The measure of our key impact variable is the whole Business Visits stock (BV) per employee.

Taking per capita values permits both standardization of our data and elimination of possible sector/country size effects. In this framework, total employment (E) is a kind of control variable: in case ($\alpha + \beta + \gamma_1 + \gamma_2 - 1$) turns out to be greater than zero, it indicates increasing returns in the labor input.

As it is common in this type of literature (Hall, Mairesse and Mohnen, 2009; Ortega-Argilés et al., 2010; Heshmati and Kim, 2011; Kumbhakar et al., 2012; Mohnen and Hall, 2013; Ortega-Argiles, Piva and Vivarelli, 2014 and 2015), stock indicators rather than flows should be considered as impact variables; indeed, productivity is affected by the accumulated stocks of different inputs and not only by volatile current or lagged flows. Furthermore, dealing with stocks rather than flows has two additional advantages: first, since stocks incorporate the accumulated investments in the past, the risk of endogeneity is minimized; second, there is no need to deal with the complex and arbitrary choice of the appropriate lag structure for the flows.

The stocks are computed following the Perpetual Inventory Method (PIM):

$$(4) \qquad S_{t0} = \frac{INV_{t0}}{(g + \delta)}; \quad S_{t1} = S_{t0}(1 - \delta) + INV_{t1}$$

where S is the stock, INV measures the investment flow, δ is a depreciation rate (6% for capital stock; 15% for knowledge capital stock; 15% for business visits stock[7]) and g is computed as an 'ex post' three-year compound growth rate.

[6] Since we do not adjust this macroeconomic indicator by employee but rather by national GDP, we do not add γ_3 to the coefficient ($\alpha + \beta + \gamma_1 + \gamma_2 - 1$). This is the reason why we isolated k_{rijt} in eq (2).

[7] This is what assumed by the reference literature, taking into account that the knowledge capital (in our case both R&D expenditures and business visits) exhibits a faster degree of obsolescence rather than the physical

4 Data

We are able to contribute towards reducing the information gap affecting most of the extant literature (see Section 2) by using a unique commercial database developed by the US National Business Travel Association to forecast trends in international short-term mobility after 9/11. Following that event, travel to the US reduced considerably and NBTA members (most air carriers around the world) were especially worried about the future demand for travel. As a result, the NBTA embarked on a major, and to date unique, exercise to gather detailed information on travel expenditures by industry and country to develop a new database to forecast future travel expenditures. This database was compiled using statistics on travel services recorded in each country's national input-output tables and sources such as various Ministries for Tourism, airlines ticket sales, and IATA (International Air Transport Association).

We combine this unique database with public OECD and WORLD BANK data on productivity, R&D expenditures, and international trade for the period 1998-2013.

An important advantage of using travel expenditures rather than people's flows is the possibility to compute the elasticity of a dollar spent on BVs on productivity, which can be compared with the corresponding estimates of elasticity for other knowledge production activities such as R&D expenditures.

In more detail, data on business travel expenditures are annual information available for 48 sectors of 72 countries over the period 1998-2013. The data aggregates expenditures made by incoming and outgoing domestic and international travelers in a given industry-country-year cell, and is reported in current US$.

As far as the other variables are concerned, value added, physical investments, R&D

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capital (see Nadiri and Prucha, 1996 for singling out 6% as the proper discount rate for physical capital; Hall, 2007 and Hall, Mairesse and Mohnen, 2009 for proposing 15% as the standard discount rate for R&D).

expenditures and employment are taken from OECD sources. In particular, OECD-STAN is the source for most of the information, merged with OECD-ANBERD as far as R&D is considered. Harmonized OECD STAN and ANBERD sectoral data, based on the two-digit ISIC Rev. 4 industrial classification, are available over the 1998-2013 time-span for the following countries: Austria, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Norway, Portugal, Slovakia, Sweden, United Kingdom and United States. The final panel, merging data from NBTA and OECD, is unbalanced (due to OECD missing values) and covers a total of 3,574 longitudinal observations. All the monetary series have been corrected for purchasing power parities, expressing, at the end, values in constant prices and PPP 2010 US dollars. Moreover, in order to control for an additional channel of technology transfer, we also considered a trade variable at the country level (measured as (Export+Import)/GDP).[8]

The sample composition by countries and by sectors is presented in Tables 1 and 2.

Table1: Sample composition by countries

Country	Observations
Austria	304
Belgium	230
Czech Republic	479
Finland	280
France	186
Germany	369
Hungary	428
Italy	310
Norway	320
Portugal	259
Slovakia	63
Sweden	140
United Kingdom	20
United States	186
Total	**3,574**

[8] This macroeconomic control turns out to be the same for all the sectors within a given country in a given year.

