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ABSTRACT

International Business Visits and the Technology Frontier*

This paper studies the impact of international business trips on the stock of knowledge available to an economy. It develops a theoretical model to analyse the possible effects, and presents an empirical application using productivity data for a panel of twelve Australian industries during 1991/2-2005/6. Business trips emerge as a significant source of productivity growth. As the knowledge transferred through business visits is non-rival, both countries of origin and destination can gain from the human capital of travellers. As a result, even countries traditionally disadvantaged by geography, size, or level of economic development have the opportunity to access the latest technology and information to stimulate growth.

JEL Classification: F2, J6

Keywords: international labour movements, face-to-face meetings, business trips, growth, productivity

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1 Introduction

Migration is a long-term or permanent movement, and non-residents are typically recorded as migrants if they reside in the host country for a minimum period of time. The United Nations and the International Monetary Fund, respectively, use a 12-month length of stay to separate *migrants* from *visitors* and to impute compensation earned abroad as income for the host rather than for the sending country. National statistical offices tend to follow this conventional cut-off. As a result, labour-related movements lasting for less than a year are neither studied by the migration literature, nor are they regulated by government policies. Indeed business visitors are *prima facie* an unlikely 'problem' for the destination country: their short stay makes them almost invisible and not taxable, and they consume too little of local public goods and amenities to significantly crowd out natives.

However, as better communication and transportation technologies facilitate the emergence of these short-term labour flows, there is an increasing need to understand their possible economic consequences. Existing work on international business visits has shown that these flows are overwhelmingly composed of highly skilled worker (IATS, 1988; Salt, 1992; Anderson, 2002; OECD, 2002), they commonly take place between firms that are not linked through a supply chain (Wood, 2001), and they are often motivated by knowledge exchanges or transfers rather than by marketing activities (e.g. Tani, 2005). Work has also shown that knowledge enters into the production process, and investment in its production maintains the absorptive capacity of a country (e.g. Dosi, 1988; Cohen and Levinthal, 1989). As international business trips motivated by knowledge transfers may be seen as an investment to access the 'technology frontier' (i.e. information and technology that are continuously developed around the world), do they enhance a country's productivity and growth?

This paper addresses this question. In particular, it investigates the relationship between international business travel and multifactor productivity at the level of industry using a unique set of Australian data covering the period 1991/2-2005/6. Australia is an ideal country on which to carry out this study. Thanks to its geographic isolation, air travel is virtually the only channel for carrying out face-to-face meetings between domestic and foreign residents, and individual information on the *population* of arriving and outgoing passengers is collected through departure and arrival cards, which, in the case of foreign visitors, are matched to entry visa. Thanks to the support of Australia's Department of Immigration and Citizenship we were able to access this rich set of data and relate it to additional information on travellers' characteristics, as well as Australia's labour market, and its industries' productivity.

The rest of the paper is organised as follows: Section 2 briefly reviews existing work on international business visits. Section 3 develops a simple theoretical growth model. Section 4 presents the data and Section 5 discusses the empirical analysis. Section 6 concludes.

2 International business visits

Labour-related visits are not new. For example, in the late 18th and early 19th century thousands of Europeans were travelling by steamships to South America to work as farmers during the harvest season, exploiting opposite season patterns between Northern and Southern hemisphere (e.g. Piore, 1979; Gould, 1980). More recent examples of short-term international labour movements include seasonal and daily commuting (as is common between France, Belgium, Germany and Luxembourg), business trips, short-term relocations and assignments, and telecommuting, albeit the latter does not involve a physical movement. Despite the relative ease with which one can actually observe international business visitors (e.g. at airports' international terminals), one would hardly say that there is a well developed literature on the phenomenon.

This *status quo* is partly due to lack of information. The only source of data on business travellers are international passenger surveys, but these are not constructed to cater for economic analyses, as they do not inform on the purpose of travel, besides indicating that it is for ‘business’, nor they collect information on the traveller’s employment.

More crucial is probably the fact that business travel is a challenging phenomenon to reconcile within the traditional interpretation applied to labour movements: namely, as a change in the labour supply. Although business travellers go overseas for work, they come back without changing residence or employer. They supply skills to the country of destination, but the benefits associated with doing so may accrue to employers located in the country of origin, where they are imputed in national accounts. In this setting, studies of short-term labour flows have generally preferred to follow the ‘labour supply change’ approach, with the consequent emphasis on the *net change* in the number of people in the countries of origin and destination while performing the quantitative analysis, as is done in the case of permanent migration. After all, as noted by Winters (2002), “workers enter a country temporarily to carry out particular jobs and thus labour inputs in one economy are reduced while those in another are increased” (p.6).

