Trade Unionism and Growth: A Panel Data Study

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Abstract

This paper investigates the long-run relationship between trade unionism and economic growth using a panel data set comprising of 18 OECD economies. Much of the existing evidence on the effects of unionism on productivity derives from micro-economic studies, with little attention to the dynamics of this relationship and the economy-wide effects. Using the recently developed mean group and pooled mean group estimation techniques on cross-country panel data, the paper offers support to the "enhancing-worker-morale face of unionism" hypothesis, revealing a positive relationship between trade union density and labour productivity.

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1. Introduction

Research on the productivity effects of unionism over the last two decades has been lively, offering new insights to the theoretical and empirical relationship between these two labour market aggregates. Following the pioneering work of Brown and Medoff (1978) and inspired by the controversial work of Freeman and Medoff (1979 and 1984), numerous empirical studies have examined the extent and direction of the union productivity effects, mainly for the cases of the UK and the USA. There is a rather widespread consensus in the literature about unionism having a negative impact on productivity and output, although a number of authors have estimated positive union productivity differentials (Brown and Medoff, 1978; Clark, 1980; Nickel et al., 1989; Gregg et al., 1993).

It is standard in this literature to investigate productivity differentials between unionised vis-à-vis non-unionised firms using industry or firm level data. Consequently, there is little attention on the economy-wide and dynamic effects of unionism, while other sources of productivity differentials, like management strategies and production efficiency, are difficult to be accounted for and distinguished from the direct union effects. There is comparatively little research on the issue using aggregate national data. Among the few studies, the OECD (1997) has found evidence of negligible effects of unionism and the structure of wage bargaining on productivity and productivity growth. Nickel and Layard (1998) have estimated a negative union effect on growth for a panel of OECD countries. A negative impact on output or productivity has also been found by earlier economy-wide studies (deFina, 1983; Lovell et all., 1988; Koedijk and Kremers, 1996).

In this paper we investigate the economy-wide effects of unionism on productivity and productivity growth at an aggregate level, for a large panel of data. A long time-series (1960-1992) for 18 OECD countries allows us to investigate the short- and long-run dynamics of unionism within an economic growth framework, while controlling for country-specific effects.[1] The source of the data is the Comparative Welfare States Data Set (Huber et al., 1997), which includes data from various sources.[2] In addition to traditional panel data techniques, we utilise newly developed econometric methods for the estimation of dynamic panel models. Having a set of 576 observations and using an auto-regressive distributed lags (ARDL) specification, we can identify a common-across-countries long-run coefficient for the union productivity effects, while allowing different short-run dynamics for each country. Hence, our estimates are largely unbiased from any business-cycle and country-specific effects. Apart from the relative novelty of the applied econometric methodology, our investigation of union productivity effects based on a large panel of data and controlling for short-run dynamics and country-specific effects is to our knowledge unique.

In the next section we make some theoretical considerations and derive an estimating model. Sections 3 and 4 present the empirical results. In section 3 we apply traditional econometric techniques, while in section 4 we briefly present and consequently apply the dynamic panel data methodologies. The final section summarises the results and concludes.

2. A model of changes in unionisation rates and growth

Union productivity differentials can arise through a variety of mechanisms. At a firm-level, unionism can affect the organisation and efficiency of production, the

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[1] The sample countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Sweden, Switzerland, UK and USA.

[2] The original data sources are: for employment, OECD Labour Force Statistics (various years); for union membership figures, Visser (1996); and for GDP and investment, Penn World Tables (Mark 5.6).

pace of technological innovation and capital accumulation, training and manning levels and so forth. At a wider level, it can impact upon average wages and wage inflation, with further effects on inflation, interest rates, investment and output growth, as well as on the national comparative advantages and international trade. At the level of theory, negative union productivity effects can be assumed if unions impose rigidities in the introduction of new technologies and working practices, or if they reduce profitability and investment. On the other hand, unions can increase workers' participation and involvement and, hence, production efficiency, while their increasing labour costs function can foster innovation and quality-based competition from the side of management.

