The circular relationship between productivity growth and real interest rates

A Bergeaud G Cette R Lecat

American Economic Association Annual Meeting
San Diego - 5 Jan 2020

Outline

Outline

Motivation: a general productivity slowdown

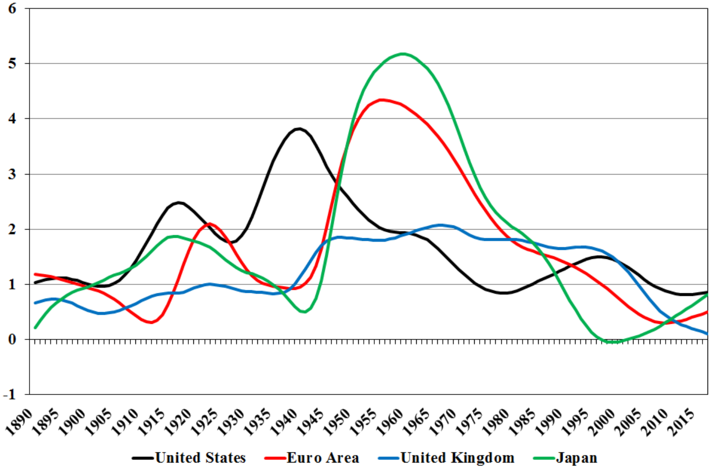


Figure: Smoothed growth rate of total factor productivity in the Euro Area, USA, JP and UK. Source: Bergeaud, Cette and Lecat (2016) (www.longtermproductivity.com)

Motivation: a general productivity slowdown

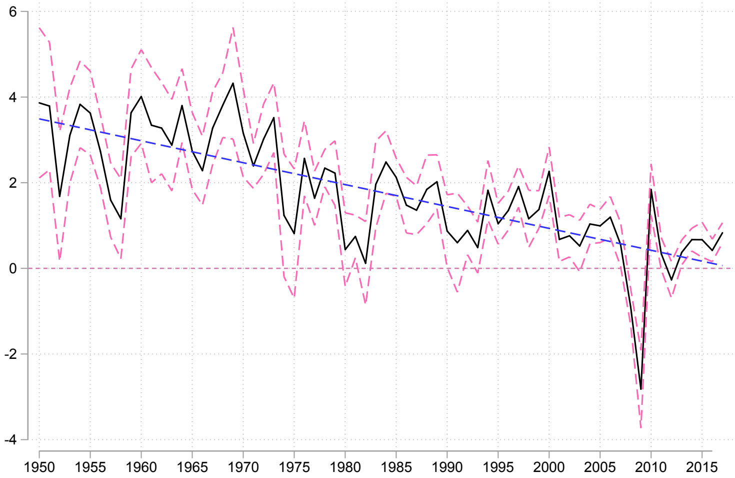


Figure: Evolution of TFP growth rates for the median of our 17 OECD countries (and inter Q range). Source: Bergeaud et al. (2016)

A general productivity slowdown

Possible explanations for the slowdown (among others):

- Productivity growth is mismeasured (Aghion et al., 2018a, Byrne et al., 2016...)
- Ideas harder to get (Bloom et al., 2017)
- The age of great invention is over (Gordon)
- Rising Market power $\longrightarrow$ reduced competition and increasing concentration (Aghion et al., 2019b; Akcigit and Ates, 2018, Liu et al. 2018...)

A general productivity slowdown

Possible explanations for the slowdown (among others):

- Productivity growth is mismeasured (Aghion et al., 2018a, Byrne et al., 2016...)
- Ideas harder to get (Bloom et al., 2017)
- The age of great invention is over (Gordon)
- Rising Market power $\longrightarrow$ reduced competition and increasing concentration (Aghion et al., 2019b; Akcigit and Ates, 2018, Liu et al. 2018...)
- In this paper, we study another mechanism
  - There exists a positive circular relationship between interest rates (r) and productivity growth (g)
  - $g \longrightarrow r$: potential output key driver of return on capital and therefore long term interest rates
  - $r \longrightarrow g$: interest rates are also a determinant of the minimum expected return from investment projects
    - Productivity level required for such an investment
    - Cleansing mechanism as in Aghion et al. (2019a, ABCLM)