This labour-supply approach to business travel makes sense if travellers transfer their embodied skills from one country to another. These skills are private inputs into production: the heart surgeon who has travelled to Manila to perform an operation cannot simultaneously perform an operation in his home hospital in Sydney. However, to the extent that the surgeon travels to demonstrate and discuss new techniques with his Philippine colleagues, a transfer of knowledge may occur. In turn this augments the productive and absorptive capacity of one or both countries. The crucial distinction here is between skills which are rival inputs and knowledge which is a non-rival input into production. Empirical support for the view that business visits are commonly motivated by knowledge exchanges comes from Rogers (1995) and Tani (2005). It follows that in analysing the economic impact of international business visits, one should focus on *gross* rather than *net* flows of travellers because a resident travelling overseas may acquire knowledge just as readily as a visiting foreigner may disseminate knowledge. We chose to abstract from the supply-side framework, whereby visitors bring with them physical capital and embodied human capital, by focusing on the relationship between business travel and multifactor productivity.

3 Modelling international business visits as facilitating flows of knowledge

A standard approach to assessing the economic impact of international labour movements is to regard them as temporary transfers of human capital, with the arrival country increasing its labour force at the expense of the departure country. This approach is not necessarily appropriate for business visits which are typically short-term and predominantly involve the movement of professional and managerial staff who are heavily involved in the informational aspects of their employers' activities. If, for example, an engineer travels to spend a week or two fixing a problem in another country, the net addition to that country's human capital for the year is trivial. If, however, the engineer spends the time training the local staff, such as transferring non-rival knowledge rather than supplying rival human capital, then the economic benefits may be substantial. Moreover, the direction of knowledge transfer may be two-way. The engineer may return to his home employment with enhanced knowledge and skill.

We formalise this approach by considering industry *i* which at time *t* produces output, Y_{it}, according to the production function:

$$Y_{it} \ = \ A_{it} \, K_{it}{}^{\alpha} \, L_{it}{}^{\beta} \, e^{\varepsilon_{it}} \tag{1}$$

where K represents the (industry) input of capital, L represents the input of labour, A represents the level of productive knowledge available to the industry and ε is a random variable capturing other factors which impact on productivity.

The logarithmic representation of the production function is:

$$y_{it} \ = \ a_{it} \ + \ \alpha k_{it} \ + \ \beta l_{it} \ + \ \varepsilon_{it} \tag{2}$$

where lower-case y, a, k and l represent natural logarithms of Y, A, K and L.

The logarithm of multi-factor productivity (*mfp*) is typically defined as:

$$mfp_{it} \ \equiv \ y_{it} \ - \alpha k_{it} \ - (1-\alpha) l_{it} \tag{3}$$

Substitution for *y* yields the result that:

$$mfp_{it} \ \equiv \ a_{it} \ + (\alpha + \beta - 1) l_{it} \ + \ \varepsilon_{it} \tag{4}$$

We see that, apart from the random error term, *mfp* is equivalent to knowledge (or technology) only if the industry operates with constant returns to scale ($\alpha + \beta = 1$). If (4) is estimated as a regression equation, a positive coefficient on the labour variable indicates increasing returns to scale and a negative coefficient indicates decreasing returns.

We represent the level of productive knowledge as a log-linear function of an initial level, a deterministic time trend representing the exogenous growth of the global technology frontier and a vector of variables representing efforts to access the knowledge frontier.

$$\ln A_{it} \equiv a_{i0} + \lambda_i t + \sum_r \gamma_r R_{rit} \qquad (5)$$

R represents a vector of knowledge enhancing activities such as R&D and knowledge gathering international travel. The coefficients γ_r represent the proportional increase in productive knowledge resulting from the r^{th} activity.

