Financial Literacy, Human Capital and Long-Run Economic Growth

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Motivation

"...The recent crisis demonstrated the critical importance of financial literacy and good financial decisionmaking, both for the economic welfare of households and for the soundness and stability of the system as a whole. [...] The Federal Reserve recognizes that informed, educated consumers not only achieve better outcomes for themselves but, through careful shopping for and use of financial products, help to increase market efficiency and innovation." (Bernanke, 2011)

Motivation

"Since the early 1980s, the growth of the financial sector has been strongly biased toward highly skilled individuals [...] Some individuals, who would have become engineers in the 1960s, now become financier. (...) Financial and Non-Financial sectors compete for the same scarce supply of human capital." (Philippon, 2010)

- **When is it growth-enhancing to push financial education for all?**

Contents

Theoretical Macroeconomic Literature

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- Theoretical macroeconomic literature $\Rightarrow$ many contributions have investigated the possible theoretical **effects of financial development** on economic growth.

Empirical Literature

- Empirical macro literature (e.g. Benveniste et al., 1993, Pagano, 1993 and Levine, 1997) on the two ways for the financial system to become more efficient, through **bigger size** = more savings to be intermediated, and through **higher efficiency** = higher return generated on every intermediated unit of savings;
- Empirical Micro literature study the determinants of profitability of banks (volume and ratio) — e.g. Berger and Mester (1997), Delis et al. (2020) — as well as efficiency (TFP) of banks — e.g. Berger and Mester (1997, 2003).

Effects of Financial Literacy

- Several papers extensively document the importance of FL for economic and financial outcomes at the **micro** level (Guiso and Jappelli, 2008; Calvet et al., 2009; Christelis et al., 2010; Yoong 2011; Van Rooij et al., 2011; Von Gaudecker, 2015; Clark et al., 2017; Deuflhard et al., 2019);
- Some works provide evidence of a positive link between FL, savings decisions and wealth accumulation (Ameriks et al., 2003, Lusardi and Mitchell, 2007, and Jappelli and Padula, 2013). The most influential paper in this area is the one by Lusardi et al. (2017), who are the first to assess the importance of financial knowledge for **wealth inequality**.

Our Contribution

- Differently from the existing literature, we explicitly allow **both** Human Capital and Financial Literacy to impact the efficiency of the banking (Financial Intermediation) sector, as e.g. Bernanke (2011) argues.
- Financial Literacy is knowledge specific to the financial world, similar to general knowledge but not producing consumption good.

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- Households maximize intertemporal utility subject to the evolution of physical capital k_t, human capital h_t, and the resources constraint:

$$c_t + s_t = w_t(u_t h_t) + r_t^b s_t + \pi_t^{bank}$$

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by determining consumption $c_t > 0$ and the shares of human capital to employ in the production of the final consumption good, $0 < u_t < 1$;
- Households' welfare is the infinite discounted sum of the instantaneous utilities, being $\beta \in (0, 1)$ the discount factor. The representative agent's instantaneous utility function depends on consumption, $u(c_t) = \ln(c_t)$.

Production

$$y_t = k_t^{\alpha}(u_t h_t)^{1-\alpha} \tag{1}$$

- where $0 < \alpha < 1$ is the physical capital share, and output can be either consumed or saved and invested in physical capital accumulation.

Human Capital Accumulation

$$h_{t+1} = b(1 - u_t - \nu_t)h_t \tag{2}$$

- where $b > 1$ measures the productivity of education in human capital formation.

Financial Literacy Accumulation

$$a_{t+1} = (\nu_t h_t)^{1-\xi} a_t^{\xi} \tag{3}$$

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- with $0 < \xi < 1$ measuring the elasticity of financial literacy production with respect to its existing stock;
- The acquisition of new financial literacy therefore combines its existing stock with the allocated share of human capital, $\nu_t h_t$;
- Different from human capital, financial literacy is not an input in the production of the final good and thus it has no effect on output.

