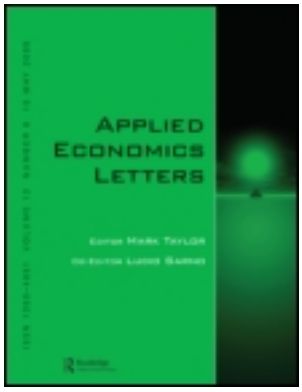

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How to offset the negative trend growth rate in the Italian economy?

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The trend growth rate of the Italian economy has been declining since the 1980s. To examine how to offset this trend, we estimate a simple specification of an endogenous growth model. Cointegrating equations for the long-run output growth and its determinants are estimated with alternative time series methods. Our results imply that policies to double trade openness are necessary.

I. Introduction

Italian economy is growing at decreasing rates especially since the mid-1980s. A quadratic trend, implying that the trend growth of Gross Domestic Product (GDP) per worker (growth rate hereafter) has been declining, fits the data well and is shown in Fig. 1. Table 1 compares growth rates of Italy with a few advanced economies. Italy's growth rate since 2001 is the lowest among these countries. Therefore, it is important to examine how its growth rate can be improved. We use three time series methods to estimate the long-run relationship between the growth rate and its determinants with a specification in Rao (2010). We examine the role of trade openness and education to offset the negative trend in Italy's growth rate. Section II specifies our model. Empirical results and policy implications are described in Section III. Section IV concludes.

II. Specification

Rao (2010) extended the following Cobb–Douglas production function to capture the permanent growth effects of variables in endogenous growth models:

$$Y_t = A_t K_t^{\alpha} L_t^{(1-\alpha)} \tag{1}$$

where Y is the real gross domestic product; K, the capital stock computed with the perpetual inventory method; L, total employment; and A, stock of knowledge. Error term is ignored for convenience. Greiner *et al*. (2004) suggested that a trend component may be augmented to capture the effect of other excluded and trended variables that affect the stock of knowledge. In the case of Italy, a second-order nonlinear trend appears satisfactory. Following Rao (2010), we assume the following evolution for A, where T is the time and Z is a vector of growth-affecting variable. We use two growth-affecting variables, which differ in their effects as shown below.

$$A_t = A_0 e^{(aT+bT^2+\gamma_1 Z_{1t})} Z_{2t}^{\gamma_2} \tag{2}$$

Transforming Equation 1 into the intensive form, substituting Equation 2 for the stock of knowledge and taking logs give

$$\ln y_t = \ln A_0 + aT + bT^2 + \gamma_1 Z_{1t} + \gamma_2 \ln Z_{2t} + \alpha \ln k_t \tag{3}$$

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Sample period: 1960 to 2009. Output, imports, exports and investment data are from the database of the World Bank. Average years of education are from Barro and Lee (2010). Employment data are from Organisation for Economic Co-operation and Development (OECD) statistics database.

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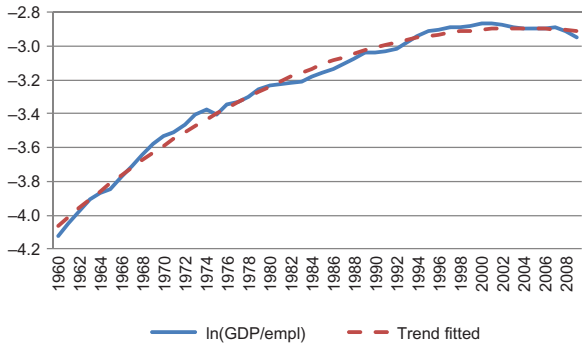

Fig. 1. Per worker GDP

$$\ln \frac{\text{GDP}}{\text{EMPLOYMENT}} = -4.06 + 0.053\text{TREND} - 0.001\text{TREND}^2$$