Substitution of (5) into (4) yields the following relationship which forms our basic estimating equation:

$$mfp_{it} \equiv a_{i0} + \lambda_i t + \sum_r \gamma_r R_{rit} + \delta l_{it} + \varepsilon_{it} \qquad (6)$$

We define the following knowledge enhancing activities:

R_1 is the R&D performed in the industry; R_2 is the number of business trips outside the country of origin taken by employees in the industry. R_3 is the number of business trips taken to the country of origin by employees of foreign firms in the industry. R_4 is the number of business trips taken to the country of origin by employees in other industries. R_5 is the number of business trips taken to the country of origin by employees of foreign firms in other industries.

The variables R_2-R_5 are measured in equivalent annual workers, calculated as the number of visit days divided by 250 (the average number of working days in a year).

To the extent that the acquisition of knowledge within an industry flows freely between firms within that industry, the appropriate measures of these activities is their absolute size. If the knowledge is retained exclusively within the acquiring firm, however, the appropriate measure of activity is visits per firm. We approximate this by calculating a measure of visits scaled by the size of the industry, e.g. departures per dollar of value added in the industry. Both alternatives are investigated.

4 Data and empirical strategy

The data on which the estimation is performed is a panel of twelve Australian industries, covering the period 1991/2 – 2005/6. Data on *mfp* by industry are sourced from the Australian Bureau of Statistics (ABS - publication 5260.0.55.001). Employment data by occupation and industry are sourced from the ABS through an extraction from the Labour Force Survey (August quarter) covering the same period.

Data on the *population* of international labour visitors come from the Overseas Arrivals and Departures (OAD) database of the Department of Immigration and Citizenship (DIAC). These data collect information from departure and landing cards, and visa granted, and disaggregate ‘visitors’ from ‘migrants’ using the conventional 12-months length of stay cut-off. Only visitors arriving and departing Australia for business purposes are considered, namely those visiting to (a) attend conferences and exhibitions, (b) carry out employment activities, and (c) ‘business’. The flows of tourists and students are excluded from the analysis.

The OAD contains information on the occupation of the traveller but unfortunately not the sector of employment, on which productivity data are based. To obtain the flow of business visitors by industry we therefore merged the OAD information with a survey of a *sample* of international business travellers transiting through Australia’s main international airports (more below). In particular, we applied a weight x_{ijt} to the annual flow of incoming and outgoing business visitors such that:

$$x_{ijt} = a_{ij06} \frac{E_{ijt}}{E_{ij06}}$$

where i indicates occupation, j is the sector (j = 1,…,12), t is time (t = 1991/2,…., 2005/6), and E indicates employment. $\sum_{ij} x_{ij} = 1$. The parameter a_{ij06} is calculated separately for incoming and outgoing visitors, and is itself a weight given by the number of travellers employed in occupation *i* and sector *j* as a proportion of the total number of travellers obtained from the airport survey.

This sample consists of 1,982 arriving and departing passengers. Of those interviewed just more than half (51% - 1,016 respondents) were Australian residents travelling abroad and almost half (49% - 966 respondents) were residents abroad visiting Australia. The geographic distribution of the respondents across airports[1] reflects that of the population of international business traveller in 2005-6, which is sourced from the OAD. Non-response bias was small, and less than 5% of those approached refused to participate in the survey. The occupational representativeness of the survey respondents was compared with the distribution of occupations resulting from a 'manual reading'[2] of a sample of departure cards. This was performed by DIAC. The occupational distribution of both samples is presented in Table 1.

TABLE 1 OCCUPATIONAL DISTRIBUTION OF INCOMING BUSINESS VISITORS, 2006

Occupational code (skill group)	Airport survey	DIAC extraction
1 (managers and administrators)	39.2	26.9
2 (professionals)	49.9	52.6
3 (associate professionals)	6.4	6.7
4 (tradespersons)	2.7	3.4
5 (advanced clerical and sales)	0.2	0.4
6 (intermediate clerical and sales)	1.1	7.7
7 (intermediate prod. and transport)	0.3	0.7
8 (elementary clerical and sales)	0.1	1.6
9 (labourers)	0.1	-
Total	100.0	100.0
	N = 1,982	N = 1,588

Source: airport survey (2006), OAD database – DIAC extraction. The occupational code is based on the Australian Standard Classification of Occupations (ASCO) at the 1-digit level.

The largest absolute difference between the two samples is in occupational categories 1 (managers and administrators) and 6 (intermediate clerical and sales workers).

[1] In particular, 65 were carried out at Adelaide International Airport, 189 at Brisbane International Airport, 1,134 at Sydney International Airport, and 594 interviews at Melbourne International Airport.

