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Determinants of Productivity per Employee: an Empirical Estimation Using Panel Data[1]

Nicolas Belorgey[(i)]

Rémy Lecat[(i)]

Tristan-Pierre Maury[(i)]

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[(i)] Banque de France, Economic Analysis and Research Division

Abstract:
Two different approaches are used in this article to study productivity per employee: the determinants of its growth rate in the 1990s are first examined, and then the determinants of its level, using a more structural approach. ICT are shown to have a positive and significant effect on both growth rates and levels of productivity. This result is consistent with that of Gust and Marquez (2002), although the sample of countries is larger and GMM are used. In both sections of the paper, the employment rate and productivity exhibit a significant negative relationship, arising from the concentration of employment on the most productive members of the workforce. Indicators of financial depth and price stability are found to be significant.

Keywords : productivity, panel, generalized method of moments, information and communication technology (ICT), growth accounting.
JEL classification : C22, C23, O47.

Non technical summary

Two different approaches are used in this article to study productivity per employee: the determinants of its growth rate in the 1990s are first examined, and then the determinants of its level, using a more structural approach. The determinants of its growth rate are estimated across a panel of 25 industrialised countries using the generalised method of moments (GMM). The determinants of productivity levels are estimated using GDP in purchasing power parity (PPP) per employee in 2000 in a 77-country sample. Additionally a sub-sample of 49 countries is used to capture the impact on productivity of spending on information and communication technologies (ICT).

ICT are shown to have a positive and significant effect on both growth rates and levels of productivity. Further, in the analysis of growth rates in the 1990s, variations in the GDP share of ICT expenditures and in the GDP share of ICT production have a separate and positive impact on the productivity growth rate. This result is consistent with that of Gust and Marquez (2002), although the sample of countries is larger and GMM is used.

In both sections of the paper, the employment rate and productivity exhibit a significant negative relationship, arising from the concentration of employment on the most productive members of the workforce.

In the first section, changes in working time and the investment ratio emerge as factors that positively influence per capita productivity.

Determinants of productivity levels are looked for among the structural characteristics of countries. Indicators reflecting the development level of public infrastructure and human capital turn out to be highly significant in both the broad sample and the narrower sample, which contains a greater proportion of industrialised countries. Indicators of financial depth and price stability are found to be significant in the broad sample. Lastly, it proves impossible to identify a significant effect from several factors that are traditionally advanced to explain divergences in productivity levels, such as research and development (R&D), market size and the investment ratio.

1. Introduction

Growth decomposition analyses attribute a large share of labour productivity growth to "technical progress". To make this blurry concept clearer, various articles have highlighted the role played by research and development (R&D) (Greenan, Mairesse and Topiol-Bensaid, 2001; Scarpetta and Tressel, 2002; Guellec and de la Potterie, 2001), the level of education (Lucas, 1988), public infrastructure (Aschauer, 1989) and the age of the capital stock. At the close of the 1990s, the economic debate expanded beyond these traditional determinants to include information and communication technologies (ICT), usually considered to comprise IT hardware, software and communications equipment.

ICT are believed to have played a part in productivity trends in the 1990s. In particular, several analyses suggest that the surge in the average productivity growth rate in the United States in the second half of 1990s can be largely ascribed to the production and utilisation of these new technologies. ICT are thought to have influenced labour productivity through three channels:

- A major contribution to productivity growth from ICT-producing sectors. Despite the small size of these sectors (7.3% of GDP[2]), their robust productivity gains are estimated to account for 40% of the acceleration in US labour productivity since 1995, according to Oliner and Sichel (2002). The falling cost of computing power – 18% a year over the last four decades – mainly owing to enhanced processor performances, has amplified the strong expansion in volumes produced by these sectors. As a result, labour productivity has raced ahead in these sectors, boosting their GDP share and hence their contribution to growth in the industrialised countries.

- ICT investment, which has soared as new-technology performances improved. The rise in investment has increased the stock of capital available per employee, or capital deepening, leading to a faster pace of equipment renewal. This appears to have had a positive impact on labour productivity. Oliner and Sichel (2002) estimate that ICT investment could be responsible for almost 60% of the pick-up in US productivity.

[2] Bart van Ark, Robert Inklaar and Robert McGuckin, 2002.

- There is still some debate about the third channel, through which ICT are said to have increased the total factor productivity (TFP) of sectors that are heavy users of ICT, such as insurance, finance, retail and aeronautics. In particular, by enhancing the co-ordination of those involved in the production process, ICT enabled inputs to be used more efficiently. The US retail sector, for example, recorded hefty productivity gains. Some authors have attributed this to utilisation of ICT, which is estimated to have improved management of inventories, the supply chain and warehouse logistics[3] [4].

Thus far, research into the impact of ICT has mainly yielded growth decomposition analyses of individual countries. In the United States, several papers, notably Jorgenson and Stiroh (2000) and Oliner and Sichel (2000), have shed light on the contribution of ICT-producing sectors to TFP growth and the contribution of ICT investment to growth in apparent labour productivity.

There are fewer cross-country comparisons of productivity determinants, however. Gust and Marquez (2002) carry out just such an analysis for 13 countries. They conclude that differences in productivity between the beginning and end of the 1990s are linked to the production and utilisation of ICT, as well as to changes in the employment rate. They also find that the following all have an indirect impact on productivity via their effect on ICT: the degree of regulation of goods and labour markets; the level of education; and the percentage of employment in the services sector. The diffusion of ICT may therefore be impeded by regulatory constraints that prevent companies from reorganising their workforce as well as by barriers to entry on certain markets. This last finding is shared by Scarpetta and Tressel (2002). Pilat and Lee (2001) also explore the relationship between ICT investment and the cost of ICT or telecommunications, which may differ across countries because of regulatory distortions.

[3] McKinsey Global Institute (2002).

[4] ICT spending by businesses, which are directly responsible for the productive process, is unlikely to have the same effect as ICT spending by households, which merely participate in the process. However, the data used here do not allow us to distinguish between the two categories. Furthermore, household expenditures also have an effect on productivity through increased human capital resulting from the use of IT at home. As this paper is exploring macroeconomic issues, and since there are no data allowing us to separate the impact of household expenditures from businesses expenditures, household ICT spending cannot be entirely excluded from the determinants of productivity.