Declining interest rates

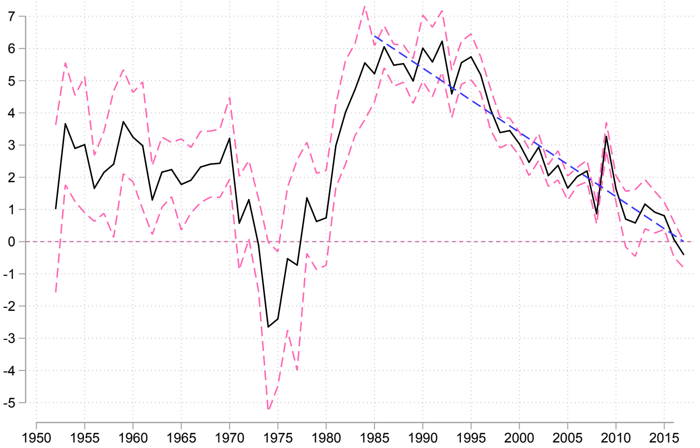
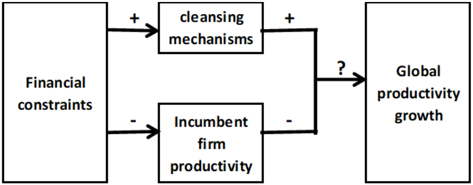


Figure: Evolution of real interest rates for the median of our 17 OECD countries (and inter Q range). Source: OECD

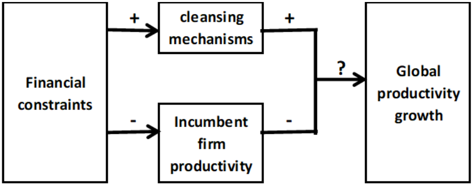
Aghion et al. (2019a) - ABCLM

- Positive effect of financial development and easing credit access on growth is well known. Shown empirically by e.g. Manaresi and Pierri (2017)
- On the other hand, if credit is *too easy*, this may create a negative misallocation effect on growth (Gropp et al., 2016).
- We combine these two approaches in a unifying framework.



Aghion et al. (2019a) - ABCLM

- Positive effect of financial development and easing credit access on growth is well known. Shown empirically by e.g. Manaresi and Pierri (2017)
- On the other hand, if credit is *too easy*, this may create a negative misallocation effect on growth (Gropp et al., 2016).
- We combine these two approaches in a unifying framework.



- Which effect dominates depends on the level of credit constraints. Overall, the cleansing mechanism dominates

What we do

- Country level analysis over the period 1950-2017
- Formal test of the circular relationship
  - Interest rate equation: $r_{i,t} = f(r_{i,t-1}, g_{i,t}, X_{i,t})$
  - TFP equation: $g_{i,t} = h(g_{i,t-1}, r_{i,t-1}, Z_{i,t})$
  - X measures financial conditions, Z contains catch-up, technology...
  - We show that $\partial f/\partial g > 0$ and $\partial h/\partial r > 0$
- Without any technological shock, the economy converges to a model with low growth and low interest rates $\longrightarrow$ secular stagnation
- From reduced form coefficients, we simulate the effect of a technological shock in the US

Outline

Dataset

- 17 OECD countries with yearly data from 1950
- Mostly western European countries (France, Germany, Spain, Italy) + USA, UK, Japan etc...
- TFP growth is taken from Bergeaud et al. (2016) $\longrightarrow$ Solow Residual
- Real interest rates taken from Jorda et al. (2018)
- Other covariates taken from various sources: life expectancy, relative investment price, inflation volatility...