Physical Capital Accumulation and Intermediation

All agents collectively own the banks. Therefore, the representative agent budget constraint is:

$$c_t + s_t = w_t(u_t h_t) + r_t^b s_t + \pi_t^{bank} \tag{4}$$

where:
r_b is the buying price of a unit of saving and,
π_t^{bank} is the representative bank's profit.

Physical Capital Accumulation and Intermediation

The dynamic evolution of physical capital reads as:

$$k_{t+1} = (y_t - c_t)F_t \quad (5)$$

$$F_t = k_t^{\eta_k} h_t^{\eta_h} a_t^{\eta_a} u_t^{\eta_u} \nu_t^{\eta_\nu} \quad (6)$$

- If $F > 1$, at least for some values of $(k_t, h_t, a_t, u_t, \nu_t)$, the representative bank may be able to earn a positive return on capital invested;
- If $F = 1$ for every $(k_t, h_t, a_t, \nu_t, u_t)$, and our model reduces to a standard multisector endogenous growth model (see for example La Torre et al., 2015).

More on Intermediation (banks)

Banks do not consume and simply distribute all their profits to agents in every period. The representative bank buys input s_t from agents at every period t at price r_t^b and sell output k_t to firms at the competitive rate $r_t = \frac{\partial y_t}{\partial k_t} = \alpha \frac{y_t}{k_t}$, earning

$$\pi_t^{bank} = r_t k_t - r_t^b s_t \tag{7}$$

where, from (5), $k_t = s_{t-1} F_{t-1}$. By substituting (7) into (4) one obtains

$$s_t = w_t(u_t h_t) + r_t k_t - c_t$$

Social Planner Problem

$$\max_{\{c_t,u_t,\nu_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \ln(c_t) \tag{8}$$

$$\begin{aligned} s.t. \qquad y_t &= k_t^{\alpha}(u_t h_t)^{1-\alpha} \\ k_{t+1} &= (y_t - c_t)\left(k_t^{\eta_k} h_t^{\eta_h} a_t^{\eta_a} u_t^{\eta_u} \nu_t^{\eta_\nu}\right) \\ h_{t+1} &= b(1 - u_t - \nu_t)h_t \\ a_{t+1} &= (\nu_t h_t)^{1-\xi} a_t^{\xi} \\ k_0, h_0, a_0 &> 0 \end{aligned}$$

As long as $\eta_a > 0$ and $\eta_\nu > 0$, financial literacy affects the returns on savings, i.e. the efficiency of the banking system, and therefore physical capital accumulation.

Proposition 1

- if $F_t = 1$ we obtain the standard U-L solution: $s = \alpha\beta y$ and $u = 1 - \beta$, constant across time;
- if $F_t > 1$, financial sector' efficiency increases with k, h, a and the relative magnitude of elasticities η_h and $\eta_u + \eta_v$ matters:

  $\eta_h < \eta_u + \eta_v$ investment in new Financial Literacy partially offsets the investment in new human capital

  $\eta_h > \eta_u + \eta_v$ the presence of the financial sector provides incentives to further accumulate human capital

Proposition 2

The financial sector and financial literacy have an effect on long run economic growth through their impact on:

- the growth rate of human capital, γ_h (**human capital channel**)
- the dynamics of the efficiency term F (**financial literacy channel**)

If F increases through time, then the relative size of different economic sectors changes through time.