In this analysis, the determinants of productivity are examined first by focusing on the 1990s, then by comparing productivity levels via a more structural approach [5].

The first section of the paper investigates the relationship of annual productivity growth to its determinants from 1992 to 2000 across a panel of 25 countries (see appendix 1). Unlike Gust and Marquez (2002), who use the ordinary or generalised least squares approach (OLS), the generalised method of moments (GMM) is employed here, which allows to examine the possibility that certain determinants may have a diffusion effect on productivity. More importantly, it enables to deal with most endogeneity and simultaneity issues. The results are quantitatively different from those of Gust and Marquez (2002), but qualitatively similar. For instance, statistical confirmation is obtained that ICT production and expenditures are significant determinants of labour productivity. In addition, the impact on productivity of the capacity utilisation rate and the investment ratio is demonstrated.

The second section, which focuses on the long term, looks at the determinants of labour productivity levels in 2000 across a large number of countries: 77 without ICT spending and 49 with. These findings confirm that the level of development of public infrastructure, the education system and the banking system all have a positive impact on the productivity level. Evidence of the positive role played by price stability as well as of the inverse relationship between the employment rate and the productivity level is also obtained. The investigation of a 49-country sub-sample demonstrates that ICT do have a significant impact on productivity.

2. Determinants of the growth rate of apparent labour productivity in the 1990s

2.1 Baseline equation, methodology and data sources

2.1.1 Baseline equation

This study is seeking to identify the main determinants of the growth rate of apparent labour productivity (here, GDP per employee). The baseline equation that is estimated takes the form:

[5] Furthermore, this is a macroeconomic analysis. Sector or business data are not available for country samples that are as large as those used here.

$$\Delta Y_{i,t} = a.\Delta Y_{i,t-1} + b.ITP_{i,t} + c.ITS_{i,t} + d.\Delta H_{i,t} + e.\Delta TE_{i,t} + g.INV_{i,t} + f.\Delta TUC_{i,t} + u_i + \eta_t + \varepsilon_{i,t}$$

where i = 1,…,N (where N is the number of countries) and t = 1992, 1993,…, 2000. Y denotes the apparent productivity of labour, measured here as GDP over employment; ITP is the GDP share of ICT production; ITS is the GDP share of ICT spending; H denotes hours worked; TE is the employment rate; INV is the GDP share of investment and TUC is the capacity utilisation rate. ΔY is the log difference of Y (the same applies to all other variables in differences). ITS, ITP and INV are in logs. The usual country-specific effect, u, is included. η is a time dummy. ε is disturbance.

An autoregressive term is included in the baseline equation. In doing so, the possibility that the independent variables may have an ongoing impact on productivity is taken account of. For instance, a rise in ICT production or spending could have an effect on per capita productivity spread over several years.

One goal of this study is to assess the impact of ICT. In the introduction, several theoretical channels of transmission from ICT to per capita productivity that the literature has identified were recalled. These channels concern ICT-producing and ICT-using sectors alike. Accordingly, ICT production and ICT spending are included in the baseline equation, as do Gust and Marquez (2002). ICT production captures the impact on per capita productivity of TFP in ICT-producing sectors, while ICT spending captures effects of substitution by ICT products in user sectors.

The employment rate is also likely to be a key determinant of apparent labour productivity. Indeed, Gust and Marquez (2002) identify a negative relationship between changes in the employment rate and productivity growth. The authors link this effect to the fact that a rise in the employment rate is accompanied by the arrival of lower-skilled workers in the workforce, which crimps per capita productivity.

Working time is also included as one of the determinants in the baseline equation. This is a vital inclusion because the endogenous variable is per capita productivity, not hourly productivity. The ratio of investment in physical capital is also one of the independent variables. The impact of this variable as a proxy for the effect of overall capital deepening on per capita productivity is assessed. Lastly, the capacity utilisation rate is added to take into account the business cycle's effect on productivity.

The significance of other independent variables is tested. It is explained in the Findings section why they were not retained.

2.1.2 Methodology

The baseline equation poses a problem: all the independent variables are contemporaneous with the endogenous variable. This creates the possibility of reverse causality, i.e. of productivity impacting the independent variables. For this reason, the baseline equation cannot be estimated with the usual techniques. These issues are dealt with by using a GMM approach, which is designed to at least partially correct biases in estimates arising from the abovementioned problems.

The generalised method of moments (GMM) for dynamic panel data models was developed by Holtz-Eakin, Newey and Rosen (1988), and Arellano and Bond (1991). Arellano and Bond (1991) propose first differencing the equation:

$$\Delta Y_{i,t} - \Delta Y_{i,t-1} = a.\left(\Delta Y_{i,t-1} - \Delta Y_{i,t-2}\right) + \beta'.\left(X_{i,t} - X_{i,t-1}\right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right) \qquad (1)$$

where the matrix X contains the set of independent variables other than the lagged endogenous variable (including time dummies). β is the vector of parameters other than a. While differencing eliminates the country-specific effect, a new problem is created: by construction, the term $\varepsilon_{i,t}$-$\varepsilon_{i,t-1}$ is correlated with the lagged endogenous variable $y_{i,t-1}$-$y_{i,t-2}$.

Under the assumptions that:

a) the error term, ε, is not serially correlated, and
b) the independent variables, X, are weakly exogenous, i.e. they are uncorrelated with future realisations of the error term,

Arellano and Bond (1991) propose the following moment conditions:

$$\begin{aligned} &E\left[\Delta Y_{i,t-s}.\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \\ &E\left[X_{i,t-s}.\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \end{aligned} \qquad (2)$$

for s > 1 and t = 3, …, T. This technique thus consists in using the lagged *levels* of variables as instruments for estimating the baseline equation *in differences*. The authors show that this method is far more accurate than previous techniques (Chamberlain's matrix, OLS in levels, within groups, and so forth). Moreover, following Arellano and Bond's approach (1991), the variables included in the matrix of instruments are multiplied by a time dummy. This technique cannot be applied to all the variables in the matrix because this would considerably increase the number of instruments. It is applied only in the case of the lagged endogenous variable and the ICT variables, i.e. the three variables that are suspected most strongly of endogeneity. The remaining lagged independent variables are included in the matrix of instruments without being multiplied by a time dummy. s is supposed to be 2≤s≤3 in equation (2) above to restrict the number of instruments (data are available on just 25 countries).