Traditionally, however, a more direct effect of unionism is assumed, as the latter can impact directly upon the productivity of the individual workers. In this case it is the marginal product of labour that differs between unionised vis-à-vis non-unionised workers. Nevertheless, despite their theoretical distance, all these mechanisms exhibit some practical equivalence, both in technical and empirical terms.[3]

In building our model we follow Brown and Medoff (1978) assuming that both unionised and non-unionised labour have the same coefficient in the production function, with unionised labour being discounted by a factor f which reflects productivity differences:

$$Y = A^t K^a (L_n + f * L_u)^b \qquad (1)$$

where the standard notation is used with the exception that L_u is unionised labour and L_n is non-unionised labour. The coefficient f can be greater or smaller than unity,

[3] A technical exposition of this and relevant empirical evidence can be found in Monastiriotis (2001).

implying higher or smaller productivity of unionised labour, respectively. By adding and subtracting L_u in (1) and further manipulating, we get:

$$Y = A^t K^a \{L * [1-(L_u / L) * (f - 1)]\}^b \qquad (2)$$

or, taking logs and using *log(1+x)»x*,

$$(y-l) = ta + ak + (b - 1)l + gTUD \qquad (3)$$

where lower case letters denote logarithms, *g = b(f-1)* and $TUD=L_u/L$. Thus, productivity growth will be a function of changes in union density:

$$\Delta(y-l) = a + a\Delta k + (b - 1)\Delta l + g\Delta TUD \qquad (4)$$

Further, we assume a standard capital accumulation process (*d* is depreciation rate)

$$K_t = I_t + (1-d)K_{t-1} \qquad (5)$$

so that the growth of capital will be

$$dK_t = \{(I_t + (1-d)K_{t-1}) - K_{t-1}\} / K_{t-1} \quad \Rightarrow \quad dK_t = (I_t / K_{t-1}) - d \qquad (6)$$

Using *Dk»dK*, approximating $(I_t/K_{t-1})-d$ with I_t/Y_t and finally introducing an error term we obtain[4]

$$\Delta(y-l)_{i,t} = a + a\,(I/Y)_{i,t} + (b - 1)\Delta l_{i,t} + g\Delta(TUD)_{i,t} + e_{i,t} \qquad (7)$$

Equation (7) is our main estimating model, relating productivity growth to the share of investment to GDP, employment growth and changes in union density. In the traditional panel estimation techniques (section 3) the one- and two-way error component (de-meaned) and dummy variables (DVLS) transformations of this specification are used. In section 4 we estimate the above specification using the Mean Group (MG) and Pooled Mean Group (PMG) estimators with a dynamic ECM equation that has (7) as a long-run solution.

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[4] The approximation of capital by GDP is introduced mainly to avoid data-quality problems related to the capital series. Data availability was however an additional problem, since using the capital series would further shorten the time-dimension of our sample and, hence, generate problems in the application of the MG and PMG estimations on the ARLD specification.

3. Empirical results

The panel nature of the sample offers a wealth of information that can be investigated. Before applying a number of pooled regression methodologies, it is interesting, therefore, to obtain first some information from the cross-sectional and time-series dimensions.

(i) Cross-sectional and time-series analyses

A first impression about the relation between productivity growth and changes in unionisation rates can be obtained by looking at scatter plots. Hence, we plotted these two aggregates against each other once for each of our sample years and once for each of our sample countries. The general pattern was surprisingly one of a positive relationship, although the graphs were often very sensitive to the inclusion of some observations. Moreover, the scatter-plots revealed some cyclicality, with positive and negative slopes alternating every around five years. These two pieces of information seem to suggest that the relationship under investigation has not been stable over the years and across countries in the period of our focus. This further suggests that country and time specific effects must be significant.

To get some more formal indication for this, we also run cross-country and time-series regressions based on the model derived earlier. The coefficients obtained for the unionisation variable were quite stable in the cross-country regressions (over the years), but less so in the time-series regressions (among countries). Moreover, the coefficients from the cross-country regressions also seemed to follow a time trend. Figure 1 plots these estimates over time.

