UNITED NATIONS UNIVERSITY

UNU-WIDER

World Institute for Development Economics Research

Research Paper No. 2005/72

Education, Financial Institutions, Inflation and Growth

Leonardo Becchetti,[1] Iftekhar Hasan,[2] and George Mavrotas[3]

December 2005

Abstract

Our paper investigates the unexplored impact of education on inflation and of this relationship on economic growth. By using a sample of 102 countries observed on non-overlapping five-year data spells over the period 1963-2001, we find that average schooling years of the working population have a significant negative impact on inflation rates after controlling for the effects of the stance of domestic monetary policy. We also show that the negative impact of inflation on growth in conditional convergence estimates is significantly increased when the former is instrumented by educational variables. Our findings outline a third potential role of human capital on conditional convergence. They show that education is not only a production factor or a variable which may reduce demographic pressures, but also an important antidote against inflationary pressures which, in turn, negatively affect economic growth and conditional convergence. We interpret our findings by identifying three potential

…/.

Keywords: financial institutions, inflation, education, growth

JEL classification: O40, I21

[1] Università Tor Vergata, Roma, Facoltà di Economia, Dipartimento di Economia e Istituzioni, Rome, email: Becchetti@economia.uniroma2.it; [2] Lally School of Management, Troy, New York, email: hasan@rpi.edu; [3] UNU-WIDER, Helsinki, email: mavrotas@wider.unu.edu

This study has been prepared within the UNU-WIDER project on Financial Sector Development for Growth and Poverty Reduction directed by Basudeb Guha-Khasnobis and George Mavrotas.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-760-X (internet version)

rationales for the education-inflation nexus: (i) education raises consumers' awareness of their power in contrasting producers' inflationary pressures; (ii) more educated individuals have lower inflationary expectations when they are also wealthier and their consumption bundle is relatively less (more) intensive in inferior (superior) goods with higher (lower) inflation potential; (iii) more (less) educated and wealthier (less wealthy) individuals tend to be net creditors (debtors) in their maturity, thereby contributing to increase (reduce) the power of anti-inflationary lobbies.

Tables given in Appendix 2.

The World Institute for Development Economics Research (WIDER) was established by the United Nations University (UNU) as its first research and training centre and started work in Helsinki, Finland in 1985. The Institute undertakes applied research and policy analysis on structural changes affecting the developing and transitional economies, provides a forum for the advocacy of policies leading to robust, equitable and environmentally sustainable growth, and promotes capacity strengthening and training in the field of economic and social policy making. Work is carried out by staff researchers and visiting scholars in Helsinki and through networks of collaborating scholars and institutions around the world.

www.wider.unu.edu *publications@wider.unu.edu*

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Camera-ready typescript prepared by T:mi LHR Editorial and Secretarial Assistance

1 Introduction

The main branch of the literature on the determinants of the equilibrium level of inflation is focused on the issue of central bank independence**.** According to this perspective inflation is the outcome of a game between a more or less independent central bank—whose main concerns are price and output stability (in different weights)—and market agents, divided or not into different interest groups, with their own inflationary expectations.

This literature has neglected, or not sufficiently investigated, the role of education on the formulation of agents' inflationary expectations and on the final equilibrium level of inflation. This neglected role may help to explain some recent anecdotal and descriptive evidence showing facts that are difficult to reconcile with standard findings of theoretical literature. First, we observe a significant gap between official and perceived inflation rates in many countries of the world and we find that perceived inflation is significantly and negatively correlated with years of education (Brischetto and De Brouwer 1999; Bryan and Ventaku 2001; Lombardelli and Saleheen 2003). Second, we have plenty of anecdotal evidence about the difficulties of poorly educated individuals in interpreting events that have occurred around currency changes such as the euro turnaround (Adriani, Marini and Scaramozzino 2003).[1]

These differences between observed facts and model predictions depend on the fact that standard theoretical models generally focus on the implications of policy measures interacting with the behaviour of a rational representative agent whose choices are based on constrained maximization. These models seldom consider that a significant part of the population deviates from such standard behaviour for cultural grounds or for insufficient education and knowledge of mechanisms regulating the economic system. More specifically, it is reasonable to assume that the success in controlling inflation depends not only on the quality of monetary policies, but also on agents' knowledge of market mechanisms, such as those of demand elasticity, empowering consumers with the possibility of counteracting inflationary pressures in competitive environments. In this perspective we argue that education enhances the capacity of individuals to understand and use market mechanisms which allow them to contrast inflationary pressures and therefore has positive effects on the equilibrium level of inflation.

This 'reduced consumer empowerment' rationale is not the only one which might illustrate a significant education-inflation nexus. A second rationale (Engel law) may be found by exploring the effects of education on the characteristics of the bundles of goods consumed by different income classes. The positive relationship between education and personal income is well established in the literature of the returns to schooling (Schultz 1988). On the basis of this relationship, it is highly reasonable to expect that, *ceteris paribus*, better educated people should on average belong to higher income groups. Another well established empirical regularity, the Engel's law, explains

1 What we would expect in a system populated by rational agents making their consumption choices in (monopolistically) competitive markets with limited search costs (such as, for instance, restaurants in big cities) is absence of 'monetary illusions' and consequently, no effect whatsoever of currency turnarounds on inflation rates. The sharp price changes that have occurred since the euro was introduced reveal, on the contrary, that insufficient consumers' scrutiny prevented them from counteracting monopolistically competitive producers' temptations of exploiting the currency turnaround to increase market prices.

that as income grows, the share of inferior goods shrinks. Inflation surveys of domestic statistical institutes document that inferior goods have inflation rates which tend to be higher than average, while an important share of superior goods (such as ICT goods and travel) belongs to highly competitive sectors and exhibits inflation rates well below average, if not declining prices. Hence, by transitive property, better educated people should effectively suffer less from inflation and therefore should formulate lower inflationary expectations. The consequence could be that in all those models in which inflationary expectations positively affect equilibrium levels of inflation, a higher share of the more educated people should lead to lower inflation.

The positive education-inflation nexus could also be supported by the existence of a third 'creditor's pressure' rationale. If the positive relationship between education and personal income can also be extended to personal wealth, we should expect that more (less) educated and wealthier (less wealthy) people tend to be net creditors (debtors) in their maturity. Institutional models of inflation setting have shown, in turn, that the relative strength of net creditors (debtors) significantly reduces (increases) equilibrium inflation rates (Piga 2000).

After a short survey of these three theoretical rationales for the existence of an education-inflation nexus, the paper explores whether the relationship holds on the empirical side. The paper is divided into six sections (including introduction and conclusions). In the second section we explore the theoretical underpinnings of the education-inflation nexus in the light of the standard inflation setting models. In the third section we survey the (scant) evidence on the relationship between education, consumption bundles, personal income, personal wealth and inflationary expectations, which forms the basis of our three rationales explaining the negative nexus between education and inflation. In the fourth section we present empirical evidence on the positive relationship between the two variables, net impact of monetary policies, and other proxies of the institutional environment. In the fifth section we document how consideration of the inflation-education nexus improves the goodness of fit in traditional conditional convergence growth estimates.

2 Theoretical underpinnings of the education-inflation nexus

In the previous section, we argued that less educated individuals tend to have higher inflationary expectations. This finding is consistent with both the 'consumers' empowerment' rationale (the less educated are less able to use market mechanism to counteract producers price changes and are therefore more pessimistic about inflation) and the 'Engel law' rationale (the less educated rationally form higher inflationary expectations because inflation rate is higher in their consumption bundle).

The simplest channel through which higher inflationary expectations may affect the equilibrium inflation rate is in a model in which the inflation rate is significantly affected by industry-specific wage settings. If less educated people have sufficient union power, they succeed in getting higher wages and therefore positively contribute to higher inflation rates.

In spite of that, the link between inflationary expectations and actual levels of inflation in standard models of the literature on central bank independence is not so clear-cut.

Quite to the contrary, standard models *à la* Rogoff (1985) and Barro and Gordon (1983) of inflationary games between an independent institution (central bank or the government) whose main concerns are price and output stability (in different weights) and a representative market agent which formulates its own inflationary expectations, show that, for a given monetary policy stance, lower inflationary expectations do not affect the equilibrium inflation rate. This is because in these models the only source of inflationary bias is the benevolent planner (or the independent central bank). Inflationary expectations enter the benevolent planner's loss function in proportion to the positive weight given by him to inflationary surprises (and, paradoxically, higher inflationary expectations reduce room for inflationary surprises). What matters for the independent central banker in choosing the optimal inflation rate is just the balance between marginal costs of inflation (i.e., distributive costs, etc.) and marginal gains from inflationary surprises.