While using the GMM approach for the equation in differences yields far more accurate estimates than do traditional techniques, the utilisation of lagged variables *in levels* is not always adequate. Alonso-Borrego and Arellano (1999), and Blundell and Bond (1998) have shown that, on small samples, coefficients can be seriously biased if the independent variables *in levels* are strongly autocorrelated.

For this reason, Arellano and Bover (1995) and Blundell and Bond (1998) propose complementing the GMM on the equation in differences with a GMM on the baseline equation *in levels* with lagged independent variables *in differences* as instruments

$$\begin{aligned} &E\left[\left(\Delta Y_{i,t-s} - \Delta Y_{i,t-s-1}\right).\left(u_i + \varepsilon_{i,t}\right)\right] = 0 \\ &E\left[\left(X_{i,t-s} - X_{i,t-s-1}\right).\left(u_i + \varepsilon_{i,t}\right)\right] = 0 \end{aligned} \qquad (3)$$

for s=1. These new conditions are valid under the additional assumption of stationarity of the independent variables, i.e. that there is no correlation between the country-specific effect and the independent variables in differences.

The combination of these two GMM techniques drastically improves the accuracy of the estimators if the independent variables are sufficiently serially correlated, which is the case in this example. Given the size of the sample (just 25 countries), using a single GMM technique would have yielded seriously biased estimates.

The quality of the GMM estimate depends in particular on two factors: the assumption that the error term is not serially correlated; and the validity of the matrix of instruments. Arellano and Bond (1991) propose the following two tests:

Test 1 (Instruments):
Let Z be the matrix of instruments. Recall that for the regression to be correct, Z must not be correlated with disturbances. This assumption is evaluated using a Sargan test.

Test 2 (Serial correlation of residuals):
Given that the baseline equation has been first-differenced, the resulting residuals should be first-order serially correlated but not second-order serially correlated. AR(1) and AR(2) tests developed by Arellano and Bond (1991) are used to verify this point.

Lastly, Arellano and Bond (1991) and Blundell and Bond (1998) propose a two-step GMM estimator. The residuals of the first-step estimate are used to make a robust estimate of the heteroskedascity of the variance-covariance matrix in the second step. However, the authors demonstrate that while the two-step estimator is far more accurate than the one-step estimator, the latter nonetheless provides a much more accurate estimate of standard deviations on small samples. The small size of the sample and the large number of instruments used could therefore cause to strongly underestimate the standard deviations of the two-step GMM estimators[6]. We follow Calderon, Chong and Loayza (1999) and Beck and Levine (2002), and use the two-step estimator after assessing its significance in the first step.

2.1.2 Data sources

GDP, investment and employment data were taken from the OECD's Economic Outlook database. Data on ICT production came from the OECD's STAN database, while the World Information Technology Service Alliance's (WITSA) database (2002) supplied the figures for ICT spending. Data on hours worked were extracted from the Total Economy Database of the

Groningen Growth and Development Centre. Capacity utilisation rates were taken from standardised national sources. (see appendix 3)

2.2 Findings

2.2.1 Overall findings

Table 1 sets out the results of the baseline equation estimates. The first column gives the estimate of the baseline equation with ICT production and spending (specification 1). The second column gives the estimate of the equation excluding ICT spending (specification 2), while the third column excludes ICT production (specification 3).

Under the first specification, neither of the ICT variables is significant individually (there is an empirical correlation of 0.45 between them). However, by running a Wald test, the two variables are jointly significant at 1%. Specifications 2 and 3 show that when ICT production and ICT expenditures are taken separately, they have a positive and significant influence on the growth rate of apparent labour productivity. These results only partially bear out those of Gust and Marquez (2002), who find ICT production and expenditures to be concurrently significant. The divergence in findings may stem from:

1) the difference in estimation methods (GMM rather than OLS), or

2) the difference in databases used (25 countries in this article, compared with 13 countries for Gust and Marquez, 2002). See Appendix 2 for a comparison of these estimates with an estimate similar to that of Gust and Marquez (2002).

[6] The same problem affects the Sargan test and the residual serial correlation test.

Table 1

Baseline equation with GMM			
$\Delta Y_{i,t} = a.\Delta Y_{i,t-1} + b.ITP_{i,t} + c.ITS_{i,t} + d.\Delta H_{i,t} + e.\Delta TE_{i,t} + g.INV_{i,t} + f.\Delta TUC_{i,t} + u_i + \eta_t + \varepsilon_{i,t}$			
	Specification 1	**Specification 2**	**Specification 3**
Autoregressive term ΔY(-1)	0.248^{**}	0.326^{***}	0.253^{**}
GDP share of ICT production (ITP)	1.586	3.228^{***}	-
GDP share of ICT expenditures (ITS)	1.354	-	2.789^{**}
Change in hours worked (ΔH)	0.477^{***}	0.437^{***}	0.388^{***}
Change in employment rate (ΔTE)	-0.378^{*}	-0.332^{*}	-0.307^{*}
Investment ratio (INV)	0.116^{*}	0.119^{**}	0.101^{*}
Change in capacity utilisation rate (ΔTUC)	0.0010^{**}	0.0012^{**}	0.0015^{**}
Joint significance of ICT	0.009	-	-

Number of countries: 25
Number of points: 149

Specification 1: baseline equation.
Specification 2: excluding ITS.
Specification 3: excluding ITP.

* indicates that the estimate is significant at 10%, ** at 5% and *** at 1%.

The Wald test gives the significance level needed to reject the null hypothesis that the two ICT variables are jointly zero.

Despite the difference with Gust and Marquez (2002), these findings confirm ICT's marked influence on changes in productivity. ICT spending has a strong impact on per capita productivity. Using specification 3, let us take the example of a country with an average ICT-expenditure-to-GDP ratio, i.e. 5.91%; if we assume that at a given date this country devotes an additional 1% of GDP to ICT spending, this will trigger an immediate increase of around 0.45 of a percentage point [7] in the growth rate of apparent labour productivity (compared with about 1 percentage point for Gust and Marquez, 2002). Of course, this is an unrefined interpretation, *ceteris paribus*, of the table's results. As Pilat and Lee (2001) rightly remind us, corresponding changes in other areas are required before the impact of higher ICT investment can feed through into productivity. Accordingly, caution must be exercised when interpreting the results of Table 1. Note, however, that a 1%-of-GDP increase in ICT spending would be a large jump; in France, it would be equivalent to a rise of some 15% in ICT expenditures. These results confirm the impact of ICT expenditure on productivity, an aspect already discussed by Oliner and Sichel (2000), and by Jorgenson and Stiroh (2000). Further, these findings square with those of Colecchia and Schreyer (2001), who conclude that the impact of capital deepening from ICT investment was responsible for the sharp surge in US productivity relative to the European and Japanese economies in the mid-1990s.