Outline

Empirical model

- We estimate a circular dynamic model

$$\begin{cases} g_{i,t} &= a g_{i,t-1} + b r_{i,t-1} + C' X_{i,t} + \varepsilon_{i,t} \\ r_{i,t} &= \alpha g_{i,t} + \beta r_{i,t-1} + \Gamma' Z_{i,t} + \eta_{i,t} \end{cases} \quad (1)$$

- We are interested in the values of α and b and their long-term counterparts: $\alpha/(1-\beta)$ and $b/(1-a)$
- α corresponds to the marginal effect of a change in the growth rate of TFP on the contemporaneous change of interest rates
- b corresponds to the marginal effect of a lagged change in interest rates on the productivity growth rate.
- We expect both α and b to be positive

Choice of covariates X and Z

- In X we want to capture the normal long-run dynamics of productivity growth (i.e. without any change in interest rates).
  - Relative price of investment at the frontier (and to countries close to it) to measure the overall level of technology
  - Catch-up for non frontier countries
  - Variation of human capital (education, life expectancy...)
- In Z, we want to capture the dynamics of real-interest rates
  - Volatility of past inflation
  - Uncertainty of economic policy
  - Age structure

Estimations

- We start by estimating the two equations separately
- Problem of endogeneity if errors are serially correlated
- Hence we use GMM
  - Instrument real-interest rates by the past realization of nominal interest rates
  - Instrument TFP using past values of ICT coefficient and electricity consumption per capita
  - Consistent estimation results
- Hence we develop simultaneous equations
  - Consistent results

Simultaneous estimations

- Estimation of the full system to account for feedback effects
- We consider that the system of equation displays contemporaneous cross-equation error correlation $\longrightarrow$ seemingly unrelated regression system (Zellner, 1962).
- We estimate this system using an iterative GLS method
- Magnitude: a 1 pp increases in r raises g by 0.065 pp. $\longrightarrow$ 5 pp decreases in r since 1985 implies -0.3 pp of TFP growth.

Simultaneous estimation: results

Estimator	SURE (1)	SURE (2)	SURE (3)
	Panel A: dependent variable: $g_{i,t}$		
$g_{i,t-1}$	0.228***	0.223***	0.226***
	(0.028)	(0.028)	(0.028)
$r_{i,t-1}$	0.035*	0.051**	0.050**
	(0.021)	(0.021)	(0.021)
Catch-up	-5.657***	-5.025***	-4.961***
	(0.476)	(0.453)	(0.447)
Variation in Relat. Price	-0.188***	-0.087*	-0.187*
	(0.041)	(0.046)	(0.103)
Variation in educ	8.147***	7.430***	7.252***
	(1.296)	(1.299)	(1.287)
Variation in Life Exp.	0.184	0.181	0.196
	(0.181)	(0.183)	(0.183)
	Panel B: dependent variable: $r_{i,t}$		
$r_{i,t-1}$	0.705***	0.704***	0.704***
	(0.021)	(0.021)	(0.021)
$g_{i,t}$	0.055**	0.064**	0.068**
	(0.027)	(0.027)	(0.027)
Age Dep Ratio	-0.043***	-0.043***	-0.043***
	(0.011)	(0.011)	(0.011)
Inflation Volat.	0.022***	0.022***	0.022***
	(0.005)	(0.005)	(0.005)
Policy Instability	0.076	0.077	0.077
	(0.052)	(0.052)	(0.052)
R^2	0.255	0.245	0.245
Observations	1105	1105	1105

Outline

Simulation

- We take the coefficients from the simultaneous estimations (col 2)
- We simulate a technological shock that translates through relative price of investment
  - Same length and magnitude as the ICT shock
- This shock will directly affect the TFP of the economies that are close to the frontier. Other economies then catch-up
- The shock also indirectly affects real-interest rates

