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Competition and the growth of nations: International evidence from Bayesian model averaging

Georg Man

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ABSTRACT

I apply Bayesian model averaging (BMA) and complementary approaches to international data for the time span 1988–2007 in order to find out whether competition in the economic and political arenas is a robust determinant of aggregate growth, and whether there exists jointness among competition variables versus other growth determinants. Several indicators of competition are used, and I control for a range of other factors potentially affecting growth. My results provide some support for the importance and positive impact on growth of financial market competition. No other competition area emerges as robust growth driver. The jointness analysis suggests a moderate degree of complementarity between financial market competition and important growth determinants, implying manageable policy complexity.

1. Introduction

Is competition in the economic versus political arena of countries a robust determinant of aggregate growth? Does it foster or retard growth? How complex is the relationship between competition and other growth determinants, and how complex are policy options? These are the central questions of the present paper. I provide an empirical answer using evidence from a cross section of countries and a comprehensive battery of model averaging approaches.

Increasingly intense competition – between many actors and along many dimensions – is often considered the hallmark of globalization. According to Friedman (2007), the globalization-driven "flattening" of the world and the concomitant surge in competition apply to companies, individuals, and governments alike, irrespective of their location. In fact, it is this very aspect and its implications for maintaining current standards of living that have received the most attention in the public debate. At the same time, the contrast between slow growth in many industrialized nations and fast growth in some emerging economies has also featured prominently in the media. Economic growth is crucial because even small differences in growth rates translate into sizeable differences in living standards over time, as pointed out by Lucas (1988) and reemphasized by Pritchett et al. (2013). From an empirical point of view, growth is an economic performance concept that can be quantified relatively well and where data is available for a broad sample of countries.

In the context of the globalization debate, the financial sector has received particular attention, due to its degree of international integration, but probably more than that because of the recent financial crises, their impact on the real macroeconomy, and costly government involvement in the rescue of financial institutions. Many academic contributions have demonstrated the centrality of the financial sector for the workings of the economy (see e.g. the seminal articles by Greenwood and Jovanovic (1990), or Bencivenga and Smith (1991)). The quantitative importance of the sector has been documented by Mehra et al. (2011), Greenwood et al. (2013), and Furlanetto et al. (2014). Financial markets emerge as the bridge between savers and investors, processing savings from households to firms who transform these savings into capital — a key source of economic growth. Consequently, it appears especially interesting to gauge the impact on growth of competition in the financial sector. The present paper does this — not least given competition data availability for a broad sample of countries, while keeping the other competition areas in view.

Academic circles may view competition as beneficial, both in the economic arena and beyond: competitive pressure in product markets is presumed to keep consumer prices low and provide firms with incentives to innovate. In the political arena, competition of ideas in the political marketplace may improve decisionmaking. In fact, Hayek (1968) has argued in favor of the vision that it is via competition – an information-gathering and information-processing mechanism – that liberal societies can realize an informational advantage over authoritarian states with centrally-planned economic systems. I will refer to the view of holding competition dear as the "traditional view" — namely the view that competition is good for growth. But while competition has been a topic of considerable interest to the classical economists, recent contributions have reopened the debate, suggesting that the impact of competition can depend on a multitude of factors and may well be ambiguous. From an empirical point of view, this state of play calls for a comprehensive sensitivity analysis that takes into account competition alongside other potential growth drivers. The present

E-mail address: plumplor@yahoo.com.

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paper conducts such an analysis by employing Bayesian model averaging (BMA) and related approaches that are well-suited for the task.

The questions of the present paper have a policy dimension, too: both ingredients – competition and growth – have played a role in policy proposals like the Lisbon Agenda, or the Sapir Report, see Sapir et al. (2004). In fact, analyzing the relationship between competition and growth appears even more warranted if there is a robust link that policy or institutional design may exploit, e.g. when asking about banking sector reforms in the European Union. I validate policy options by applying a novel, Bayesian concept of variable jointness developed and introduced into growth research by Doppelhofer and Weeks (2009). Jointness captures relations among regressors and is therefore valuable for informing policy, which typically does not look at variables in isolation and also considers the complexity of decisions.[1]

Bringing together several literatures – competition analysis, finance, political economy, growth, and model averaging – the present paper adds to existing research in various ways. Firstly, I look at all competition areas (goods markets, financial sector, political marketplace) and their impact on growth simultaneously, providing a synopsis of competition effects that have previously been analyzed in isolation; special attention is paid to the financial sector. Secondly, by considering an international cross section, the investigation is not restricted to a single country — extending the scope of analysis, taking a global perspective, and assessing the geographical outreach of existing studies that have been carried out for national contexts. Here, the present paper also wants to find out how much can ultimately be learnt about the question at hand from the cross-country approach, which is fairly well-established in empirical growth research. Thirdly, and importantly, the present paper asks whether competition is a *robust* determinant of aggregate growth. This is accomplished by employing multiple controls and applying several econometric approaches to model uncertainty and identifying robust growth determinants, namely Bayesian model averaging, extreme bounds analysis (EBA), and reasonable extreme bounds analysis (REBA). Furthermore, several versions of the data are analyzed, several dimensions and components of competition (e.g. static versus dynamic, legislature versus executive) are investigated, and the impact of alternative prior structures on the results is checked. Fourthly, the present study provides an assessment of the jointness between competition variables and other determinants of growth, using the concept introduced by Doppelhofer and Weeks (2009).