Table 1. Average growth rate

Period	1971 to 1980	1981 to 1990	1991 to 2000	2001 to 2009
Italy	3.64	2.42	1.6	0.16
USA	3.21	3.27	3.41	1.56
Germany	2.91	2.32	2.1	0.59
Greece	4.70	0.71	2.36	3.28
France	3.71	2.41	1.99	1.17
Spain	3.57	2.95	2.81	2.35

where $y = (Y/L)$ and $k = (K/L)$. Equation 3 implies that in the steady state, when $\Delta \ln k \to 0$, the Steady-State Growth Rate (SSGR) of Output equals the rate of growth of the stock of knowledge (ΔA), and this is $a + 2bT + \gamma_1 \Delta Z_1 + \gamma_2 \Delta \ln Z_2$.[1]

III. Empirical Results

Three estimation techniques are implemented, namely, Fully Modified Ordinary Least Squares (FMOLS), Canonical Cointegration Regression (CCR), Dynamic Ordinary Least Squares (DOLS). These estimators deal with the problem of second-order asymptotic bias arising from serial correlation and endogeneity and they are asymptotically equivalent and efficient. The *p*-values of the coefficients are reported in the square brackets below the coefficients. Two dummy variables added are as follows: a dummy in the last years of 1960, which captures the important changes that occurred in that period in the Italian labour market (Modigliani *et al.*, 1986); and a dummy for the years 1988 and 1989 for capturing the progress in the financial markets with the introduction of new structures and instruments.

Table 2. Model 1

	FMOLS	CCR	DOLS
Intercept	–0.869	–0.886	–0.982
	[0.04]	[0.03]	[0.01]
ln *k*	1.105	1.099	1.060
	[0.00]	[0.00]	[0.00]
TREND	0.014	0.014	0.015
	[0.01]	[0.00]	[0.00]
TREND^2	–3E–04	–3E–04	–3E–04
	[0.00]	[0.00]	[0.00]
DUM60	0.047	0.048	0.048
	[0.00]	[0.00]	[0.00]
DUM80	–	–	–
EG residual test		–3.465	
		[0.29]	
λ		–	
DW test		–	
JB test		–	
BPG test		–	

Notes: Regressand = $\ln(Y/L)$. Time period 1960 to 2009. *p*-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger *t*-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

Six different models are estimated. Table 2 has the estimates of the baseline specification. In Tables 3–7, estimates with additional determinants of A, namely, trade openness and human capital (average years of education), are given. We check whether nonlinear effects for the added variables explain the downward trend in growth. In particular, we check whether the nonlinear effect for education may have a role. The results confirm that the nonlinear pattern of GDP per worker is well captured by the nonlinear effects of education.

Our strategy is the following: we first estimate the long-run relationship with the three methods. Only if all these techniques show plausible and similar results, we pass to verify the existence of the cointegrating relationship through the Engle–Granger (EG) residual test. If the test confirms its existence, we construct an Error Correction Model (ECM) with the long-run relationship and we study the factor loading and the tests for correct specification (normality, absence of autocorrelation and no heteroscedasticity in the

[1] This is derived by taking the total differential of Equation 2. Note that $dT = 1$, and in the steady state $(dk/dT) \to 0$.

$$(dA/dT) = a(dT) + 2bT(dT) + \gamma_1(dZ_1/dT) + \gamma_2(d\ln Z_2/dT)$$

Table 3. Model 2

	FMOLS	CCR	DOLS
Intercept	–1.820	–1.857	–1.993
	[0.00]	[0.00]	[0.00]
ln k	0.584	0.567	0.507
	[0.00]	[0.00]	[0.00]
TREND	0.023	0.023	0.024
	[0.00]	[0.00]	[0.00]
TREND^2	–4E–04	–4E–04	–4E–04
	[0.00]	[0.00]	[0.00]
ln TRADE	0.315	0.322	0.342
	[0.00]	[0.00]	[0.00]
DUM60	0.047	0.048	0.048
	[0.00]	[0.00]	[0.00]
DUM80	0.027	0.028	0.028
	[0.00]	[0.00]	[0.00]
EG residual test		–6.144	
		[0.01]	
λ		–1.336	
		[0.00]	
DW test		2.03	
JB test		1.563	
		[0.46]	
BPG test		0.242	
		[0.91]	

Notes: Regressand = ln(Y/L). Time period 1960 to 2009. p-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger t-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