Shock

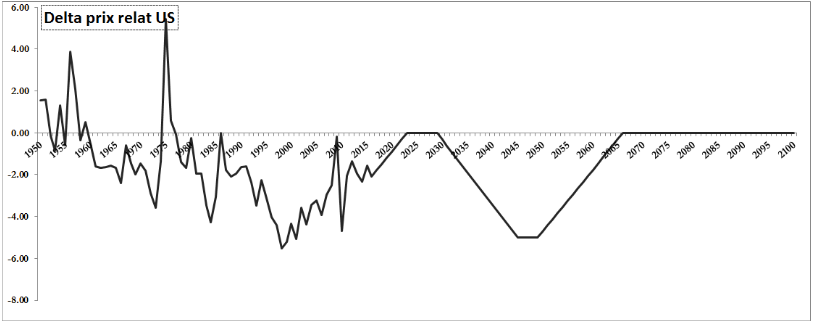


Figure: Variations in relative IT price with respect to GDP price and projections. Source: BEA and authors' calculation

Results

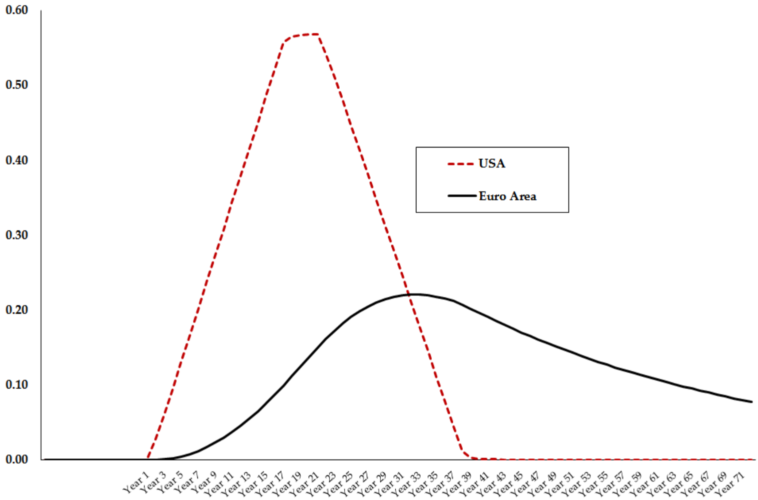


Figure: Simulation results in the Euro Area and in the US for a shock in the US. Response of the growth rate of TFP g (as difference with baseline without shock) in pp.

Results

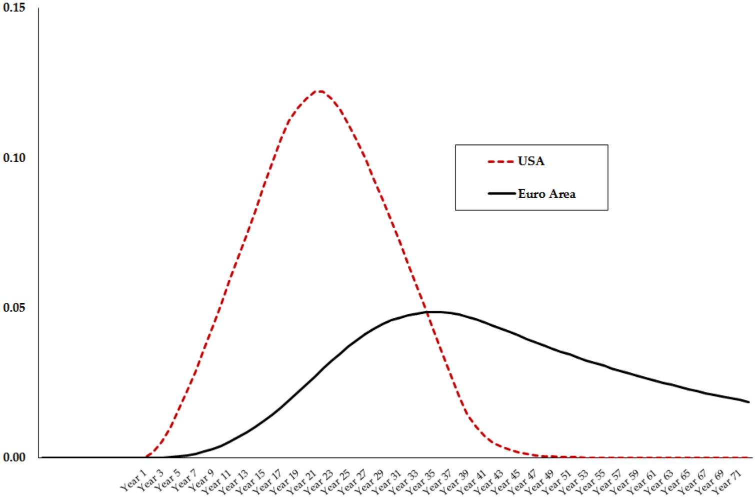


Figure: Simulation results in the Euro Area and in the US for a shock in the US. Response of the real interest rate r (as difference with baseline without shock) in pp.

Discussion

- Without any positive technology or education shocks, the equation system converges towards a low TFP growth/low real interest rate equilibrium
- A low cleansing intensity leads to the survival of low productivity firms thanks to low real interest rates
  - Real interest rates are maintained low by the population ageing
- A positive impact through an increase in average years of education of the working age population can be foreseen only for a limited number of countries
- Only a technological shock would allow to escape the secular stagnation trap
- The shock we simulate is smaller than other shocks during the 20th century. It could stem from a second IT wave