The evidence for my data provides some support for the relevance and positive impact on economic growth of financial market competition. Specifically, static measures of market structure and conduct in the banking sector emerge as important.[2] No other area of competition (neither product market nor the political marketplace) emerge as robust determinants of growth. Because of this, the overall picture as to the impact of competition on growth appears agnostic. The relatively good performance of financial competition can be rationalized by recalling the prominent role which the sector plays in the process of growth, being the bridge between saving and investment and determining the quantity and quality of the capital stock.[3]

The fact that no other competition area emerges as important implies that many findings on competition effects obtained for national contexts – e.g. that political competition fosters growth as indicated by Besley et al. (2010) – cannot be replicated using international data. Along this dimension, it therefore remains an open question whether policy conclusions derived from individual country studies carry over to the international context. Not least given data availability issues, there are obvious limits to what can be learnt about the question at hand from cross-country data. This, in turn, commends care when drafting general policy recommendations; policy advice should presumably be based on and tailored to the specific situation of individual countries. As another policy-relevant point, the jointness results for the data at hand indicate that there is a moderate degree of positive jointness i.e. complementarity between some financial sector competition variables and other growth determinants such as the degree of globalization. Generally, complementarity implies that policymaking may be complex and dependencies among variables should be taken into account when putting policies to work. In the present case, however, the complexity of policymaking turns out to be manageable since the number of complementarity instances with competition variables is small; policies aimed at increasing bank competition may lead to faster growth.

The paper is structured as follows: Section 2 provides a literature review, while Sections 3 and 4 explain the econometrics and my estimation strategy. Section 5 describes the data and Section 6 presents the results. Checks and extensions are contained in Section 7, and Section 8 concludes. Figures and tables are collected at the end of the paper.

2. Background literature

2.1. Model averaging

Economic growth is a complex phenomenon, presumed to be driven by many different factors. Bayesian model averaging (BMA), the primary econometric technique used in the present paper, has been introduced into empirical growth research through the contribution by Fernández et al. (2001). As pointed out by Ley and Steel (2009), the approach is well-suited to the analysis of growth determinants with a large number of regressors but only a relatively small number of observations. Subsequently, BMA has been applied to various topics in economic growth: for instance, Crespo Cuaresma et al. (2009) analyze the growth determinants of 255 European regions between 1995 and 2005, pointing out e.g. the importance of highly educated workforce. Eicher et al. (2007a) investigate the drivers of growth in OECD versus Non-OECD countries, and find that both country groups share only a relatively small number of common growth determinants. Coyne and Tan (2012) analyze the impact of political institutions on growth, establishing that for the time span 1970–2007, less democratic countries appear to follow a different growth regime (namely, tend to grow slower) than more democratic ones.

What recent studies on competition and economic performance have in common is the focus on one specific area of competition, e.g. the political arena, but that specific area of competition is being looked at in isolation: for example, the result that political competition fosters growth abstracts from the potential impact of financial sector competition on growth.[4] However, all competition areas can be presumed to affect the growth process simultaneously, and it is therefore important to keep all areas in view. Likewise, growth analyses should control for a

[1] Another aspect in this context is that international organizations may draw up guidelines and implement measures deemed applicable to all countries in which these organizations operate — e.g. that the banking sector be deregulated to enhance competition and growth. But the scope for such general recommendations (aimed at all countries according to a "one-size-fits-all" principle) depends on the relationships of interest showing up robustly and convincingly in international data and the results aligning reasonably well with lessons from case studies for individual countries. I pay attention to this aspect as well.

[2] This finding comes with a caveat, however, because in a broad sample of countries, competition data is more readily available for the financial sector than for the other competition areas — which may be behind the more conclusive estimation results for this sector.

[3] Here, my results partly align with existing literature, e.g. Cetorelli and Gambera (2001), and with my past research on which I build and where I have conducted an analysis similar to the present one but focused exclusively on the financial sector, a different time span, and a special variety of the BMA approach.

[4] Conversely, as exemplified by the experience of some countries, economic reforms and the concomitant surge in economic competition alone does not deliver sustained growth: In addition, political competition may emerge as vital for growth. A related aspect is the linkages between competition areas, e.g. political economy and the structure of the financial sector or access to finance (see Pagano and Volpin (2001), or Claessens et al. (2006)).

range of factors, apart from the variables of interest. This is where BMA – as a tool for a comprehensive and systematic sensitivity analysis – comes in.

2.2. Competition and growth

The rekindled interest in the topic of competition and growth is documented by a number of contributions which also suggest that the relationship between competition and growth is far from obvious and further research therefore warranted. Many of the underlying ideas originate in endogenous growth theory seeking to understand the drivers behind technological progress and capital accumulation i.e. the key sources of growth.