[2] Although landing and departure cards contain information on the traveller's occupation, this information is not electronically stored, but can be accessed by extracting the actual picture of the card filled in by the traveller and 'manually' record the occupation reported. We are grateful to the statistics section of DIAC for sampling the arrival cards, and providing us with the data.

Rather than introducing additional assumptions and noise in the occupation data, we decided against adjusting the over/under-representation of the groups in the airport sample and in calculating weights a_{ij06}.

However, adjustments were made with respect to the industry of employment. The airport survey did not distinguish between retail and wholesale trade, and between transport and communication. We decided that breaking down the combined data was preferable to their outright elimination. This helps conserving observations for the empirical analysis, and allows one to include communications and IT, which account for a large share of business travel and is viewed as having relevant 'spill-over' effects to other industries (e.g. OECD, 2000). We followed four 'sector allocation' strategies to break down the aggregated industry data. These are:

(i) leave out observations of the two aggregate sectors in the empirical analysis;

(ii) apportion the aggregate data using the relative employment share each of the sectors involved, as per the labour force, defining the weight as:

$$transport_{airsvy} = \frac{transport_{lforce}}{transport_{lforce} + (comm\ \&\ IT)_{lforce}} \ .$$

(iii) use additional information on the job and the employer to reclassify the sector in each of the 1,982 responses collected from the airport survey[3].

(iv) follow (iii) but apply the employment share of the sector in the aggregate sectors only for individual responses where additional information is insufficient to make a clear-cut decision.

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[3] This procedure uncovered very few 'true' misclassifications, such as three full-time students being in a sample theoretically covering only people in employment, and a number of 'possible' misclassifications, especially in the field of "culture and personal services", where the overlap between market and public sector is perhaps strongest (e.g. people working in museums, artistic directors, conductors). Both types of misclassification were addressed, resulting in a net increase of 69 responses in the sub-sample covering the market sector. With reference to the two 'merged' sectors, the reallocation of respondents was based on the additional information collected and, where this was still insufficient, based on a regression using personal and occupational characteristics.

The resulting number of observations used to generate the weights then applied to the series on business travellers are reported in Table A.1 in the Appendix. As shown (i) and (ii) are based on a smaller number of observations than (iii) and (iv). The most relevant difference between these two groups is the split of transport and communications and IT. For ease of exposition, we report our regression analysis using data on business visits generated by the reallocation strategies (i) and (iv). Table 2 reports the means of the main data used for the empirical analysis.

TABLE 2 MEANS OF MAIN VARIABLES (LOGARITHMS): 1991-2 TO 2005-6

	mfp	Employment	Arrivals (i)	Arrivals (iv)	Departures (i)	Departures (iv)
Agriculture	4.38	12.90	7.67	7.33	8.18	7.79
Mining	4.67	11.40	7.13	6.72	8.62	8.19
Manufacturing	4.56	13.90	9.27	8.81	9.91	9.47
Utilities	4.67	11.27	7.46	7.05	7.71	7.30
Construction	4.50	13.39	7.47	7.06	8.33	7.91
Wholesale trade	4.46	13.06	-	6.31	-	7.43
Retail trade	4.52	14.05	-	7.14	-	7.86
Hotels, rest	4.52	12.92	6.68	6.11	7.16	6.62
Transport	4.48	12.90	-	7.51	-	7.96
Communication	4.51	11.95	-	8.22	-	8.77
Finance, real est	4.55	12.71	8.34	7.97	8.82	8.50
Culture, recr	4.57	13.72	6.24	6.90	6.96	7.82
N	*15*	*16*	*16*	*16*	*16*	*16*
Other variables						
Real GDP growth			.0398			
Terms of trade (ln index)			4.55			

The summary statistics reported in Table 2 suggest that during the period examined Australia was on average a net exporter of business visitors in each industry. In fact, the (log) number of departing travellers is larger than the corresponding number of visitors arriving. Table 2 also shows that the sectors with the highest intensity of business visitors do not rank in the same order as those reflecting the number of people employed across Australia's economy. The highest volume of business visits occurs in manufacturing, followed by communication, finance, and mining. The lowest volumes are recorded in wholesale and retail trade, utilities, and culture and recreation activities. In contrast, domestic employment is large in retail and wholesale trade, followed in descending order by manufacturing, culture and recreational activities, and construction. Employment in Australia is smallest in utilities, communication, and mining, respectively.

