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Abstract

Despite the fact that financial development is recognised as a vital determinant of countries' economic growth path, many empirical studies fail to further isolate the role of socioeconomic indicators on accelerating growth. This study attempts to fill this gap by examining the statistical significance and the behavior of several socioeconomic indicators on economic growth. We apply parametric (System GMM estimators) and semi-parametric techniques along the lines of Baltagi and Li (2002) on a panel data set of 19 EU countries over the period 1995-2017. We test for nonlinear effects on economic growth for three banking indicators (domestic credit, non-performing loans and banking capitalization). In contrast to the related literature, our findings provide sufficient evidence of nonlinear relationships between several aspects of financial development and economic growth. Our results imply significant policy implications for policy makers and regulators in their effort of balancing banking development with a resurgence in economic growth within the EU periphery.

Keywords: Socioeconomic aspects; Growth; Banking development; Semi-parametric analysis; Non-linear effects.

JEL Codes: C14; G20; O11

1. Introduction

Economic theory describes the mechanism in which financial development accelerates economic growth (Mankiw, 1992). Through the last decade given the new methodological advances and the different data samples applied, the cross-country empirical evidence has provided conflicting results on the examined relationship.

Specifically, one strand of literature supports the evidence of strong positive linear effects (see for example Asteriou and Spanos, 2019; Adusei, 2019; Caporale et al, 2015; Loayza and Ranciere, 2006; Ketteni et al, 2007; McCaig and Stengos, 2005; Levine et al, 2000), while other studies by using threshold techniques claim that the relationship between financial development and economic growth is nonlinear (see among others Samargandi et al, 2015; Cecchetti and Kharroubi, 2012; Rioja and Valev 2004a,b; Deidda and Fattouh, 2002). Both approaches have important limitations since the former studies impose a specific functional form, while the latter techniques are sensitive to the threshold variable chosen (endogeneity issues). In other words, most of the exiting studies, rely on parametric regression models that often lead to misspecification of their functional form unless it is correctly specified by the economic theory (Tran and Tsionas, 2010).

To the best of our knowledge, there is a shortage of studies combining socioeconomic indicators with financial development to better exemplify the drivers of economic growth. To this end, our study contributes to the existing literature by adopting for the first time in the empirical literature a semi-parametric fixed effects model described in Baltagi and Li (2002) to properly account for the imposition of possible nonlinear effects on growth. We supplement our analysis by using parametric techniques (GMM estimators) in order to compare and contrast our findings.

The remainder of the paper is organized as follows: Section 2 provides the literature review. Section 3 discusses the theoretical framework of the growth model. Section 4 describes the data and the methodology applied. Section 5 presents the preliminary cross section dependence and stationarity testing along with the existence of a possible cointegration relationship. Section 6 presents the empirical findings, while Section 7 concludes the paper providing some policy implications.

2. Literature Review

The diligent research on the link between financial and economic development in the last two decades has documented mixed results. For example, Christopoulos and Tsionas (2004), King and Levine (1993) and Levine et al. (2000) have contributed a significantly amount of work showing that there is a positive impact of financial development on economic growth. Contrary, Ang and McKibbin (2007), Andersen and Tarp (2003), Levine (2005) and Ang (2008a) have described a slight impact of finance on economic development while further denoting that in many cases it is economic development which leads to a financial development. Both sides could possibly stimulate the policy makers under a thoughtful question: are there any valuable circumstances where financial development could lead to economic growth, i.e., under what kind of policies financial development could be beneficial to economic growth (Yilmazkuday, 2011).

Over the past several years, a significant number of conventional banks in Eurozone adopt more "socially responsible" or "green" strategies for their products or policies. For instance, Deutsche Bank with its "Green IT"[1] and "Go Green"[2] policies, BNP Paribas with its "green" initiatives[3] and many more conventional banks have accelerated these apparently green innovations. The last decade Eurozone tried to implement new regulations for the banking sector in order to prevent any future unpleasant events for the economy. Kaeufer (2010) deems that these

[1] https://www.db.com/cr/en/concrete-green-it.htm
[2] https://www.deutschebank.co.in/go_green.html
[3] https://group.bnpparibas/en/news/green-initiatives-bnp-paribas

regulations are focused on limiting the potential negative impact that the financial sector can have on the real economy. Socially responsible and green banks turn this perspective around with the idea that they can use their unique position in the economic system as leverage for addressing some of the most pressing issues of our time.

According to Weber & Remer (2011) a new era in the banking sector has already come and it has a name, “Social Banking”. Weber & Remer (2011) define social banking as banking that aims to have a positive impact on people, the environment and culture by means of banking, i.e. savings accounts, loans, investments and other banking products and services. Over the past decades, the scope of financing along with social frameworks has significantly modified on an institutional level creating like so a range of new organizations and financial entities (Emerson and Spitzer, 2007; Nicholls and Pharoah, 2007; Nicholls, 2010a, 2010b; Bishop and Green, 2010; SIITF, 2014). As it was expected, new types of capital have been fashioned by new institutions in order to contribute to this arising demand, forming in this way a new social finance market (Spitzer et al., 2007; J.P. Morgan and the GIIN, 2010, 2011, 2013; O’Donohoe et al., 2010; Brown and Norman, 2011; Cabinet Office, 2011; Brown and Swersky, 2012; Cabinet Office, 2012; Harji and Jackson, 2012; Addis et al., 2013; Nicholls, 2013; Clark et al., 2014; Nicholls and Lehner, 2014; Nicholls and Schwartz, 2014).

According to Nicholls et al. (2015), the term social finance includes philanthropic donations; government grants; ‘soft’ return debt and equity; mutual finance; as well as ‘finance first’ and ‘total portfolio’ impact investing strategies. The wide variety of types of capital available in social finance - and the complex set of risk and return calculations attendant on each type - offers opportunities for innovative structured deals and funds that do not exist outside of this sector.

The only way to tackle the problems that are currently afflict the world is to strengthen social business organizations with funds that will emerge from the above capital combinations (Rayner, 2006).

In its simplest terms, social finance refers to the allocation of capital primarily for social and environmental returns, as well as in some cases, a financial return. The Social Investment Taskforce (established at the 2013 G8 Social Impact Investment Forum) defined a key part of this market as "*Social impact investments are those that intentionally target specific social objectives along with a financial return and measure the achievement of both" (SIITF, 2014, p. 1)*

Others have referred to it as 'three-dimensional capital': capital allocated according to conventional, financial, risk and return criteria plus optimizing a given social or environmental return. Such finance has also been referred to as 'blended value investing' (World Economic Forum, 2013, 2014). However, social finance goes beyond being just a new set of 'social' capital return opportunities for investors. As Nicholls and Pharoah (2007, p. 2) noted that social finance is considered as a new ethical way by which money is used and it is at the same time a flow of funding for social impact and a proof that the conventional financial system fails to drive the world to economic development as it concentrates in social inequalities and environmental catastrophe. Thus, social finance adopts the externalities of mainstream investment by setting social and environmental goals. It is both a positive generator of new social and environmental value and a corrective to the negative effects of conventional investing (Nicholls et al., 2015) which ultimately slow down growth.

3. Theoretical framework

Following Mankiw *et al.* (1992) and the relative empirical growth studies (Delgado *et al*., 2014; Henderson, 2010; Maasoumi *et al.*, 2007; Ketteni et al, 2007; Racine *et al.*, 2006; Barro and Sala-i-Martin, 2004; Barro, 1990), we extent the growth Solow model as follows:

$$\ln(GDP_{it}) = a + b_1 HCS_{it} + b_2 \ln(INC_{it}) + b_3 \ln(POP_{it}) + b_4 \ln(GOV_{it}) + b_5 \ln(TRA_{it}) + cX + dZ + \eta_i + \gamma_i + e_{it} \quad (1)$$

where GDP indicates the growth rate of real per capita gross domestic product of country i at time t (dependent variable). HCS denotes the school enrolment used as a proxy to human capital.[4] INC denotes the adjusted net national income per capita. *POP* measures the average annual population growth rate, while GOV denotes the government size. TRA denotes the openness to trade as a percentage of GDP, while $X = \begin{bmatrix} CRE_{it} \\ NPL_{it} \\ BANK_{it} \end{bmatrix}$ represents the vector of the three indicators of financial development. Specifically, CRE_{it} denotes the value of credit by financial intermediaries to the private sector divided by GDP used also in related studies (see for example Ketteni et al, 2007).[5] The relevant variable constitutes the most widely used measure of financial development (Swamy and Dharani, 2018; Arcand et al., 2012; Demetriades and Law, 2006).