Similarly, a one-percentage-point increase in the ratio of ICT production to GDP has an immediate impact of around 0.7 of a percentage point on the productivity growth rate, compared with more than 1 percentage point for Gust and Marquez (2002). This result affirms the impact on per capita productivity of an increase in TFP in ICT-producing sectors. Studies such as Oliner and Sichel (2002) and Gordon (2000) have demonstrated the significance of this mechanism on US data. Gust and Marquez (2002) and this paper confirm it on an international sample.

Findings for the other variables:

- Employment rate changes consistently have a negative and significant effect on the productivity growth rate across all specifications. There is little variation in the coefficient between specifications. The sign of this relationship was expected: it supports the hypothesis of diminishing returns for the employment rate in the production function put forward by Gust and Marquez (2002). Similarly, changes in average working hours have a positive and significant influence on the labour productivity growth rate. This is a logical finding because the endogenous variable is per capita productivity and not hourly productivity: an increase in working time naturally raises the extra production of an additional worker. These results are consistent with Malinvaud's estimates (1973).

- Remarkably, the investment ratio has a positive impact on the productivity growth rate. This contradicts Gust and Marquez's estimates (2002), which reject the significance of this variable. There are problems attached to the investment ratio, however: ICT investment is included in both ICT spending and in the investment ratio, even though it accounts for a

[7] Recall that the ratio of ICT expenditure to GDP is expressed logarithmically in the baseline equation.

fraction of the latter. Therefore, estimates similar to those of Table 1 were conducted but without the investment ratio. The results are practically unaltered.

- Changes in the capacity utilisation rate influence the productivity growth rate significantly and positively. Thus, the capacity utilisation rate significantly captures part of the business cycle. This result is consistent with the estimates of Guellec and de la Potterie (2001), who identify a linkage between the capacity utilisation rate and the TFP level.

Plainly, the list of independent variables used is not an exhaustive one. Since the main aim of this paper is to test the significance of ICT, other variables were rejected:

- R&D expenditures are too closely correlated with ICT and so are not included among the significant determinants of per capita productivity. This partially supports findings obtained by Greenan, Mairesse and Topiol-Bensaid (2001) on French microeconomic data. These authors demonstrate that the impact on productivity of ICT is markedly higher than that of R&D expenditures. Note that Gust and Marquez (2002) also reject R&D expenditures (which are significant if ICT variables are excluded).

- Years of schooling and human capital are also too strongly correlated with ICT to significantly influence per capita productivity. This supports Caselli and Coleman (2001), who identify a positive linkage between the level of human capital and computer expenditures. Human capital thus appears to have an indirect impact on productivity via its effect on ICT spending. It would therefore be pointless to include both ICT expenditures and human capital in the baseline equation.

- The degree of employment protection (cf. Gust and Marquez, 2002; and Scarpetta and Tressel, 2002) is rejected for similar reasons. Gust and Marquez (2002) demonstrate that employment protection is a determinant of ICT expenditures and so *indirectly* affects per capita productivity.

2.2.2 Additional findings

An analysis to determine the sensitivity of the findings to a decomposition of ICT expenditures is conducted. The two main components of these series are telecommunications expenditures and computer expenditures, which are taken from the WITSA (2002). The same relationship as before is estimated, by testing alternately each of the components as an independent variable.

Table 2

ICT decomposition		
	Specification 1	**Specification 2**
Autoregressive term $\Delta Y(-1)$	0.333^{***}	0.182^{**}
X	-0.043	3.184^{**}
Change in hours worked (ΔH)	0.362^{**}	0.264^{***}
Change in employment rate (ΔTE)	-0.246	-0.562^{**}
Investment ratio (INV)	0.115^{*}	0.094^{*}
Change in the capacity utilisation rate (ΔTUC)	0.0012^{**}	0.0013^{***}
Number of countries: 25		
Number of points: 149		
Specification 1: X = telecommunications expenditures. Specification 2: X = computer expenditures.		
* indicates that the estimate is significant at 10%, ** at 5% and *** at 1%.		

The key finding in this table is that computer expenditures appear to have a greater effect than telecommunications expenditures on the growth rate of apparent labour productivity. Indeed, the coefficient estimator is not significant for the communication expenditures component. One possible explanation for this result is that communication spending definitely includes a greater volume effect than computer spending, but also a fairly variable price effect across countries.

3. Factors determining the level of apparent labour productivity in 2000

This second section rounds out the preceding short-term study with a long-term analysis of the determinants of apparent labour productivity levels in 2000. In order to permit a cross-country comparison of productivity levels, the ratio of GDP in purchasing power parity (PPP) to total employment is used. This raises major evaluation and methodological problems, discussed in the Appendix entitled “Statistical Difficulties in Measuring Productivity” of Lecat (2004).

Given the relative inertia of the productivity levels being compared, determinants are selected from the structural indicators of economic performance, namely the levels of education, public infrastructure, financial depth and macroeconomic stability.

3.1 Baseline equation, methodology and data sources

3.1.1 Baseline equation and methodology

The method used, an OLS regression on the productivity level of a given year, does not take account of the time dimension. Some of the variables used as determinants could in fact reflect the country’s level of development (a simultaneity bias). To get round this problem, determinants are taken, where appropriate, as a long-run average and prior to 2000. The baseline equation is therefore:

$$\Pi_i = a.X_i + \varepsilon_i$$

where i=1,…, N, the number of countries; □$_{i,}$ is GDP in USD PPP million divided by the total employment of country i in thousands. X_i denotes the vector of determinants for country i, while a is the vector of parameters.