As it can be seen, the estimated union effects have been rather volatile with a mean value close to zero, especially during the 1970s. The logarithmic trend fitted, suggests an original negative union effect which in the 1980s turns positive. Overall, however, the results obtained are not statistically significant, as Table 1 reveals.

As the overall performance of the estimated regressions is not satisfactory, this is as much of inferences as we can make from the uni-dimensional regressions. The next step is to look at the panel dimension, by pooling the data together.

(ii) Traditional panel data analysis

In order to get as much information as possible from the panel, we ran all possible regression specifications, both for productivity growth and for output growth. The results are presented in Table 2. The union coefficient is significant in all cases for both the output and productivity growth regressions, with the exception of the time random effects model (second last column), which also performs very poorly, with the implication that the time effects are fixed and not random. However, all specification tests show both time and country effects to be significant, suggesting that the correct specification is a two-way error component model (last column).

This last model suggests that the net effect of unionism on productivity, controlling for time and country specific effects, has been positive in the three decades and for the 18 countries of our sample. The interpretation of the theoretical model in (7) suggests that unionised labour has -other things equal- been by around 19% (=0.214/1.115) more productive than non-unionised labour. The coefficients on the capital and labour variables have the expected signs and are significant. Moreover, the results are very stable across the different specifications. The results from the traditional analysis on the panel seem to suggest that unionism enhances the productivity of labour.

On the other hand, the country specific effects are always highly significant. It is interesting to investigate the determinants of these effects. One possible explanation is that the productivity effects of unionism might differ among countries depending on the strategies employed by the national trade unions and the structure of wage bargaining (centralisation and co-ordination) in each country. To test for that, we examined the relationship between the estimated country-fixed effects and some indicators of union co-ordination and centralisation of wage bargaining, produced by the OECD (1997). Correlation analysis between these variables returned a statistically significant correlation coefficient of 0.34, suggesting that the estimated positive union productivity effect is weaker in countries with more rigid wage bargaining structures.

4. Robustness of the empirical findings

The unconventional result obtained above, of a positive relationship between unionism and productivity requires further investigation, since the data used here have complex dynamics and are characterised by strong trends and non-stationarity. The identified time and country effects could be possibly capturing country specific long- or short-run dynamics which the traditional pooled estimators, such as the fixed and random effects, cannot estimate. Therefore, these methods might not be appropriate in our case. New estimation techniques are now available in the literature that allow such effects to be controlled for and measured.

(i) The MG and PMG estimation methodology

It has become conventional to view long-run parameters as reflecting cointegrating relationships among a set of I(1) variables. The standard methodology in such cases first establishes the order of integration of the variables in question, and then - having established that the variables are of the same order of integration - tests whether there is at least one linear relationship among these variables.

Our analysis follows a different approach. This can be justified by two facts. First, there are only a few (and even fewer statistically satisfactory) tests of cointegration in a panel data context, while it is also well known that tests of order of integration in panel data do not reliably distinguish between series that contain a unit root and those that are stationary with a "near-unit root". Second, long-run parameters may be consistently estimated using the traditional autoregressive-distributed lag (ARDL) approach (Pesaran and Shin, 1998). Moreover, as Pesaran, Shin and Smith (1999) have shown, this approach yields consistent and asymptotically normal estimates of the long-run coefficients irrespective of whether the underlying regressors are I(1) or I(0).[5] Further, it compares favourably in Monte Carlo experiments with conventional methods of cointegration analysis.