The second indicator is the ratio of bank non-performing loans to total gross loans denoted by NPL_{it}. The third indicator ($BANK_{it}$), represents the ratio of bank capital and reserves to total assets. [6]

[4] Gross enrolment ratio 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.
[5] This variable refers to financial resources provided to the private sector by financial corporations, such as loans, purchases of non-equity securities, and trade credits.
[6] Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments.

$Z = \begin{bmatrix} RD_{it} \\ ENER_{it} \\ EMP_{it} \end{bmatrix}$ represents the vector of the socioeconomic variables accounting for the impact of total research and development expenditure (RD_{it}), energy intensity of the economy ($ENER_{it}$) and total employment rate (EMP_{it}). Moreover, n_i is the unit-specific residual that differs between countries but remains constant for any particular country (country dummies), while γ_t captures the time effect (time dummies) and therefore differs across years but is constant for all sample countries in a particular year.

4. Data and Methodology

This section presents the data used in the empirical analysis along with the empirical methodologies (parametric and semi-parametric techniques) used to quantify the determinants of economic growth and the subsequent effect of social banking development.

4.1 Sample selection and variables

We use an unbalanced panel data set for 19 EU countries (N=19) over the period 1995-2017 (T=23).[7] The reason for choosing the specific time period and the countries is strictly dictated by data availability. We must stress thought that many studies on growth use five or three year non-overlapping averages to account for business cycle fluctuations. However, Bassanini et al., (2001) argue that the lack of synchronicity in country business cycles does not purge five-year averages from cyclical effects. Based on that and in alignment with other related studies (see for example Adusei, 2019; Swamy and Dharani, 2018 and Caporale et al, 2015) we use annual estimations. All of the sample variables have been extracted from the World Bank database (World Development Indicators).

[7] The sample countries are the following: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain.

The model employed in this study follows closely the specification of Swamy and Dharani (2018). However, we extend this analysis in multiple ways. First, the aforementioned study does not account for cross-sectional dependence since no relevant tests (Breusch and Pagan, 1980; Pesaran, 2004) are implemented for this purpose. However, one of the additional complications that arise when dealing with panel data compared to the pure time-series case, is the possibility that the variables or the random disturbances are correlated across the panel dimension (Pesaran, 2015). The early literature on unit root and cointegration tests adopted the assumption of no cross-sectional dependence. However, it is common for macro-level data to violate this assumption, which will result in low power and size distortions of tests that assume cross-section independence (Polemis and Tsionas, 2019). For example, cross-section dependence in our data may arise as a result of common unobserved effects due to changes in countries' banking legislation. We tackle this issue by employing the proper tests to investigate the existence of cross-sectional dependence in our sample (CD test). Second, the study of Swamy and Dharani, (2018) does not imply for the effect of human capital on economic growth. We control for this limitation by incorporating the school enrolment ratio as a human capital indicator. Third, in contrast to the relevant study which uses only parametric techniques (GMM estimators) that rely on specific functional form of the growth equation, our study employs a flexible semi-parametric approach (semi-parametric fixed effects model) to quantify the non-linear effects of financial development when socioeconomic indicators (e.g., R&D, energy intensity, etc) enter the parametric part of the model.

The following table reports a complete set of summary statistics for all the variables used in the econometric analysis.

<Insert Table 1 about here>

From the relevant table, it is evident that the sample data are well behaved showing limited variability in relation to the mean of the population, since the values of the coefficient of variation measure are close to zero. By contrast, the variables are not normally distributed, since the relative values of the skewness and kurtosis measures are not zero and three respectively.

4.2 Econometric methodology

In this section, we present the econometric methodology applied for the estimation of the augmented growth equation. We first begin by parametric techniques organised around the instrumental variables estimators (GMM) developed in Arellano and Bond (1991) and Blundell, and Bond, (1998) respectively (Difference GMM estimators and System GMM estimators). We enrich our identification strategy by relying on semi-parametric techniques that do allow some variables to enter non-linearly in the estimated equation. Specifically, we employ the semi-parametric fixed effects model (SPFEM) proposed by Baltagi and Li (2002) to account for the impact of financial development under the presence of social banking variables.

4.2.1 Parametric models

With the intention to examine the dynamic aspects we use dynamic panel data techniques such as Difference Generalised Method of Moments (DIF-GMM) estimators attributed to Arellano and Bond, (1991) and System Generalised Method of Moments (SYS-GMM) estimators proposed by Arellano and Bover (1995) and Blundell and Bond (1998) respectively. The use of the latter is mainly justified as it improves significantly the estimates' accuracy and enlarges efficiency when the lagged dependent variables are considered as poor instruments as in the first-differenced regressors (Greene, 2003, Baltagi, 2002, Abid, 2017). As a consequence, the SYS-GMM gives more robust results than the first-differenced GLS and GMM estimation methods (Bond et al., 2001).

The GMM estimators rely on moments of the form:

$$h(\beta) = \sum_{i=1}^{N} h_i(\beta) = \sum_{i=1}^{N} \Psi_i' u_i'(\beta) \tag{2}$$

where Ψ_i is a $T_i xp$ matrix of instruments for cross section i and $u_i(\beta) = \left(Y_i - f\left(X_{it}, \beta\right)\right)$.

Specifically, GMM minimizes the following quadratic form with respect to β

$$M(\beta) = \left(\sum_{i=1}^{N} \Psi_i' u_i(\beta)\right)' W \left(\sum_{i=1}^{N} \Psi_i' u_i(\beta)\right) = \zeta'(\beta) W \zeta(\beta) \tag{3}$$

where W is a pxp weighting matrix.

The coefficient covariance matrix is estimated as:

$$V(\hat{\beta}) = (G'WG)^{-1}(G'W\Xi WG)(G'WG)^{-1} \tag{4}$$

Where Ξ is estimated as

$$E\left(\zeta_i(\beta)\zeta_i(\beta)'\right) = E\left(\Psi_i' u_i(\beta) u_i(\beta)' \Psi_i\right) \tag{5}$$

And G is a $T_i \times k$ matrix given as:

$$G(\beta) = \left(-\sum_{i=1}^{N} \Psi_i' \nabla f_i(\beta)\right) \tag{6}$$

The weighting of matrix W can be calculated using the White robust covariances, which are given as:

$$\left(\frac{M^*}{M^* - k^*}\right)\left(\sum_t X_t' X_t\right)^{-1}\left(\sum_t X_t' \hat{u}_t \hat{u}_t' X_t\right)\left(\sum_t X_t' X_t\right)^{-1} \tag{7}$$

The first parenthesis is an adjustment to the degrees of freedom relying on the total number of observations; M^* is the total number of stacked observations and k^* the number of estimated parameters. The general form of the equation estimated with panel data dynamic models is one with individual effects like the following:

$$Y_{it} = \lambda_t + \eta_i + \sum_{k=1}^{p} \alpha_k Y_{i(t-k)} + \beta'(L) X_{it} + v_{it} \tag{8}$$

for $i = 1,2, \dots, T$

where λ_t and η_i correspond to specific and individual effects, X_{it} is a vector of explanatory variables, $\beta(L)$ is a vector of associated polynomials in the lag operator and q is the maximum lag length. Identification of the model requires restrictions on the serial correlation of the error term v_{it} and on the properties of the independent variables X_{it} allowing only for MA or white noise errors. If the error term was originally autoregressive, the model is transformed.

Orthogonal deviations as proposed by Arellano and Bond (1988) express each observation as the deviation from the average of future observations in the sample and weight each deviation to standardize the variance:

$$x_{it}^{*} = \left[x_{it} - (x_{i(t+1)} + \dots + x_{iT}) / (T-t) \right] \sqrt{(T-t)} / \sqrt{T-t+1} \tag{9}$$

for $t = 1,2, \dots, T-1$

The $T_i - q$ equations for individual unit i can be written as:

$$Y_i = \delta w_i + d_i \eta_i + v_i \tag{10}$$

Where δ is a parameter vector including α_κ, β and λ; and w_i is a data matrix containing the time series of the lagged endogenous variables, the x' s, and the time dummies. The d_i is a $(T_i - q) \times 1$ vector of ones. Following Arellano and Bond (1998), linear GMM estimators of δ may be computed by the following expression:

$$\widehat{\delta}=\left[\left(\sum_i w_i^{*\prime} Z_i\right)\frac{1}{\frac{1}{N}\sum_i Z_i' H_i Z_i}\left(\sum Z_i' w_i^*\right)\right]^{-1}\left(\sum_i w_i^{*\prime} Z_i\right)\frac{1}{\frac{1}{N}\sum_i Z_i' H_i Z_i}\left(\sum_i Z_i' Y_t^*\right) \tag{11}$$

where w_i^* and Y_i^* denote some transformation of w_i and Y_i such as first differences, orthogonal deviations or levels. Z_i is the matrix of instrumental variables and H_i is an individual specific weighting matrix. We may have one-step estimates, which use some known matrix as the choice for H_i. For a first - difference procedure, the one-step estimator uses H_i, while for orthogonal deviations or for a levels procedure the one-step estimator sets H_i to an identity matrix. If the v_{it} are heteroskedastic, a two-step estimator is used.