Financial knowledge as an externality

1. At our knowledge no estimations of the banking profit functions, using decentralized databases, includes financial knowledge as a determinant (e.g. Berger and Mester, 2003 for US banks; Velliscig et al., 2023 for European Banks);
2. Financial literacy seems to be constant/decrease in the past few years in the US:

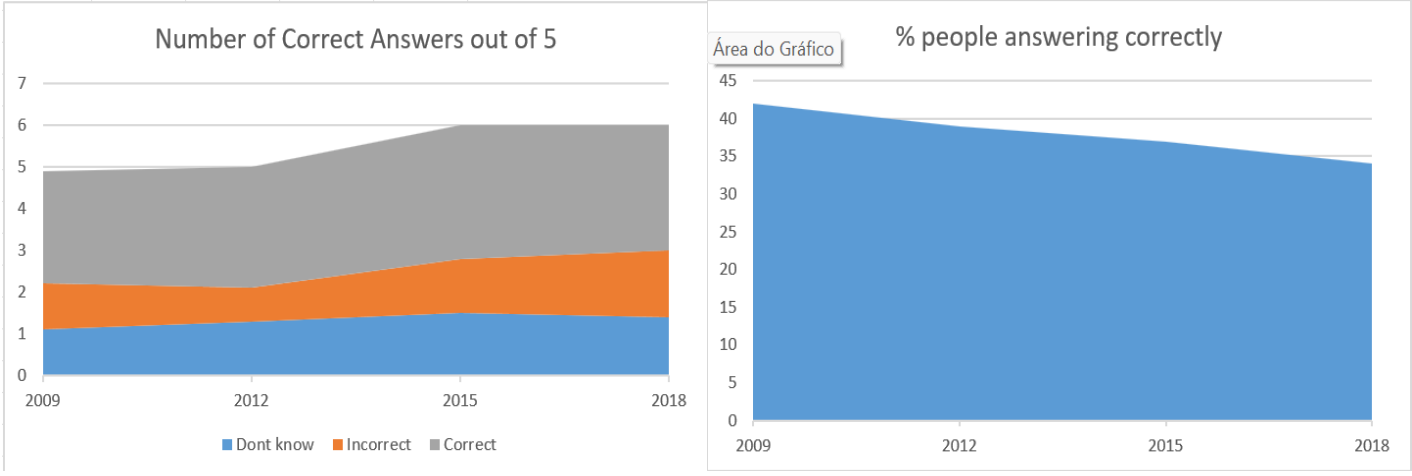

Figure: Financial Literacy does not increase. Data from FINRA - Investor Education Foundation, The State of U.S. Financial Capability

Motivation: human capital has a secular increase

1. In the US there is a steady growth of human capital since there is data on human capital (e.g. Barro and Lee, 2000; Cohen and Sotto, 2007);
2. According to Cohen and Sotto (2007) among others there is a positive effect of human capital on economic growth.

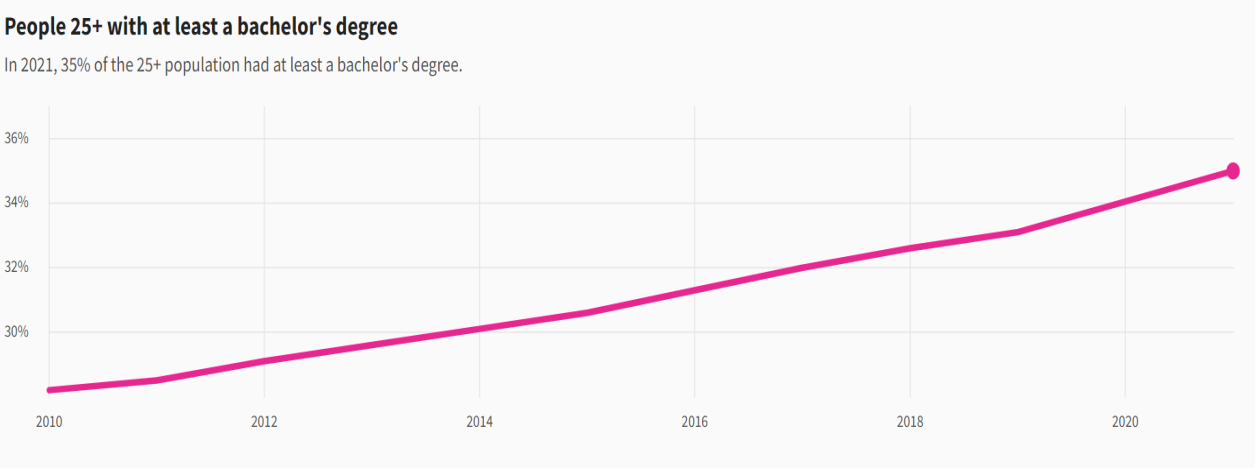

Figure: Human capital in the US (Census Data)