Therefore, our estimates were obtained using two recently developed methods for the statistical analysis of dynamic panel data: the Mean Group (MG) and the Pooled Mean Group (PMG) estimation. These methods are particularly suited to the analysis of panels with large time and cross-section dimensions.[6] MG estimation derives the long-run parameters for the panel from an average of the long-run parameters from ARDL models for individual countries (see Pesaran and Smith, 1995). For example, if the ARDL is the following

[5] In our analysis the GDP, Investment, Employment and Union Density variables are clearly trended for all countries and can be assumed to be I(1), hence become stationary after first differencing (productivity and employment growth, changes in union density) or taking their ratio (investment share).

$$a_i(L)y_{it} = b_i(L)x_{it} + d_i z_{it} + e_{it} \qquad (8)$$

for countrly i, where $i=1,\ldots,N$, then the long-run parameter for country i is

$$q_i = \frac{b_i(1)}{d_i(1)} \qquad (9)$$

and the MG estimator for the whole panel will be given by

$$q = \frac{1}{N}\sum_{i=1}^{N}\hat{q}_i \qquad (10)$$

It can be shown that MG estimation with sufficiently high lag orders yields super-consistent estimators of the long-run parameters even when the regressors are I(1) (see Pesaran, Shin and Smith, 1999).

The PMG method of estimation, introduced by Pesaran, Shin and Smith (1999) occupies an intermediate position between the MG method, in which both the slopes and the intercepts are allowed to differ across country, and the standard fixed effects method, in which the slopes are fixed and the intercepts are allowed to vary. In PMG estimation, only the long-run coefficients are constrained to be the same across countries, while the short-run coefficients are allowed to vary.

Setting this out more precisely, the unrestricted specification for the ARDL system of equations for $t=1,2,\ldots T$ time periods and $i=1,2,\ldots N$ countries for the dependent variable y is

$$y_{it} = \sum_{j=1}^{m} l_{ij} y_{i,t-j} + \sum_{j=0}^{n} d'_{ij} x_{i,t-j} + m_i + e_{it} \qquad (11)$$

where x_{ij} is the $(k´1)$ vector of explanatory variables for group i and m_i represents the fixed effects. In principle the panel can be unbalanced and m and n may vary across countries. This model can be re-parameterised as a VECM system

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[6] Quah (1993) has referred to such data sets as “data fields”.

$$\Delta y_{it} = q_i (y_{i,t-1} - b_i' x_{i,t-1}) + \sum_{j=1}^{m-1} g_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{n-1} g_{ij}' x_{i,t-j} + m_i + e_{it} \qquad (12)$$

where bi s are the long-run parameters and q_i s are the error correction parameters. The pooled group restriction is that the elements of b are common across countries, so that

$$\Delta y_{it} = q_i (y_{i,t-1} - b' x_{i,t-1}) + \sum_{j=1}^{m-1} g_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{n-1} g_{ij}' x_{i,t-j} + m_i + e_{it} \qquad (13)$$

All the dynamics and the ECM terms are free to vary. Estimation of this model is by maximum likelihood. Again it is proved that under some regularity assumptions, the parameter estimates of this model are consistent and asymptotically normal for both stationary and non-stationary I(1) regressors. Both MG and PMG estimations require selecting the appropriate lag length for the individual country equations. This selection was made using the Schwarz Bayesian Criterion.

(ii) The MG and PMG estimation results

Initially we estimated the model given in (7) assuming that all of the long run coefficients are the same across countries. The estimation results from the MG and PMG methods are presented in Table 3. The PMG estimates provide further evidence to our previous finding of a strong positive relationship between changes in unionisation and productivity growth, while the MG results are in the same line but less strongly so. The capital growth variable (investment share) has the expected sign, which for the PMG model is highly significant. The growth of employment has again a positive estimated effect, but this is insignificant in the PMG estimation, with the implication that labour productivity is constant across different employment levels. Although the Hausman test for the poolability of this coefficient is rejected, for both the unionism variable and investment as a share of GDP, the pooling restrictions cannot be rejected (p-values 0.31 and 0.34 respectively). Moreover, the joint Hasuman test suggests that the PMG results are more appropriate than the MG ones.