The absence of a link between inflationary expectations and actual levels of inflation obviously depends on the fact that in these models, the central bank is assumed to have monopoly power in setting the equilibrium level of inflation and, therefore, higher inflationary expectations cannot be traduced into higher wage claims which affect the final level of prices. This class of models has been shown to be subject to criticism with respect to micro-foundations (Chari, Kehoe and Prescott 1989), accountability (Fischer 1993) and renegotiation (McCallum 1997) as well as being hardly compatible with stylized facts.

Moreover, assumptions of benevolent planner models of inflation setting may eventually fit the characteristics of more industrialized economies in which the central banker has a high degree of institutional independence (or those where a dictatorial government sets the inflation rate), but appears particularly devoid of the generality needed in frameworks that should include inflation-setting mechanisms of countries where central banks are not independent.

We must, therefore, more realistically argue that in most countries, the equilibrium inflation rate is the result of the interaction between multiple institutions and heterogeneous pressure groups. An example of a theoretical framework taking into account these considerations is the Pecchi and Piga (1999) model in which inflation is determined by the interplay of the government, central bank, a debt management agency, net creditors and taxpayers.

In the model the final outcome is determined at the end of four sequential stages. In the first stage the debt management government agency announces the composition of debt to be issued deciding the share of nominal vis à vis real index bonds. In the second stage creditors purchase the debt at the internationally given interest rate plus expected inflation when they purchase nominal bonds. In the third stage net creditors and debtors exert lobbying pressure to affect government inflationary stance, and in the final stage the government acts as a Stackelberg leader trying with its pressure to condition the behaviour of the central bank in setting inflation.

The model finally demonstrates that the equilibrium level of inflation is crucially affected by the relative strength of the net creditors' vis à vis that of the taxpayers' lobby. The impact of net creditors' strength on equilibrium inflation is, in turn, affected by the relative degree of central bank independence (zero if the central bank is fully independent), the government cost of deviations from its own target inflation and by the degree of central bank aversion to inflation.

3 Descriptive evidence on the education-inflation nexus

Very few empirical analyses measuring the relationship between education and inflationary expectations exist. Brischetto and De Brouwer (1999) analyse the Melbourne Institute Survey of Householders' Inflation Expectations and find that these vary significantly with household personal characteristics. The authors find that higher educated individuals tend to have lower and more accurate inflation expectations. Along the same line, Bryan and Ventaku (2001) examine monthly data from the Inflation Psychology Survey (1996-2001) and negative and significant relationship between education and inflationary expectations. Lombardelli and Saleheen (2003) find that a level of education above high school is negatively and significantly correlated with inflationary expectations on a sample of around 2,000 individuals extracted from the UK Central Bank's survey on inflationary expectations.

The interpretation of this finding may be twofold. According to the Engel law rationale, it is possible that individuals with higher education, productivity and wages fall into an income class which consumes a bundle of goods with relatively lower average inflation rate. On this point Bagella *et al.* (1998) show that in Italy the cost of living calculated on the basis of the bundle of goods purchased by each income class deviates from the official 'cost of living' inflation index calculated by the domestic statistical institute (ISTAT). The authors find that higher-income classes have a slightly lower cost of living since they purchase a higher share of high-tech goods sold in highly competitive markets and a lower share of inferior goods generally sold in less competitive markets.

On the same line, Idson and Miller (1997) investigate, using Consumer Expenditure Survey data, the determinants of household inflation rates for a sample of around 13,000 US families spanning the period 1969 to 1987. As in the Bagella *et al.* (1998) paper, the authors identify household inflation rates on the basis of their specific consumption bundles. Their descriptive evidence shows that education is negatively related with inflation rates and the econometric estimates confirm that even after correcting for the effect of income, the significance of the negative link is confirmed.

On the other hand, according to the consumers' empowerment rationale, it is possible that the higher educated people have a more qualified cultural background and are closer to the *homo economicus* behaviour typical of rational, fully-informed, constrained maximizers. More specifically, less educated people may find it more difficult to adopt the principles of selective choice and may have a lower understanding of their role in reducing inflation than the consumers who exhibit elastic demand. This is also one of the interpretations that Brischetto and De Brouwer (1999) give to their results, arguing that experience and cultural background do matter in developing information-processing skills or in understanding how the economy works and in subsequently generating also lower inflationary expectations.

The euro turnaround provides us with a lot of anecdotal evidence where, even in presence of competitive markets, price tags have been doubled (under the wrong equivalence of 1 euro with 1000 liras instead of 2000 liras) without generating significant reductions of sales (Adriani, Marini and Scaramozzino 2003). In presence of (monopolistically) competitive markets and reasonable search costs (such as in the case of restaurants), the persistence of these abnormally high prices can be explained only by assuming the existence of a large ratio of uninformed consumers with poor information-processing skills and poor understanding of how economy works.

4 Empirical analysis on the education-inflation nexus

4.1 The empirical model

Our first point is to test for the existence of a robust education-inflation nexus. As is well-known, the problem of endogeneity in testing the relationship between these two variables may be severe.

We propose two alternative estimation methods. The first is a fixed effect estimate where inflation rates are regressed on human capital and proper controls in eight 5-year spells of panel data from 1963 to 2001 under the following specification:

$$\ln\left(\inf lm_t\right) = \alpha_0 + \alpha_i + \alpha_2 \ln\left(s_h\right) + \sum_i \beta_i X_i + \varepsilon$$

The second is a first-order autoregressive model

$$\ln\left(\inf lm_t\right) = \alpha_0 + \alpha_1 \ln\left(\inf lm_{t-1}\right) + \alpha_2 \ln\left(s_h\right) + \sum_i \beta_i X_i + \varepsilon$$

where the dependent variable is the log of the average inflation rate in the last of the 5-year period and regressors are education, the one period lagged dependent variable and a set of control variables measuring quality of financial institutions, which includes the stance of domestic monetary policy.

More specifically, we consider as controls:

EFW3am the average growth of money supply (last five years) minus growth of real GDP (last ten years);

EFW4 index of freedom to exchange with foreigners;

EFW5 regulation of credit, labour and business;

EFW4a index of taxes on international trade;

EFW4d difference between the official and black market exchange rate;

EFW4e index of international capital market controls;

EFW5a index of credit market regulation.

All these data are taken from the *Economic Freedom of the World* database issued by the Frazer Institute.

4.2 The choice of the human capital variable

We consider three alternative proxies for the human capital variable. The first proxy, typically used in benchmark contributions of this type of literature (Mankiw, Romer and Weil 1992), is represented by measures of school enrolment ratios at different educational levels, collected by the World Bank database and reported to the UNESCO Institute for Statistics by national authorities.[2]

The use of this indicator has recently been the subject of severe criticism (Wossmann 2003) since current enrolment ratios represent the investment of future, not current, workers and even if we lag this variable, it is very difficult to relate it exactly with the human capital investment of current workers. This may not represent a problem if the model is in steady state but is a problem so when we are in transition to the steady state, as in the human capital augmented exogenous growth model (Mankiw, Romer and Weil 1992) and in a framework of endogenous growth models (Bernanke and Gurkaynak 2001). Furthermore, under the three rationales of the education-inflation nexus, the more educated people are supposed to know demand elasticity mechanisms better, to have lower inflationary expectations, and to lobby relatively more for lower inflation rates being net creditors. All these characteristics are better proxied by the human capital achievement of current working aged population rather than the human capital investment of current students and future workers. For this reason we prefer average schooling years of the working population. The variable is taken from the Barro and Lee (2000) dataset.

The same methodology based on census and survey data on educational attainment levels, is applied by Barro and Lee, extending the coverage of countries and years. Attainment levels are based on UNESCO's International Standard Classification of Education (ISCED) on the following scale: no schooling, incomplete first level, completed first level, entered the first stage of secondary level, entered second stage of secondary level and entered higher level.[3]

---

[2] Usually in conditional convergence estimates we find measures of gross and net school enrolment ratios as proxies of human capital investment. The first is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown, the second is the ratio of children of primary school age who are enrolled in school. Although the net enrolment ratio is more precise because it excludes over-aged students, we use the gross enrolment ratio in the attempt to capture more accurately the system's coverage, because of the scarcity of data available for the net ratio.

[3] Barro and Lee (2000) also use data on adult illiteracy rates to estimate the fraction of the working aged population with no schooling when direct data from censuses or survey are not available. Since they observe a high correlation between the no-schooling fraction n_0 and adult illiteracy rates (1-l) they estimate missing values of the fraction of the working aged population with no schooling fraction n_0 and a value for adult illiteracy in another year $T \pm t$ based on $n_0 = (1-l) \cdot \frac{n_{0,T\pm t}}{(1-l_{T\pm t})}$.

Barro and Lee obtain 40 per cent of this information directly from census or survey data. They estimate missing observations on the basis of school enrolment ratio data. They use a perpetual inventory method, starting with the directly observed data points as benchmark stock using data on population by age to estimate survival rate, and they account for variations in the duration D_a of schooling levels over time within a country.