Product market competition has been shown to affect firms' incentives to innovate which translates into the rate of technological progress and thereby growth at the aggregate level. Specifically, Aghion et al. (2005) demonstrate that, on the one hand, competition is good since it forces firms to innovate, generating the "escape-competition" effect. However, competition is also bad as it destroys monopoly rents that provide incentives to innovators, following Schumpeterian reasoning. Consequently, product market competition exerts opposing effects on innovational activity, feeding into technological advance and economy-wide growth, see Aghion et al. (2013). This strand of research also highlights agency issues, indicating that product market competition can reduce slack — thus acting as a disciplinary device with respect to a firm's management and fostering technology adoption. In the era of globalization, competition from foreign firms also plays a role, of course (see e.g. Gorodnichenko et al. (2008)). Importantly, Aghion and Howitt (1998) emphasize the complementarity between innovation and capital accumulation: while innovations improve the quality of capital goods and stimulate their accumulation by raising the marginal product of capital, capital goods are used in innovational activities, and capital accumulation also stimulates secondary innovations through the process of learning by doing.

Financial sector competition affects the dynamic macroeconomy in different ways. For example, market power typically leads to rent extraction and X-inefficiency and, especially in low-income countries, can make access to finance more difficult so that less saving gets mobilized than under competitive conditions, see Beck et al. (2004). However, market power can also benefit the economy, mitigating informational asymmetries and stimulating capital stock formation — as shown by Cetorelli (1997) who accomodates the ideas of Petersen and Rajan (1995) within a dynamic macromodel with a financial sector: because of an information problem where the financial intermediary has to screen borrowers for their entrepreneurial skills, a perfectly competitive banking sector will not invest in screening (due to the free riding problem) and thus lower the average quality of the capital stock. In contrast, a banking monopoly does use its market power to extract rents, but now there is no free riding problem and the bank will invest in screening and establish close ties with good entrepreneurs, increasing the average quality of the capital stock. Empirically, Cetorelli and Gambera (2001) analyze the impact of banking sector competition on industrial growth in manufacturing for a sample of 41 countries, concluding that competition fosters the growth of sectors that are more dependent on external finance.[5] Using U.S. manufacturing data, Cetorelli (2002) finds a differential impact of bank competition on firm growth and entry across start-ups versus mature establishments, opening up a possible link to innovation (if start-ups are more active in innovational output).

Lastly, the literature has proposed various links between political competition and investment resp. innovational activity. Besley et al. (2010) build a model of political competition where the positive relationship between competition and growth runs through business-friendly resp. growth-enhancing policy choices not aimed at narrow groups only, e.g. infrastructure investment contributing to capital accumulation. However, Alfano and Baraldi (2011) point out that competition in the political arena can also reduce welfare since it may lead political incumbents whose reelection is threatened just to extract rents. Pinto and Timmons (2005) mention other potential effects of political competition, e.g. that non-democracies are free from redistributional pressures, rulers have longer planning horizons, but also tend to extract rents and pursue policies that benefit narrow groups. Finally, the theoretical model and case studies due to Acemoglu and Robinson (2006) suggest that the impact of political competition on growth also runs through innovation, the government implementing policies favoring innovation either when it need not fear the loss of power or when the threat of replacement forces them to move on.

3. Econometric methodology

The primary framework employed in the present study is BMA, or Bayesian model averaging, as applied to growth regressions, see Doppelhofer (2005), Fernández et al. (2001), Madigan and York (1995), and Raftery et al. (1997). The present study is embedded into this methodology, following its conventions and research design. As frameworks of secondary importance, extreme bounds analysis (EBA) and reasonable extreme bounds analysis (REBA) are used. The key motivation for the use of BMA, EBA, and REBA derives from the aspiration of the present paper, namely to assess the robustness of competition areas as growth determinants.[6]

3.1. Growth regressions, model uncertainty, and BMA

Going back to the work by Barro (1991), the underlying idea of growth regressions is to regress growth rates of major macroeconomic aggregates on a group of explanatory variables, with the aim of identifying important determinants of growth. The estimation model can therefore be written as:

$$y = \alpha + X\beta + \varepsilon. \tag{1}$$

In this equation, y is the dependent variable (e.g. growth rate of GDP per capita), α is the intercept, X is the group of explanatory variables, β the slope coefficients, and ε is the error term. Here, X contains the potential growth drivers — the controls, environment variables and, most importantly, variables capturing competition. Fernández et al. (2001) stress the major role of specification uncertainty, both in the form of parameter and model uncertainty ("uncertainty about the choice of regressors," p. 565), and Doppelhofer (2005, p. 6) refers to model uncertainty as a situation where "the decision-maker does not know which explanatory variables to include in the regression."

BMA is the formal statistical framework which has been devised to deal with specification uncertainty explicitely, both in the form of parameter and model uncertainty. Raftery et al. (1997, p. 180) represent the underlying idea formally as follows:

$$\Pr(\Delta|D) = \sum_{k=1}^{K} \Pr(\Delta|M_k, D) \cdot \Pr(M_k|D) \tag{2}$$

In this expression, Δ is the quantity under investigation, D is the data, K is the model space, and M_k stands for model k. In the present application,

[5] Fernández de Guevara and Maudos (2011a, 2011b) extend this analysis in various ways, e.g. by also considering the impact on regional economic growth.