Table2: Sample composition by sectors

Industries	ISIC Rev. 4	Observations
Agriculture, forestry and fishing	01-03	149
Mining and quarrying	05-09	47
Food products, beverages and tobacco products	10-12	149
Textiles	13	70
Wearing apparel	14	75
Leather and related products, footwear	15	62
Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	16	139
Paper and paper products	17	67
Printing and reproduction of recorded media	18	113
Coke and refined petroleum products	19	32
Chemicals and chemical products and basic pharmaceutical products and pharmaceutical preparations	20-21	145
Rubber and plastics products	22	93
Other non-metallic mineral products	23	106
Basic metals	24	89
Fabricated metal products, except machinery and equipment	25	181
Computer, electronic and optical products	26	183
Electrical equipment	27	183
Machinery and equipment n.e.c.	28	183
Motor vehicles, trailers and semi-trailers	29	87
Other transport equipment	30	182
Furniture; other manufacturing; repair and installation of machinery and equipment	31-33	158
Electricity, gas and water supply; sewerage, waste management and remediation activities	35-39	55
Construction	41-43	190
Wholesale and retail trade, repair of motor vehicles and motorcycles	45-47	161
Transportation and storage	49-53	62
Accommodation and food service activities	55-56	105
Telecommunications	61	110
IT and other information services	62-63	86
Financial and insurance activities	64-66	97
Real estate activities	68	18
Scientific research and development	72	165
Public administration and defense; compulsory social security	84	16
Education	85	16
Total		**3,574**

Some descriptive statistics and preliminary univariate correlation coefficients are reported in Table 3.

Table 3: Descriptive statistics and correlation matrix

	Mean (St.Deviation)	ln(VA/E)	ln(C/E)	ln(K/E)	ln(Trade)	ln(BV/E)
ln(VA/E)	4.22 (0.58)					
ln(C/E)	4.06 (1.89)	0.527*				
ln(K/E)	1.94 (1.61)	0.613*	0.501*			
ln(Trade)	4.39 (0.44)	-0.200*	-0.415*	-0.185*		
ln(BV/E)	1.83 (1.38)	0.542*	0.565*	0.393*	-0.320*	
ln(E)	4.52 (1.53)	-0.116*	0.032	-0.307*	-0.434*	-0.167*

Notes:
- Employees are expressed in thousands of persons engaged, monetary variables are expressed in millions of constant PPP 2010 US dollars. Trade is the sum of exports and imports of goods and services measured as a share of GDP.
- * Significant at 95%

5 Results

Specification (3) has been estimated through different econometric methodologies. Firstly, pooled ordinary least squared (POLS) regressions have been run to provide preliminary evidence. Even if simple, POLS regressions have been controlled for two sets of dummies (country and time, turning out to be always jointly significant, as shown in Table 4[9]) and for heteroscedasticity (robust standard errors).

Secondly, fixed effect (FE) regressions have been performed in order to take into account sector specific unobservable time-invariant characteristics. When different sectors are not pooled together, estimates control for unobserved heterogeneity as well as for within-sector

[9] Country and time dummies control for other determinants of productivity growth such as the initial level of value added and the advances in the global technological frontier (see eq.1).

path dependence (see Capone *et al.*, 2019). The shortcoming is that constant variables - such as country belonging - are no longer individually identified, as they are encompassed by the individual sector-level fixed effects.

Thirdly, random effect (RE) regressions have also been ran and tested versus the FE specification. According to the outcomes of the Hausman test (see Table 4), the FE estimates are preferable to the RE ones.

Table 4: Dependent variable: ln (Value Added per employee)

	(1) POLS	**(2) FE**	**(3) POLS**	**(4) FE**
ln(C/E)	0.452*** (0.011)	0.131*** (0.023)	0.421*** (0.012)	0.078*** (0.023)
ln(K/E)	0.037*** (0.005)	0.098*** (0.012)	0.046*** (0.006)	0.101*** (0.012)
ln(Trade)	0.158* (0.081)	0.227*** (0.036)	0.132* (0.081)	0.141*** (0.035)
ln(BV/E)			0.006*** (0.001)	0.021*** (0.002)
ln(E)	0.033*** (0.006)	0.014 (0.024)	0.048*** (0.006)	0.169*** (0.026)
Constant	1.212*** (0.083)	3.457*** (0.177)	1.285*** (0.082)	2.578*** (0.186)
Time-dummies	Yes	Yes	Yes	Yes
Country-dummies	Yes	-	Yes	-
Time-dummies Wald test	2.30*** (0.003)	6.64*** (0.000)	2.63*** (0.000)	10.21*** (0.000)
Country-dummies Wald test	165.66*** (0.000)	-	129.24*** (0.000)	-
Hausman test (p-value)		10.35*** (0.000)		43.90*** (0.000)
Adj. R^2 R^2 within	0.73	0.27	0.74	0.30
Number of country/sector	287			
Number observations	3,574			

Note: * Significant at 90%; ** Significant at 95%; *** Significant at 99%

Columns 1 and 2 in Table 4 report the results from the estimates without the BV stock. These are in line with the previous literature about the link between physical capital and R&D on the one side and productivity on the other side: physical capital appears to have a positive and highly significant impact on productivity with an elasticity ranging from 0.131 to 0.452; at the same time also knowledge capital shows a positive and highly significant impact ranging from 0.037 to 0.098[10]. As expected, our trade control participates to increase labour productivity with a highly significant coefficient in the preferred FE estimation.