This method sheds light on static not dynamic correlations: a positive correlation between the productivity variable and one of the determinants of productivity identified by the equation does not signify that an increase in the level of the determinant in a given country will mechanically drive up the productivity level. This correlation merely captures the differences in productivity between countries in 2000.

This method is applied to two different country groups. The first sample comprises 77 countries representing the world’s main economic areas – Western Europe, North America, Asia, Eastern Europe, Africa and the Middle East – and different levels of development, from OECD member countries and developing countries to the transition economies and the least developed countries (see appendix 1). The second group comprises a narrower sample of just

49 countries, allowing to include an ICT variable for which data are not available on the broader scale of the first sample.

3.1.2 Data Sources

Data are taken from the World Bank's database of World Development Indicators, except data on total employment, which come from the International Labour Organisation's Laborsta database. (see Appendix 3)

3.2 Findings

3.2.1 77-country sample, no ICT

The findings for the first group of countries, set out in the table below, show that there is a positive correlation between the productivity level and public infrastructure, human capital, price stability and financial depth, while a negative correlation exists with the employment rate.

Table 3

Productivity levels in a broad country sample, excluding ICT

Dependent variable: GDP in USD PPP million divided by total employment in thousands (□$_i$)

Independent variables	Unit	Coefficient	Significance
Public infrastructure			
Number of km of roads divided by surface area (RT)	Km/km² Average in 1990s	2.1	4.1%
Number of telephone lines per person (TEL)	Lines per person Average, 1960-2000	77.1	0.0%
Education			
Gross enrolment rate in primary education of a given age group (a) (PRIM)	As a % Average, 1970-1995	0.13	0.6%
Gross enrolment rate in tertiary education of a given age group (a) (TERT)	As a % Average, 1970-1999	0.22	3.6%
Macroeconomic variables			
Employment rate: total employment divided by total population (b) (TE)	As a % En 2000	-0.23	5.6%
GDP share of domestic credit to the private sector (CRD)	As a % Average, 1970-2000	0.13	0.4%

Standard deviation of the inflation rate (consumer prices) (c) (INFL)	In points Average, 1970-2000	-0.56	6.3%

OLS estimate on level variables

$$\Pi_i = a.RT_i + b.TEL_i + c.PRIM_i + d.TERT_i + e.TE_i + g.CRED_i + f.INFL_i$$

Where i=1,…,77, the number of countries
R^2 adjusted for the number of independent variables = 82.4%

(a) Official age group varies across countries.
(b) In some countries, working age begins before 15 and ends after 65. As a result, the employment rate is calculated as a percentage of the entire population.
(c) The standard deviation is slightly more significant than the level of inflation.

Public infrastructure, which is represented by the density of the road and telephone networks, is an especially significant determinant of the productivity level. Aschauer (1989) calls attention to the impact of the public capital stock on private sector TFP. He thus attributes the break in the pace of US productivity growth in the 1970s to the slowdown in public investment capital spending. The public infrastructure made available to private agents is necessary for a wide range of economic activities, and the productivity of private companies may depend on the quality of such infrastructure. To limit problems of simultaneity, telephone and road density levels are calculated as averages over periods that are made as long as possible[8]. The existence of externalities related to public infrastructure is often contested, with critics pointing to the high income elasticity of demand of the main categories of infrastructure (cf. notably Englander and Gurney, 1994). Because variables that group countries by income level are used, the coefficient of the public infrastructure variables is reduced but nonetheless remains significant (see below). Telephone and road network densities do a particularly good job of explaining differences in productivity within the group of high- and upper-middle-income countries[9], as the additional tests show (see Appendix 4).

The *level of human capital* is estimated by gross enrolment rates in primary, secondary and tertiary education. This ratio is calculated by the number of people enrolled in a given level of education, regardless of age, divided by the total number of people in the corresponding official age group. Lucas (1988) formulated the idea that human capital exhibits constant returns, not diminishing returns like other inputs, thereby placing education at the heart of the catch-up strategies of developing countries. In this paper, enrolment rates in primary and

[8] 10 years for road density, 40 years for telephone line density.
[9] The World Bank defines a high-income country as being one where the average per capita income in 2002 was over $9,076 in terms of PPP, and an upper middle-income country as being one where income was between $9,076 and $2,936.

tertiary education are significant determinants of the productivity level, with a particularly strong coefficient for tertiary education. By contrast, the enrolment rate in secondary education is not significant because of its collinearity with tertiary education (70.8% correlation) and does not improve the regression's overall significance. The variables for teaching quality, i.e. the teacher/student ratio and the GDP share of education spending, do not strengthen the regression's significance, but a finer level of data is doubtless required.

A country's *financial depth*, measured by the GDP share of domestic credit to the private sector, also emerges as a significant determinant of labour productivity. The banking system helps to ensure that resources are efficiently allocated, by making it easier for the business community to finance projects, but also by selecting the most productive undertakings. Conversely, the market capitalisation of listed companies as a percentage of GDP is not significant. This may be because of the small role of equity markets in some high-productivity countries like Ireland, France and Italy, and because these markets have become international in scope, allowing companies to issue securities on foreign markets.

Turning to the *indicators of macroeconomic stability, the volatility and level of inflation* both have a negative effect on productivity. High price volatility raises the level of uncertainty in the economy and undermines the efficiency of the price system. A stable macroeconomic environment provides support for investment decisions, which can strengthen labour productivity by increasing the capital stock per employee. A poorly-functioning price system prevents inputs from being channelled to the most productive opportunities. By contrast, a *large current-account deficit* does not have a significant impact on the productivity level. Some countries that are structurally in deficit are highly productive, like the United States and Ireland, while oil-exporting countries, such as Venezuela and Kuwait, exhibit low or average levels of productivity. Similarly, (official) *exchange rate volatility* does not have a significant effect, doubtless because of foreign exchange controls in certain countries.

The *employment rate* has a negative impact on the level of labour productivity. Here, the rate is computed as a percentage of total population because in many countries the working age extends outside the 15-65 age group[10]. A low employment rate indicates that only the most productive workers are involved in the production process, because of their skill level or their age; as the employment level rises, less productive workers are hired (Artus and Cette, 2004).

Unlike in the preceding section, it was not possible to test the impact of *working time*, because there were insufficient reliable data on all the countries in the sample.