5 Empirical analysis

5.1 Pre-estimation

Pre-estimation testing was extensive, though judgement was necessary to interpret the results and to select the final estimation strategy. Despite the very large number of observations on business travellers, productivity data are available only at the industry level. This forces us to use only 12 cross sectional points for a period of 14 years, or a total of 168 observations. While it is possible to apply most techniques to a panel of size N =12 and T = 14, our estimation strategy had to take into account the low power of many of the tests applied, especially those testing for unit roots[4]. Notwithstanding the limits imposed by the few observations on the power of the tests, we run a simple model based on Greene (1990, p. 567-8: example 19.4) to test whether productivity and business trips may be cointegrated. The test result supports this hypothesis. So our preferred strategy is to assume cointegration and estimate equation (6) in levels, acknowledging that the tests performed are neither unequivocal in supporting our choice nor have sufficient power to make us think otherwise.

We chose to estimation equation (6) using industry fixed-effects, as the null of zero values for the coefficients on the industry dummies was strongly rejected. We tested

[4] For example, we tested for unit roots at the level of each industry time series (Dickey – Fuller test) and of the panel as a whole for both dependent and independent variables. Of the panel unit root tests, we applied the Levin-Lin-Chu, Im-Pesaran-Shin, and the Hadri LM tests. The results obtained indicate the possible presence of a unit root in the dependent variable in 8 of the 12 industries when a 5% level of significance is chosen, and in 6 out of 12 industries with a 10% level of significance. Inspection of the coefficients obtained on the dependent variable regressed on its lagged value plus a trend (by industry) indicate that in most cases the centre of the confidence interval is about 0.5-0.7, with the upper bound being just slightly over unity (1.008-1.06). A related situation emerges with the flows of business visitors: here the null of a unit root fails to be rejected in three industries at the 5% significance level, and in nine when that is dropped to 10%. As for the dependent variable, the centre of the confidence

for autocorrelation of the error term (Durbin-Watson), and whether or not its AR1 structure should be modelled with a common coefficient for all industries or with an industry-specific parameter – finding support for the hypothesis of a common coefficient. Accordingly we estimate equation (6) by feasible generalised least squares with a common AR1 error term.

With reference to model specification, we apply the RESET test. To conserve degrees of freedom we do not include control variables whose estimated coefficients did not meet statistical significance. As industry R&D expenditures (BERD) are not available for all industries, this variable was discarded as the estimated coefficient was never statistically significant. This result is similar to what found by Australia's Productivity Commission in a recent report (Shanks and Zheng, 2006). To limit problems of multicollinearity we estimate equation (6) using arrivals and departures separately rather than jointly.

To reduce the effect of endogeneity between business trips and multifactor productivity, we lag all independent variables with the exclusion of real GDP growth, which we use as a proxy for the business cycle. Because the time trend of equation (6) is highly correlated with the arrivals and departures in other industries (correlation coefficient is close to 0.9), the signs and statistical significance of the coefficients obtained from the fully specified model (6) are affected. In particular, the multicollinearity problem arises as a result of including the last two years of data (2004/5 and 2005/6). This period coincides with a marked productivity downturn. Among the alternative strategies used to address this problem[5], we decided to remove the last two years of data, and to estimate equation (6) excluding the 'externality'

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interval is in the 0.5-0.7 range, with upper bound marginally over unity when unit root is not rejected.

[5] These included replacing the trend with: (i) year dummies for each year; (ii) multiple time trends; (iii) stepwise bi-annual trend; (iv) combinations of multiple time trends and dummy variables; (v) restricting the analysis to the period up to 2003 included.

effect of departures and arrivals on the other industries (R3 and R4, respectively in equation (6) – see footnote 6).

5.2 *Empirical results*

Table 3 summarises the empirical results. Separate results are reported for regressions performed on data constructed using different weights. The results obtained from weights obtained from strategies (i) and (iv) appear to the left and right of Table 3, respectively. Three sets of results are reported, based on different estimation techniques applied to equation (6): Ordinary Least Squares (OLS), Generalised Least Squares (GLS), and Prais-Winsten (PW). While the inclusion of OLS is made to provide a 'regression-wise' benchmark, pre-estimation testing supports the use of panel data techniques. Of these, the estimation performed by GLS is more general than that based on PW, and hence is used as main reference. The cells referring to the independent variables contain the estimate and the corresponding standard error in parentheses. Statistical significance at the 5% level is reported with a double star, while a single star indicates statistical significance at the 10% level. Table 3 also reports the results of post-estimation tests about the overall fit and statistical significance of the model, the estimated coefficient of the common AR1 error term, and the number of observations, respectively. The results reported in Table 3 are organised from top to bottom in three groups: namely, gross flows of business visitors, gross arrivals, and gross departures. The estimates of the control variables are included only for the first group.