4.2.2 Semi Parametric Fixed Effects Model

We estimate a flexible SPFEM following the spirit of Baltagi and Li (2002). Let the model be given by the following equation:

$$y_{it} = a_i + x_{it}^T \beta + w_{it}\gamma + f(z_{it}) + \varepsilon_{it} \tag{12}$$

where $f(z_{it})$ is an unknown function of z_{it}, entering the model in a non-parametric way. Y_{it} is the dependent variable. X_{it} is the vector of exogenous linear regressors, while the *w*-vector includes the year dummy variables. Lastly, ε_{it} are zero mean i.i.d. innovations.

Following Baltagi and Li (2002), we approximate $f(z_{it})$ by series differences $p^K(z_{it})$ where the latter are the first k terms of a sequence of functions $[p_1(z), p_2(z), \dots]$ [. By taking first differences in order to remove fixed effects, we end up with the following equation:

$$\Delta(y_i) = \Delta(x_i^T)\beta + \Delta(w_i)\gamma + \Delta\{p^k(z_t)\}\delta + \Delta(\varepsilon_t) \tag{13}$$

Eq. 13 can be estimated by using OLS. In the next step, we use the fitted fixed effects $\hat{a}_i$ in order to estimate the error component residual of Eq.13. Thus we have:

$$\hat{u}_{it} = y_{it} - x_{it}^T \hat{\beta} - w_{it}\hat{\gamma} - \hat{a}_i = f(z_{it}) + \varepsilon_{it} \tag{14}$$

In this case, we could estimate $f(z_{it})$ using a nonparametric estimator based on a kernel local polynomial fit or spline interpolation. We use the latter approach (B-spline of order K=4) since it better approximates complex shapes and does not suffer from Runge's phenomenon (Newson, 2012).

5. Preliminary testing

This section, presents the necessary diagnostic checks to account for cross section dependence and unit root testing along with the existence of possible cointegrated relationships. We begin by checking for cross-section dependence, which is a common problem when we are dealing with panel data. We supplement our analysis by applying "*second generation*" unit root tests and panel cointegration testing properly dealing with cross-section dependence in unbalanced panel data sets.

5.1 Cross section dependence

Before proceeding to unit root and cointegration tests we test for cross-section dependence. We use the cross-section dependence test (CD test) proposed by Pesaran (2004). The test is based on the estimation of the linear panel model of the following form:

$$y_{it} = \alpha_i + \beta_i' x_{it} + u_{it}, \;\; i = 1,..N; T = 1,..T \tag{15}$$

where T and N are the time and panel dimensions respectively, α_i the provincial-specific intercept, and x_{it} a $k \times 1$ vector of regressors, and u_{it} the random disturbance term. The null hypothesis in both tests assumes the existence of cross-section correlation: $Cov(u_{it}, u_{jt}) = 0$ for all t and for all $i \neq j$. This is tested against the alternative hypothesis that $Cov(u_{it}, u_{jt}) \neq 0$ for at least one pair of i and j. CD test is a type of Lagrange-Multiplier test that is based on the errors obtained from estimating Eq. 16 by the OLS method.

<Insert Table 2 about here>

As it is evident from Table 2, CD test strongly rejects the null hypothesis of cross-section independence for all the sample variables. In face of this evidence, we proceed to test for unit roots using the so-called "s*econd generation*" tests for unit roots in panel data that are robust to cross-section dependence (see Pesaran, 2015).

5.2 Panel Unit Root Tests

To examine the stationarity properties of the variables in our models we use the second generation panel unit root tests developed by Maddala and Wu (1999) and Pesaran (2003) both suitable for unbalanced panel data set and cross-section dependence.

The former, which is a Fisher type test, combines the p-values from N independent unit root tests and on these p-values, it assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Unlike other tests (see for example Im-Pesaran-Shin or CIPS tests) the Fisher's test does not require a balanced panel as in this case. The latter (PESCADF) is based on the mean of individual Dickey Fuller (DF) or Augmented Dickey Fuller (ADF) t-statistics of each unit in the panel. To eliminate the cross dependence, the standard DF (or ADF) regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series (CADF statistics). This test allows to avoid size distortions, especially in the case of models with residual serial correlations and linear trends (Pesaran, 2003).

<Insert Table 3 about here>

Table 3 presents the results from the unit root testing along with the bootstrapped P-values. As it is evident, the null hypothesis of a unit root (non-stationarity) cannot be rejected for all the sample variables.[8] This means that the variables contain a unit root (e.g., integrated of order one) as expected by the visual inspection of their time series.

5.3 Panel Cointegration Testing

In order to investigate whether a long-run equilibrium relationship exists among the sample variables we implement Pedroni's (1999) ADF-based and PP-based cointegration tests as well as Kao's (1999) ADF-based tests. All these tests allow for cross-section dependence and are suitable for an unbalanced panel data (Pedroni, 2000; 2001). This is the reason for not using the error-correction-based panel cointegration tests proposed by Westerlund (2007) broadly applied in similar empirical studies (see Fotis and Polemis, 2018).

Both tests suggest the rejection of the null hypothesis of no cointegration null at any significance level.[9] This means that cointegration statistics provide sufficient evidence to support the existence of a structural relationship between the level of economic growth and the rest of covariates.

[8] However, in one case (lnBANK), the Pesaran ADF test rejects the non-stationarity hypothesis at α=0,10 level of statistical significance. We must stress though that the Fisher type test cannot reject the null hypothesis and therefore we rely on the latter to infer about the stationarity properties of this variable.
[9] To preserve space, the results are available from the authors upon request.

6. Results and discussion

In the previous section we found evidence in favor of cointegration. Hence, our next step is to estimate the (long-run) equilibrium growth relationship. We must stress thought that using simple OLS to estimate the cointegrating relation will lead to bias in the estimated coefficients unless all of the explanatory variables are strongly exogenous. Therefore, due to severe econometric problems, cross-sectional data using standard OLS estimation methods that predict the finance–growth nexus are unreliable (see Barro, 1991; Christopoulos and Tsionas, 2004; Beck et al, 2012).

Furthermore, other OLS estimators that remove the endogeneity bias such as the Fully-Modified OLS (Pedroni, 2000) or the Dynamic OLS (Kao and Chiang, 2000) are inadequate for our data since they assume cross-section independence, which does not hold in this study (see Section 4.1). As Pesaran and Smith (1995) point out, other traditional methods for estimating pooled models such as the Fixed Effects can produce very misleading estimates of the average values of the parameters in panel data models unless the slope coefficients are in fact identical.

For this reason, we rely on parametric estimation techniques that use the instrumental variables estimators (GMM) proposed by Arellano and Bond (1991) and Blundell and Bond, (1998). Moreover, we supplement our empirical analysis with semi-parametric techniques (SPFEM) that do allow some variables to enter non-linearly in the model.

We begin by estimating the parametric (baseline) model described in Eq. 1 expressed in linear and nonlinear form. To effectively tackle with endogeneity between financial development and growth, we adopt the instrumental variable approach using GMM estimators (see Swamy and Dharani, 2018; Caporale et al, 2015; Ketteni et al, 2007; McCaig and Stengos, 2005).