The limitation in the use of years of schooling as a proxy for human capital investment is that all schooling years are equally weighted, regardless of the efficiency of the educational system, of the quality of teaching, of the educational infrastructure, or of the curriculum. To encompass this problem, Hanushek and Kimko (2000) devise an educational quality index as a third proxy of human capital. This is conveniently normalized by Wossmann (2003) for each country relative to the measure for the United States. We therefore input values for the average of schooling years and for the quality calculated by Hanushek and Kimko (2000) to calculate the third proxy of human capital investment.

4.3 Econometric methodology issues

As is well-known, under the second approach an important problem to be solved that is typical of dynamic panel estimates, is the likely correlation between the lagged dependent variable and the residual. Such correlation renders OLS estimates biased and inconsistent, even when error terms are not serially correlated (Arellano and Bover 1995; Blundell and Bond 1998).

A first generation first-differenced GMM approach tackles this issue by using lagged levels as instruments for first-differenced variables (Blundell and Bond 1988). The limitation of this approach lies in the fact that lagged levels are often poor instruments for first differences and that the estimator is shown to have poor finite sample properties when the autoregressive parameter (the correlation of output with its one period lagged value) approaches unity or the variance of individual effects, which are time invariant, is large with respect to time varying and transient shocks (Bond, Hoeffler and Temple 2001). On the same issue, Blundell and Bond (1998) also observe that the first-differenced GMM approach produces a large downward finite sample bias when the number of available periods is small. This is a problem that typically occurs in conditional convergence growth estimates which are conveniently estimated in short panels, given that output is highly persistent and only by using multi-year averages it is possible avoid modelling cyclical dynamics (Bond, Hoeffler and Temple 2001).

More recently, a new ‘second generation’ system GMM combines the standard set of equations in first differences, typical of the ‘first generation’ first-differenced GMM (Arellano and Bond 1991), with a second set of equations in levels with suitably lagged first-differences as instruments (Arellano and Bover 1995; Blundell and Bond 1998). This is the approach we follow in our econometric analysis.[4]

4.4 Empirical results on the education-inflation nexus

Fixed effect regression estimates on the inflation education nexus are presented in Tables 2a and 2b. The sample includes 102 countries observed on non-overlapping 5-year data spells for the period 1963 to 2001 (for the list of developing countries included in the sample, see Appendix 1). In any spell the dependent variable is measured as the final year and the regressors are 5-year lagged levels. As we can see, the negative impact of education on inflation is significant both when we use plain

4 Fixed effect panel specifications have nonetheless been estimated and confirm the significance of the education-inflation nexus. Results are available from the authors on request.

average schooling years (Table 2a) and when we corrected for quality (Table 2b). The result is robust to the inclusion of different controls measuring monetary policy and quality of financial rules and institutions. The elasticity of education is quite high and not far from one. Hence, our result implies (under the linear approximation of the education-inflation nexus assumed by the model) that a 10 per cent increase in schooling years generates a 10 per cent decrease of inflation from its previous level. Estimates presented in Tables 2a and 2b also show that fixed effects are weak but still significant and that the goodness of fit is significantly higher when we introduce controls measuring monetary policy stance and quality of rules and financial institutions.

To check the robustness of the inflation-education nexus, we propose an alternative system-GMM estimate where the impact of the lagged dependent variable is taken into account and where the potential endogeneity between inflation and education is reduced at minimum by instrumenting regressors different from the lagged dependent variable starting with their t-2 lags.

The diagnostics of our estimates show that the hypothesis of overidentifying restrictions is rejected by the Sargan test while tests on residuals reject second order but not first order autocorrelation. This provides additional support for our choice to start from t-2 lags when instrumenting our regressors. Our findings document the significance of the education variable and also that of the proxy for the stance of domestic monetary policy. The impact of the lagged dependent variable is weak.

4.5 The education-inflation nexus and conditional convergence estimates

Our framework for the econometric estimation of the relationship between education, inflation and growth is a generalized Solow growth model augmented for additional capital factors and allowing for the impact of additional components augmenting labour productivity.

The model assumes that the observed countries have the following domestic production function:

$$Y_t = F(\Sigma K_j, \Sigma A_i L) = \Sigma K_j^{\alpha j} (\Sigma A_{it} L_t)^{1-\Sigma \alpha j} \qquad \text{with } \Sigma \alpha j < 1 \qquad (1)$$

Where L is the labour input, Ki includes the standard physical capital and other possible capital inputs (such as human capital) and

$$A_{(t)} = \Sigma_i A_{i\,(t))} \qquad (2)$$

with $A_{i\,(t)} = A_{i\,(0)}\, e^{g_{\mathrm{i}}\,(t)}$

where Ai is the i-th additional factor of conditional convergence affecting growth by increasing labour productivity.

In the above model, physical and human capital follow the standard laws of motion and under the assumption of exogenous growth of the labour input,[5] we may rewrite the

[5] The exogeneity of labour force growth is a restrictive assumption which can, however, be accepted considering that changes in per capita income on fertility affect labour force with lags that go beyond the time interval considered in our estimates (especially panel estimates). Moreover, we may assume

production function in terms of output per efficiency units as $y = k^{\Sigma\alpha i}$ where lowercase letters express input and output variables divided per efficiency units. Therefore, we can obtain the two standard growth equations:

$$\dot{k}_{jt} = s_{kj} y_t - \left(n + g + \delta\right) k_{jt} \tag{3}$$

$$\dot{h}_{jt} = s_{hj} y_t - \left(n + g + \delta\right) h_{jt} \tag{4}$$

under the assumption of a common depreciation rate (δ) and where g = $\Sigma_i g_i$.

Following Mankiw, Romer and Weil (1992) and relaxing the assumption that countries are in steady state, it is possible to estimate the following growth equation:

$$\ln\left(\frac{Y_t}{L_t} \bigg/ \frac{Y_0}{L_0}\right) = c + \sum_i (1-e^{-\lambda t})\gamma_i[\ln(A_i) + g_i t] + \sum_j (1-e^{-\lambda t})\frac{\alpha_j}{1-\sum \alpha_j}\ln(s_k) + (1-e^{-\lambda t})\frac{\beta}{1-\sum \alpha_j}\ln(s_h) + \tag{5}$$
$$-\frac{\alpha_j}{1-\sum \alpha_j}\ln(n+g+\delta) - (1-e^{-\lambda t})\ln\left(\frac{Y_0}{L_0}\right)$$

Variables for our empirical analysis are taken from the World Bank database. The dependent variable *Y/L* is the real gross domestic product per working aged person, *L* is the working age population (population aged between 15-64). s_k is gross domestic investment over GDP and is calculated using values taken from Penn World Tables or, alternatively, World Bank data.[6] The construction of the human capital proxies is discussed in detail in section 4.2.

We perform our estimates on World Bank data for a dataset recording values for 102 countries for a sample period ranging from 1963 to 2001. Data are grouped into eight 5-year spells in order to provide acceptable time lags to test conditional convergence effects in growth estimates.[7] We perform growth estimates using the basic Mankiw,

---

that with migration and albeit imperfect international mobility of labour, the effect of domestic fertility on the labour force is limited.

6 Penn World Tables (PWT) are the result of a United Nations International Comparison Project whose aim is to create information for consistent cross-country comparisons in time and space, starting from price surveys of identical sets of goods and services in different countries. One of the advantages in using PWT data is in the adoption of perpetual inventory methods which allows us to obtain more reliable information on net investment. The purpose of the PWT data is to obtain data which control for distortions arising from comparing value-based indicators across different industries. Such distortions may be of three types. First, measures based on comparisons between values of output and values of input, if not deflated by the specific (output and input) price indexes, may create biases in comparisons across time. Second, heterogeneity in market structures across sectors generates dispersion of prices above the competitive price level. As a consequence, industry-driven differences may be affected industry-specific differences in competitive environments. Third, indicators should be adjusted for input quality adjustment. Indeed, higher capital stock investment expenditure can conceal not just higher ‘quantity’ of the same capital good, but higher, same or less ‘quantity’ of a higher vintage capital good. For a detailed discussion of the methodology and of the critical issues of PWTs, see Heston and Summers (1991 and 1996).

7 Conditional convergence growth estimates need to be estimated in short panels, since output is highly persistent and in using 5-year averages we avoid modelling cyclical dynamics (Bond, Hoeffler and Temple 2001).

Romer and Weil (1992) approach in which the two main factors of growth are physical and human capital.

The approach adopted for testing the education-inflation-growth nexus consists of three steps. First, in dynamic panel models we test the significance of the Mankiw-Romer-Weil augmented Solow specification by performing a conditional convergence estimate in which human and physical capital are considered as inputs. We therefore estimate the following specification:

$$\ln\left(\frac{Y_t}{L_t}\Big/\frac{Y_0}{L_0}\right) = c + (1-e^{-\lambda t})\frac{\alpha}{1-\alpha-\beta}\ln\left(s_k\right) + (1-e^{-\lambda t})\frac{\beta}{1-\alpha-\beta}\ln\left(s_h\right) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln\left(n+g+\delta\right) - (1-e^{-\lambda t})\ln\left(\frac{Y_0}{L_0}\right) \quad (6)$$

The rationale outlined in the previous section leads us again to use a system GMM approach where regressors are instrumented with their own t-2 (and available further) lagged values.