TABLE 3 EMPIRICAL RESULTS

	Strategy (i)			Strategy (iv)		
	OLS	**GLS**	**PW**	**OLS**	**GLS**	**PW**
Gross flows *i*	.0096	.0095*	.0014	.0154*	.0116**	.0114**
	(.0110)	(.0060)	(.0076)	(.0081)	(.0021)	(.0059)
Employment *i*	-.0771**	-.0659**	-.0703**	-.0560**	-.0364**	-.0486**
	(.0089)	(.0121)	(.0145)	(.0089)	(.0071)	(.0120)
Real GDP growth	-.2100	.0827	-.1052	.0084	-.0375	.1154
	(1.445)	(.1556)	(.4461)	(.9438)	(.0959)	(.3053)
Time trend	.0126**	.0088**	.0110**	.0159**	.0159**	.0155**
	(.0036)	(.0010)	(.0028)	(.0025)	(.0006)	(.0019)
Constant	-19.79**	-12.39**	-16.59**	-26.75**	-26.86**	-25.91**
	(7.283)	(2.139)	(5.627)	(5.017)	(1.211)	(3.823)
R^2	.3892		.9887	.3896		.9883
Wald chi		110.34	39.44		858.63	97.97
Common AR1 coefficient (rho)		.717			.695	
Observations (N=12, T=12)		88			144	
Gross arrivals *i*	.0031	.0018	-.0083	.0049	.0035	.0006
	(.0111)	(.0067)	(.0087)	(.0086)	(.0023)	(.0078)
R^2	.3852		.9889	.3824		.9887
Wald chi		100.81	38.32		677.41	88.29
Common AR1 coefficient (rho)		.729			.725	
Observations (N=12, T=12)		88			144	
Gross departures *i*	.0117	.0127**	.0057	.0190**	.0146**	.0152**
	(.0106)	(.0057)	(.0070)	(.0080)	(.0023)	(.0061)
R^2	.3916		.9886	.3939		.9885
Wald chi		116.00	40.83		808.23	93.89
Common AR1 coefficient (rho)		.709			.707	
Observations (N=12, T=12)		88			144	

(a) = eight industries; (d) = 12 industries, but sectoral allocation of business travellers in four industries uses additional information. See Section 4 for discussion.

Post-estimation indicators reported in Table 3 suggest that the regression yielded coefficients that were statistically significantly different from zero (Wald test), and a substantial autocorrelation coefficient in the error term (rho: 0.7-0.8).

Before presenting the results on the productivity effects of business trips, a brief comment on the control variables. There is strong evidence that industries operate under decreasing returns to scale, as indicated by the negative and highly statistically significant coefficient on the lagged labour force in all regressions - it should be zero for constant returns to scale. The drop in productivity due to an increase of employment is in the order of 2.5% - 4.5%. The coefficient on real GDP growth is instead always statistically insignificant, with alternate signs, suggesting the lack of any clear relationship between multifactor productivity and the business cycle. In contrast, the coefficient of the time trend is always positive and statistically significant. This coefficient, which represents the annual average growth of technology over the period, is in the range 0.9% - 1.6%.

With reference to business trips the results on the upper part of Table 3 clearly support the hypothesis that they make a positive contribution on productivity within and across industries, independently of the weight used. In every case, the coefficients of business visits are positive. Those results are robust to additional industry-specific explanatory variables (R&D expenditures and value added), or economy-wide controls (terms of trade). They also emerge when equation (6) is estimated with no control variables (here the statistical significance is stronger) and when estimation is performed on variables measured in changes rather than levels (lower).