Given the nature of the underlying model, we would expect a fixed effects model to be more appropriate than a random effects model. This could be attributed to the fact that the fixed effects static model avoids the potential biases which could arise in the random effects model owing to correlation between the included exogenous variables and omitted country attributes (Cubbin and Stern, 2006; Polemis, 2016). However, we tested this assumption using the Hausman test and the random effects model was consistently rejected in favour of a fixed effects model.[10]

Regarding the non-linear specifications of the GMM model (see Columns 4-6 of Table 4), all the estimated coefficients are statistically significant and have the anticipated signs. The effect of human capital on growth appears to be non-linear in all of the cases. This finding contradicts earlier studies (Ahsan and Haque, 2017; Henderson, 2010; Delgado et al, 2014) where the insignificant impact on growth is argued. Moreover, the effect of income is (INC) is positive in all of the specifications as supported by the existing literature (see among others Swamy and Dharani, 2018; Caporale et al, 2015). Financial development when significant (see columns 4 and 5) is negatively correlated with the level of economic growth. This is not confirmed by earlier studies (Ketteni et al, 2007; Loayza and Ranciere, 2006; Levine et al, 2000) where they argue that domestic credit (CRE) which is mostly used as a proxy for financial development is positively and statistically significant correlated with economic growth. However, we argue that the impact of non-performing loans (NPL) on economic growth is also negative, which calls for future regulatory intervention by the European Central Bank (ECB) in order to mitigate its distorting effects to the EU economy. The three main variables of interest (RD, ENER and EMP) which capture the socioeconomic impact on growth when significant exhibit a negative correlation with economic development. Specifically, all the estimated coefficients of energy intensity (ENER),

[10] The results are available upon request.

are statistically significant and negative ranging from -0.860 to -0.506. This indicates that energy penetration to the EU economy (as a percentage of GDP), increases the level of greenhouse gas emissions (GHG) resulting in an economic downturn.

<Insert Table 4 about here>

Next we apply the Hardle and Mammen (1993) specification test to assess if the nonparametric fit can be approximated by a parametric adjustment of a second order polynomial. The reason for setting the polynomial order to two instead of other higher order (three or four) stems from the fact that previous studies such as Ketteni, et al, (2007) uncover quadratic effects of financial development on growth when initial per capita income and human capital enter in a non-monotonic way.

The test results suggest that all parametric specifications of Eq. 1 are rejected with p-values of 0.000 in all cases. We thus proceed to estimate the SPFEM by allowing the financial development variables (CRE, NPL and BANK) to enter non-parametrically, while we also account for possible nonlinear effects (third degree polynomial) of human capital on growth suggested by other studies (Jones, 2014; Ketteni et al, 2007; Mamuneas, et al, 2006; Kalaitzidakis et al, 2001).

As it is evident, nearly all of the variables are statistically significant and properly signed. Specifically, our findings support the work by several studies (see for example Azariadis and Drazen, 1990; Kalaitzidakis *et al.*, 2001; Temple, 2001; Racine *et al.*, 2006; Maasoumi *et al.*, 2007; Henderson, 2010, Delgado *et al.*, 2014) dignifying that the effect of human capital has a nonlinear effect on countries' economic growth rates. In other words, a "*sideways-S*" relationship is revealed, since the estimated coefficients in all of the three specifications (see Columns 1-3) of the polynomial cubic form alternate their signs starting from negative to positive and back to negative. Moreover, we observe a positive and significant effect (at 1% level of significance) of income (lnINC) on economic growth, postulating that richer (poorer) exhibit higher (lower) levels of economic development which in turns accumulates growth. The point estimates suggest that a 10% point increase (decrease) in the income level variable is associated with a 3.2% to 4.5% increase (decrease) of average growth. Our findings coincide with that of Swamy and Dharani, (2018) who argue that the relationship between national income growth and (per capita) economic growth rate is positive in the short run.

Looking at the other right hand side variables (RHS) some interesting remarks emerge. First, one cannot fail to notice that the share of government expenditures (lnGOV) and population growth rate (lnPOP) are negatively correlated with the level of growth. This means that decreases (increases) in government spending and population tend to raise (downturn) the growth rate of an economy as expected by the existing literature (see among others Ahsan and Haque, 2017). Second, the estimated coefficients for trade as a percentage of GDP are positive and statistically significant, in all of the three models, implying that increases in trade tend to raise the growth rate of an economy. This finding is also reported in similar studies (Caporale et al, 2014; Ahsan and Haque, 2017; Swamy and Dharani, 2018). Third, we observe surprisingly that some of the socioeconomic variables (see for instance R&D expenditures and employment) have been found to be statistically insignificant. This result finds also support in Henderson (2010), suggesting that the insignificances reported in the non-parametric growth regressions (both for the cases of lnRD and lnEMP) may result due to omitted variables (i.e. institutions), selection bias or small sample size. However, the estimated coefficient of energy intensity (lnENER) is statistically significant and comes with a negative sign. In addition it appears that model 2 (using NPL as the financial development indicator) has the highest explanatory power (better data fit) explaining countries' growth variations (R^2=0.878).

Figures 1-3 plot estimates of the impact of financial development expressed by the three relevant indicators (horizontal axis) on economic growth (vertical axis) along with 95% confidence intervals (CI).[11] Specifically, as it is observed from Figure 1, there is a "*hump-shaped*" relationship between domestic credit and growth when the previously documented nonlinearity of human capital is taken into consideration. This finding contradicts some earlier studies on the field (see among others Ketteni et al, 2007; McCaig and Stengos, 2005), who claim that the finance-growth nexus is linear when nonlinearity between initial per capita income, human capital and economic growth is taken into account.

<Insert Figure 1 about here>

Our study supports the existence of an "*inverted U-shape*" relationship between financial development and economic growth. As we notice this relationship is statistically significant since the 95% CI does not take zero values, expect for some part of the curve at the beginning and at the end of the sample. The increasing part of the curve reflects the positive effect of domestic credit on growth. During this stage, an increase in the domestic credit finance accelerates growth up to a certain level (threshold), since we assume that financial development is distributed through private sector activities which can lead to growth. This optimal level reflects a "*turning*" point since a marginal increase or decrease in its value reverses the relationship between finance and growth. However, when domestic credit crosses this level, the effect on growth turns to negative (decreasing part). Our findings partially confirm earlier studies who have explored non-linear effects of financial development to growth (see for instance Aghion et al, 2005; Deidda and Fattouh, 2002; Easterly et al, 2000; Shen and Lee, 2006). These studies argue that there is a convex

[11] The curvatures drawn from the linear models do not show significant differences and therefore omitted from the analysis. However, they are available from the authors on request.

relationship between financial depth and the volatility of GDP growth rate. Our results are in alignment with the recent study of Law and Singh (2014) report that there is an "*inverted U-shaped*" relationship between financial development and growth.

Similar findings are also traced when non-performing loans (lnNPL) impact the level of economic growth (see Figure 2). As it becomes clear, the effect is still non-monotonic and has an "*inverted-U shaped*" curve. Specifically, the relevant figure concurs that financial development expressed by the extent of non-performing loans to total gross banking loans, exhibits very strong nonlinear effects on economic growth, since nearly all of the estimated effect is significantly different from zero, as the 95% confidence band do not include zero. This result contradicts the study of Ketteni et al, (2007).

<Insert Figure 2 about here>

Figure 3 indicates that financial development expressed by the third indicator (e.g., bank capital and reserves to total assets) exhibits very weak nonlinear effects on growth, yet most of the estimated effect is not significantly different from zero, as the 95% confidence band includes zero, especially at the end of the sample. This result is robust to whether the previously documented nonlinearity between initial income and human capital is not taken into account. Moreover, this finding, partially confirms earlier studies (see for example Ketteni et al, 2007), where it is argued that the finance-growth relationship appears to be linear when nonlinearities between initial per capita income, human capital and economic growth are taken into account, but not in terms of its statistical significance.

<Insert Figure 3 about here>

7. Conclusions and policy implications

This study investigates the contribution of several socioeconomic indicators on economic growth within the Eurozone. The empirical evidence initially verifies standard conclusions at the relevant literature. The fact that financial development is related to economic growth is significantly testified by this study.

However, a major implication refers to the relationship among financial and economic growth which appears to be influenced by socioeconomic factors and moreover under non-linear conditions. Accordingly, the level of lending to the private sector can positively affect economic growth up to a turning point. Following that point, the impact of direct funding has a negative impact on a country's economy and therefore a country should at least identify this threshold in order to balance this particular exposure. Our results verify that the European Central Bank's (ECB) desire to reduce the exposure of banks in overdue loans is explained in the most prominent way. Increasing NFLs in an economy is a brake on its growth. Furthermore, findings decompose the impact of individual socioeconomic changes on a country's economic development associated with financial development. Optimum policy choices of each EU country should aim at investing in research and development, thus creating new jobs resulting lower unemployment rate, ensuing in the country's economic revival. As an avenue for future research, we argue that the finance–growth nexus can be tested using principal component analysis by combining proxies for financial development and other social policy variables that affect the development of the financial sector.