[6] An additional technical section (available upon request) contains further details of the methods and references. For BMA, I employ the R programming language (see R Development Core Team (2010)); specifically, I use the BMS package developed by Feldkircher and Zeugner (2012) explicitly for Bayesian Model Averaging. In a review of currently available BMA software, Amini and Parmeter (2011) emphasize several strengths of this package. The jointness analysis uses an additional function for the BMS package written by Amini (2012). EBA and REBA are implemented in the robustness analysis software MetaGrowth 1.0 (see Heijungs et al. (2001)).

the models are growth regression models, and the corresponding model space is the set of all models resulting from all possible combinations of all explanatory variables used in the analysis. Hence, the expression describes a procedure where the posterior distribution of the quantity under investigation, given the data, is equal to the average of the posterior distributions of this quantity under each of the models considered, weighted with their respective posterior model probabilities. The BMA approach thus takes model uncertainty into account by averaging over all models (see Madigan and York (1995)).[7]

The implementation of BMA requires the specification of a prior distribution for the parameters of each element (econometric regression model) of K; these parameters are the intercept, the slope coefficients, and the precision. Furthermore, a prior distribution over the model space K needs to be specified.[8] Given that the set of all possible regression specifications is 2^K, when the model space K is large, a complete summation across models as implied by Eq. (2) is likely to be practically infeasible (see Fernández et al. (2001) and Doppelhofer (2005)). Random sampling is then used to move through the model space, making it possible to explore a large number of potential regressors while significantly reducing the computational burden.

3.2. Jointness of growth drivers

In addition to assessing the importance of individual variables, I also analyze the *jointness* between competition variables and other determinants of growth. The concept of jointness has been developed and introduced by Doppelhofer and Weeks (2009) with the aim of capturing dependence among explanatory variables within the model averaging context i.e. taking model uncertainty into account. Specifically, they consider the joint posterior distribution of variables over the model space, and define the corresponding jointness statistic J_{il} in the following way (ibid., p. 218):

$$J_{il} \equiv \ln cpr(i, l|y) = \ln\left[\frac{p(i \cap l|y)}{p\left(\bar{i} \cap l|y\right)} \cdot \frac{p\left(\bar{i} \cap \bar{l}|y\right)}{p\left(i \cap \bar{l}|y\right)}\right] \quad (3)$$

This statistic captures formally the degree of dependence between two variables, indexed i and l, with $p(i \cap l|y)$ being the posterior joint probability of inclusion of the variables. Jointness is thus defined as the natural logarithm of the cross-product ratio associated with the joint posterior distribution. Positive jointness ($J > 0$) is interpreted as reflecting a complementary relationship between variables, namely the case where variables represent complementary, mutually reinforcing economic effects, while negative jointness ($J < 0$) refers to substitutability i.e. when variables capture a similar underlying mechanism. An additional distinction is made between significant jointness ($|J| > 1$) resp. strong jointness ($|J| > 2$).

The jointness concept has implications for policymaking. Specifically, significant complementarity ($J > 1$) between control variables and variables viewed as policy instruments means that the distribution of controls and instruments is complex, which is likely to make policymaking more difficult. On the other hand, significant substitutability ($J < -1$) means that variables (including policy instruments) act as substitutes with respect to their effects on economic growth (see Doppelhofer and Weeks (2009) who emphasize the potential value of the jointness concept for policymaking).[9]

3.3. EBA and REBA as sensitivity analyses

Extreme bounds analysis (EBA) and reasonable extreme bounds analysis (REBA) are used as secondary analytical frameworks. Building on the ideas of Leamer (1983, 1985) and prior to the introduction of BMA into empirical growth research, both methodologies have addressed the issue of sensitivity of variables to alternative specifications of the regression equation.[10]

Levine and Renelt (1992) were the first to apply EBA to growth regressions. Their approach consists in taking over 50 variables (potential growth determinants) used so far in the literature, focusing on one of these variables, and asking the following question: does the sign and significance of this variable survive alternative specifications of the regression equation (i.e. including/removing other variables)? If it does, the variable is labeled as robust. The analysis of Levine and Renelt (1992) reveals that only a handful of variables emerge as robust by EBA standards, among them initial income and some schooling indicators.

REBA has been developed by Granger and Uhlig (1990) and addresses one potential objection to the approach of Levine and Renelt (1992), namely that the fit of regression models should also be considered when assessing the robustness of predictors. Consequently, REBA takes the fit of regression models into account, restricting attention to models which fit relatively well, as measured by a high R^2 statistic.

4. Estimation strategy

In the context of BMA, prior choice is of considerable importance. I therefore conduct a sensitivity analysis by obtaining estimation results for a wide range of prior structures, assessing the sensitivity of results to alternative prior choices. A prior structure be the combination of a hyperparameter on the g-prior and a model prior which allocates prior inclusion probabilities to each regressor resp. determines prior model size. I consider four prior structures.[11]

Firstly, I set $g = \max(n, k^2)$ where n is the number of observations and k the number of regressors, and combine this setting with the uniform model prior. The first prior structure thus follows Fernández et al. (2001) who introduced BMA into empirical growth research and, in this sense, can be regarded as a benchmark of sorts, despite subsequent critique e.g. by Ley and Steel (2009). Secondly, I use a prior structure combining a hyper-g prior with a random model prior.[12] Thirdly, I emulate the BACE framework due to Sala-i-Martin et al. (2004), by setting $g = n$ and thus combining the unit information prior with the fixed model prior i.e. fixed, common inclusion probabilities for each

[7] Likewise, the use of model averaging – which the other techniques used in the present paper (EBA, REBA) also rely on – is in the spirit of "thick modelling" advocated by Granger and Jeon (2004) i.e. basing analysis and conclusions not on a single model but an ensemble of different models. Importantly, note that BMA need not be regarded as the last word on whether a variable matters for growth or not. On the contrary — if identified as robust determinant of growth, a variable may indeed be subjected to an array of further checks.