Our evidence rejects the model confirming the puzzle of the insignificance of human capital in dynamic panel growth estimates both under a fixed effect (Islam 1995) and a system GMM estimate (Bond, Hoeffler and Temple 2001), while it is well-known that the variable turns out to be significant in cross-sectional estimates (Mankiw, Romer and Weil 1992) (Tables 4a-4b: columns 1 and 2). A likely interpretation of such a finding is that dynamic panels capture mainly within-country effects of changes in regressors across time, while cross-sectional estimates capture mainly the effect of the between-country distribution of a regressor on the dependent variable. Hence, from our results and others in the literature already mentioned, it seems that the between effect of human capital happens to be stronger than the within time effect.

As a second step, we estimate a conditional convergence model in which inflation replaces human capital as a second factor of convergence in the empirical test of the Solow growth model.

$$\ln\left(\frac{Y_t}{L_t}\Big/\frac{Y_0}{L_0}\right) = c + (1-e^{-\lambda t})\gamma\ln\left(\inf lm\right) + (1-e^{-\lambda t})\frac{\alpha}{1-\alpha-\beta}\ln\left(s_k\right) + \frac{\alpha+\beta}{1-\alpha-\beta}\ln\left(n+g+\delta\right) + \\ -(1-e^{-\lambda t})\ln\left(\frac{Y_0}{L_0}\right) \quad (7)$$

The adoption of a GMM system approach allows us to estimate a first order autoregressive model in levels of the following form:

$$\ln\left(\frac{Y_t}{L_t}\right) = \alpha_0 + \alpha_1\ln(\inf l) + \alpha_2\ln\left(s_k\right) + \alpha_3\ln\left(n+g+\delta\right) + \alpha_4\ln\left(\frac{Y_0}{L_0}\right) \quad (8)$$

where, by subtracting $\ln\left(\frac{Y_0}{L_0}\right)$ from both sides, we have a dependent variable in first differences and a coefficient of convergence which can be calculated as (α_4-1). By adopting the same system GMM approach with properly lagged instruments, we find that inflation is highly significant (Tables 4a-4b, column 3). This finding is also consistent with several results in the literature.[8]

When we look at diagnostics of this equation, we find, however, that instruments selected perform poorly.

As a third step, we try to improve the goodness of fit and selection of instruments in this equation by replacing lagged inflation with lagged education values as instruments (Tables 4a-4b: columns 4 and 5). Surprisingly we now find that the Sargan null hypothesis is not rejected and that the goodness of fit of the regression is now much higher.

Another relevant point is that if we invert the steps of the procedure at stage three by instrumenting education with inflation, we still obtain unsatisfactory results with the education variable which remains insignificant.[9]

4.6 Sensitivity analysis

We perform several robustness checks on the results presented in Tables 4a and 4b. In order to test the model on more homogeneous country subgroups in which the hypothesis of invariance of the production function is more likely to hold, we adopt the three-step procedure for different subgroups (non-oil countries, OECD and non-OECD countries, 15 EU countries and 15 non-EU) (Tables 5a to 8b). Our most important results outlined in the previous section remain remarkably stable. The human capital variables are not significant in the first step (columns 1 and 2), the inflation variable is significant when it replaces human capital (column 3), the goodness of fit is much higher and the test on the validity of the instruments improves when we add average schooling years corrected or not for quality among instruments (columns 4 and 5).

---

8 Earlier empirical papers identify a direct negative correlation between output growth and current and lagged inflation values (Grimes 1991; Stanners 1993; McTaggart 1992 and Smyth 1994), while Rudebusch and Wilcox (1994) illustrate a similar negative relationship with productivity. Bruno and Easterly (1998) analyse the inflation-economic growth relationship in the context of an inflation crisis (higher than 40 per cent inflation rates) and find that the latter is positive before the crisis (1.6 per cent on average), negative during (-1.2) and more positive than before after the crisis (2.6 per cent). Cukierman *et al.* (1993) overcome the potential endogeneity between economic growth and inflation by instrumenting the latter with a measure of central bank independence. Kormendi and Meguire (1985) and De Gregorio (1992, 1993) identify in the negative inflation-investment nexus the root of the impact of the former on economic growth. The rationale for this nexus is that in presence of high inflation rates, nominal prices are updated in an uncoordinated way and therefore more difficult to have a correct perception of changes in relative prices, and therefore, more difficult to evaluate investment profitability (Harberger 1998). In a framework of asymmetric information in which investment entails sunk costs and some form of irreversibility, high inflation rates may increase volatility of investment returns, therefore increasing the value of the option to wait or delaying the investment (Pindyck and Solimano 1993). An important normative consequence is that the stability of the macroeconomic framework is more beneficial to investment than frequent changes in fiscal policies.

9 Results of these additional estimates are omitted for reasons of space and available from the authors on request.

5 Conclusions

The mainstream literature on the impact of human capital on the levels and growth of per capita GDP mainly identifies a direct effect via returns to schooling and an indirect effect via reduction of fertility rates due to the higher female education. In this paper we document the existence of a third channel which operates through the education-inflation-growth nexus.

Our findings provide robust evidence on the education-inflation nexus at aggregate level in both fixed effect and system GMM estimates where inflation is regressed on education and proper control variables. This evidence parallels recent empirical findings documenting a negative relationship between education and inflationary expectations, on the one side, and 'effective' inflation rates calculated by evaluating price dynamics of effective consumption bundles, on the other side.

We explain the education-inflation link by focusing on three rationales: (i) education raises consumers' awareness of their power in contrasting producers' inflationary pressures ('reduced consumer empowerment' rationale); (ii) more educated individuals have lower inflationary expectations since they are also wealthier and their consumption bundle is relatively less (more) intensive in inferior (superior) goods with higher (lower) inflation potential (Engle's law rationale); (iii) more (less) educated and wealthier (less wealthy) individuals tend to be net creditors (debtors) in their maturity, thereby contributing to increase (reduce) the power of anti-inflationary lobbies ('creditors pressure' rationale).

A second part of our results shows the strength of the second link in the education-inflation-growth nexus, documenting how inflation rates are a significant factor of conditional convergence in growth estimates.

The relationship between the first and the second link is demonstrated through a three-step procedure. In the first we confirm the puzzle of the lack of significance of human capital investment in panel human capital augmented growth estimates of conditional convergence. In the second we show that inflation rates may successfully replace human capital investment in these estimates. In the third we find that goodness of fit and quality of instruments are significantly improved when we introduce instrument inflation with human capital investment.

Overall, our findings open the path for a new unexplored field in the analysis of determinants of economic growth which deserves to be further explored and documented.

Appendix 1: List of countries included in econometric estimates

OECD and/or high income countries

Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Arab Emirates, UK, USA

Transition countries

Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia

Developing countries

Algeria, Argentina, Bangladesh, Benin, Bolivia, Botswana, Brazil, Cameroon, Chile, China, Colombia, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Equador, Egypt, El Salvador, Gambia, Ghana, Guatemala, Haiti, Honduras, India, Indonesia, Iran, Jamaica, Japan, Jordan, Kenya, Korea, Rep., Kuwait, Lesotho, Malaysia, Mauritania, Mauritius, Mexico, Myanmar, Nepal, Nicaragua, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Senegal, South Africa, Sri Lanka, Sudan, Swaziland, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad & Tobago, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

Appendix 2: Tables

Variable legend for Tables 1-6

Legend

ngd	sum of the rate of growth of population, stock of capital depreciation and technological progress
Gcapform	gross capital formation over GDP (WB data)
Capfis	Heston-Summers corrected investment/GDP ratio
Schoolsecgro	gross secondary school enrolment ratio
Schooltergro	gross tertiary school enrolment ratio
Averschol	average schooling of the working population
Schoolqua	average schooling of the working population corrected for quality
QIRMP	quality of institutional rules

Legend

REER real effective exchange rate (see Table 2 legend)

QIRMP index of the quality of institutions and of economic policies. It is measured as a simple average of the following composed indicators:

1) Size of government: expenditures, taxes, and enterprises
   - a General government consumption spending as a percentage of total consumption
   - b Transfers and subsidies as a percentage of GDP
   - c Government enterprises and investment as a percentage of GDP
   - d Top marginal tax rate (and income threshold to which it applies) (i) top marginal tax rate (excluding applicable payroll taxes) (ii) top marginal tax rate (including applicable payroll taxes)

2) Legal structure and security of property rights
   - a Judicial independence—the judiciary is independent and not subject to interference by the government or parties in disputes
   - b Impartial court—a trusted legal framework exists for private businesses to challenge the legality of government actions or regulation
   - c Protection of intellectual property
   - d Military interference in rule of law and the political process
   - e Integrity of the legal system

3) Access to sound money
   - a Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years
   - b Standard inflation variability in the last five years
   - c Recent inflation rate
   - d Freedom to own foreign currency bank accounts domestically and abroad

4) Freedom to exchange with foreigners
   - a Taxes on international trade (i) revenue from taxes on international trade as a percentage of exports plus imports (ii) mean tariff rate (iii) standard deviation of tariff rates
   - b Regulatory trade barriers (i) hidden import barriers—no barriers other than published tariffs and quotas (ii) costs of importing—the combined effect of import tariffs, license fees, bank fees, and the time required for administrative redtape raise the costs of importing equipment
   - c Actual size of trade sector compared to expected size
   - d Difference between official exchange rate and black market rate
   - e International capital market controls (i) access of citizens to foreign capital markets and foreign access to domestic capital markets (ii) restrictions on the freedom of citizens to engage in capital market exchange with foreigners index of capital controls among 13 IMF categories.