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References

Addis, R., McLeod, J., and Raine, A. (2013). *IMPACT-Australia: Investment for Social and Economic Benefit*. Canberra, Australia: Department of Education, Employment and Workplace Relations/JBWere.

Adusei, M. (2019). The finance–growth nexus: Does risk premium matter? *International Journal of Finance and Economics*. 24: 588– 603.

Aghion, P., Howitt, P., and Mayer-Foulkes, D. (2005). The effect of financial development on convergence: Theory and evidence. *Quarterly Journal of Economics*, 120: 173–222.

Ahsan, H., and Haque, M.E. (2017). Threshold effects of human capital: Schooling and economic growth. *Economics Letters* 156: 48-52.

Andersen, T.B. and Tarp, F., 2003. Financial liberalization, financial development and economic growth in LDCs. *Journal of International Development: The Journal of the Development Studies Association*, 15(2), pp.189-209.

Ang, J.B. and McKibbin, W.J., 2007. Financial liberalization, financial sector development and growth: evidence from Malaysia. *Journal of development economics*, 84(1), pp.215-233.

Ang, J.B., 2008. A survey of recent developments in the literature of finance and growth. *Journal of economic Surveys*, 22(3), pp.536-576.

Arellano, M. and S. Bond. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economics and Statistics*, 58, 277-297.

Asteriou, D. and Spanos, K., 2019. The relationship between financial development and economic growth during the recent crisis: Evidence from the EU. *Finance Research Letters*, 28, pp.238-245.

Azariadis C, and Drazen A (1990) Threshold externalities in economic development. *Quarterly Journal of Economics* 105: 501-526.

Baltagi, B.H., and Li, D. (2002). Series estimation of partially linear panel data models with fixed effects. *Annals of Economics and Finance* 3(1): 103–116.

Bassanini, A., Scarpetta, S. and Hemmings, P. (2001). Economic Growth: The Role of Policies and Institutions. Panel Data Evidence from OECD Countries, *OECD Working Paper* 283, 1-68.

Barro, R.J., (1990). Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy* 98(5), 103-125.

Barro, R.J. (1991). Economic growth in a cross-section of countries. *Quarterly Journal of Economics*, 106, 407–443.

Barro, R.J. and Xavier Sala-i-Martin (2004). *Economic Growth.* MIT Press.

Beck, T., Buyukkaraback, B., Rioja, F. K., and Valev, N.T. (2012). Who gets the credit? And does it matter? Household vs. firm lending across countries. *BE Journal of Macroeconomics*, 12(1), 1–44.

Bishop, M. and Green, M. (2008). *Philanthrocapitalism: How the Rich Can Save the World and Why We Should Let Them*. London: A. & C. Black.

Blundell, R., and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics*, 87(1): 115-143.

Breusch, T., and Pagan, A. (1980). The Lagrange multiplier test and its application to model specifications in econometrics. *The Review of Economic Studies*, 47, 239–253.

Brown, A., and Norman, W. (2011). 'Lighting the Touchpaper: Growing the Market for Social Investment in England'. Boston Consulting Group/Young Foundation, London.

Brown, A., and Swersky, A. (2012). *The First Billion: A Forecast of Social Investment Demand*. London: Boston Consulting Group/Big Society Capital.

Cabinet Office (2011). *Growing the Social Investment Market: A Vision and Strategy*. London: HM Government, Cabinet Office.

Cabinet Office (2012). *Growing the Social Investment Market: Progress Update*. London: HM Government, Cabinet Office.

Caporale, G. M., Rault, C., Sova, A. D. and Sova, R. (2015). Financial Development and Economic Growth: Evidence from 10 New European Union Members, *International Journal of Finance and Economics*, 20: 48– 60

Cecchetti, G., and Kharroubi, E. (2012). Reassessing the impact of finance on growth. *BIS Working Papers No. 381*, Bank for International Settlements.

Christopoulos, D.K., and Tsionas, E.G. (2004). Financial development and economic growth: Evidence from panel unit root and cointegration tests. *Journal of Development Economics*, 73(1), 55–74.

Cubbin J., Stern J. (2006). The impact of regulatory governance and privatization on electricity industry generation capacity in developing economies, *World Bank Economic Review,* 20 1: 115-141.

Delgado, M.S., Henderson, D.J., and Parmeter, C.F. (2014). Does education matter for economic growth? *Oxford Bulletin of Economics and Statistics* 76: 334-359.

Demetriades, P., and Law, S.H. (2006). Finance, institutions and economic growth. *International Journal of Finance and Economics*, 11(3), 245–260.

Deidda, L., and Fattouh, B. (2002). Non-linearity between finance and growth. *Economics Letters*, 74, 339–345.

Easterly, W., Islam, R., and Stiglitz, J. (2000). *Shaken and stirred, explaining growth volatility*, Annual Bank Conference on Development Economics. Washington D.C: World Bank.

Emerson, J., Spitzer, J. and Nicholls, A., 2007. *From Fragmentation to Function: Critical Concepts and Writings on Social Capital Markets' Structure, Operation, and Innovation*. Skoll Centre for Social Entrepreneurship.

Fotis, P., and Polemis, M. (2018). The impact of market deregulation on milk price: A dynamic panel data approach, *MPRA Paper 86542, University Library of Munich*.

Hardle W.E. and Mammen (1993). Comparing nonparametric versus parametric regression fits, *Annals of Statistics*, 21, 1926-1947.

Harji, K., and Jackson, E. T. (2012). *Accelerating impact: Achievements, Challenges, and What's Next in Building the Impact Investing Industry*. New York, NY: The Rockefeller Foundation.

Henderson, D.J. (2010). A test for multimodality of regression derivatives with application to nonparametric growth regressions. *Journal of Applied Econometrics* 25: 458-480.

Jones B.F. (2014). The human capital stock: a generalized approach. *American Economic Review* 104: 3752-3777.

J.P. Morgan and the GIIN (2010). *Impact Investments: An Emerging Asset* Class. New York, NY.

J.P. Morgan and the GIIN (2011). *Insight into the Impact Investment Market*. New York, NY.

J.P. Morgan and the GIIN (2013). *Perspectives of Progress: The Impact Investor Survey*. New York, NY.

Kaeufer K (2010), Banking as a Vehicle for Socio-economic Development and Change: Case Studies of Socially Responsible and Green Banks. Cambridge, MA: Presencing Institute, p. 6.

Kalaitzidakis, P., T. Mamuneas, A. Savvides and T. Stengos. (2001). Measures of human capital and nonlinearities in economic growth. *Journal of Economic Growth*, 6: 229-254.

Kao, C. and Chiang, M. H (2000). On the estimation and inference of a cointegrated regression in panel data. *Advances in Econometrics* 15, 179-222.

Ketteni E., Mamuneas, T., Savvides, A., and Stengos, T. (2007). Is the Financial Development and Economic Growth Relationship Nonlinear? *Economics Bulletin*, 15(14): 1-12.

King, R.G. and Levine, R., 1993. Finance, entrepreneurship and growth. *Journal of Monetary economics*, 32(3), pp.513-542.

Kyung S.I., Pesaran, H., and Shin, Y. (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*, 115: 53-74.

Law, S.H., and Singh, N. (2014). Does too much finance harm economic growth? *Journal of Banking and Finance*, 41: 36–44.

Levine, R., Loayza N, and Beck T (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics* 46: 31-77

Levine, R., 2005. Finance and growth: theory and evidence. *Handbook of economic growth*, 1, pp.865-934.

Loayza, N. and R. Ranciere. (2006). Financial development, financial fragility and growth. *Journal of Money, Credit and Banking* 38(4): 1051-1076.

Maasoumi E, Racine J, and Stengos T. (2007) Growth and convergence: A profile of distribution dynamics and mobility. *Journal of Econometrics* 136: 483-508.

McCaig, B., and Stengos, T. (2005). Financial intermediation and growth: Some robustness results, *Economics Letters*, 88(3): 306-312.

Maddala, G.S. and Wu, Shaowen. (1999). A Comparative Study of Unit Root Tests With Panel Data and A New Simple Test. *Oxford Bulletin of Economics and Statistics* 61: 631-652.

Mamuneas, T., A. Savvides, and Stengos, T. (2006). Economic development and the return to human capital: A smooth coefficient semiparametric approach. *Journal of Applied Econometrics*, 21, 111-132.

Mankiw NG, and Romer D, Weil DN (1992) A contribution to the empirics of economic growth. *Quarterly Journal of Economics,* 107:407-437.