With reference to the statistical significance of the coefficients, gross flows (first and second rows in Table 3) are generally statistically significant and suggest an average elasticity of 1.1% *within* an industry[6]. These estimates imply that a 10% rise in the gross flows of business visits in industry *i* increases multifactor productivity in the same industry by about 0.11%. As the average number of business visitors in an industry in 2006 was about 8,000 equivalent workers, a 10% increase corresponds to approximately 800 equivalent workers per industry, or 9,600 for 12 sectors. Although the elasticity of business visits with respect to productivity is small, it is not irrelevant, as it typically translates into growth for the economy. When measures of business visits in equivalent workers are replaced with the number of flows trips, we obtain

[6] Separate estimation replacing the time trend indicate that there is also a positive externality from business visits to other

similar signed but generally statistically stronger coefficients. This result suggests that the frequency of visits might play a more relevant role in raising productivity than the length of stay.

To better understand the contributions to productivity of arriving and departing visitors equation (6) was estimates separately for each group. The results are shown in the lower part of Table 3. Although incoming and outgoing business visitors contribute positively to multifactor productivity, the within-industry contribution of departing residents is clearly driving the overall results, as highlighted by the corresponding coefficient's statistical significance. Overall, the results indicate that business visitors enhance the stock of knowledge available to Australia, and that such contribution is provided by departing residents. The inflow of business visitors is positively related to productivity, but the estimates obtained are not statistically significantly different from zero.

To investigate the possible causes of this outcome we analyse the characteristics of incoming and outgoing visitors. In particular we applied a simple test of the means of the airport sample and the population of international business travellers with respect to some personal and occupational features. These results are reported in Table 4. Statistically significantly different means at the 5% and 10% significance level are indicated with double and single stars, respectively. The means reported for the airport survey are based on qualitative data and generally do not offer an immediate interpretation, aside from the quantitative variables age, number of trips, length of stay, and income, as well as for the dummy scientist/engineer, for which higher mean values correspond to higher levels.

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industries from those of the travellers. In such case, the average elasticity of the contribution of business trips to multifactor productivity is 5%-6% *across* sectors.

TABLE 4 TEST OF SAMPLE MEANS OF INCOMING AND OUTGOING INTERNATIONAL BUSINESS VISITORS

	Airport Survey		OAD	
	Incoming	**Outgoing**	**Incoming**	**Outgoing**
Age	3.40*	3.48*	37.71**	38.05**
Marital status			4.08**	4.29**
Scientist or engineer	1.49*	1.52*		
Occupation 2-digit ASCO	20.9	20.3		
Function	4.89**	5.36**		
Industry	8.15	8.16		
Nr trips	3.06**	2.57**		
Length of stay	2.99**	3.18**	18.87**	33.48**
Income	5.17**	5.30**		
N	966	1,016	462,375	403,793

Source: Airport survey and OAD database.

These tests support that incoming and departing business visitors do not belong to the same population. With respect to personal characteristics, outgoing domestic residents tend to be older, married and travel more often than incoming visitors. With respect to occupational characteristics, they also have higher mean incomes, work experience, and perform different functions within the organisation: they often are business owners or managers in charge of production and R&D, or professionals, suggesting a type of knowledge that has a strong industry-, and most likely firm-, specific character. In contrast, arriving visitors contain a higher proportion of people in sales and marketing - in fact this is the most common response. The higher incidence of trips motivated by sales and marketing functions among foreign-based visitors is consistent with the lack of statistical significance of the coefficients reported in Table 3 under the assumption that the products/services offered do not result in new technology being adopted after a trip[7]. This however does not imply that the inflow of business visits is irrelevant, as, in a circular argument, these may lead to subsequent visits abroad of Australian businesspeople which might then end up in new

[7] We extended the empirical to try to contemporaneously capture the productivity effect of business trips on the industry of the traveller as well as spillover effects on the productivity of other industries. In these regressions, whose results are available from the authors but are not reported due to the occasionally problematic effect of the time trend, the gross flows of arriving visitors in industry *i* has a positive and statistically significant effect on productivity in industries *j* (and a positive but statistically

technology being adopted, though we do not have the microeconomic information to test this hypothesis.

6 Conclusion

This paper presents a simple theoretical model to study the impact of international business trips on productivity and the growth rate of an economy, and presents estimates of such effect for twelve Australian industries during 1991/2-2005/6. Business trips emerge as a significant source of productivity growth. In particular, it emerges that departing visitors contribute significantly to productivity within their industry, while arriving visitors do not. This outcome is a likely reflection of the functional nature of trips. Australian residents travel for reasons related to production, R&D, and strategy while business visitors from abroad commonly come to Australia for purposes related to sales and marketing functions. As the knowledge gained and transferred through business visits is non-rival, both countries of origin and destination can gain from the human capital of travellers. Business visits therefore offer countries that are disadvantaged by geography, size or level of economic development, the opportunity to overcome their disadvantage and access the technology frontier.