5) Regulation of credit, labour, and business

   a Credit market regulations (i) ownership of banks—percentage of deposits held in privately owned banks (ii) competition—domestic banks face competition from foreign banks (iii) extension of credit—percentage of credit extended to private sector (iv) avoidance of interest rate controls and regulations that lead to negative real interest rates (v) interest rate controls—interest rate controls on bank deposits and/or loans are freely determined by the market.

   b Labour market regulations (i) impact of minimum wage—the minimum wage, set by law, has little impact on wages because it is too low or not obeyed (ii) hiring and firing practices—hiring and firing practices of companies are determined by private contract (iii) share of labour force whose wages are set by centralized collective bargaining (iv) unemployment benefits—the unemployment benefits system preserves the incentive to work (v) use of conscripts to obtain military personnel.

   c Business regulations (i) price controls—extent to which businesses are free to set their own prices (ii) administrative conditions and new businesses—administrative procedures are an important obstacle to starting a new business (iii) time with government bureaucracy—senior management spends a substantial amount of time dealing with government bureaucracy (iv) starting a new business—starting a new business is generally easy (v) irregular payments—irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications are very rare.

Table 1
Descriptive statistics of variables used in econometric estimates

Variable	Obs	Mean	Std. dev.	Min	Max
Inflation	874	31.447	213.399	-13.056	4157.317
EFW3a	685	30.736	157.736	-64.6	2294.3
EFW4	690	6.021	1.697	1.660	9.764
EFW4a	698	6.070	2.621	0	10
EFW4d	768	7.374	3.769	0	10
EFW4e	782	2.974	3.289	0	10
EFW5	654	5.366	1.109	2.473	8.755
EFW5a	749	5.839	2.737	0	10
Averschool	558	5.469	2.695	0.2	12.005
Averschoolqua	523	5.715	3.914	0.183	16.677

Variable	Obs	Mean	Std. dev.	Min	Max
Ln(Inflation)	825	2.076	1.326	-2.882	8.333
Ln(EFW3a)	639	2.365	1.178	-1.897	7.738
Ln(EFW4)	690	1.746	0.338	0.507	2.279
Ln(EFW4a)	673	1.719	0.596	-2.302	2.302
Ln(EFW4d)	648	2.087	0.542	-1.609	2.302
Ln(EFW4e)	481	1.360	0.694	-0.956	2.302
Ln(EFW5)	654	1.656	0.229	0.905	2.169
Ln(EFW5a)	697	1.724	0.571	-1.791	2.302
Ln(Averschool)	558	1.545	0.613	-1.609	2.485
Ln(Averschool-qua)	521	1.468	0.797	-1.696	2.814

Table 2a
Fixed-effect non-autoregressive estimates of the education-inflation nexus
(education variable: average schooling years)

Dependent variable: *Ln*(Inflation)

	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ln(Averschool)	-0.911	-1.015	-0.623	-0.973	-1.051	-1.216	-0.746	-0.704	-0.619	-0.981	-1.242
	[-3.79]	[-4.32]	[-2.48]	[-3.45]	[-3.87]	[-4.75]	[-2.11]	[-2.74]	[-1.79]	[-4.04]	[-4.82]
Ln(EFW3a)		0.397	0.376	0.273	0.36	0.364	0.225	0.33	0.232	0.333	0.279
		[6.84]	[6.63]	[4.72]	[6.00]	[6.09]	[3.61]	[5.53]	[3.61]	[5.57]	[4.88]
Ln(EFW4)			-1.3	-0.709				-1.018			
			[-5.39]	[-2.56]				[-3.86]			
Ln(EFW5)				-2.04			-2.969				-2.442
				[-4.81]			[-6.18]				[-6.30]
Ln(EFW4a)					-0.247						
					[-1.70]						
Ln(EFW4d)						-0.259					
						[-2.27]					
Ln(EFW4e)							-0.375		-0.455		
							[-3.12]		[-3.76]		
Ln(EFW5a)								-0.295	-1.297	-0.514	
								[-1.96]	[-5.39]	[-3.63]	
Constant	3.653	2.845	4.595	7.832	3.455	3.771	8.551	4.854	5.727	3.835	7.643
	[9.59]	[6.98]	[9.05]	[10.50]	[7.37]	[7.43]	[8.91]	[9.14]	[7.81]	[8.27]	[10.35]
F test	14.35	33.82	33.66	32.92	22.56	27.45	34.85	23.8	29.56	26.87	42.21
(overall reg. signific.)	[0.0002]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
R-sq Within	0.0342	0.1643	0.2316	0.2995	0.1741	0.2217	0.3879	0.2287	0.3415	0.1968	0.2861
R-sq Overall	0.0684	0.3002	0.3397	0.322	0.2679	0.29	0.3572	0.3282	0.3746	0.3022	0.2983
F test u_i=0	3.28	1.81	1.98	2.45	1.98	1.9	2.7	1.97	2.33	1.93	2.52
	[0.0000]	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Observations	507	434	426	400	412	379	306	413	315	420	407
Groups	101	88	88	88	88	87	82	88	83	88	88

Table 2b
Fixed-effect non-autoregressive estimates of the education-inflation nexus
(education variable: average schooling years corrected for quality)

Dependent variable: *Ln*(Inflation)

	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ln(Averschoolqua)	-0.83	-1.025	-0.601	-0.924	-1.086	-1.26	-0.765	-0.709	-0.626	-1.014	-1.185
	[-3.32]	[-4.08]	[-2.24]	[-3.16]	[-3.73]	[-4.51]	[-2.11]	[-2.58]	[-1.77]	[-3.91]	[-4.41]
Ln(EFW3a)		0.402	0.382	0.273	0.365	0.368	0.229	0.334	0.239	0.336	0.279
		[6.72]	[6.54]	[4.59]	[5.89]	[5.94]	[3.58]	[5.42]	[3.61]	[5.44]	[4.74]
Ln(EFW4)			-1.299	-0.695				-0.99			
			[-5.28]	[-2.48]				[-3.65]			
Ln(EFW5)				-2.138			-3.038				-2.539
				[-4.91]			[-6.10]				[-6.36]
Ln(EFW4a)					-0.231						
					[-1.54]						
Ln(EFW4d)						-0.254					
						[-2.19]					
Ln(EFW4e)							-0.365		-0.442		
							[-2.93]		[-3.51]		
Ln(EFW5a)								-0.319	-1.324	-0.543	
								[-2.05]	[-5.29]	[-3.73]	
Constant	3.463	2.768	4.493	7.829	3.401	3.746	8.666	4.79	5.74	3.86	7.636
	[9.18]	[6.67]	[8.77]	[10.38]	[7.06]	[7.08]	[8.77]	[8.87]	[7.67]	[8.04]	[10.22]
F test	11.01	32.01	32.12	32.02	21.3	25.96	34.34	22.76	28.95	25.96	41.06
(overall reg. signific.)	[0.0010]	[0.0000]	[0..0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
R-sq Within	0.0277	0.1625	0.2303	0.302	0.1718	0.2207	0.3954	0.2282	0.3469	0.1982	0.2891
R-sq Overall	0.1068	0.301	0.3577	0.3452	0.273	0.288	0.3961	0.3434	0.4056	0.308	0.3181
F test u_i=0	3.25	1.65	1.84	2.31	1.85	1.76	2.46	1.83	2.13	1.8	2.36
	[0.0000]	[0.0013]	[0.0001]	[0.0000]	[0.0001]	[0.0005]	[0.0000]	[0.0002]	[0.0000]	[0.0002]	[0.0000]
Observations	477	412	405	380	391	357	289	392	298	398	386
Groups	90	80	80	80	80	79	75	80	76	80	80

Notes: Inflation = consumer Price (annual %)—final value for each time section; Averschool = average of schooling years; Averschoolqua = average of schooling years weighted for quality of institutions; EFW3a = average growth of money supply (last 5 yrs) minus growth of real GDP(last 10 yrs); EFW4 = freedom to exchange with foreigners; EFW5 = regulation of credit, labour, business; EFW4a = taxes on international trade; EFW4d = diff. official exchange rate and black market rate; EFW4e = international capital market controls; EFW5a = credit market regulation. T statistics in parentheses.