Newson, R. (2012). Sensible parameters for univariate and multivariate splines. S*tata Journal* 12-3: 479-504.

Nicholls, A. (2010a). 'The Institutionalization of Social Investment: The Interplay of Investment Logics and Investor Rationalities', *Journal of Social Entrepreneurship*, 1(1): 70-100.

Nicholls, A. (2010b). *The Landscape of Social Finance in the UK*. University of Birmingham: Third Sector Research Centre.

Nicholls, A. (2013). 'Filling the Capital Gap: Institutionalizing Social Finance', in S. Denny and F. Seddon (eds), *Evaluating Social Enterprise*. Basingstoke: Palgrave MacMillan, pp. 161-96.

Nicholls, A., Paton, R. and Emerson, J. eds., 2015. Social finance. Oxford University Press.

Nicholls, A., and Pharoah, C. (2007). *The Landscape of Social Finance*. Oxford: Skoll Centre for Social Entrepreneurship.

Nicholls, A., and Lehner, O. (2014). 'Social Finance and Crowd-Funding for Social Enterprises: A Public–Private Case Study Providing Legitimacy and Leverage, *Journal of Venture Capital*, 16(4): 271–86.

Nicholls, A., and Schwartz, R. (2014). 'The Demandside of the Social Investment Marketplace', in L. Salamon (ed.), *New Frontiers of Philanthropy: A Guide to the New Tools and New Actors that Are Reshaping Global Philanthropy and Social Investing*. San Francisco: Jossey-Bass, pp. 562–82.

O'Donohoe, N., Leijonhufvud, C., and Saltuk, Y. (2010). *Impact Investments: An Emerging Asset Class*. New York: J.P. Morgan and Rockefeller Foundation.

Pedroni, P. (2000). Fully Modified OLS for Heterogeneous Cointegrated Panels in Nonstationary Panels, Panel Cointegration and Dynamic Panels. Advances in Econometrics, edited by Badi H. Baltagi, T. B. Fomby, and R. C. Hill, 15: 93–130.

Pedroni, P. (2001). Purchasing Power Parity Tests in Cointegrated Panels. *Review of Economics and Statistics* 83:727–731.

Pesaran, M.H, (2015). *Time Series and Panel Data Econometrics.* Oxford University Press.

Pesaran, M.H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels, *Cambridge Working Papers in Economics 0435*. Faculty of Economics (DAE), University of Cambridge.

Pesaran, M.H. (2003). A Simple Panel Unit Root Test in the Presence of Cross Section Dependence, *Cambridge Working Papers in Economics 0346*, Faculty of Economics (DAE), University of Cambridge.

Pesaran, M.H., and Smith, R.P. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68(1): 79-113.

Phillips, P.C.B., and P. Perron. (1988). Testing for a Unit Root in aTime Series Regression. *Biometrika* 75:335–346.

Polemis, M. (2016). New evidence on the impact of structural reforms on electricity sector performance. *Energy Policy*, 92(C): 420-431

Polemis, M., and Tsionas M (2019). Bayesian nonlinear panel cointegration: an empirical application to the EKC hypothesis. *Letters in Spatial and Resource Sciences* https://doi.org/10.1007/s12076-019-00230-4

Racine JS, and Hart J, Li Q (2006) Testing the significance of categorical predictor variables in nonparametric regression models. *Econometric Reviews* 25: 523-544.

Rayner, S. (2006). ‘Wicked Problems: Clumsy Solutions: Diagnoses and Prescriptions for Environmental Ills’, Jack Beale Memorial Lecture on Global Environment, <>, accessed 5 May 2015.

Samargandi, N., Fidrmuc, J., and Ghosh, S. (2015). Is the relationship between financial development and economic growth monotonic? Evidence from a sample of middle-income countries. *World Development*, 68: 66–81.

Shen, C. H., and Lee, C.C. (2006). Same financial development yet different economic growth–why? *Journal of Money, Credit and Banking*, 38(7): 1907–1944.

SIITF (Social Impact Investment Task Force) (2014). *The Invisible Heart of Markets: Harnessing the Power of Entrepreneurship, Innovation and Capital for Public Good*. London: SIITF.

Spitzer, J., Emerson, J., and Harold, J. (2007). *Blended Value Investing: Innovations in Real Estate*. Oxford: Skoll Centre for Social Entrepreneurship.

Swamy, V, and Dharani, M. (2018). An alternate approach in exploring the causal link between financial development and economic growth—Evidence from advanced economies. *International Journal of Finance and Economics*. 23: 55– 76.

Temple, J.R. (2001) Generalizations that aren't? Evidence on education and growth. *European Economic Review* 45: 905-918.

Tran K. and Tsionas, E. (2010). Local GMM Estimation of Semiparametric Panel Data with Smooth Coefficient Models. *Econometric Reviews*, 29(1): 39-61.

Weber O and Remer S (2011), Social Banks and the Future of Sustainable Finance. London: Routledge, pp. 1–14.

Westerlund J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*. 69:709–48.

Yilmazkuday, H., 2011. Thresholds in the finance-growth nexus: A cross-country analysis. *The World Bank Economic Review*, 25(2), pp.278-295.

List of Tables and Figures

Table 1: Summary statistics

Variables	**Observations**	**Mean**	**Standard deviation**	**Min**	**Max**
ln(GDP)	410	9.958	0.618	8.243	11.34
HCS	412	101.9	4.941	78.81	122.4
ln(POP)	337	-5.458	1.093	-11.05	-3.529
ln(INC)	401	9.860	0.732	7.276	11.32
ln(GOV)	430	3.676	0.269	2.826	4.587
ln(TRA)	437	4.641	0.527	3.614	6.032
ln(CRE)	289	4.495	0.385	3.521	5.534
ln(NPL)	201	1.572	1.046	-1.927	3.885
ln(BANK)	204	1.909	0.326	1.169	2.664
ln(RD)	374	0.164	0.640	-1.609	1.322
ln(ENER)	394	5.138	0.445	4.084	6.589
ln(EMP)	375	4.217	0.0836	3.945	4.368

Table 2: Cross-section dependence test

Variable	**CD test**	**P-value**	**Correlation**	**Absolute (correlation)**
ln(GDP)	46.93***	0.000	0.776	0.779
HCS	4.15***	0.000	0.068	0.313
HCS *(squared)*	4.21***	0.000	0.069	0.314
HCS *(cubed)*	4.27***	0.000	0.070	0.314
ln(POP)	4.59***	0.000	0.074	0.315
ln(INC)	54.04***	0.000	0.943	0.943
ln(GOV)	15.43***	0.000	0.254	0.445
ln(TRA)	41.13***	0.000	0.656	0.726
ln(CRE)	12.59***	0.000	0.260	0.539
ln(NPL)	17.53***	0.000	0.457	0.602
ln(BANK)	24.20***	0.000	0.609	0.645
ln(RD)	24.78***	0.000	0.481	0.643
ln(ENER)	48.83***	0.000	0.824	0.824
ln(EMP)	19.92***	0.000	0.392	0.532

Note*:* Under the null hypothesis of cross-sectional independence the CD statistic is distributed as a two-tailed standard normal. Results are based on the test of Pesaran (2004). The p-values are for a one-sided test based on the normal distribution. Correlation and Absolute (correlation) are the average (absolute) value of the off-diagonal elements of the cross-sectional correlation matrix of residuals. Significant at ***1%.

Table 3: Panel unit root tests

	Statistic	
Variable	**Fisher type ADF**	**Pesaran ADF**
ln(GDP)	32.6478 (0.7149)	-0.725 (0.234)
HCS	47.8434 (0.1315)	2.687 (0.996)
HCS *(squared)*	47.4338 (0.1403)	2.575 (0.995)
HCS *(cubed)*	46.9300 (0.1518)	2.476 (0.993)
ln(POP)	20.0128 (0.9510)	3.842 (0.999)
ln(INC)	19.8658 (0.9866)	0.396 (0.654)
ln(GOV)	33.9800 (0.6559)	0.994 (0.840)
ln(TRA)	22.4803 (0.9786)	0.840 (0.787)
ln(CRE)	36.1923 (0.5532)	0.525 (0.700)
ln(NPL)	43.5377 (0.2475)	2.510 (0.994)
ln(BANK)	14.5386 (0.9986)	-1.367^{*} (0.086)
ln(RD)	30.1275 (0.8149)	0.607 (0.728)
ln(ENER)	20.5780 (0.9905)	0.589 (0.722)
ln(EMP)	36.6071 (0.4405)	1.449 (0.926)

Note: The number of lags has been set to two according to BIC. The Augmented Dickey Fuller (ADF) test is used rather than Phillips-Perron test (Phillips and Perron, 1988). The null hypothesis assumes that the variable contains a unit root. Bootstrapped P-values reported in parentheses. * $p<0.1$.