References

Anderson, E. (2002). "Skilled Worker Mobility and International Inequality". Unpublished mimeo, University of Sussex.

Australian Bureau of Statistics (2007). Cat. No. 5260.0.55.001 Information Paper: Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates.

Cohen, W. and Levinthal, D. (1989). "Innovation and Learning: the Two Faces of R&D". Economic Journal 99(397), 569-596.

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insignificant effect on the productivity of industry *i*). In contrast, the gross flows of departures positively and statistically significantly affects productivity in industry *i* but its positive effect on industries *j* is not statistically significant.

Dosi, G. et al. (eds) (1988). Technical Change and Economic Theory, Maastricht Economic Research Institute on Innovation and Technology (MERIT), International Federation of Institutes for Advanced Study (IFIAS) Research Series, no. 6. London and New York: Pinter.

Gould, J.D. (1980). "European Inter-Continental Emigration: the Role of 'Diffusion' and 'Feedback'". *Journal of European Economic History*, 9(2), 267-315.

International Air Travel Survey (IATS) (1988). The European Frequent Business Traveller. Henley on Thames: European Data and Research Limited.

Organisation for Economic Co-operation and Development (OECD) (2000). Knowledge, Technology and Economic Growth: Recent Evidence from OECD Countries. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD) (2002). International Mobility of the Highly Skilled. Paris: OECD.

Piore, M. (1979). *Birds of Passage: Migrant Labor Industrial Societies*. Cambridge: Cambridge University Press.

Rogers, M. (1995). International Knowledge Spill-Overs: A Cross-Country Study. In Steve Dowrick (ed), Economic Approaches to Innovation. Aldershot, UK and Brookfield, US: Edward Elgar Publications.

Salt, J. (1992). "Migration Processes among the Highly Skilled in Europe". *International Migration Review*, 26(2), 484-505.

Shanks, S. and Zheng, S. (2006). "Econometric Modelling of R&D and Australia's Productivity". Productivity Commission, Staff Working Paper, April.

Tani, M. (2005). "On the motivations of business travel: evidence from an Australian survey". *Asian and Pacific Migration Journal*, 14(4), 419-440.

Winters, L.A. (2002). "The Economic Implications of Liberalising Mode 4 Trade". Joint WTO-World Bank Symposium on the Movement of Natural Persons (Mode 4) Under the GATS, WTO Geneva, 11-12 April.

Wood, A. (2001). "Globalisation and Wage Inequalities: A Synthesis of Three Theories". *Weltwirtschaflisches Archiv*, 138(1), 54-82.

Appendix

TABLE A.1

	Actual number of observations			
	(a)	**(b)**	**(c)**	**(d)**
Agriculture	75	75	79	79
Mining	94	94	93	93
Manufacturing	451	451	434	434
Utilities	58	58	58	58
Construction	101	101	101	101
Whol.trade	114	28	62	42
Ret.trade		86	72	92
Hotels	37	37	32	32
Transport	372	269	82	117
Communic		103	286	251
Finance	167	167	178	178
Culture	27	27	88	88
N (market sectors only)	*1,496*	*1,496*	*1,565*	*1,565*

	Weights			
	(a)	**(b)**	**(c)**	**(d)**
Agriculture	5.0%	5.0%	5.0%	5.0%
Mining	6.3%	6.3%	5.9%	5.9%
Manufacturing	30.1%	30.1%	27.7%	27.7%
Utilities	3.9%	3.9%	3.7%	3.7%
Construction	6.8%	6.8%	6.5%	6.5%
Whol.trade	7.6%	1.9%	4.0%	2.7%
Ret.trade		5.7%	4.6%	5.9%
Hotels	2.5%	2.5%	2.0%	2.0%
Transport	24.9%	18.0%	5.2%	7.5%
Communic		6.9%	18.3%	16.0%
Finance	11.2%	11.2%	11.4%	11.4%
Culture	1.8%	1.8%	5.6%	5.6%
N (market sectors only)	100.0%	100.0%	100.0%	100.0%