Overall, the results obtained from the ARDL specifications are highly consistent to the ones derived from the more traditional methods. The estimated effect of unionisation changes on productivity growth suggests that discount factor for unionised labour, f, is equal to 1.19, or that unionised labour is 19% more productive than non-unionised labour. This result is identical to the one obtained from the two-way error component model of Table 2. The estimated returns to capital are also very similar to the ones obtained earlier.[7] Further, restricting the coefficient of unionism to be the same in all countries but removing this restriction for the other two coefficients does not affect significantly our main conclusions (Table 4). Again the unionism coefficient is positive and significant for the PMG estimates (which are again approved by the Hausman test for poolability), while now both coefficients for investment share and employment growth become insignificant. Alternative estimates – not reported here for economy of space – restricting subsets of the long-run coefficients gave similar results with those initially obtained.[8] The employment growth coefficient verifies the constant returns to scale long run effect of employment on labour productivity, which was not captured in the traditional estimation methods that didn't control for the short-run dynamics.[9] For capital growth, the insignificant result strengthens our earlier conclusion about the poolability of this coefficient. This time however, the union productivity effect increases further, to around 23%.

[7] The estimated coefficient in all specifications is lower than theory would suggests, but this is largely due to a scaling effect caused by our approximation of capital growth with the investment share.

[8] Tables and results are available from authors upon request.

[9] The short-run dynamics are very different from the fixed country-specific effects estimated before. A correlation analysis of the impact of the wage bargaining structure on these dynamics returned a significant correlation coefficient of -0.45, which implied that in countries with more rigid wage bargaining structures unionism had also a positive short-run effect.

This figure is at the margin of plausibility if one assumes that the union productivity effects are solely activated through workers' performance (Brown and Medoff, 1978). Hence, an explanation suggesting that union productivity effects are activated through a number of plausible mediating factors (production efficiency, capacity utilisation and the extent of labour hoarding being but a few) cannot be ruled out. In any case, the overall productivity effect of unionism is robustly found to have been positive in the three decades and for the 18 countries of our sample.

5. Conclusions

Numerous studies at the firm and industry levels have provided evidence of a negative productivity effect of unionism, although there are cases where a positive union productivity effect has been estimated. Most of the empirical literature uses Anglo-Saxon data and there are few cross-country studies. Further, time-series analysis on the issue is rather scarce, with the implication that the dynamics of the relationship at question have been relatively overlooked.

Attempting to partially fill this gap, in this paper we examined the long- and short-run relationship between unionism and productivity using a panel of 18 OECD countries over a 32-year period. The MG and PMG estimation techniques that we used together with more traditional methods are at the forefront of panel data econometrics. Our time-series and cross-country analyses revealed that this relationship has been different among countries and over time. Controlling for possible time and country-specific effects, the panel data analyses allowed the estimation of a common across countries long-run coefficient. The good performance of our regressions and the stability of our results, we interpret as evidence in support of the appropriateness of the econometric method we employed.

Our basic results provide robust evidence of a positive impact of unionism on productivity. Both the long- and short-run effects are positive and statistically significant, although we also offer some evidence suggesting that country-specific factors, like the strategies employed by the national trade unions and the degree of co-ordination among them and between them and the employers, might play an important role at the short-run.

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Figure 1: The effect of changes in unionism on productivity growth (cross-country regressions)

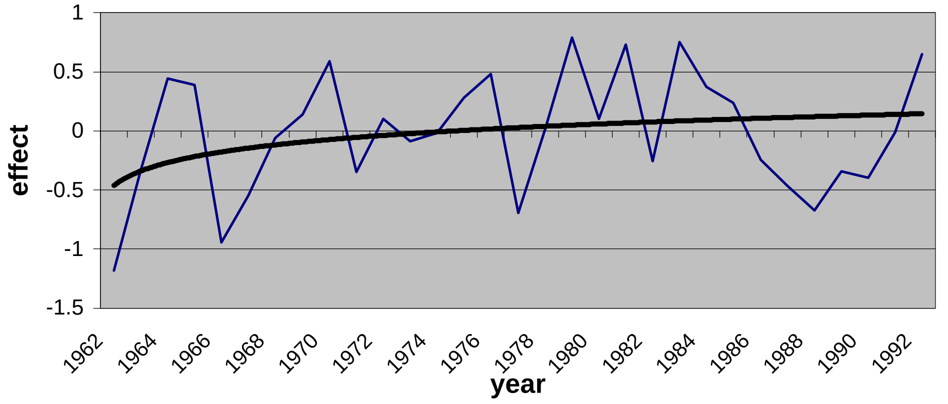

Table 1: Estimated union effect on growth (cross-country and time-series regressions)