[8] The Bayesian averaging of classical estimates (BACE) approach developed and introduced by Sala-i-Martin et al. (2004) can be considered a variety of BMA emphasizing the prior distribution over the model space; formulating priors amounts to choosing the prior model size. I emulate this estimation design by using fixed common inclusion probabilities for the regressors (see Feldkircher and Zeugner (2012)).

[9] Doppelhofer and Weeks (2009) implement their analysis of growth determinants within the BACE framework; in order to ensure comparability of results, I also use this strategy. Following Doppelhofer and Weeks (2009), a discussion of the jointness concept has evolved (see e.g. Ley and Steel (2007)). A treatment of alternative jointness measures is beyond the scope of the present paper.

[10] The technical implementation details of EBA and REBA as well as the estimation strategies followed here are detailed in an additional technical section, as mentioned above.

[11] These prior structures reflect the lack of strong prior information, as is often the case in the growth regressions context (see Fernández et al. (2001)), and given the ambiguous theoretical predictions regarding the impact of competition on economic growth. I have conducted an extended sensitivity analysis e.g. by employing the Empirical Bayes Prior (see George and Foster (2000)), where the data at hand is used to increase the informational content of the prior. The results align with those reported here.

[12] The hyper-g prior has been proposed by Liang et al. (2008) and recommended by Feldkircher and Zeugner (2009) as well as Ley and Steel (2012). Under this prior, the researcher imposes a prior distribution on the parameter g, where this distribution involves yet another hyperparameter called a. The advantage of the hyper-g prior is its flexibility (model-specific and adapts to the data) (see Zeugner (2012)). Following Ley and Steel (2012), I set $a = 3$, but obtain similar results when implementing the hyper-g prior as the "HG-RIC specification" of Feldkircher and Zeugner (2009).

Table 1
Description of dataset.

Variable	Description	Source
grgdpch	Annual growth rate of real GDP per capita.	PWT 6.3
lnrgdpch	Logarithm of real GDP per capita.	PWT 6.3
comp1	Economy-wide degree of goods market competition, calculated as the ratio of the price level of investment divided by the price level of GDP (higher values indicate *less* competition).	PWT 6.3, J. Fischer
openk	Openness, calculated as exports plus imports, divided by GDP.	PWT 6.3
ki	Investment share of real GDP per capita.	PWT 6.3
kg	Government share of real GDP per capita.	PWT 6.3
dbagdp	Deposit money banks' assets to GDP.	BDKL
pcrdbgdp	Private credit by deposit money banks to GDP.	BDKL
overhead	Bank overhead costs as share of total assets.	BDKL
nim	Net interest margin (accounting value of bank net interest revenue as share of total assets).	BDKL
conc	Concentration in banking, calculated as the ratio of the three largest banks' assets to total banking sector assets.	BDKL
roa	Average return on bank assets, calculated as net income divided by total assets.	BDKL
roe	Average return on bank equity (net income divided by total equity).	BDKL
nrbloan	Offshore bank loans (i.e. loans from non-resident banks) to GDP.	BDKL
offdep	Offshore bank *deposits* divided by domestic deposits.	BDKL
spread	Interest rate spread (lending rate minus deposit rate).	WDI
fintr	Dummy variable for whether there is a finite term in office imposed upon the executive (1 if there is a finite term, and 0 otherwise).	DPI
defmin	Dummy variable for whether the defense minister is a military officer (1 if military officer, and 0 otherwise).	DPI
liec	Legislative index of electoral competitiveness (higher values indicate stronger political competition).	DPI
eiec	Executive index of electoral competitiveness (higher values indicate stronger political competition).	DPI
fraud	Measure of vote fraud and candidate intimidation affecting the outcome of elections (higher values indicating fraud being more pervasive).	DPI
herfgov	Herfindahl index government, calculated as the sum of the squared seat shares of all parties in the government.	DPI
polity2	Democracy score (higher values indicate a more democratic polity).	Polity IV
durable	Count of the number of years since the most recent regime change.	Polity IV
xrcomp	Competitiveness of executive selection (higher values indicate more competitive selection).	Polity IV
xropen	Openness of executive recruitment (higher values indicate more open recruitment).	Polity IV
exrec	Composite measure of executive recruitment (higher values indicate stronger political competition).	Polity IV
polcomp	Summary measure of political competition (higher values indicate stronger political competition).	Polity IV
ecglob	The KOF economic globalization index (higher values indicate higher degree of economic globalization of country).	A. Dreher
allglob	The KOF *overall* globalization index (higher values indicate higher degree of overall globalization).	A. Dreher
pr	Index of overall political rights (higher values indicate *less* political rights).	FH

regressor. While the BACE framework has been criticized (see Ley and Steel (2009)), my motivation behind the use of this prior structure is to make results comparable to the widely-cited study by Sala-i-Martin et al. (2004). Fourthly and lastly, I employ a prior structure which combines the unit information prior with the uniform model prior.

For three out of the four prior structures described above, I am using the birth-death sampler, except for the case of the hyper-g prior structure where I use the reversible-jump sampler (which augments the birth-death algorithm). Throughout, the results are based on three million draws, after a burn-in phase of half this number. Across the board, the correlation between iteration counts and analytical posterior model probabilities suggests very good convergence.