When the BV stock per employee is added to the estimated specification, previous results are substantially confirmed (columns (3) and (4)).

Focusing on our key variable, the impact of the BV stock per employee on productivity turns out to be positive and statistically significant at the 99% level of confidence in both the estimates, ranging from 0.006 to 0.021 (POLS *vs* FE). This outcome supports the view that productivity is also significantly explained by the expenditures devoted to the business visits, although this additional impact is lower in magnitude than those originated by capital formation, knowledge capital and trade. This result is also consistent with the literature (see Section 2); in particular, in comparison with our previous study (Piva, Tani and Vivarelli, 2018) the increased number of observations and the inclusion of the trade control - while confirming a highly significant impact of the BVs - have involved a smaller magnitude of the estimated coefficient (from 0.053 to 0.021 in the preferred FE estimate). Therefore, our previous results might have been inflated by the possible interrelationship between trade links and BVs.

We now move forward, in order to better evaluate the presence of possible different impacts of BVs, looking for the possibility of decreasing returns both in terms of business visit

[10] These magnitudes are quite consistent with the extant literature, reporting estimated elasticities of productivity to R&D ranging from 0.05 to 0.25.

intensity and in terms of productivity performance. With this aim in mind, we decided to split the sample into two subsamples on the basis of the average business visit intensity (BV/E) at the sectoral level. Choosing this strategy allowed us having two comparable subsamples including 17 industries for the low BV-intensive aggregate and 16 industries for the high one.

Estimates have been run using the preferred FE specification. Results presented in Table 5 are, in general, consistent with the previous ones (with the exception of the loss of statistical significance of the physical capital in the low BV-intensive industries). Focusing on the magnitude of the BVs effect, it turns out an impact of 0.027 in the low-intensive industries and an impact of 0.011 in the high-intensive ones (both highly significant). These results tend to support a decreasing returns interpretation: the lower the starting level of business visits per capita, the higher their impact on productivity. This is consistent with the powerful effect of the initial face-to-face contacts and interactions, bringing a significant impact especially at the starting stage of the investment in short-term mobility (see Section 2).

Table 5: Dependent variable: ln (Value Added per employee)

	(1) FE Av.BV/E < 10.000	(2) FE Av.BV/E >=10.000
ln(C/E)	-0.033 (0.030)	0.162*** (0.034)
ln(K/E)	0.135*** (0.016)	0.080*** (0.017)
ln(Trade)	0.186*** (0.043)	0.109** (0.057)
ln(BV/E)	0.027*** (0.002)	0.011*** (0.002)
ln(E)	0.076** (0.035)	0.229*** (0.039)
Constant	3.354*** (0.252)	2.266*** (0.271)
Time-dummies	Yes	Yes
Time-dummies Wald test	6.23*** (0.000)	4.63*** (0.000)
R^2 within	0.44	0.22
Number of sectors	17	16
Number observations	1,847	1,727

Note: * Significant at 90%; ** Significant at 95%; *** Significant at 99%

As a further extension of the analysis, we chose to analyze the relationship between BVs and productivity using a quantile regression based on the productivity level. As the panel is unbalanced, we opted for a quantile estimator controlling for country and time-dummies. Results turn out to be generally consistent with the ones in Table 4. Nevertheless, additional evidence has emerged as BVs tend to have a positive impact on productivity, but with an almost monotonically decreasing effect moving from the first quantile to the last one (see Table 6). This suggests an effect of BVs more important for productivity laggers than for productivity champions. While this outcome cannot be interpreted as a further evidence of

decreasing returns *stricto sensu*, it appears consistent with a context where BVs exert their more powerful productivity impact in the early stages of the competition process.