Table 3
System GMM estimates of the determinants of inflation

Dependent variable: INFL: log of the end of period inflation rate

	GMM (1)	GMM (2)	GMM (3)	GMM (4)
Lag $(\text{INFL})_{t-1}$	0.073	0.051	0.087	0.061
	[1.35]	[1.00]	[1.60]	[1.18]
Ln(Averschool)	-0.620	-0.479		
	[-2.48]	[-1.93]		
Ln(Averschoolqua)			-0.368	-0.358
			[-2.47]	[-2.43]
Ln(EFW3a)	0.522	0.608	0.498	0.608
	[6.55]	[7.15]	[6.41]	[7.46]
Ln(EFW4e)	0.045	-0.074	-0.136	-0.201
	[0.30]	[-0.53]	[-0.96]	[-1.50]
Ln(EFW5)	-2.157		-1.696	
	[-3.97]		[-3.29]	
Ln(EFW5a)		-0.669		-0.303
		[-2.32]		[-1.07]
Constant	5.563	2.853	4.588	2.090
	[5.45]	[4.21]	[4.94]	[3.53]
F test	45.63	44.88	50.47	48.17
Pr > F	[0.000]	[0.000]	[0.000]	[0.000]
Sargan test	115.71	118.11	109.39	109.23
Pr > chi2	[0.073]	[0.054]	[0.148]	[0.151]
AR(1)	-4.72	-4.07	-4.87	-4.26
Pr > z	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	1.56	1.51	1.72	1.53
Pr > z	[0.119]	[0.131]	[0.086]	[0.125]
Observations	294	304	282	292
Groups	75	76	71	72
Instruments	101	101	101	101

Table 4a
Conditional convergence estimates
(Heston-Summers corrected physical capital investment)

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1 *Ln*(GDPwr)	0.9839	0.9596	0.9743	0.9737	0.9719
	[59.41]	[60.24]	[83.31]	[87.28]	[79.75]
***Ln*(CapFis)**	0.1416	0.1497	0.1000	0.0961	0.0898
	[6.32]	[6.56]	[4.08]	[3.65]	[3.16]
Ln(mAverschool)	-0.0740				
	[-2.43]				
Ln(mAverschoolqua)		-0.0160			
		[-0.61]			
Ln(NGD)	-0.3584	-0.4577	-0.3297	-0.3390	-0.3223
	[-4.38]	[-5.16]	[-4.87]	[-3.40]	[-3.18]
*Lag*1*Ln*(Inflation)			-0.0155	-0.0179	-0.0175
			[-2.74]	[-2.06]	[-1.87]
Constant	-0.3501	-0.4814	-0.3581	-0.3908	-0.3446
	[-1.68]	[-2.08]	[-1.85]	[-1.77]	[-1.59]
F test Pr > F	5094.04	5078.50	6086.61	9751.84	10472.62
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sargan test	145.12	136.97	152.06	86.56	89.79
Pr > chi2	[0.001]	[0.005]	[0.001]	[0.170]	[0.117]
AR(1)	-5.79	-5.39	-5.99	-5.18	-5.13
Pr > z	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-0.89	-0.72	-2.00	-1.18	-0.94
Pr > z	[0.374]	[0.474]	[0.045]	[0.238]	[0.346]
Observations	569	539	588	437	418
Groups	93	86	118	91	85
Instruments	102	102	109	80	80

Notes: Sample period (1963-2001) (eight 5-year spells of panel data).

Columns 1 and 2 augmented with human capital (average years of schooling and average years of schooling corrected for quality, respectively). Column 3 augmented with inflation. Columns 4 and 5 augmented with inflation using human capital among instruments (average years of schooling and average years of schooling corrected for quality, respectively).

Table 4b
Conditional convergence estimates
(World Bank physical capital investment)