All posterior statistics (posterior inclusion probabilities or PIPs, posterior means etc.) reported in Section 6 are calculated on the basis of analytical likelihoods for the best 10,000 models encountered by the sampling chain. The assessment of variable importance resp. "significance" is based on PIPs. Specifically, I consider a variable to exert a significant effect on growth when its PIP exceeds 50%. In addition, when implementing the BACE framework, for a comparison I also use the criterion of Sala-i-Martin et al. (2004): These authors call a variable significant if its PIP is higher than its prior inclusion probability.[13]

5. Dataset

5.1. Sources, organization, and scope

Table 1 describes the data.[14] I consider observations on 187 countries over the time span 1988–2007, determined by the availability of financial competition data but also capturing a phase in modern history with considerable dynamics in the political arena across the world — such as the fall of the Iron Curtain.

The dataset is organized as a cross section, of which I consider three versions: the averaged cross section, the pooled cross section, and the initial values cross section.[15] Throughout, the average growth rate of GDP per capita is used as the dependent variable, and the controls are measured at the onset of the respective time span. But the measurement of the competition and environment variables differs: these variables are taken as averages over the entire time span (1988–2007) for the averaged cross section, and each of the decades for the pooled cross section. In the initial values cross section, all variables are measured in the year 1988; this version of the dataset thereby capitalizes on the "initial values regressions" idea utilized by Levine and Zervos (1998). Using three dataset versions and comparing results serves as a robustness check.

[13] The latter is defined as prior model size divided by the number of covariates (see the expression $\bar{k}/K$ in Sala-i-Martin et al. (2004, p. 818)). Eicher et al. (2007b) interpret PIPs above 50% such that a regressor does have an impact on growth, while PIPs exceeding 95% are taken to imply a *strong* effect on growth. These authors also provide a critical view on the BACE significance criterion due to Sala-i-Martin et al. (2004) – under which more variables tend to emerge as significant – but note that results do not appear to differ dramatically.

[14] The column labelled "Source" in Table 1 uses the following conventions: PWT 6.3 stands for Heston et al. (2009), J. Fischer stands for Fischer (2008), BDKL for Demirgüç-Kunt and Levine (2001), WDI for World Bank (2010), DPI stands for World Bank (2008), Polity IV stands for Marshall and Jaggers (2009), A. Dreher for KOF Swiss Economic Institute (2010), and FH stands for Freedom House (2010).

[15] Using a cross section is the traditional approach to growth regressions (see e.g. Barro (1991)) and also guards against the impact of short-term influences such as business-cycle effects likely to be present in a panel with annual observations.

5.2. Variable groups

The explanatory variables in my dataset are divided into two groups. The first group of variables contains the classical controls used in the growth regressions literature with international data, as well as environment variables for each competition area (e.g. the financial sector). I therefore include as regressors e.g. initial GDP (check for income convergence), the investment share, proxies for openness, as well as the size and activity of the financial sector, or voting irregularities during elections for the political arena.[16] The inclusion of enviroment variables serves the purpose of disentangling the growth effects of competition (the primary object of analysis) from the impact of environmental factors such as financial development.

5.3. Focus variables

The second group of explanatory variables comprises competition measures. The international perspective of the present study implies that the availability of data at this level will also determine how much can be learnt from the analysis. In a broad sample of countries, competition data is less readily available than is the case for selected individual countries or homogeneous country groups. For example, Lerner indices as a widely-used measure of goods market competition is not available for a broad international sample. Similarly, the so-called H-statistic which captures effective competition in banking is available for some developed and emerging countries only (see Claessens and Laeven (2004)). But the cross-country approach has several advantages. Countries differ at times considerably in terms of competition characteristics, and this variation can be exploited for the purpose of empirical testing. Furthermore, as regards political competition, it is adequate to choose the country as the unit of analysis, also following the comparative political economy literature (see e.g. Beck et al. (2001) or Persson and Tabellini (2009)). The empirical analysis of financial systems has also employed the cross-country approach and, given that I ask about the growth impact of all three competition areas, product market competition analysis is to be matched with this framework. Technically, the methodology provides more robust estimates and is less affected by measurement error (see Delgado et al. (2014)); not least, most BMA growth analyses have been conducted within this framework.

Competition is an inherently multifaceted concept and measuring it in any area is a difficult task, each measure having advantages as well as disadvantages. Because I look at several areas of competition, namely goods markets, the financial sector, and the political arena, a number of variables constructed in the literature shall reflect different dimensions and components of competition in these three areas. Firstly, goods market competition is proxied via the variable *comp1*, intended to capture the overall (economy-wide) degree of goods market competition. Due to the way the variable is constructed, higher values indicates less competition. Fischer (2008) also uses this measures and justifies its interpretation on the grounds that the ratio of the investment price to the total price index is likely to be smaller when competition is strong. While this measure appears relatively crude, it is the only one that can be obtained for a broad sample of countries.