Other determinants[11] are tested, but they prove to have insufficient explanatory power. *R&D expenditures* as a percentage of GDP do not improve the significance of the regression. This contrasts notably with the findings of Guellec and de la Potterie (2001) for OECD countries notably. First, there are gaps in the database, especially for developing countries, which account for a large section of the panel. Second, in these countries, where economic take-off relies on a phase of imitation rather than innovation, the R&D drive may also be of less significance.

The medium-term and long-term investment ratio is used as a proxy for the capital stock, with no significant results. Indeed, the investment ratio was especially high in former planned economies, even though the investments there proved to be unproductive.

An *indicator of the size of the market* to which companies have access was also taken into account. Some sectors may enjoy economies of scale associated with access to a larger market, either because of the size of the domestic market (estimated by national GDP divided by world GDP), or because of access to foreign markets (estimated by the economy's degree of openness). These two indicators do not have a significant effect: large countries like China, Russia and Brazil do not have high productivity levels; nor do countries, such as Nigeria, that display a high degree of openness because they export raw materials.

Lastly, the countries were sorted into *groups by income*[12] (see Appendix 4). Differences in the density of telephone and road networks do not explain differences in productivity in low- or lower-middle income countries. But they do explain differences in productivity for high- and upper-middle-income countries[13]. Furthermore, these groupings qualify the importance of

[10] However, the employment rate computed for the 15-65 age group is also significant.
[11] Some indicators used in the literature to capture cross-country differences in productivity on the basis of differences in regulatory levels are not available on a sufficiently large scale to be included here. This is the case notably for the Employment Protection Legislation (EPL) and Product Market Regulation (PMR) indicators used by Scarpetta and Tressel (2002).
[12] Again using the World Bank's classification based on average per capita income.
[13] The density of the telephone and road networks may be significant among high-income countries because these are superior goods. There is strong demand for such goods in high-income countries, which also have the highest levels of productivity.

certain determinants and confirm the significance of others. Thus, the coefficients for enrolment rates in tertiary education, for inflation volatility and for the employment rate are impressively stable and significant across all specifications. By contrast, the coefficients for the public infrastructure variables are halved for the richest countries, while the enrolment rate for primary education and the financial depth indicator no longer appear significant.

3.2.2 49-country sample, with ICT spending

The second group of countries, like the first, represents the world's main geographical regions. Unlike in the first, though, half the countries in this sample are OECD members. Additional data on ICT spending were taken, as in the first section of the paper, from the database published by the World Information Technology Service Alliance (2002).

The results of tests carried out on this second group of countries (see table below) reveal fewer significant variables: public infrastructure, human capital, and ICT spending have a significant and positive impact on the level of productivity, while financial depth and macroeconomic stability variables do not appear to be significant. As in the previous study, R&D spending, although positively correlated with the productivity level, does not have a significant effect in the regression.

As in the first part of the study, the average long-run densities of the road and telephone networks are used as indicators of the level of development of *public infrastructure*. And, as with the previous sample, they notably explain differences in productivity between high-income and upper-middle-income countries (see Appendix 4). The coefficient of telephone network density is lower than in the previous equation: the marked difference between OECD countries and developing countries plays a smaller role than in the previous sample.

Table 4

Productivity level in a narrow sample of countries, including ICT

Dependent variable: GDP in USD PPP million divided by total employment in thousands

Independent variables	**Unit**	**Coefficient**	**Significance**
Public infrastructure			
Density of road network (number of km of roads divided by surface area) (RT)	Km/km² Average, 1990s	4.2	0.3%
Density of telephone network (number of telephone lines per person) (TEL)	Lines per person Average, 1960-2000	46.9	0.1%

Education			
Gross enrolment rate in tertiary education for a given age group (TERT)	As a % Average, 1970-1999	0.43	0.1%
ICT			
ICT spending (ITS)	As a % of GDP Average, 1992-2000	200	0.2%

OLS estimate on level variables

$$\Pi_i = a.RT_i + b.TEL_i + c.TERT_i + e.ITS_i$$

Where i=1,…,49, the number of countries

R^2 adjusted for the number of independent variables = 78.9%

In terms of the *level of education*, the rate of enrolment in tertiary education is a significant determinant of labour productivity. The rates of primary and secondary enrolment were also tested, but the former failed to yield significant results and the latter is closely correlated with tertiary rates of enrolment (correlation of 67.7%). It might be expected that the difference in productivity would occur at the tertiary level in developed countries, given the high and similar rates of primary and secondary enrolment. In their study of OECD countries, Englander and Gurney (1994) also estimate that productivity gains of 0.6 point per year could be traced back to a higher rate of enrolment in secondary education.

Average ICT spending between 1992-2000 was used as a proxy for the contribution made by ICT. This is a more satisfactory variable than a snapshot of the level of spending in 2000 because it suggests that it is the accumulation of these expenditures over a given period that may have a positive effect on productivity. In addition, this average variable yields more significant results than the snapshot variable.

Other variables were tested but did not improve the specification. *R&D spending* displays strong collinearity with other independent variables, exhibiting a 69.7% correlation with telephone network density and 63.5% correlation with enrolment in tertiary education. In addition, compared with the results ultimately provided by the selected specification, regressions based on R&D or on the number of scientists and engineers per million people explain a smaller part of the differences in productivity between the sample countries (adjusted R^2 of 64% instead of 79%). This is consistent with the microeconomic results of Greenan, Mairesse and Topiol-Bensaid (2001). They found that ICT and R&D had a combined effect on business productivity but that this was smaller than the sum of the individual impacts of the two variables, offering clear evidence of duplication between R&D and other independent variables. Furthermore, R&D appears to have a weaker impact than ICT, providing grounds to prefer the latter as an independent variable.

The *share of services in value added* emerges as a significant factor. However, it is difficult to break down the contribution made to growth in services between increases in income (services regarded as superior goods) and other factors, such as more intensive use of ICT on average by the services sector. The *share of credit to the private sector* does not appear to have a significant effect. Indeed, in the case of developed countries, it acts more as an indicator of debt levels than of the sophistication of the financial system. The *indicators of macroeconomic stability* do not yield significant results. As regards inflation, the difference in findings stems from the lower variance of the second sample: while countries that have experienced hyperinflation, like Argentina, Chile and Poland, have lower productivity levels than countries with moderate inflation, the difference within the smaller sample is less marked than in the broad sample. That said, in their study of OECD member countries, Englander and Gurney (1994) estimated that 10 additional points of inflation took 0.6 of a point per year off productivity gains.