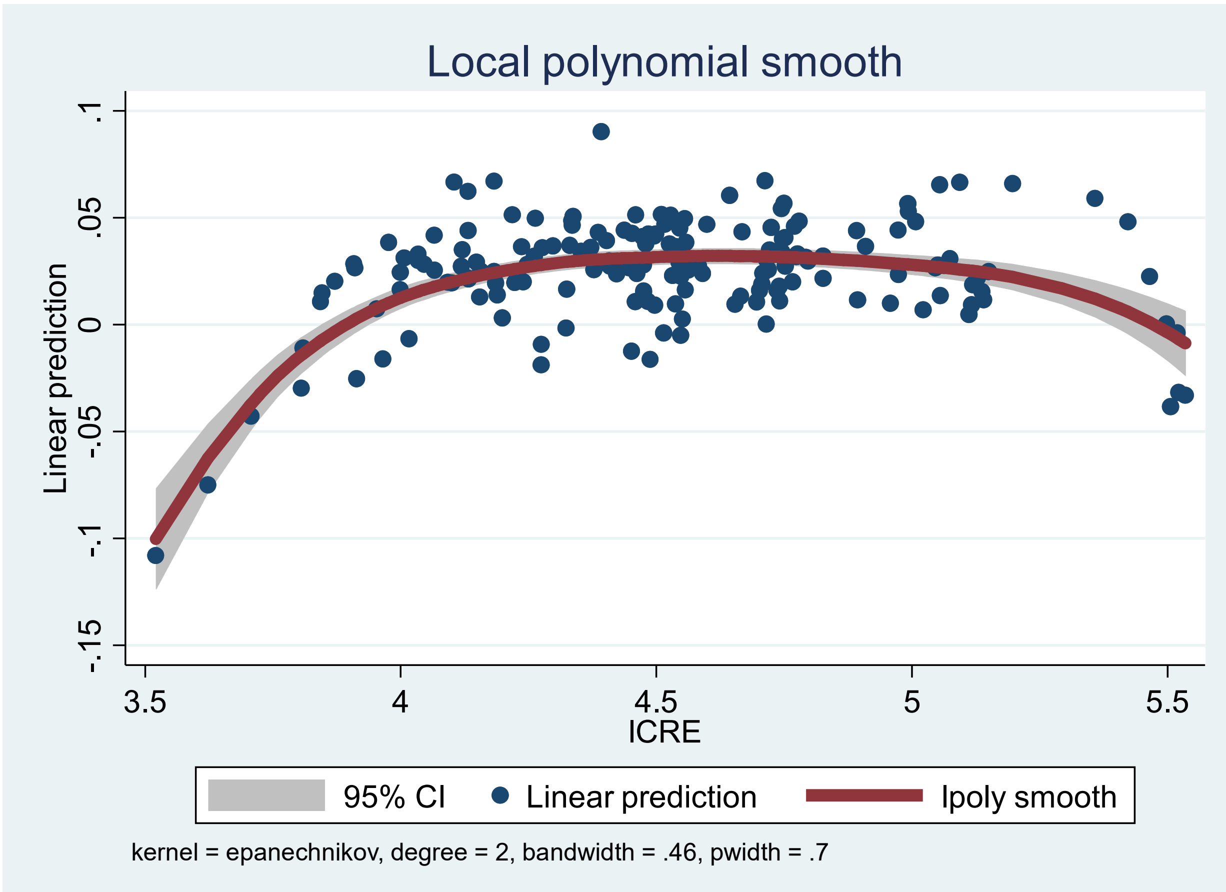
Table 4: Estimation results

	Nonlinear estimates						Linear estimates					
Dependent variable: ln(GDP)	**SPFEM**			**SYS-GMM**			**SPFEM**			**SYS-GMM**		
Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HCS	-0.516*	-1.753*	-1.341*	0.505**	0.351***	0.524*	0.000	0.001	0.000	0.052	-0.001	0.009
	(0.305)	(0.910)	(0.720)	(0.152)	(0.077)	(0.173)	(0.001)	(0.001)	(0.001)	(0.053)	(0.016)	(0.017)
HCS *(squared)*	0.005*	0.016*	0.012*	-0.004*	-0.003**	-0.006**	-	-	-	-	-	-
	(0.003)	(0.008)	(0.007)	(0.002)	(0.001)	(0.003)						
HCS *(cubed)*	0.000*	-0.000*	-0.000*	0.000	0.000*	0.000*	-	-	-	-	-	-
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
ln(INC)	0.322***	0.381***	0.455***	0.349**	0.441***	0.272	0.319***	0.383***	0.432***	0.230	0.700	0.707**
	(0.037)	(0.067)	(0.068)	(0.098)	(0.094)	(0.174)	(0.037)	(0.068)	(0.067)	(0.213)	(0.093)	(0.209)
ln(GOV)	-0.024*	-0.017	-0.017	-0.189	0.089	-0.245	-0.027*	-0.017	-0.0196	0.073	0.061	-0.149
	(0.014)	(0.015)	(0.016)	(0.311)	(0.076)	(0.276)	(0.014)	(0.015)	(0.015)	(0.210)	(0.187)	(0.191)
ln(POP)	-0.005**	-0.005*	-0.002*	0.134***	0.036	0.076	-0.005*	-0.006*	-0.003	0.084	-0.087	-0.058
	(0.003)	(0.003)	(0.003)	(0.023)	(0.024)	(0.032)	(0.002)	(0.003)	(0.004)	(0.051)	(0.047)	(0.059)
ln(TRA)	0.091***	0.150***	0.122***	0.140	0.148***	0.238	0.093***	0.146***	0.102***	0.143	0.180	0.146
	(0.029)	(0.042)	(0.039)	(0.238)	(0.035)	(0.158)	(0.029)	(0.042)	(0.0383)	(0.157)	(0.106)	(0.14)
ln(RD)	0.018	0.0252	0.0236	-0.141	0.109	-0.006	0.016	0.034*	0.0394*	0.194	-0.066	-0.156
	(0.016)	(0.021)	(0.022)	(0.165)	(0.070)	(0.104)	(0.016)	(0.021)	(0.0208)	(0.198)	(0.111)	(0.184)
ln(ENER)	-0.158***	-0.161***	-0.112**	-0.820*	-0.506***	-0.660***	-0.151***	-0.167***	-0.0987**	-1.052**	-0.829	-0.903**
	(0.033)	(0.049)	(0.045)	(0.402)	(0.123)	(0.170)	(0.032)	(0.050)	(0.0455)	(0.445)	(0.279)	(0.262)
ln(EMP)	0.219**	0.072	0.059	-2.100	-1.103*	-0.846	0.217**	0.109	0.0834	2.240*	1.350	1.405**
	(0.092)	(0.139)	(0.130)	(1.234)	(0.607)	(0.789)	(0.092)	(0.138)	(0.131)	(1.266)	(0.447)	(0.616)
ln(CRE)	-	-	-	-0.484**	-		-	-	-	-0.501		
				(0.133)						(0.304)		
ln(NPL)	-	-	-	-	-0.105**	-	-	-	-	-	-0.047	
					(0.029)						(0.023)	
ln(BANK)	-	-	-	-	-	-0.239	-	-	-	-		0.056
						(0.147)						(0.146)
Diagnostics												
Observations	155	82	88	175	98	104	155	82	88	175	98	104
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

R-squared	0.863	0.878	0.874				0.860	0.870	0.867			
F-test	-	-	-	10626.41	124949.46	31281.20	-	-	-	4420.34	52984.42	4244.91
RMSE	0.0119	0.0117	0.0117				0.0120	0.0119	0.0119			
Instruments				L.LGDP lANNI lEXPENS E lPOP lTRADE lCRE	L.LGDP lANNI lEXPENS E lPOP lTRADE lNPL	L.LGDP lANNI lEXPENS E lPOP lTRADE lBANK				L.LGDP lANNI lEXPEN SE lPOP lTRADE lCRE	L.LGDP lANNI lEXPEN SE lPOP lTRADE lNPL	L.LGDP lANNI lEXPENS E lPOP lTRADE lBANK
AR(1)				0.65	-1.51	-0.80				2.71	-0.39	-0.11
AR(2)				-0.60	-2.16	-1.80				-0.47	-2.54	-2.57
Hansen test				1.03	2.32	0.06				1.48	1.08	0.40