Secondly, in order to measure competition in financial markets – which is a key focus of the present study – I employ primarily the variables net interest margin *nim*, the interest rate spread (lending rate minus deposit rate) *spread*, and the three-bank concentration ratio *conc*. The net interest margin is taken to proxy for market conduct in banking. Since competition is assumed to bring down margins, a high value of the variable will reflect a low degree of bank competition. Consequently, a negative coefficient sign on this variable supports the traditional view as regards the impact of competition on growth. Similarly, a high value of the interest rate spread presumably indicates a high degree of market power and low degree of competition. The three-bank ratio has an economic interpretation similar to that of concentration ratios used in the empirical IO literature: A high value suggests that the banking market is highly concentrated and indicates a low degree of bank competition. Thirdly, as regards the measurement of political competition, I utilize the major components of political competition relating to two key sub-systems of a polity, namely the legislature (variable *liec*) and the executive (*eiec*), as well as the overall competitiveness within the political system (variable *polcomp*). While the latter measure is a composite, summary measure of overall political competition within a country, the former two indices capture how competitive the legislature and the executive is: The coding of these variables follows a checklist including various characteristics, e.g. whether political parties are banned and the largest party got less than 75% of the vote, this way taking into account barriers to entry into the political marketplace. For all three variables, higher values indicate stronger political competitiveness, so that a positive association with growth suggests that political competition fosters growth. The variables are obtained from international data projects like the DPI or Polity IV that assess the degree of political competition in individual countries and code it on a given scale, taking into account the complexity of the concept.[17]

6. Main results

For each of the three dataset versions, I first report the findings regarding the effect of competition areas on aggregate growth from the BMA approach. Secondly, I perform jointness analysis, again focusing on competition results.[18]

6.1. Competition effects

Table 2 shows the BMA estimation results for the pooled cross section obtained under the Fernández et al. (2001) prior structure (henceforth FLS), namely posterior inclusion probabilities (PIPs), posterior means, standard deviations, and sign certainties (CPS). The grey shaded area in the first column highlights variables which are significant according to the 50% rule: it is obvious that the degree of economic globalization, initial income (a key control) and banking concentration emerge is significant. Banking concentration as an economic competition variable is included in four of the five best models which are relatively small, containing around three to five regressors. The data at hand therefore appears to favor "relatively modest parametrizations" in the language of Sala-i-Martin et al. (2004, p. 818). The negative sign of the posterior mean associated with banking concentration implies a *positive* effect of competition in banking on growth. This is supported by the good performance of globalization (positive growth impact) and initial income (convergence effect).

Apart from banking concentration, no other competition variable is significant by the 50% rule; the signs for most political competition proxies like the component variables *liec*, *eiec*, and *exrec*, the vote share variable *herfgov*, and the overall variable *polcomp* consistently imply a positive impact of political competition on aggregate economic growth. For this interpretation, see also the sign certainties in the fourth

[16] The proxies for openness used here take into account various dimensions of the concept; the KOF index of globalization Fernández de Guevara and Maudos, 2011a incorporates trade flows, foreign direct investment, portfolio investment, as well as restrictions on international transactions — thus representing a fairly comprehensive operationalization.

[17] In the present study, political competition is not equated with democracy; this distinction is important, because in a broad sample of countries, only a relatively small number of observational units qualify as holding free and fair elections i.e. as democracies. For the same reason, vote shares do not represent a very revealing measure of political competition for a broad sample of countries and are not used here.

[18] Due to the fact that three dataset versions are considered and an extensive sensitivity analysis conducted, the amount of estimation output is large. Only a small portion of it can therefore be reported in tabular resp. graphical form.

Table 2
BMA estimation results for FLS priors.

Variable	PIP	Posterior Mean	Posterior Stdev	CPS
ecglob	0.9999	0.0889	0.0255	1.0000
lnrgdpch	0.8136	−1.0663	0.3030	0.0000
conc	0.7261	−2.9667	1.0068	0.0000
offdep	0.7242	−1.9668	0.6733	0.0000
overhead	0.3896	−20.5552	8.1609	0.0000
nim	0.3154	−19.9049	8.3723	0.0000
allglob	0.2580	−0.0868	0.0365	0.0000
durable	0.2271	−0.0155	0.0073	0.0000
dbagdp	0.1373	−1.1851	0.6517	0.0000
pcrdbgdp	0.1138	−1.2321	0.7352	0.0053
spread	0.0776	−0.0092	0.0060	0.0000
eiec	0.0735	0.2252	0.1609	1.0000
nrbloan	0.0484	0.5785	0.4764	0.9970
pr	0.0386	0.1682	0.1890	0.9083
liec	0.0360	0.1845	0.2119	0.9394
openk	0.0308	0.0038	0.0045	0.9860
xrcomp	0.0306	−0.1953	0.3197	0.1533
defmin	0.0305	−0.3948	0.4740	0.0044
ki	0.0276	0.0150	0.0252	0.9009
exrec	0.0266	0.0467	0.1486	0.6908
polity2	0.0265	0.0079	0.0684	0.5493
roe	0.0258	−0.9235	1.5343	0.0751
milit	0.0251	−0.1093	0.7721	0.4629
xropen	0.0250	0.0933	0.2020	0.8060
polcomp	0.0246	0.0433	0.0949	0.8355
kg	0.0245	0.0130	0.0215	0.9893
fraud	0.0229	0.1933	0.7002	0.7697
comp1	0.0226	0.0657	0.2904	0.6727
roa	0.0221	2.1315	12.2522	0.5372
fintr	0.0213	0.1251	0.8311	0.6182
herfgov	0.0210	−0.2987	0.7496	0.0419

column of Table 2. However, according to Fig. 1, these and most other competition variables are virtually invisible as regards their inclusion in overall model mass. The results broadly coincide with those obtained under alternative prior structures.[19]