As for the first sample, *the countries are grouped by income*[14], with similar results (see Appendix 4): road density is the only public infrastructure variable to have a significant impact; the ICT coefficient is greatly reduced and is no longer significant.

Several key findings emerge from this study, which focuses on the determinants of apparent labour productivity and the impact on productivity of information and communication technologies (ICT):

- An initial analysis of the 1990s demonstrates that the GDP share of ICT spending and the GDP share of ICT production may have a *separate* and positive impact on the productivity growth rate. Of the components of ICT spending, the computer sector appears to have a far more influential role than the telecommunications sector. The positive and significant role played by ICT is confirmed in an examination of productivity levels.

- A negative association between apparent labour productivity and the employment rate is found, linked to the concentration of employment on the most productive members of the workforce. This result holds for both analyses, i.e. of levels and of growth rates. The analysis of growth rates also reveals a positive relationship between hours worked and productivity.

- A long-term analysis of productivity levels demonstrates the positive impact of public infrastructure in a 77-country and a 49-country sample. The level of education is also shown to have a positive impact in both samples. Meanwhile, inflation volatility and the depth of the banking system have a positive impact in the 77-country sample only.

This analysis confirms the role of the traditional determinants of productivity, some of which, such as public infrastructure, are still disputed. Until now, ICT have been examined as part of growth decomposition analyses (Oliner and Sichel, 2002, for example) or across a small number of countries (13 countries in Gust and Marquez, 2002). In this estimate on a panel of 25 industrialised countries and using the generalised method of moments, ICT appear to have played a significant role in labour productivity trends in the 1990s. These findings offer some explanation as to why Europe ceased to narrow the productivity gap with the United States in the 1990s: the extensive use of ICT in the United States is one reason; the rise in employment rates in European countries is another.

[14] Again using the World Bank's classification based on average per capita income.

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Appendix 1

Composition of samples

Part 2

Determinants of the growth rate in apparent labour productivity in the 1990s

Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Mexico, Netherlands, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, United Kingdom, United States.

Part 3

Determinants of the level of apparent labour productivity in 2000, excluding ICT

Argentina, Armenia, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Cyprus, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Egypt, El Salvador, Estonia, Fiji, Finland, France, Germany, Greece, Guatemala, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Kyrgyzstan, Kuwait, Lithuania, Macedonia, Madagascar, Malaysia, Malta, Mauritius, Mexico, Moldavia, Mongolia, Netherlands, New Zealand, Nigeria, Norway, Panama, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Venezuela.

Determinants of the level of apparent labour productivity in 2000, including ICT

Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Denmark, Egypt, El Salvador, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Venezuela.

Appendix 2

Additional results

Several factors may explain why these results differ from those of Gust and Marquez (2002). First, they do not include an autoregressive term in their regression. Second, they use ordinary least squares to estimate their baseline equation. Third, their estimates are produced on a sample of just 13 countries.

OLS on baseline equation

Without autoregressive term

	Specification 1	**Specification 2**	**Specification 3**
GDP share of ICT production (ITP)	1.034	1.912*	-
GDP share of ICT expenditures (ITS)	0.779	-	1.647
Change in hours worked (ΔH)	0.333***	0.336***	0.321**
Change in employment rate (ΔTE)	-0.310	-0.311***	-0.394**
Change in capacity utilisation rate (ΔTUC)	0.0010**	0.0010***	0.0010**
Joint significance of ICT	0.009	-	-
R2 adjusted	0.375	0.362	0.321

Number of countries: 25

Number of points: 167

Specification 1: baseline equation without autoregressive term.

Specification 2: without autoregressive term and ITS.

Specification 3: without autoregressive term and ITP.

* indicates that the estimate is significant at 10%, ** at 5% and *** at 1%.

The baseline equation is re-estimated using OLS after taking out the autoregressive term, which would skew the OLS estimate, and the investment ratio, which is rejected in all cases. By comparing these results with those of Table 1, the contribution of GMM can be assessed.

The results are summarised in Table 2. The three specifications correspond to the same specifications as in the first table (except the exclusion of the autoregressive term).

Comments:

- There is no change in the sign and significance of the coefficients for hours worked, the employment rate and the capacity utilisation rate.

- By contrast, the results for specifications 2 and 3 are not nearly as good as those in Table 1: even taken individually, the coefficients for ICT production and expenditures are not significant. However, they are still significant if a joint Wald test is carried out.

Appendix 3

Data used

Abbreviations used:

D: used in the analysis of growth rates; N: used in the analysis of levels

BM-IDE: World Bank Database of World Development Indicators

OCDE-PE: OECD Economic Outlook Database

OCDE-STAN: OECD STAN Database

OCDE-PIE: OECD Main Economic Indicators Database

OCDE-MSTI: OECD Main Science and Technology Indicators Database

OIT: Laborsta base

WITSA: World Information Technology Service Alliance

Description	D / N	Average*	Standard deviation	Source	Comments
Labour productivity					
Real GDP at market prices	D	n.s.	n.s.	OCDE-PE	
Total employment (millions)	D	17.1	26.6	OCDE-PE	
GDP in PPP expressed in current dollars (billions)	N	US 538.8	US 1,314	BM-IDE	
Total employment (millions)	N	26.2	86.5	ILO Laborsta base	
Information and communication technologies (ICT)					
ICT expenditures As a % of GDP	D/N	5.9	1.7	WITSA (2002)	Internal and external spending on IT (computers, software, services) and communication (public and private networks, services).
ICT production As a % of GDP	D	4.1	1.5	OCDE-STAN	Sum of four ICT-producing items: a) office, accounting and IT equipment, b) radio, television and communication equipment, c) telecommunications, d) computers. Additional data for d)