Decentralized Equilibrium

The representative agent considers that fin lit does not affect the financial sector efficiency. Her problem therefore reads as:

$$\max_{\{c_t,u_t,\nu_t\}_{t=0}^{\infty}} \quad \sum_{t=0}^{\infty} \beta^t \ln(c_t) \tag{9}$$

$$\begin{aligned} k_{t+1} &= (w_t(u_t h_t) + r_t k_t - c_t) FF_t \\ y_t &= k_t^{\alpha}(u_t h_t)^{1-\alpha} \\ FF_t &= k_t^{\eta_k} h_t^{\eta_h} u_t^{\eta_u} \\ h_{t+1} &= b(1 - u_t - \nu_t) h_t; \;\; k_0, h_0, a_0 > 0 \end{aligned}$$

Proposition 4

Let $\eta_i \geq 0$ *for all* $i = \{k, h, a, u, \nu\}$. If $\eta_k \leq \frac{1-\alpha}{\beta}$ *then:*

i)

$$c_t = \frac{1-\alpha\beta-\beta\eta_k}{1-\beta\eta_k} y_t = \frac{1-\alpha\beta-\beta\eta_k}{1-\beta\eta_k} k_t^{\alpha} \left(\overline{u}^{DE} h_t\right)^{1-\alpha} \quad (10)$$

$$u_t = \overline{u}^{DE} = 1 - \beta\Theta' \quad (11)$$

$$\nu_t = \overline{\nu}^{DE} = 0 \quad (12)$$

where:

$$\Theta' = \frac{(1-\alpha)(1-\beta\eta_k)+\alpha\beta\eta_h}{(1-\alpha)(1-\beta\eta_k)+\alpha\beta^2\eta_h+\alpha\beta(1-\beta)\eta_u} \quad (13)$$

Proposition 4

ii) The optimal dynamics of physical capital k_{t+1}, human capital h_{t+1} and financial literacy a_{t+1} are given by:

$$k_{t+1} = \frac{\alpha\beta}{1-\beta\eta_k} y_t FF_t \quad (14)$$

$$h_{t+1} = b(1-\overline{u})h_t \quad (15)$$

$$a_{t+1} = a_t = a_0 \quad (16)$$

where:

$$FF_t = k_t^{\eta_k} h_t^{\eta_h} u_t^{\eta_u} \quad (17)$$

Interpretation

1. The saving rate of the DE equals the one fixed by the SP: financial literacy does not impact the production sector directly.
2. The representative agent **does not accumulate financial literacy**, $\overline{\nu}^{DE} = 0$, so that the aggregate financial literacy level stays constant across time. Investing in financial literacy is not beneficial for the individual, because she fails to recognize that it increases the return on savings generated by banks.
3. Moreover, $\overline{u}^{DE}$ is also lower than the sum $\overline{u} + \overline{\nu}$ in the SP. This in turn implies that $1 - u - v$ used to produce new human capital is **higher in the DE than in the SP**.

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- The financial sector' efficiency increases at a lower path because there is no financial literacy accumulation;
- The difference between the growth rates of output in DE versus First Best is related to the elasticity η_a.

Calibration Strategy

- From the PWT 10.0 (Feenstra et al., 2015 and Hugget et al., 2006) gross average growth rates of physical capital and human capital 1950-2019 are $\gamma_k = 5.193\%$ and $\gamma_h = 1.67$, respectively. From PWT 10.0 data we also obtain $\gamma_y = 1.98\%$;
- We set α to 0.4 (e.g., Feenstra et. al., 2015), the discount factor β as 0.9524 (Samwick, 1998; Gustman and Steinmeier, 2005; Bozio et al., 2017);
- Berger and Mester (2003) use the variation in TFP from more than 10,000 US banks between 1984 and 1997, as well as the physical capital stocks of those banks in the given years, which allowed us to calculate $\eta_k = 0.1086$.