Outline

Introduction

Background and Data

Circular Relationship

Simulation

Conclusion

Conclusion

- We have emphasized a positive circular relationship between r and g
- A downward pressure on r negatively impacts TFP growth (cleansing) which negatively affects r and so on...
- In our model, only a technological shock, that would shift g exogenously can allow OECD countries to escape secular stagnation trap
  - Such shock can come from the diffusion of new technologies (AI, self-driving cars...)
  - Such shock would affect first frontier economies, and then others by the convergence dynamics
- We illustrate this thanks to a realistic (but conservative) simulation

BACK-UP SLIDES

Comovement

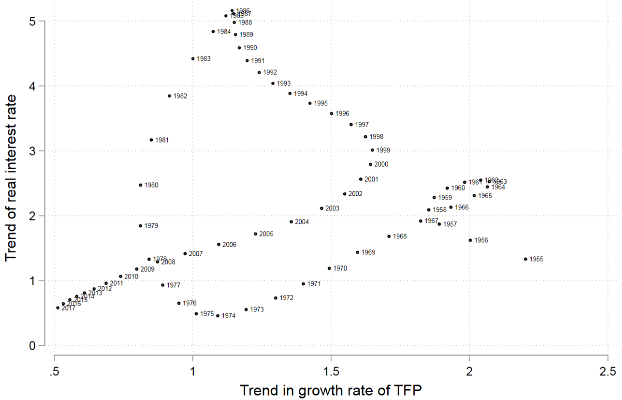


Figure: Coevolution of real interest rates and growth rate of TFP in the USA since 1955

Motivation

- How can we explain this comovement between r and g?
- Positive effect from g to r is clear:
  - In the long-run, the ratio of capital to output ratio is roughly constant, thus $\downarrow$ (expected) growth $\implies$ $\downarrow$ demand for investment
  - Literature survey from Marx et al. (2017)
- Positive effect from r to g is less known.
  - Relaxation of credit allows low productive firms to survive
  - Negative impact on business dynamism and thus on growth
  - If r is low enough, this effect dominates the positive investment effect of reducing credit constraints
  - To show this $\longrightarrow$ Schumpeterian model (ABCLM)
  - Cleansing effect dominates

Quick glance at the model

- Standard version of Schumpeterian growth a la Klette and Kortum (2004)

$$g = (z_e + z_i) ln(\gamma),$$

- z_e and z_i depend upon γ, the number of scientists ψ, the size of the population L, the Poisson innovation rate of innovation $\frac{1}{\eta}$, a scale parameter ζ and the discount rate ρ

$$z_e = \frac{\gamma - 1}{\gamma} \frac{L}{\psi} - \frac{1}{\eta} \left(\frac{\psi}{\eta\zeta} \right)^{\frac{1}{\eta - 1}} - \frac{\rho}{\gamma} \quad (2)$$

$$z_i = \left(\frac{\psi}{\eta\zeta} \right)^{\frac{1}{\eta - 1}} . \quad (3)$$

Quick glance at the model

- We introduce credit constraints in a stylized way: firms cannot invest more than μ times their current market value.
  - Condition not binding for entrants
- This yields:

$$z_e = \frac{\gamma - 1}{\gamma}\frac{L}{\psi} - \mu - \frac{\rho}{\gamma} \tag{4}$$

$$z_i = \left(\frac{\mu\psi}{\zeta}\right)^{\frac{1}{\eta}} \tag{5}$$

- μ captures the inverse of the tightness of credit constraints in the economy (evolve with $-r$)

hox

Quick glance at the model

- If μ is large enough $\uparrow$ credit constraints $\implies$ $\uparrow$ growth by increasing the contribution of entrants (z_e) relatively more than it reduces the contribution of incumbents to growth (z_i)
- $$\frac{dg}{d\mu} = -ln(\gamma_e) + \frac{\psi}{\zeta\eta}\left(\frac{\mu\psi}{\zeta}\right)^{\frac{1}{\eta}-1} ln(\gamma_i) < 0,$$
  if $\mu > \left(\frac{\psi}{\zeta}\right)^{\frac{1}{\eta-1}} \left(\frac{ln(\gamma_i)}{ln(\gamma_e)\eta}\right)^{\frac{\eta}{\eta-1}}$.
- This relationship shows how decreasing real interest rates can negatively impact growth through a reallocation effect if the level of credit constraints is already low enough
- On the contrary, if μ is close to 0, a fall in real interest rates reduces the cost of capital and spurs corporate investment