Year	Impact of ΔTUD	Year	Impact of ΔTUD	Year	Impact of ΔTUD	Year/ Country	Impact of ΔTUD	Country	Impact of ΔTUD
1961	2.873 (2.09)	**1971**	-0.347 (-1.10)	**1981**	0.731 (0.95)	**1991**	-0.009 (-0.01)	**IRE**	1.848 (2.25)
1962	-1.180 (-2.21)	**1972**	0.101 (0.33)	**1982**	-0.254 (-0.29)	**1992**	0.648 (2.70)	**ITA**	-0.343 (-0.86)
1963	-0.331 (-0.274)	**1973**	-0.085 (-0.15)	**1983**	0.753 (1.31)	**AUL**	-1.690 (-2.50)	**JPN**	4.024 (2.11)
1964	0.446 (0.36)	**1974**	-0.018 (-0.09)	**1984**	0.373 (1.41)	**AUS**	-0.547 (-0.38)	**NET**	-0.580 (-1.24)
1965	0.388 (0.55)	**1975**	0.280 (1.89)	**1985**	0.240 (0.43)	**BEL**	-0.370 (-0.71)	**NOR**	-0.429 (-0.99)
1966	-0.945 (-1.15)	**1976**	0.481 (0.69)	**1986**	-0.247 (-0.72)	**CAN**	-0.475 (-0.77)	**NZL**	0.143 (0.87)
1967	-0.547 (-0.58)	**1977**	-0.693 (-0.78)	**1987**	-0.466 (-1.30.)	**DEN**	0.237 (0.51)	**SWE**	0.095 (0.24)
1968	-0.058 (-0.05)	**1978**	0.017 (0.03)	**1988**	-0.671 (-1.69)	**FIN**	0.777 (1.63)	**SWZ**	-0.820 (-0.51)
1969	0.141 (0.32)	**1979**	0.79 (0.20)	**1989**	-0.344 (-0.54)	**FRA**	0.970 (0.92)	**UKM**	-0.475 (-1.10)
1970	0.589 (1.37)	**1980**	0.103 (0.16)	**1990**	-0.397 (-0.59)	**FRG**	0.312 (0.30)	**USA**	0.006 (0.01)

Notes: All regressions have been estimated by OLS. t-statistics are in parentheses.

Table 2: Pooled regressions on productivity and output growth

Model	NE	CFE (1)	CFE (2)	TFE	CRE	TRE	(C/T)FE
			Productivity growth				
Investment share	0.145	0.171	0.171	0.127	0.157	0.135	0.129
	(5.71)	(4.22)	(4.22)	(5.49)	(4.78)	(2.31)	(3.11)
Employment growth	0.149	0.222	0.222	0.034	0.201	-0.774	0.115
	(2.43)	(3.57)	(3.57)	(0.62)	(3.30)	(-2.10)	(2.08)
Change in union density	0.166	0.191	0.191	0.168	0.186	-0.428	0.214
	(1.86)	(2.13)	(2.13)	(2.05)	(2.10)	(-0.74)	(2.67)
Constant	-0.015		-0.023		-0.019	-0.003	
	(-2.28)	-	(-2.15)	-	(-2.15)	(-0.22)	-
Brausch-Pagan test	-	-	4.19[#]	-	59.17	-	-
Hausman test	-	-	-	-	11.07	-	-
F-test (year dummies)	-	-	-	7.14	-	-	7.60
F-test (country dummies)	-	4.28	-	-	-	-	5.29
F-test (y+c dummies)	-	-	-	-	-	-	7.13
R-squared	0.08	0.50	0.08	0.60	0.08	0.00	0.66
			Output growth				
Investment share	0.152	0.220	0.220	0.116	0.185	0.118	0.124
	(7.38)	(6.79)	(6.79)	(6.26)	(6.92)	(2.42)	(3.75)
Employment growth	0.377	0.415	0.415	0.277	0.410	-0.341	0.337
	(7.65)	(8.33)	(8.33)	(6.28)	(8.36)	(-1.11)	(7.69)
Change in union density	0.226	0.229	0.229	0.146	0.235	-0.280	0.179
	(3.13)	(3.18)	(3.18)	(2.42)	(3.30)	(-0.58)	(2.80)
Constant	-0.018		-0.037		-0.027	-0.002	
	(-3.34)	-	(-4.32)	-	(-3.80)	(-0.16)	-
Brausch-Pagan test	-	-	4.75[#]	-	69.90	-	-
Hausman test	-	-	-	-	17.75	-	-
F-test (year dummies)	-	-	-	8.00	-	-	8.31
F-test (country dummies)	-	5.17	-	-	-	-	5.58
F-test (y+c dummies)	-	-	-	-	-	-	7.91
R-squared	0.20	0.63	0.19	0.71	0.19	0.00	0.75