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1 *Ln*(GDPwr)	1.0140	0.9906	0.9963	0.9861	0.9811
	[74.27]	[71.39]	[121.70]	[120.94]	[110.20]
***Ln*(GCapForm)**	0.1685	0.1830	0.1087	0.1361	0.1371
	[5.36]	[5.47]	[3.38]	[3.89]	[3.77]
Ln(mAverschool)	-0.0984				
	[-3.14]				
Ln(mAverschoolqua)		-0.0371			
		[-1.35]			
Ln(NGD)	-0.3845	-0.4995	-0.2877	-0.3368	-0.3345
	[-4.94]	[-6.06]	[-4.61]	[-3.80]	[-3.82]
*Lag*1*Ln*(Inflation)			-0.0183	-0.0249	-0.0257
			[-3.13]	[-3.15]	[-3.12]
Constant	-0.6557	-0.8327	-0.4596	-0.4522	-0.3990
	[-3.17]	[-3.64]	[-2.92]	[-2.26]	[-2.07]
F test	4795.42	5280.61	5914.43	9171.94	9697.99
Pr > F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sargan test	136.17	139.00	164.31	101.15	99.97
Pr > chi2	[0.005]	[0.003]	[0.000]	[0.024]	[0.029]
AR(1)	-5.93	-5.97	-5.79	-5.75	-5.74
Pr > z	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.30	-1.14	-2.00	-1.07	-0.86
Pr > z	[0.195]	[0.255]	[0.045]	[0.283]	[0.388]
Observations	577	543	596	448	428
Groups	99	89	125	93	87
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 5a
Conditional convergence estimates
(Heston-Summers corrected physical capital investment)
OECD countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr	0.961596 [77.15]	0.9446 [75.44]	0.9388 [82.76]	0.9453 [77.25]	0.9451 [76.06]
***Ln*(CapFis)**	0.1228 [3.29]	0.1417 [3.99]	0.1252 [3.54]	0.0784 [2.09]	0.0780 [2.08]
Ln(mAverschool)	-0.0596 [-1.89]				
Ln(mAverschoolqua)		-0.0104 [-0.45]			
Ln(NGD)	-0.1865 [-3.45]	-0.2066 [-4.06]	-0.1876 [-3.80]	-0.1245 [-2.16]	-0.1237 [-2.16]
Lag1Ln(Inflation)			-0.0170 [-2.49]	-0.0227 [-2.72]	-0.0227 [-2.72]
Constant	0.2776 [1.49]	0.3263 [1.81]	0.4244 [2.22]	0.4622 [2.32]	0.4660 [2.35]
F test Pr > F	2187.44 [0.000]	2377.07 [0.000]	2656.09 [0.000]	2472.55 [0.000]	2476.88 [0.000]
Sargan test Pr > chi2	128.73 [0.017]	126.63 [0.023]	137.43 [0.016]	96.47 [0.048]	96.48 [0.048]
AR(1) Pr > z	-4.35 [0.000]	-4.66 [0.000]	-5.07 [0.000]	-5.17 [0.000]	-5.16 [0.000]
AR(2) Pr > z	1.50 [0.134]	1.63 [0.104]	1.28 [0.201]	1.99 [0.046]	1.99 [0.047]
Observations	185	182	186	155	155
Groups	29	28	28	27	27
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 5b
Conditional convergence estimates
(World Bank physical capital investment)
OECD countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr)	0.9754 [79.41]	0.9566 [77.72]	0.9646 [86.83]	0.9551 [80.77]	0.9554 [80.08]
***Ln*(GCapForm)**	-0.0056 [-0.14]	0.0243 [0.65]	0.0300 [0.82]	-0.0194 [-0.51]	-0.0187 [-0.49]
Ln(mAverschool)	-0.0458 [-1.24]				
Ln(mAverschoolqua)		0.0064 [0.23]			
Ln(NGD)	-0.1482 [-2.33]	-0.1627 [-2.65]	-0.1379 [-2.51]	-0.1588 [-2.48]	-0.1603 [-2.53]
*Lag*1*Ln*(Inflation)			-0.0182 [-2.50]	-0.0246 [-2.88]	-0.0247 [-2.89]
Constant	0.0208 [0.12]	0.1097 [0.62]	0.1525 [0.86]	0.1236 [0.62]	0.1175 [0.60]
F test Pr > F	2215.44 [0.000]	2334.19 [0.000]	2535.67 [0.000]	2331.93 [0.000]	2336.3 [0.000]
Sargan test Pr > chi2	115.2 [0.100]	110.85 [0.159]	127.28 [0.060]	88.5 [0.137]	88.48 [0.137]
AR(1) Pr > z	-3.59 [0.000]	-4.06 [0.000]	-4.77 [0.000]	-4.94 [0.000]	-4.94 [0.000]
AR(2) Pr > z	1.51 [0.132]	1.67 [0.094]	1.58 [0.114]	1.77 [0.076]	1.78 [0.075]
Observations	177	174	177	155	155
Groups	29	28	28	27	27
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 6a
Conditional convergence estimates
(Heston-Summers corrected physical capital investment)
Non-OECD countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr)	1.0031	0.9817	1.0042	0.9932	0.9892
	[54.49]	[58.33]	[55.10]	[69.25]	[69.17]
***Ln*(CapFis)**	0.1223	0.1238	0.0803	0.1007	0.0933
	[5.40]	[5.11]	[3.08]	[3.54]	[3.02]
Ln(mAverschool)	-0.0643				
	[-1.87]				
Ln(mAverschoolqua)		-0.0048			
		[-0.17]			
Ln(NGD)	-0.3439	-0.4371	-0.3543	-0.4092	-0.4156
	[-3.51]	[-3.57]	[-3.92]	[-3.17]	[-2.84]
*Lag*1*Ln*(Inflation)			-0.0153	-0.0131	-0.0093
			[-2.20]	[-1.24]	[-0.83]
Constant	-0.5087	-0.6598	-0.6902	-0.7198	-0.7302
	[-1.70]	[-1.79]	[-2.24]	[-2.04]	[-1.90]
F test	2139.93	1996.57	1327.46	2164.65	2159.34
Pr > F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sargan test	126.85	129.52	130.92	85.76	85.20
Pr > chi2	[0.023]	[0.015]	[0.038]	[0.186]	[0.197]
AR(1)	-4.39	-4.11	-4.65	-3.70	-3.59
Pr > z	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.30	-1.12	-2.33	-1.83	-1.62
Pr > z	[0.195]	[0.264]	[0.020]	[0.068]	[0.104]
Observations	384	357	402	282	263
Groups	64	58	90	64	58
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 6b
Conditional convergence estimates
(World Bank physical capital investment)
Non-OECD countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr)	1.0158 [58.45]	0.9940 [58.02]	1.0000 [59.30]	0.9952 [82.95]	0.9887 [76.42]
***Ln*(GCapForm)**	0.1505 [4.28]	0.1549 [3.98]	0.0912 [2.52]	0.1397 [3.37]	0.1328 [3.07]
Ln(mAverschool)	-0.0863 [-2.46]				
Ln(mAverschoolqua)		-0.0182 [-0.59]			
Ln(NGD)	-0.3935 [-3.96]	-0.5441 [-4.60]	-0.2824 [-3.62]	-0.3223 [-2.79]	-0.3568 [-2.85]
*Lag*1*Ln*(Inflation)			-0.0170 [-2.44]	-0.0162 [-1.73]	-0.0179 [-1.85]
Constant	-0.7303 [-2.38]	-1.0325 [-2.79]	-0.4968 [-1.76]	-0.4965 [-1.55]	-0.5403 [-1.56]
F test Pr > F	1796.18 [0.000]	1802.68 [0.000]	1245.60 [0.000]	2336.58 [0.000]	2184.62 [0.000]
Sargan test Pr > chi2	116.66 [0.085]	126.87 [0.023]	149.99 [0.002]	95.22 [0.058]	92.38 [0.084]
AR(1) Pr > z	-4.47 [0.000]	-4.48 [0.000]	-4.22 [0.000]	-4.18 [0.000]	-4.13 [0.000]
AR(2) Pr > z	-1.84 [0.066]	-1.76 [0.079]	-2.50 [0.013]	-1.74 [0.082]	-1.58 [0.114]
Observations	400	369	419	293	273
Groups	70	61	97	66	60
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 7a
Conditional convergence estimates
(Heston-Summers corrected physical capital investment)
Non-oil countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1 *Ln*(GDPwr)	0.9853 [60.04]	0.9597 [60.59]	0.9719 [86.19]	0.9689 [88.58]	0.9683 [81.28]
***Ln*(CapFis)**	0.1425 [6.48]	0.1552 [6.85]	0.1076 [4.63]	0.1043 [4.04]	0.0966 [3.48]
Ln(mAverschool)	-0.0871 [-2.87]				
Ln(mAverschoolqua)		-0.0265 [-1.02]			
Ln(NGD)	-0.3536 [-4.40]	-0.4702 [-5.42]	-0.3144 [-4.79]	-0.3586 [-3.71]	-0.3373 [-3.41]
*Lag*1*Ln*(Inflation)			-0.0147 [-2.70]	-0.0169 [-1.96]	-0.0161 [-1.74]
Constant	-0.3261 [-1.60]	-0.4872 [-2.14]	-0.2826 [-1.53]	-0.3857 [-1.79]	-0.3410 [-1.61]
F test Pr > F	5301.59 [0.000]	5262.51 [0.000]	6780.6 [0.000]	9999.56 [0.000]	10696.51 [0.000]
Sargan test Pr > chi2	142.84 [0.002]	135.66 [0.006]	155.26 [0.001]	88.73 [0.133]	92.21 [0.086]
AR(1) Pr > z	-5.95 [0.000]	-5.50 [0.000]	-6.01 [0.000]	-5.33 [0.000]	-5.28 [0.000]
AR(2) Pr > z	-0.86 [0.387]	-0.69 [0.493]	-1.60 [0.110]	-1.15 [0.251]	-0.91 [0.360]
Observations	564	534	577	432	413
Groups	92	85	116	90	84
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 7b
Conditional convergence estimates
(World Bank physical capital investment)
Non-OECD countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr)	1.0280 [70.49]	0.9985 [64.45]	0.9958 [131.05]	0.9889 [121.35]	0.9861 [110.78]
***Ln*(GCapForm)**	0.1607 [5.22]	0.1888 [5.87]	0.1328 [4.44]	0.1423 [4.27]	0.1367 [3.97]
Ln(mAverschool)	-0.1287 [-4.14]				
Ln(mAverschoolqua)		-0.0553 [-2.00]			
Ln(NGD)	-0.3034 [-3.61]	-0.4759 [-5.32]	-0.2578 [-4.00]	-0.2709 [-2.93]	-0.2542 [-2.72]
*Lag*1*Ln*(Inflation)			-0.0172 [-3.16]	-0.0239 [-3.11]	-0.0234 [-2.95]
Constant	-0.5243 [-2.56]	-0.8018 [-3.52]	-0.3383 [-2.15]	-0.2939 [-1.46]	-0.2356 [-1.19]
F test Pr > F	4963.81 [0.000]	5425.99 [0.000]	7240.31 [0.000]	10141.72 [0.000]	11057.38 [0.000]
Sargan test Pr > chi2	122.77 [0.040]	125.98 [0.026]	149.09 [0.002]	91.99 [0.089]	91.76 [0.091]
AR(1) Pr > z	-6.29 [0.000]	-6.34 [0.000]	-6.68 [0.000]	-6.38 [0.000]	-6.34 [0.000]
AR(2) Pr > z	-0.69 [0.488]	-0.38 [0.702]	-1.27 [0.205]	-0.78 [0.433]	-0.59 [0.556]
Observations	565	531	578	439	419
Groups	96	86	121	91	85
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 8a
Conditional convergence estimates
(Heston-Summers corrected physical capital investment)
Non-EU (15) countries only

Dependent Variable: *Ln*(GDP per worker)

	GMM (1)	GMM (2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1 *Ln*(GDPwr)	1.0006 [49.77]	0.9753 [51.38]	0.9811 [68.21]	0.9801 [83.81]	0.9781 [77.53]
***Ln*(CapFis)**	0.1363 [5.69]	0.1430 [5.89]	0.0979 [3.74]	0.1005 [3.62]	0.0922 [3.07]
Ln(mAverschool)	-0.0826 [-2.42]				
Ln(mAverschoolqua)		-0.0190 [-0.66]			
Ln(NGD)	-0.2668 [-3.05]	-0.3598 [-3.67]	-0.2952 [-3.94]	-0.2976 [-3.00]	-0.2978 [-2.80]
*Lag*1*Ln*(Inflation)			-0.0148 [-2.38]	-0.0165 [-1.80]	-0.0153 [-1.54]
Constant	-0.2409 [-0.99]	-0.3579 [-1.27]	-0.3235 [-1.43]	-0.3244 [-1.37]	-0.3278 [-1.33]
F test Pr > F	2807.91 [0.000]	2754.35 [0.000]	3029.38 [0.000]	5632.10 [0.000]	5789.1 [0.000]
Sargan test Pr > chi2	128.02 [0.019]	128.48 [0.018]	134.89 [0.022]	77.8 [0.390]	79.05 [0.352]
AR(1) Pr > z	-5.32 [0.000]	-4.98 [0.000]	-5.47 [0.000]	-4.65 [0.000]	-4.56 [0.000]
AR(2) Pr > z	-0.84 [0.402]	-0.67 [0.504]	-1.92 [0.055]	-1.19 [0.235]	-0.96 [0.336]
Observations	473	443	484	355	336
Groups	79	72	103	77	71
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