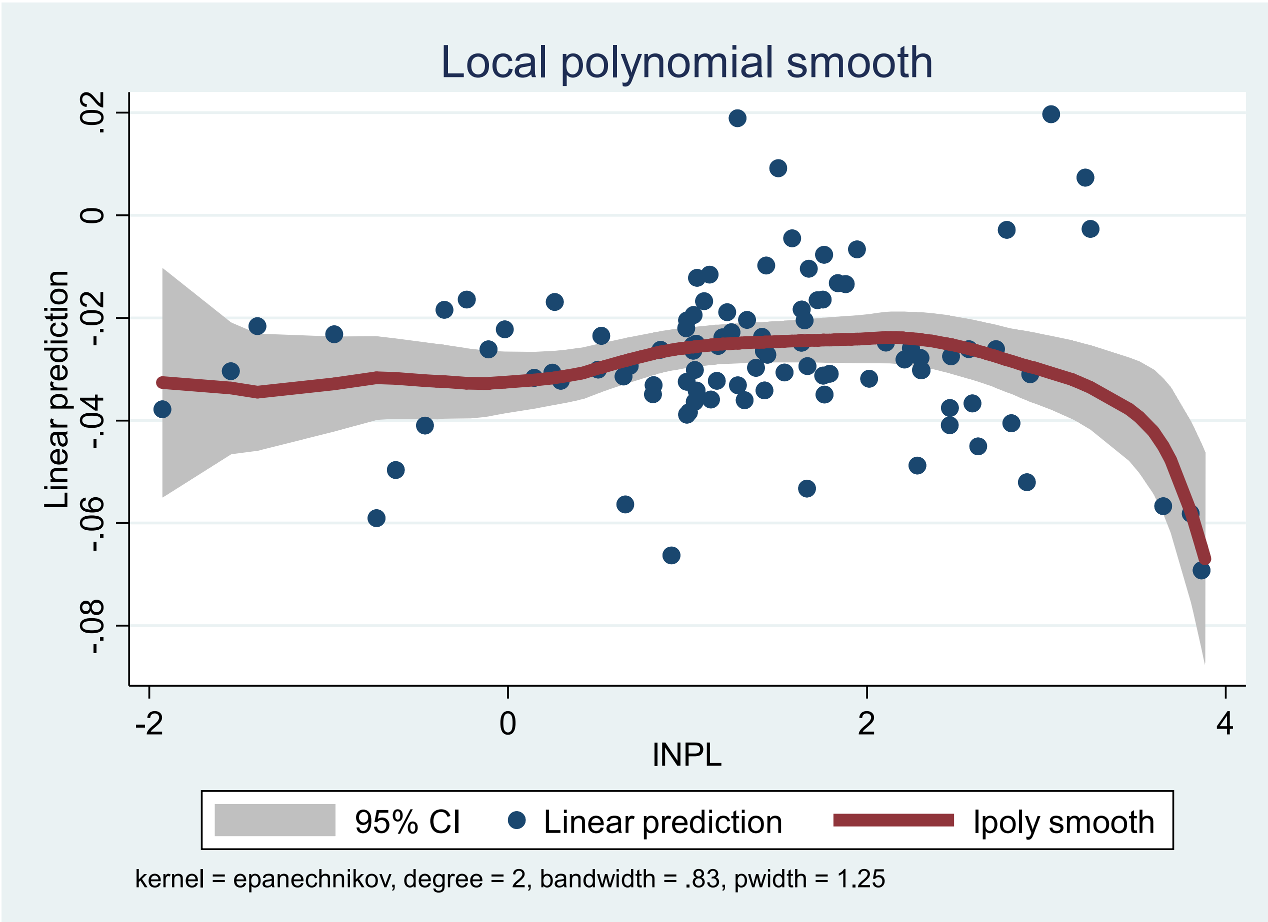
Notes: Al the regression estimates come with a three digit specification. Time effects are included but not reported. RMSE stands for the Root Mean Squared Error. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 SYS-GMM is the system GMM estimator. The numbers in square brackets denote the p-values. AR(1) and AR(2) are tests for first and second order serial autocorrelation. F test denotes the joint statistical significance of all the covariates. Hansen denotes the test of over identifying restrictions of the instruments. Significant at ***1%, **5% and *10% respectively.

Figure 1: Nonparametric estimates of domestic credit on growth (logged) on growth (non-linear model)



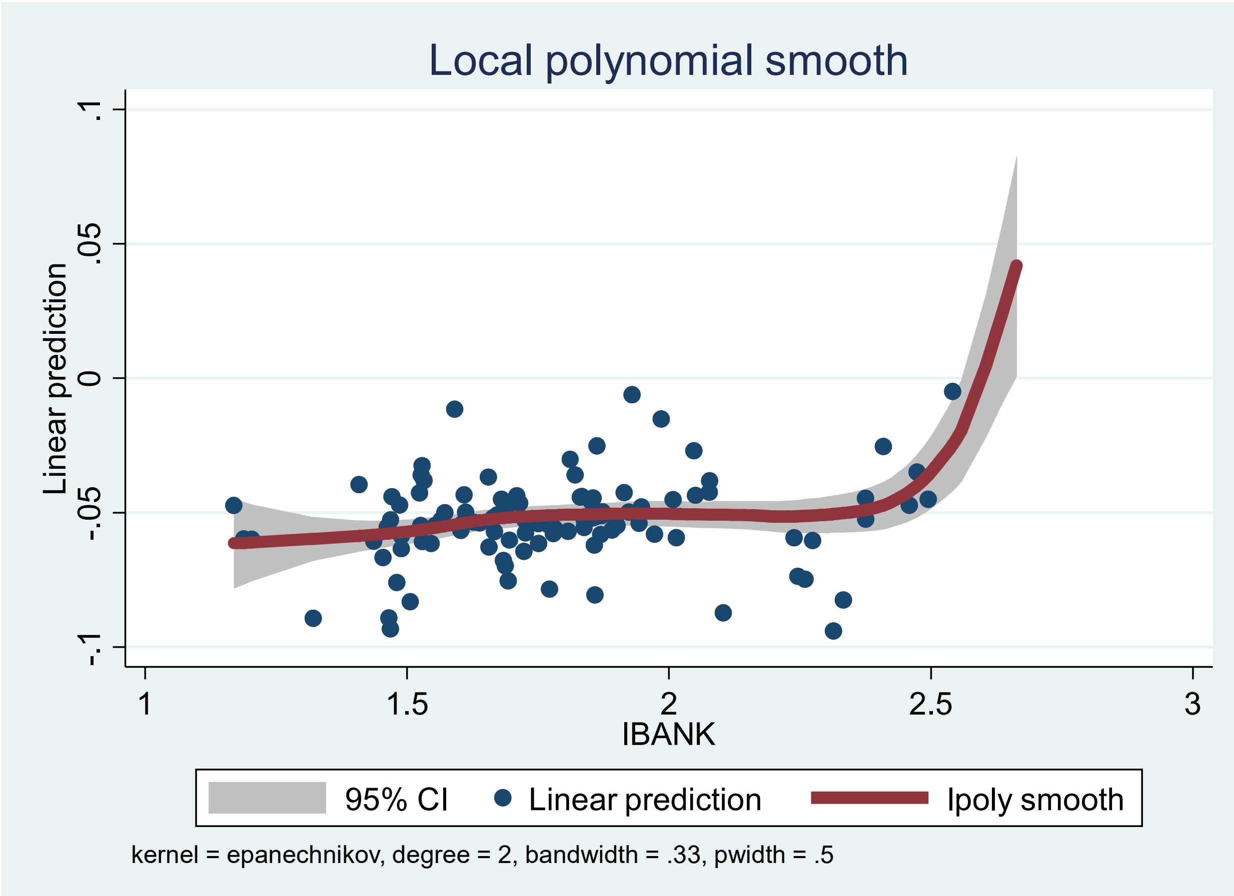
Notes: Grey shaded area denotes the 95% confidence intervals

Figure 2: Nonparametric estimates of non-performing loans (logged) on growth (non-linear model)



Notes: Grey shaded area denotes the 95% confidence intervals

Figure 3: Nonparametric estimates of bank capital and reserves to total assets (logged) on growth (non-linear model)



Notes: Grey shaded area denotes the 95% confidence intervals