Table 6: Dependent variable: ln (Value Added per employee)

	(1) First quantile (0.2)	(2) Second quantile (0.4)	(3) Third quantile (0.6)	(4) Forth quantile (0.8)
ln(C/E)	0.282*** (0.007)	0.325*** (0.007)	0.436*** (0.010)	0.497*** (0.009)
ln(K/E)	0.099*** (0.004)	0.086*** (0.004)	0.042*** (0.005)	0.010** (0.005)
ln(Trade)	0.156** (0.075)	0.258*** (0.064)	0.199*** (0.063)	0.180*** (0.069)
ln(BV/E)	0.008*** (0.001)	0.005*** (0.001)	0.003*** (0.001)	0.003*** (0.001)
ln(E)	0.093*** (0.005)	0.073*** (0.005)	0.054*** (0.004)	0.035*** (0.005)
Constant	2.157*** (0.137)	2.551*** (0.116)	2.419*** (0.110)	2.414*** (0.123)
Time-dummies	Yes	Yes	Yes	Yes
Country-dummies	Yes	Yes	Yes	Yes
Time-dummies Wald test	6.77*** (0.000)	4.88*** (0.000)	6.43*** (0.000)	4.06*** (0.000)
Country-dummies Wald test	120.09*** (0.000)	194.83*** (0.000)	181.64*** (0.000)	264.89*** (0.000)
Pseudo R^2	0.52	0.51	0.51	0.52

Note: * Significant at 90%; ** Significant at 95%; *** Significant at 99%

6 Conclusions

This paper reviews existing evidence and offers new, comprehensive results supporting that BVs increase productivity and enhance technology transfer. Together with capital formation, R&D expenditures and trade, BVs play a substantive role in positively and significantly affecting productivity growth across different industries.

This outcome is consistent with the extant industry-based empirical studies as well as the scarce microeconomic literature on the subject. In particular, we confirm what found in our previous study (Piva, Tani and Vivarelli, 2018), but the increased number of observations and the inclusion of the trade control result in a smaller magnitude of the BVs coefficient, meaning that our previous results might have been inflated by the possible correlation between trade links and BVs.

Importantly, we find robust and novel evidence that BVs exhibit decreasing returns, being more crucial in those sectors characterized by less mobility and by lower productivity performances, such as in the early stages of the competition process or in sectors disadvantaged by size, location, or limited endowments of human capital and resources.

These outcomes strongly support the hypothesis that mobility offers firms and nations disadvantaged by geography, size or historical circumstances a way to access the talent and knowledge necessary to kick-start or continue industry transformations, and uplift productivity and economic conditions. As mobility is relatively simple to implement vis-à-vis productivity channels that require large initial costs or expertise, it has the advantage of being a flexible and effective tool to access or share 'sticky' productive knowledge.

In turn, this consideration carries interesting managerial and policy implications.

Within organisations, general managers might make a better strategic use of the productivity enhancing role of BVs. Short-term mobility should be thought as a strategic investment at the company's level and not just as a localised choice undertaken by decision nodes scattered across the organisation. Moreover, our results indicate that those firms less investing in BVs and less productive are likely to be the ones that can benefit more from engaging in this particular type of investment. This paves the way to a specific policy focus on SMEs and less

productive companies, in order to foster their opening in terms of incoming and outgoing BVs[11].

At the national level, our results suggest that short-term labour movements are not only consumption expenditures that can be taxed at will, but also an investment in knowledge enhancing activities. In this respect, mobility could be gainfully embraced to foster human capital growth, as in the case of Europe's Erasmus programme (Ackers, 2005), as well as technology transfer and productivity gains. Therefore, policy makers should foster short-term labour movements through adequate incentives and tax exemptions, particularly in those sectors where BVs are less frequent and where productivity growth is below the average.

Furthermore, unlike migration and long-term assignments and relocations, short-term mobility amplifies a nation's endowment of human capital without permanently affecting its people's headcount. Knowledge exchanges arising from in- and out-bound movements cannot be netted out in some unlikely mobility-related knowledge balance, and as such they offer both origin and destination firms and countries the opportunity to enhance their productivity; in other words, mobility is far from being a zero sum gain where there are net importers and exporters of knowledge.

Perhaps most importantly our work highlights the need for better and structured data collection at the firm level. It is unlikely that the outcomes of the literature we have contributed to in this paper can be incorporated into innovation policy until firm-specific data become available, for instance by expanding the CIS questionnaire to include short-term labour mobility as a distinct innovation input. Indeed, without firm-specific information it is neither possible to quantify the direct benefits of BVs on revenues, profits, and productivity,

[11] As mentioned in Section 1, the lack of a holistic approach to manage business visits among organisations has been identified as a potentially costly source of inefficiency (Welch, Welch and Worm, 2007): travel budgets are typically treated as generic expenditures that can be cut indiscriminately at times of economic challenges rather than used as a strategic resource that enables effective access to new knowledge.

nor to measure whether mobility generates externalities that are socially valuable and deserve to be further incentivised by appropriate policy measures.

In sum, until better data are made available at the firm level, it will be challenging to quantify exactly the private and social benefits of BVs; improving the data on short-term labour mobility is indeed an area where research policy can make a very important contribution.

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