Table 8b
Conditional convergence estimates
(World Bank physical capital investment)
Non-EU (15) countries only

Dependent variable: *Ln*(GDP per worker)

	GMM (1)	GMM(2)	GMM (3)	GMM (4)	GMM (5)
*Lag*1*Ln*(GDPwr)	1.0208 [62.79]	0.9936 [60.80]	1.0026 [90.94]	0.9916 [114.09]	0.9860 [104.01]
***Ln*(GCapForm)**	0.1673 [4.93]	0.1751 [4.85]	0.1089 [3.17]	0.1400 [3.65]	0.1368 [3.41]
Ln(mAverschool)	-0.1004 [-2.92]				
Ln(mAverschoolqua)		-0.0270 [-0.91]			
Ln(NGD)	-0.3411 [-4.09]	-0.4373 [-4.78]	-0.2726 [-3.98]	-0.2859 [-3.13]	-0.2944 [-3.11]
*Lag*1*Ln*(Inflation)			-0.0170 [-2.67]	-0.0226 [-2.64]	-0.0237 [-2.63]
Constant	-0.5907 [-2.42]	-0.7142 [-2.54]	-0.4684 [-2.29]	-0.3597 [-1.57]	-0.3377 [-1.44]
F test Pr > F	2914.76 [0.000]	3149.87 [0.000]	2679.94 [0.000]	5353.29 [0.000]	5425.45 [0.000]
Sargan test Pr > chi2	129.09 [0.016]	140.35 [0.003]	152.42 [0.001]	92.89 [0.079]	91.23 [0.098]
AR(1) Pr > z	-5.46 [0.000]	-5.44 [0.000]	-5.21 [0.000]	-5.16 [0.000]	-5.11 [0.000]
AR(2) Pr > z	-1.25 [0.209]	-1.12 [0.265]	-1.95 [0.051]	-1.07 [0.286]	-0.88 [0.381]
Observations	488	454	499	366	346
Groups	85	75	110	79	73
Instruments	102	102	109	80	80

Notes: See notes to Table 4a.

References

Adriani, F., G. Marini, and P. Scaramozzino (2003). 'The Inflationary Consequences of a Currency Hangover: Evidence from the Michelin Red Guide'. *CEIS Tor Vergata Research Paper Series*, 9 (27). Rome: Centre of International Studies on Economic Growth, University of Rome Tor Vergata.

Arellano, M., and S. Bond (1991). 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations'. *Review of Economic Studies*, 58: 277-97.

Arellano, M., and O. Bover (1995). 'Another Look at the Instrumental Variable Estimation of Error-Components Models'. *Journal of Econometrics*, 68 (1): 29-51.

Bagella, M., L. Becchetti, G. Corrado, and M. Gomellini (1998). 'Quali Spazi per l'Introduzione di Titoli ad Indicizzazione Reale?'. *Economia Italiana*, 2: 417-88.

Barro, R. J., and D. B. Gordon (1983). 'A Positive Theory of Monetary Policy in a Natural Rate Model'. *Journal of Political Economy*, 91 (4): 589-610.

Barro, R. J., and J.-W. Lee (2000). 'International Data on Educational Attainment Updates and Implications'. NBER Working Paper No. 7911. Cambridge, MA: National Bureau of Economic Research.

Bernanke, B. S., and R. S. Gurkaynak (2001). 'Is Growth Exogenous? Taking Mankiw Romer and Weil Seriously'. NBER Working Paper No. W8365. Cambridge, MA: National Bureau of Economic Research.

Blundell R., and S. Bond (1998). 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models'. *Journal of Econometrics*, 87 (1): 115-43.

Bond, S., A. Hoeffler, and J. Temple (2001). 'GMM Estimation of Empirical Growth Models'. Discussion Paper No. 01/525. Bristol: University of Bristol

Brischetto, A., and G. De Brouwer (1999). 'Householders' Inflation Expectations'. RBA Research Discussion Paper No. 1999-03. Sydney: Reserve Bank of Australia.

Bruno, M., and W. Easterly (1998). 'Inflation Crises and Long-Run Growth'. *Journal of Monetary Economics,* 41 (1): 3-26.

Bryan, M. F., and G. Ventaku (2001). 'The Demographics of Inflation Opinion Surveys'. Federal Reserve Bank of Cleveland Economic Commentary, 15 October. Cleveland.

Chari, V. V., P. J. Kehoe, and E. C. Prescott (1989). 'Time Consistency and Policy', in R. J. Barro (ed.), *Modern Business Cycle Theory*. Cambridge, MA: Harvard University Press, 265-305.

Cukierman, A., P. Kalaitzidakis, L. H. Summers, and S. B. Webb (1993). 'Central Bank Independence, Growth, Investment, and Real Rates'. *Carnegie-Rochester Conference Series on Public Policy*, 39: 95-140.

De Gregorio, J. (1992). 'The Effects of Inflation on Economic Growth: Lessons from Latin America.' *European Economic Review*, 36 (2-3): 417-24.

De Gregorio, J. (1993). 'Inflation, Taxation and Long-Run Growth'. *Journal of Monetary Economics*, 31 (3): 271-98.

Fischer, S. (1993). 'The Role of Macroeconomic Factors in Growth'. *Journal of Monetary Economics*, 32 (3): 485-512.

Grimes, A. (1991). 'The Effects of Inflation on Growth: Some International Evidence'. *Weltwirtschaftliches Archiv*, 127 (4): 631-44.

Hanushek, E. A., and D. D. Kimko (2000). 'Schooling, Labour-Force Quality, and the Growth of Nations'. *American Economic Review*, 90 (5): 1184-208.

Harberger, A. (1998). 'Monetary and Fiscal Policy for Equitable Economic Growth', in V. Tanzi and K.-Y. Chu (eds), *Income Distribution and High-Quality Growth.* Cambridge, MA: MIT Press.

Heston, A., and R. Summers (1991). 'The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988'. *Quarterly Journal of Economics*, 106 (2): 327-68.

Heston, A., and R. Summers (1996). 'International Price and Quantity Comparisons: Potentials and Pitfalls'. *American Economic Review*, 86 (2): 20-4.

Idson, T., and C. Miller (1997). 'The Implications of Demographic-Specific Inflation Rates for Trends in Real Educational Wage Differentials'. *Journal of Business & Economic Statistics*, 15 (4): 464-9.

Islam, N. (1995). 'Growth Empirics: A Panel Data Approach'. *Quarterly Journal of Economics*, 110 (4): 1127-69.

Kormendi, R. C., and P. G. Meguire (1985). 'Macroeconomic Determinants of Growth: Cross-Country Evidence'. *Journal of Monetary Economics*, 16 (September): 141-63.

Lombardelli, C., and J. Saleheen (2003). 'Public Expectations of UK Inflation'. *Bank of England Quarterly Bulletin*, 43.

McTaggart, D. (1992). 'The Cost of Inflation in Australia', in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy*. Sydney: Ambassador Press.

Mankiw, N. G., D. Romer, and D. Weil (1992). 'A Contribution to the Empirics of Economic Growth'. *Quarterly Journal of Economics*, 107 (2): 407-37.

McAllen, B. (1997). 'Crucial Issues Concerning Central Bank Independence'. *Journal of Monetary Economics*, 39 (1): 99-112.

Pecchi, L., and G. Piga (1999). 'The Politics of Index-Linked Bonds'. *Economics and Politics*, 11 (2): 201-12.

Piga, G. (2000). 'Dependent and Accountable: Evidence from the Modern Theory of Central Banking'. *Journal of Economic Surveys*, 14 (5): 563-95.

Pindyck, R. S., and A. Solimano (1993). 'Economic Instability and Aggregate Investment. *NBER Macroeconomics Annual 1993*. Cambridge, MA: MIT Press, 259-303.

Rogoff, K. (1985). 'The Optimal Degree of Commitment to an Intermediate Monetary Target'. *Quarterly Journal of Economics*, 100 (November): 1169-89.

Rudebusch, G. D., and D. W. Wilcox (1994). 'Productivity and Inflation: Evidence and Interpretations'. Washington, DC: Federal Reserve Board. Mimeo.

Schultz, T. P. (1988). 'Education Investments and Returns', in H. Chenery and T. N. Srinivasan (eds), *Handbook of Development Economics*. Amsterdam: North Holland.

Smyth, D. J. (1994). 'Inflation and Growth'. *Journal of Macroeconomics*, 16 (2): 261-70.

Solow, R. M. (1956). 'A Contribution to the Theory of Economic Growth'. *Quarterly Journal of Economics*, 70 (1): 65-94.

Stanners, W. (1993). 'Is Low Inflation an Important Condition for High Growth?'. *Cambridge Journal of Economics*, 17 (1): 79-107.

Wossmann, L. (2003). 'Specifying Human Capital'. *Journal of Economic Surveys*, 17 (3): 239-70.