Calibration Strategy

- In the DE described in Section 4, the representative agent considers $\eta_a = \eta_\nu = 0$, and therefore we impose these values when calibrating our DE equilibrium to the real data.
- As a baseline case, we consider $\eta_u = 0$, which is equivalent to assume that the quota of human capital used for final good production has no direct effect on banks' profitability.
- b and η_h are calculated to match the other values in the data.
- Then, we study how the solution changes with η_u and η_k in the robustness analysis.

Baseline quantitative results

In the baseline case we consider

$$\alpha = 0.4 \quad \beta = 0.9524 \quad \eta_k = 0.1086 \quad \eta_u = 0 \tag{18}$$

Proposition 5 provides three equations in three growth rates:

$$\begin{aligned} 1+\gamma_h &= b\beta\Theta' = 1.0167 \\ 1+\gamma_k &= (1+\gamma_h)^{\frac{1-\alpha+\eta_h}{1-\alpha-\eta_k}} = (1.0167)^{\frac{1-\alpha+\eta_h}{1-\alpha-\eta_k}} \\ 1+\gamma_y &= (1+\gamma_k)^{\alpha}(1+\gamma_h)^{1-\alpha} = (1.0167)^{\alpha\frac{1-\alpha+\eta_h}{1-\alpha-\eta_k}+1-\alpha} \end{aligned}$$

where the unknowns are (b, η_h, η_u). We fix $\eta_u = 0$. Then we obtain:

$$\boxed{\eta_h = 0.11720}; \quad \boxed{b = 1.0636} \tag{19}$$

Interpretation of the baseline results

- for b the obtained value is consistent with Wedel (2021);
- we could not find empirical values for η_h
  - We are not aware of studies investigating the productivity or the efficiency of the banking sector in the US that identify variables that could match human capital definition.

The effect of Financial Literacy on Growth

To quantify the effect of the externality on final output growth, we go back to the solution of the SP in Proposition 2, where possibly $\eta_a > 0$ and $\eta_\nu > 0$, to obtain the growth rates of human capital, γ_h, and of final output γ_y.