Table 4. Model 3

	FMOLS	CCR	DOLS
Intercept	–0.858	–0.815	–0.585
	[0.09]	[0.12]	[0.07]
ln k	1.195	1.221	1.039
	[0.00]	[0.00]	[0.00]
TREND	0.006	0.004	0.023
	[0.59]	[0.72]	[0.00]
TREND^2	–2E–04	–2E–04	–2E–04
	[0.00]	[0.00]	[0.00]
SCHOOL	0.053	0.060	–0.097
	[0.59]	[0.58]	[0.07]
DUM60	0.051	0.052	0.043
	[0.00]	[0.00]	[0.00]
DUM80	0.037	0.041	0.019
	[0.01]	[0.01]	[0.00]
EG residual test		–3.850	
		[0.27]	
λ		–	
DW test		–	
JB test		–	
BPG test		–	

Notes: Regressand = ln(Y/L). Time period 1960 to 2009. p-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger t-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

residuals). Only if all these conditions are satisfied, we conclude that there is a cointegrating relationship.

In Model 1, the coefficient for capital is above unity and is implausible. This suggests that other variables have to be added to capture the trend of the output. In Model 2, we add trade openness and the results are encouraging. The three cointegrating methods show very similar results with a coefficient for the capital now plausible. The EG cointegration test confirms the presence of this long-run relationship. The ECM shows a factor-loading significance and with the expected negative sign.

Model 3 considers the average years of education (schooling) instead of openness and the results are somewhat unsatisfactory. Model 4 considers both openness and schooling and the results are more plausible. An interesting aspect to note is that the schooling and the exogenous linear trend component seem to share some statistical properties. In CCR and FMOLS, although the trend is significant, schooling is insignificant. In DOLS, the opposite occurs. This means that the exogenous linear trend information could be 'endogenized' by schooling. In Model 5, we check whether schooling also has nonlinear effects and the results confirm this. Although the coefficients of SCHOOL^2 and TREND^2 have the expected sign, they are not very statistically significant. The last experiment is to drop the two trend components and consider only SCHOOL and SCHOOL^2. The results are impressive. All the coefficients are statistically significant, the EG test confirms the presence of a long-run relationship and ECM is satisfactory. This is our preferred estimate and it implies that the unobservable steady-state growth rate is

$$\Delta A = 0.603\Delta\text{SCHOOL} - 0.082\Delta\text{SCHOOL}\times\text{SCHOOL} + 0.370\Delta\ln\text{TRADE} \quad (4)$$

where TRADE is the ratio of exports plus imports to GDP.

Table 5. Model 4

	FMOLS	CCR	DOLS
Intercept	–1.955	–2.125	–2.545
	[0.00]	[0.00]	[0.00]
ln k	0.602	0.588	0.531
	[0.00]	[0.00]	[0.00]
TREND	0.019	0.016	0.009
	[0.00]	[0.03]	[0.12]
TREND^2	–4E–04	–4E–04	–4E–04
	[0.00]	[0.00]	[0.00]
ln TRADE	0.311	0.327	0.400
	[0.00]	[0.00]	[0.00]
SCHOOL	0.038	0.070	0.158
	[0.42]	[0.29]	[0.01]
DUM60	0.031	0.031	0.030
	[0.00]	[0.00]	[0.00]
DUM80	0.028	0.029	0.027
	[0.00]	[0.00]	[0.00]
EG residual test		–6.194	
		[0.02]	
λ		–1.345	
		[0.00]	
DW test		2.07	
JB test		3.432	
		[0.18]	
BPG test		0.172	
		[0.95]	

Notes: Regressand = ln(Y/L). Time period 1960 to 2009. p-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger t-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