Separate estimations: TFP equation

Dependent variable: $g_{i,t}$						
Estimator	OLS	GMM	OLS	GMM	OLS	GMM
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$g_{i,t-1}$	0.214***	0.204***	0.210***	0.202***	0.214***	0.206***
	(0.036)	(0.036)	(0.035)	(0.036)	(0.036)	(0.037)
$r_{i,t-1}$	0.042*	0.123**	0.056**	0.118*	0.054**	0.113*
	(0.023)	(0.061)	(0.024)	(0.062)	(0.025)	(0.066)
Catch-up	-6.026***	-5.945***	-5.428***	-5.446***	-5.366***	-5.395***
	(0.595)	(0.601)	(0.559)	(0.578)	(0.543)	(0.563)
Variation in Relat. Price	-0.174***	-0.134**	-0.088**	-0.059	-0.197**	-0.128
	(0.049)	(0.056)	(0.036)	(0.044)	(0.092)	(0.118)
Variation in educ.	7.953***	8.013***	7.335***	7.432***	7.163***	7.292***
	(1.339)	(1.364)	(1.296)	(1.300)	(1.270)	(1.276)
Variation in Life Exp.	0.308	0.337	0.291	0.321	0.304	0.328
	(0.289)	(0.291)	(0.292)	(0.292)	(0.291)	(0.291)
R^2	0.273	0.263	0.264	0.258	0.264	0.259
Observations	1122	1122	1122	1122	1122	1122
KP LM stat. p-val.		0.000		0.000		0.000
KP Wald F-stat.		50.191		45.114		39.999

$^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Magnitude

- The median real interest rate in our sample declined from 5.2% in 1985 to 0.5% at the end of the period.
- Over the same period, median TFP growth declined from 2.5% to 0.5%
- 0.7 percentage point of the decline in TFP growth or 35% of the slowdown could be attributed to the decrease in interest rates
- Education has the expected magnitude (7-10% increases in TFP when the average education duration in the working age population increases by 1 year)
- Catch-up coefficient involves a convergence speed of around 5% per year

Separate estimations: interest rate equation

Dependent variable: $r_{i,t}$					
Estimator	OLS	GMM	GMM	GMM	GMM
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$r_{i,t-1}$	0.705***	0.692***	0.691***	0.690***	0.697***
	(0.040)	(0.040)	(0.039)	(0.041)	(0.040)
$g_{i,t}$	0.103***	0.112	0.121*	0.218***	0.208***
	(0.032)	(0.088)	(0.073)	(0.070)	(0.068)
Age Dep Ratio	-0.048***	-0.048***	-0.050***	-0.064***	-0.060***
	(0.014)	(0.017)	(0.014)	(0.016)	(0.015)
Inflation Volat.	0.125*	0.106	0.105	0.109	0.120
	(0.074)	(0.076)	(0.076)	(0.076)	(0.074)
Policy Instability	0.071	0.084	0.083	0.089	0.095
	(0.065)	(0.067)	(0.067)	(0.068)	(0.067)
R^2	0.540	0.527	0.527	0.530	0.531
Observations	1122	1088	1088	1056	1056
KP LM stat. p-val.		0.000	0.000	0.000	0.000
KP Wald F-stat.		46.588	47.917	125.583	63.217
Hansen-J p-val.			0.842		0.478

Magnitude

- Given a 0.7 autoregressive coefficient and a 0.1 TFP coefficient, the long run impact of a 1 pp increase in TFP on the level of interest rates is about 0.3 pp.
- A higher age dependency ratio, which could lead to an increased supply of savings, weighs on interest rates: a 1pp increase in the age dependency decreases TFP by about 0.07pp in the long run.
  - demography exerts a continuous downward pressure on long-term real interest rates as this ratio is expected to increase in the next decades