* Average and standard deviation for sample of 77 countries or 25 countries.
n.s: not significant

					drawn from the Groningen base.
Labour market					
Hours worked per person in employment	D	1,755	161	Groningen Growth and Development Centre	
Employment rate (as a % of the labour force)	D	63.6	7.7	OCDE-PE	
Employment rate (as a % of the labour force)	N	40.9	8.2	BM-IDE ILO Laborsta base	
Macroeconomic variables					
Investment ratio	D	21	5.1	Eurostat OCDE PE	Total real investment divided by real GDP
Investment ratio 10, 20, 30 yr average	N	22	4.6	BM-IDE	
Capacity utilisation rate (standardised)	D	77.2	8.4	OCDE-PIE	
Inflation rate (as a %)	N			BM-IDE	
10, 20, 30 yr average		74	171		
Standard deviation over 30 yrs		132	351		
Official exchange rate Standard deviation	N	n.s.	n.s.	BM-IDE	
Balance of goods and services (as a % of GDP)	N	-2.47	6.54	BM-IDE	
Research and development					
Gross domestic spending on R&D (as a % of GDP)	D	1.6	0.7	OCDE - MSTI	
R&D spending (as a % of GNP)	N	0.98	0.88	BM-IDE	
Number of scientists and engineers per million people	N	1,277	1,239	BM-IDE	
Public infrastructure					
Telephone mainlines per	N	186	157	BM-IDE	

1,000 people Average 1960-2000					
Roads, total network in km divided by total surface area in km² (1990-2000)	N	0.80	1.09	BM-IDE	
Human capital					
Gross rate of enrolment in primary education (as a % of the official age group)	N	100	10	BM-IDE	Number of pupils enrolled in primary school, regardless of age, divided by the total number of people in the official age group.
Gross rate of enrolment in secondary education (as a % of the official age group)	N	76	26	BM-IDE	Number of pupils enrolled in secondary education, regardless of age, divided by the total number of people in the official age group.
Gross rate of enrolment in tertiary education (as a % of the official age group)	N	23	14	BM-IDE	Number of pupils enrolled in tertiary education, regardless of age, divided by the total number of people in the official age group.
Total public spending on education (as a % of GDP)	N	4.3	1.6	BM-IDE	
Pupil-teacher ratio in primary education	N	24	8	BM-IDE	
Financial depth					
Domestic credit to the private sector (as a % of GDP) 10, 20, 30 yr average	N	10yr/54 20yr/50 30yr/45	42 36 31	BM-IDE	
Capitalisation of listed companies (as a % of GDP) Average, 1988-2000	N	36	39	BM-IDE	
Market size					
Degree of openness (as a % of GDP) 10, 20, 30 yr average	N	74	46	BM-IDE	

GDP in PPP as a % of world GDP in PPP	N	1.2	2.9	BM-IDE	
Employment protection					
Employment protection legislation indicator Average, 1990-1998	D	2.3	1.0	OECD Employment outlook	Nicoletti, Scarpetta and Boylaud (1999)

Appendix 4

Tests by country group

Two types of dummies are used in the regressions below:

- Dummy constants, which stand for membership of a country group; they capture the impact of such membership.
- Dummy variables, which stand for a given variable, such as telephone or road density, in a group of given countries only (high/medium/low income); they capture the impact of the variable in the group in question.

Some regressions use dummy constants, others dummy variables, and others still both types of dummies.

Still using the income criteria, other factors are also considered, which slightly changed the groupings. For instance, political factors are taken account of, such as past membership of the communist block, or geographical considerations, separating countries into sub-Saharan Africa, Latin America and EU accession countries. The rationale behind these groupings is that the variables used hitherto may not have successfully captured certain particular political and/or geographical features. However, the new groupings do not yield satisfactory results, challenging the idea of such specificities.

The baseline equations for the first sample (77 countries) and for the second (which includes ICT variables) are, respectively, equations No. (1) to (4) and No. (5) to (8).

Description of variables:

CONST.	Constant
TEL	Density of telephone network.
ROAD	Density of road network.
HH	"Member of high-income country group" dummy.
LL	"Member of low-income country group" dummy.
Suffix "HH"	Variable applied to high-income country group (e.g. TELHH: telephone network density in high-income countries).
Suffix "LL	Variable applied to low-income country group (e.g. TELLL: telephone network density in low-income countries).
Suffix "M"	Variable applied to middle-income country group (e.g. TELM: telephone network density in middle-income countries).
Suffix "LML"	Variable applied to low-income and lower-middle-income country group.
Suffix "HMH"	Variable applied to high-income and upper-middle-income country group.

Suffix "2"	Variant in which the group of upper-middle-income countries begins at $3,000 per person rather than $2,900.
UNI	Enrolment rate in tertiary education.
PRIM	Enrolment rate in primary education.
VOL	Inflation volatility.
CRED	Domestic credit to the private sector.
TEMP	Employment rate.
SYS	"Past member of communist block" dummy.
ICT	ICT spending.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	PROD	PROD	PROD	PROD	PROD	PROD	PROD	PROD
No. obs.	77	77	77	77	49	49	49	49
R^2 adjusted (%)	82	88	88	88	79	85	86	85
CONST.	-	18*	20**	20**	-	7.5*	12***	9**
TEL	77****	39**	41***	-	47***	15	-	16
TELHH	-		-			-	-	-
TELLL	-		-			-	-	-
TELM	-		-			-	-	-
TELHMH	-		-			-	*24*	-
TELLML	-		-			-	*-36*	-
TELHMH 2	-		-	*45****		-		-
TELLML 2	-		-	*2*		-	*2*	-
ROAD	2.1***	1.28	-	1.4*	4.2***	2.7**	2.6**	
ROADHH	-		-			-	-	-
ROADLL	-		-			-	-	-
ROADM	-		-			-	-	-
ROADHMH	-		-			-	-	-
ROADLML	-		-			-	-	-
ROADHMH 2	-		*1.5**				-	*2.8***
ROADLML 2	-		*-1.8*				-	*-1.7*
UNI	0.22**	0.20**	0.18**	0.21**	0.43***	0.33***	0.32***	0.33****
PRIM	0.13***	0.04	0.03	0.04	-	-	-	-
VOL	-0.6*	-0.5**	-0.55**	0.47*	-	-	-	-
CRED	0.13***	0.05	0.03	0.03				-
TEMP	-0.23*	-0.3***	-0.3****	-0.3**	-	-	-	-
ICT	-		-		200***	103	45	92
SYS	-		-			-	-	-
HH	-	17.7***	16***	13.6***	-	17***	14***	16***
LL	-	-9.7***	-10***	-12***		-5	-7	-5

- * significant at 10%
- ** significant at 5%
- *** significant at 1%

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