Table 6. Model 5

	FMOLS	CCR	DOLS
Intercept	–2.606	–2.838	–3.109
	[0.00]	[0.00]	[0.00]
ln k	0.572	0.567	0.530
	[0.00]	[0.00]	[0.00]
TREND	0.015	0.012	0.007
	[0.04]	[0.08]	[0.42]
TREND^2	–2E–04	–2E–04	–1E–04
	[0.08]	[0.15]	[0.30]
ln TRADE	0.335	0.339	0.422
	[0.00]	[0.00]	[0.00]
SCHOOL	0.249	0.315	0.458
	[0.18]	[0.07]	[0.02]
SCHOOL^2	–0.018	–0.021	–0.033
	[0.19]	[0.11]	[0.01]
DUM60	0.033	0.034	0.030
	[0.00]	[0.00]	[0.00]
DUM80	0.025	0.025	0.023
	[0.00]	[0.00]	[0.00]
EG residual test		–6.440	
		[0.02]	
λ		–1.315	
		[0.00]	
DW test		2.04	
JB test		3.013	
		[0.12]	
BPG test		0.120	
		[0.97]	

Notes: Regressand = ln(Y/L). Time period 1960 to 2009. p-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger t-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

Using the actual data, the unobservable SSGR of Italy is plotted in Fig. 2 for the period 2001 to 2009. It can be seen that it has declined until 2003, then steadily increased up to 2007 and then declined again until 2009. During this period, SSGR has been negative and this explains the low growth rate of Italy. The average SSGR during this period is –0.242. To make this slightly positive at about 0.03%, it is necessary to double the openness of the economy from its 2001–2009 average of 0.54 to slightly more than 1. It is difficult to achieve this by increasing education because of its strong and negative nonlinear effects. It is likely that SCHOOL may be capturing some nonlinear effects of other variables. Only further analysis can throw more light on the growth effects of this variable and this is beyond the scope of our article.

IV. Conclusions

In this article, we used alternative methods of estimating the long-run relationship between the growth rate and its determinants in Italy. We found that education with nonlinear effects and trade openness can adequately explain the declining trend rate of growth in Italy. However, this negative trend can be offset if trade openness of the economy is almost doubled.

Table 7. Model 6

	FMOLS	CCR	DOLS
Intercept	–3.651	–3.733	–3.660
	[0.00]	[0.00]	[0.00]
ln k	0.589	0.557	0.533
	[0.00]	[0.00]	[0.00]
ln TRADE	0.370	0.385	0.438
	[0.00]	[0.00]	[0.00]
SCHOOL	0.603	0.619	0.637
	[0.00]	[0.00]	[0.00]
$SCHOOL^2$	–0.041	–0.042	–0.045
	[0.00]	[0.00]	[0.00]
DUM60	0.034	0.034	0.032
	[0.00]	[0.00]	[0.00]
DUM80	0.027	0.027	0.024
	[0.00]	[0.00]	[0.00]
EG residual test		–6.425	
		[0.01]	
λ		–1.198	
		[0.00]	
DW test		2.00	
JB test		2.398	
		[0.30]	
BPG test		0.109	
		[0.98]	

Notes: Regressand = ln(Y/L). Time period 1960 to 2009. p-Values are in square brackets. FMOLS, Fully Modified Ordinary Least Squares; CCR, Canonical Cointegration Regression; DOLS, Dynamic Ordinary Least Squares; EG, Engle–Granger t-test for cointegration; λ, factor loading in the ECM; DW, Durbin–Watson test for serial correlation; JB, Jarque–Bera normality test; BPG, Breusch–Pagan–Godfrey test. DUM60 and DUM80 are two dummy variables used to capture, respectively, important changes in the Italian labour and financial markets. FMOLS and CCR use Newey–West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS estimation, leads and lags are selected according to HQ criteria. The SEs for the DOLS estimation are calculated using the Newey–West correction.

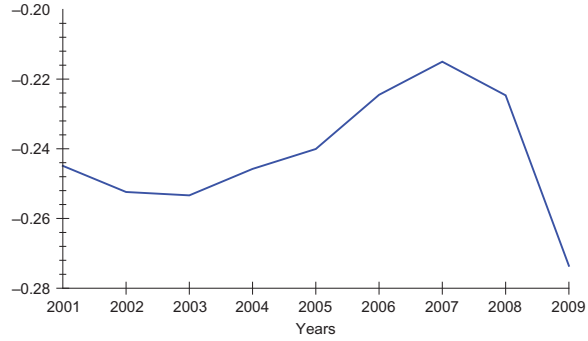

Fig. 2. Steady-state growth rate of Italy 2001–2009

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