Notes:

t-statistics are in parentheses. The Brausch-Pagan and Hausman tests are χ^2 tests for the significance of random effects (against no effects and fixed effects, respectively). The various F-tests refer to the significance of the corresponding dummies. The abbreviations in the head of the Table are as follows (estimation method in parenthesis): NE, pooled regressions with no controls for any effects (OLS); CFE (1), country fixed effects (DVLS); CFE (2), country fixed effects (GLS); TFE, time fixed effects (DVLS); CRE, country random effects (GLS); TRE, time random effects (GLS); and (C/T)FE, two-way error component model with both time and country fixed effects (DVLS).

[#]: Instead of the B-P test, an F-test for zero variance of the random effects is used in the CFE (2) model.

Table 3: Pooled Mean Group and Mean Group Estimates

(Dependent Variable: Dy_{it})

	PMG Estimates			MG Estimates			Hausman Test	
	Coef.	**s.e.**	**t-ratio**	**Coef.**	**s.e.**	**t-ratio**	**H**	**p-val**
$(I/Y)_{it}$	0.124	0.021	6.006	0.67	0.063	1.061	0.91	0.34
Dl_{it}	0.036	0.043	0.854	0.247	0.105	2.361	4.86	0.03
$DTUD_{it}$	0.190	0.067	2.846	0.435	0.252	1.726	1.01	0.31
					Joint Hausman test:		5.42	0.14
Error Correction Coefficients								
f	-0.979	0.021	-46.791	-0.988	0.012	-82.313		
Short-Run Coefficients not reported for economy of space								

Notes:
The maximum number of time periods and groups are: 32 18
SBC (Schwarz) has been used to select the lag orders for each group.
All the long-run parameters have been restricted to be the same across groups.
The mean group estimates have been used as initial estimate(s) of the long-run parameter(s) for the pooled maximum likelihood estimation.

Table 4: Pooled Mean Group and Mean Group Estimates

(Dependent Variable: Dy_{it})

	PMG Estimates			MG Estimates			Hausman Test	
	Coef.	**s.e.**	**t-ratio**	**Coef.**	**s.e.**	**t-ratio**	**h**	**p-val**
Long-Run Coefficients Restricted to be the Same Across all Groups								
$DTUD_{it}$	0.231	0.064	3.582	0.453	0.252	1.726	0.70	0.40
Unrestricted Long-Run Coefficients								
Dl_{it}	0.054	0.066	0.818	0.067	0.063	1.061		
$(I/Y)_{it}$	0.121	0.0177	1.035	0.247	0.105	2.361		
Error Correction Coefficients								
f	-0.988	0.012	-80.809	-0.988	0.012	-82.313		
Short-Run Coefficients not reported for economy of space								

Notes:
The maximum number of time periods and groups are: 32 18
SBC (Schwarz) has been used to select the lag orders for each group.
All the long-run parameters have been restricted to be the same across groups.
The mean group estimates have been used as initial estimate(s) of the long-run parameter(s) for the pooled maximum likelihood estimation.