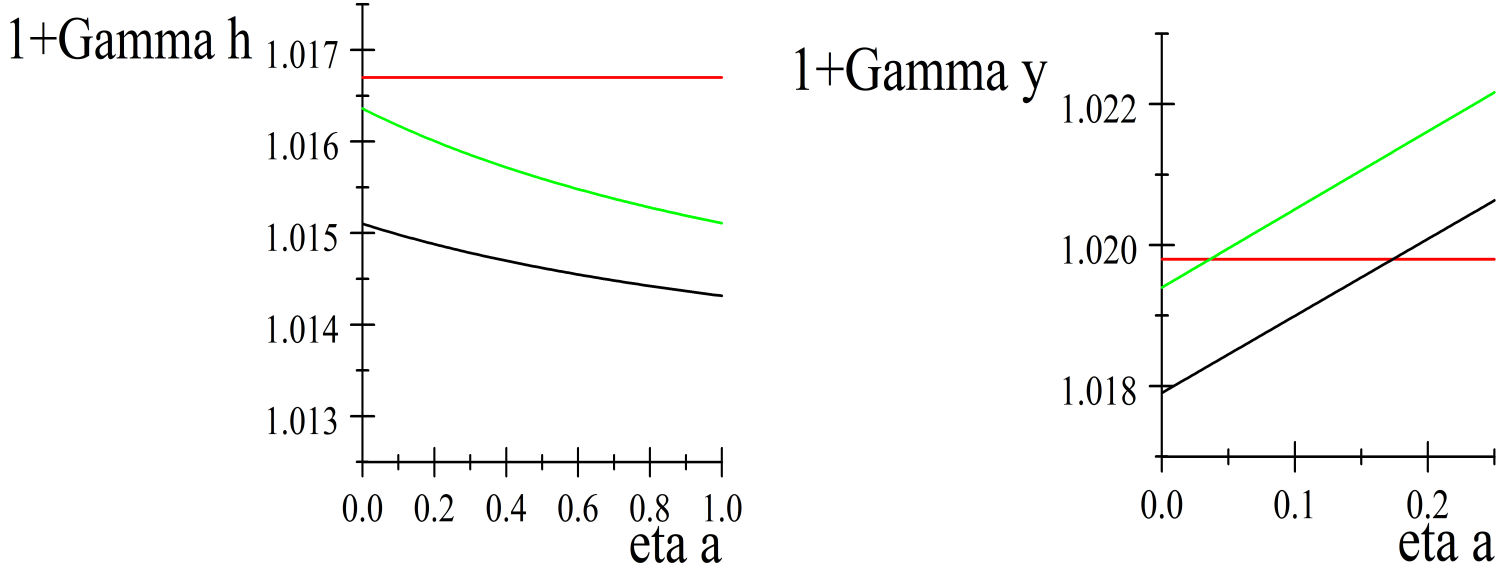

Figure: Baseline effects of increasing η_a. *Red Line* represents the DE. *Green Line* when $\eta_\nu = 0.01$ and *Black Line* when $\eta_\nu = 0.05$.

Interpretation

- Human capital grows faster in the DE than in SP: in the latter solution, the agent uses some of her existing human capital to acquire new Financial Literacy
- this "crowding out" of new Human capital by new Financial Literacy is stronger the higher η_v;
- for the same reason, γ_y is lower when η_v increases;
- As η_a increases, the existing level of Financial literacy positively affects banks' efficiency, and this increases resources for production of the final good, and growth;
- Internalizing a positive effect of financial literacy on the financial sector efficiency stimulates growth, but only if η_a is sufficiently high.

Threshold values of η_a and η_v above which financial literacy stimulates growth

- We obtain the threshold value of η_a (or η_v) above which financial literacy stimulates growth:

η_v	η_a
0	0.000705
0.001	0.00443
0.01	0.03627
0.025	0.08733
0.05	0.1736
0.075	0.26135
0.1	0.35230

Robustness: $\eta_u = 0.05$ and $\eta_u = 0.10$

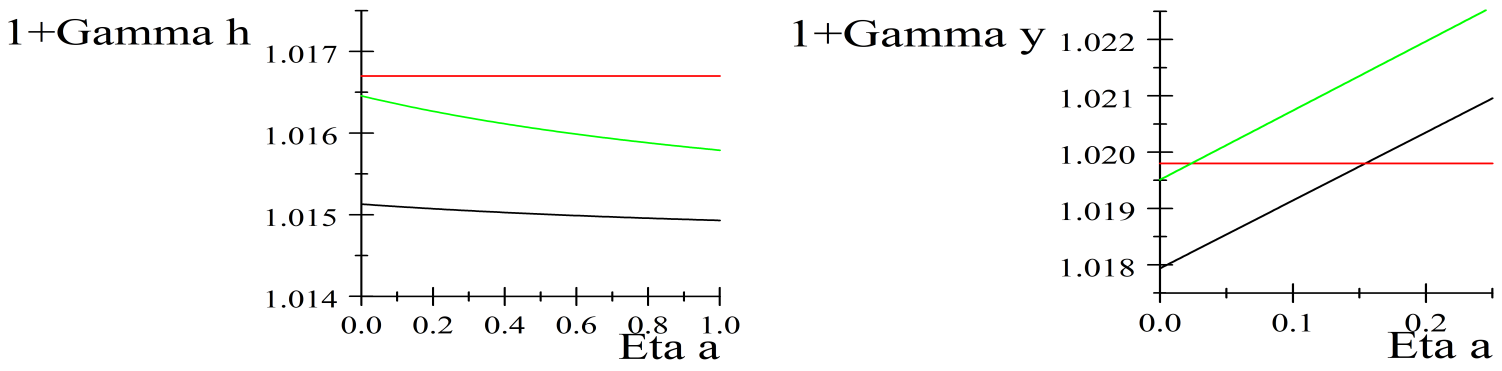

Figure: Robustness check to $\eta_u = 0.05$. *Red Line* represents the DE. *Green Line* when $\eta_\nu = 0.01$ and *Black Line* when $\eta_\nu = 0.05$.

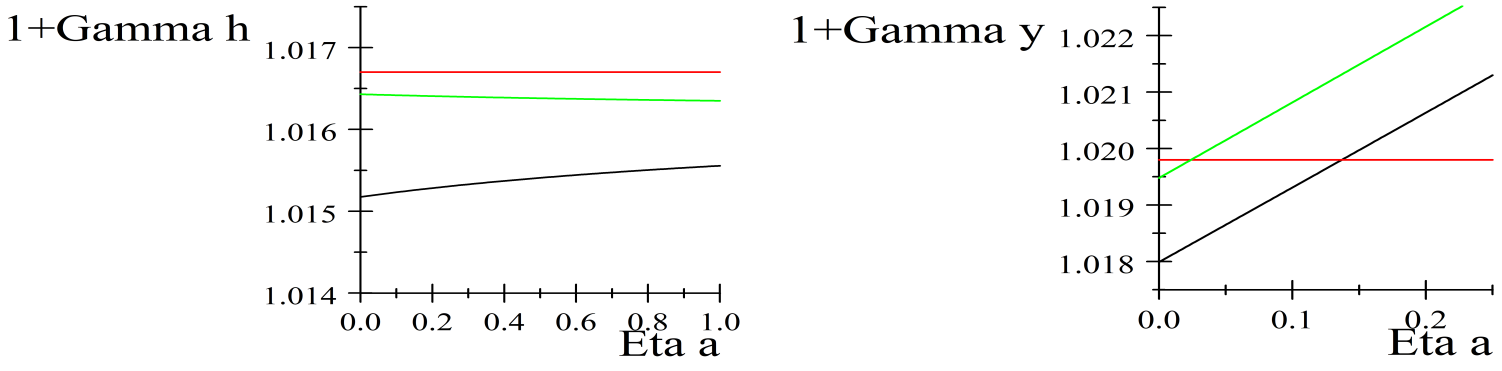

Figure: Robustness check to $\eta_u = 0.10$. *Red Line* represents the DE. *Green Line* when $\eta_\nu = 0.01$ and *Black Line* when $\eta_\nu = 0.05$.

Robustness: $\eta_k = 0.05$ and $\eta_k = 0.15$

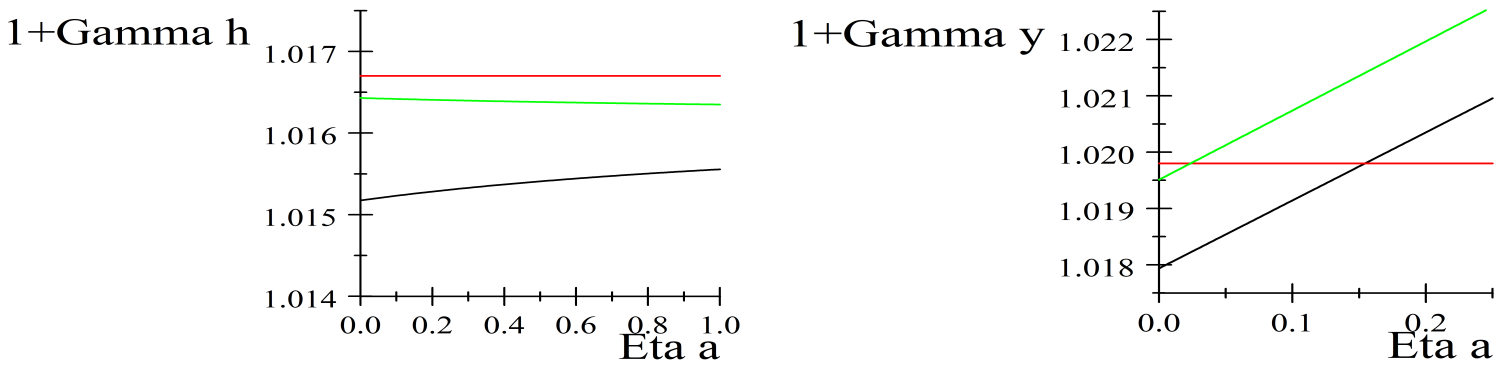

Figure: Robustness check to $\eta_k = 0.05$. *Red Line* represents the DE. *Green Line* when $\eta_\nu = 0.01$ and *Black Line* when $\eta_\nu = 0.05$.

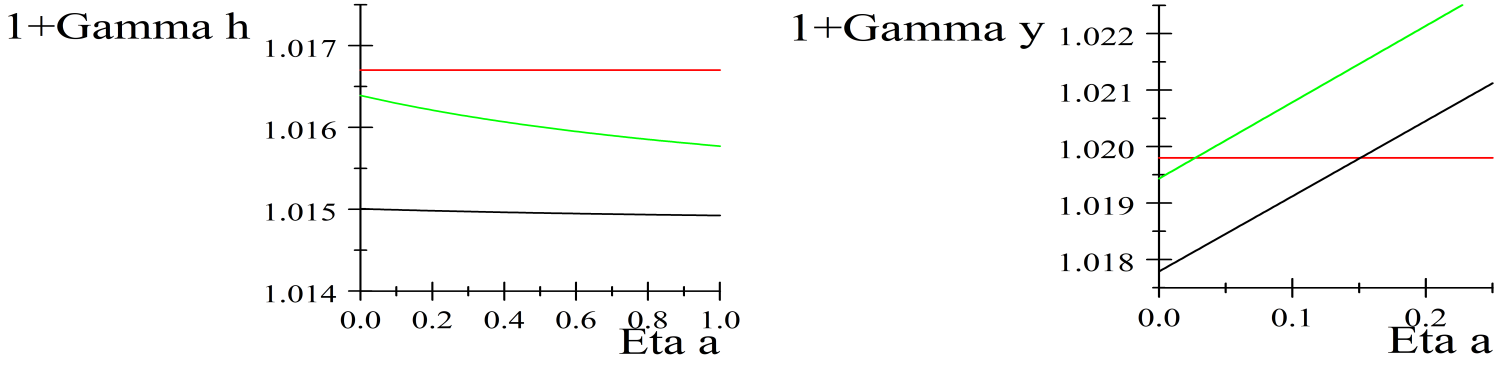

Figure: Robustness check to $\eta_k = 0.15$. *Red Line* represents the DE. *Green Line* when $\eta_\nu = 0.01$ and *Black Line* when $\eta_\nu = 0.05$.

Conclusions

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- We identify two distinct channels through which finance and FL can benefit economic growth, a **"human capital channel"** , and a **"financial literacy channel"** which also highlights the trade-off between investing in human capital or financial literacy;
- In the Second Best, the output growth is lower than in the centralized economy if the elasticity of the financial sector efficiency to the level of FL is sufficiently high;
- The higher the elasticity of the financial sector efficiency function to the newly acquired FL, the less likely it is that, by internalizing the effect of FL on financial sector efficiency, the final output growth rate increases with respect to the centralized solution.

Further Research

Our model emphasizes the importance to quantify the impact of Human Capital and of Financial Literacy on the financial intermediaries' efficiency.