As regards the estimation results for the averaged cross section, under the FLS prior structure, neither competition variable's PIP exceeds 50% and so neither area of competition appears to exert a significant effect on aggregate growth. The posterior means associated with the financial competition variables *conc*, *nim*, and *spread* as well as the goods market competition variable *comp1* have signs which support the traditional view, according to which more competition leads to faster growth; this is also confirmed by the corresponding sign certainties. In contrast, the evidence for variables capturing political competition (overall as well as components) is mixed: some covariates suggest a negative growth impact of political competition, while others point to positive effects of competition in the political arena.

The picture emerging under prior structures other than FLS is similar; an interesting result is that, under the unit information prior, more variables are classified as significant, among them initial income, measures of openness, and goods market competition (positive impact on growth). This prior structure thus appears optimistic as regards the view that growth is a complex phenomenon driven by a multitude of factors. Accordingly, this prior structure also favors larger models.

Lastly, according to the results from the initial values cross section, only the openness variables are significant, with the PIPs for these variables markedly higher than for most other variables; the posterior mean signs suggest a positive impact of openness on growth, which is in line with the literature. In contrast, no competition variable emerges as significant determinant of aggregate growth. Alternative prior structures paint a similar picture, although the assessment of the competition effects (and control variables) is now more favorable: namely, the interest rate spread and political competitiveness within the legislature emerge as exerting a significant and positive effect on economic growth.

[19] The good performance of the variable *offdep* (which is the ratio of offshore bank deposits to domestic bank deposits) is not directly related to the impact of competition on growth. Rather, domestic assets being tied up abroad implies that they are not available for investment and capital stock formation at home, which slows down growth, presumably. This shows up in the negative sign of the posterior mean estimate.

6.2. Jointness analysis

When investigating the jointness of growth determinants, in order to ensure comparability to Doppelhofer and Weeks (2009), I focus on a prior structure which emulates the BACE framework used by these authors and conduct a sensitivity analysis by considering different prior model sizes.[20]

The results from the analysis of the pooled cross section are shown in Table 3. Significant resp. strong jointness is confined to a small number of variable pairs, and mostly takes the form of positive jointness i.e. complementarity involving the degree of economic globalization (*ecglob*) which is the variable with the highest PIP. It is positively linked to aggregate growth and exhibits complementarity with initial income (a key control) and – importantly from the perspective of the present study – with economic and political competition variables. Specifically, the financial sector competition variables banking concentration and net interest margin (both significantly positive factors in growth) are complementary to *ecglob*; intuitively, globalization and e.g. banking concentration both represent important but distinct and, using the language of Doppelhofer and Weeks (2009, p. 209), "mutually reinforcing" drivers of growth. Furthermore, goods market competition (*comp1*) and some measures of political competition like the military's presence within the executive (*milit*) and the Herfindahl index government (*herfgov*) also display complementarity with globalization, but neither variable is significant. While the signs of the posterior means associated with political variables (positive) allow for a similar interpretation as in the case of the financial competition variables, this does not apply to goods market competition.

On the other hand, I find strong negative jointness i.e. substitutability between economic globalization and the offshore bank deposit ratio (significantly negatively related to growth) as well as the direct openness measure (*openk*). A possible interpretation is that these variables capture aspects of an economy's international integration and in this sense reflect "similar aspects of the cross-country variation in economic growth," see Doppelhofer and Weeks (2009, p. 231). A similar interpretation can be given to the significant substitutability relationship between the offshore bank deposit ratio and bank overhead costs resp. the net interest margin.

For the averaged cross section, my findings can be summarized as follows. The regulatory quality index – which is the only significant variable according to PIP – exhibits significant negative jointness with a number of covariates, especially those which reflect openness resp. the degree of international economic integration. However, regulatory quality is also complementary with initial income and banking concentration. The intuition for this is that, presumably, all three factors affect growth, although in distinct ways. Apart from this, a small number of variables with low PIPs display positive jointness.[21] Note that goods market competition and initial income are strong complements, which can be interpreted along similar lines. There are virtually no jointness relationships for political competition variables.

Lastly, in the initial values cross section, only few variable pairs exhibit significant resp. strong positive jointness; these pairs typically involve at least one significant variable, namely the institutional measure of openness *swopen* as well as the interest rate spread, and e.g. initial income or the size of the domestic banking sector. Such a complementarity relationship is intuitive, because e.g. competition in

[20] The layout (and, in the online version of this article, also the colour-coding) employed by Doppelhofer and Weeks (2009) is followed. Specifically, in Table 3 (which contains the jointness statistic J_{il}), blue resp. boldface highlights positive jointness, while yellow and orange resp. italics is used for negative jointness. All variables in the dataset are shown and information on variable significance is included via two greyscales as applied to the row "Variable", resp. the column "Rank": Variables inside the inner, dark grey area are significant according to the 50% rule, while variables inside the outer, light grey area are significant only by the BACE threshold.

[21] For this dataset version, the pattern found by Doppelhofer and Weeks (2009), namely high significance according to PIP matching significant negative jointness i.e. substitutability, seems to be partially supported.

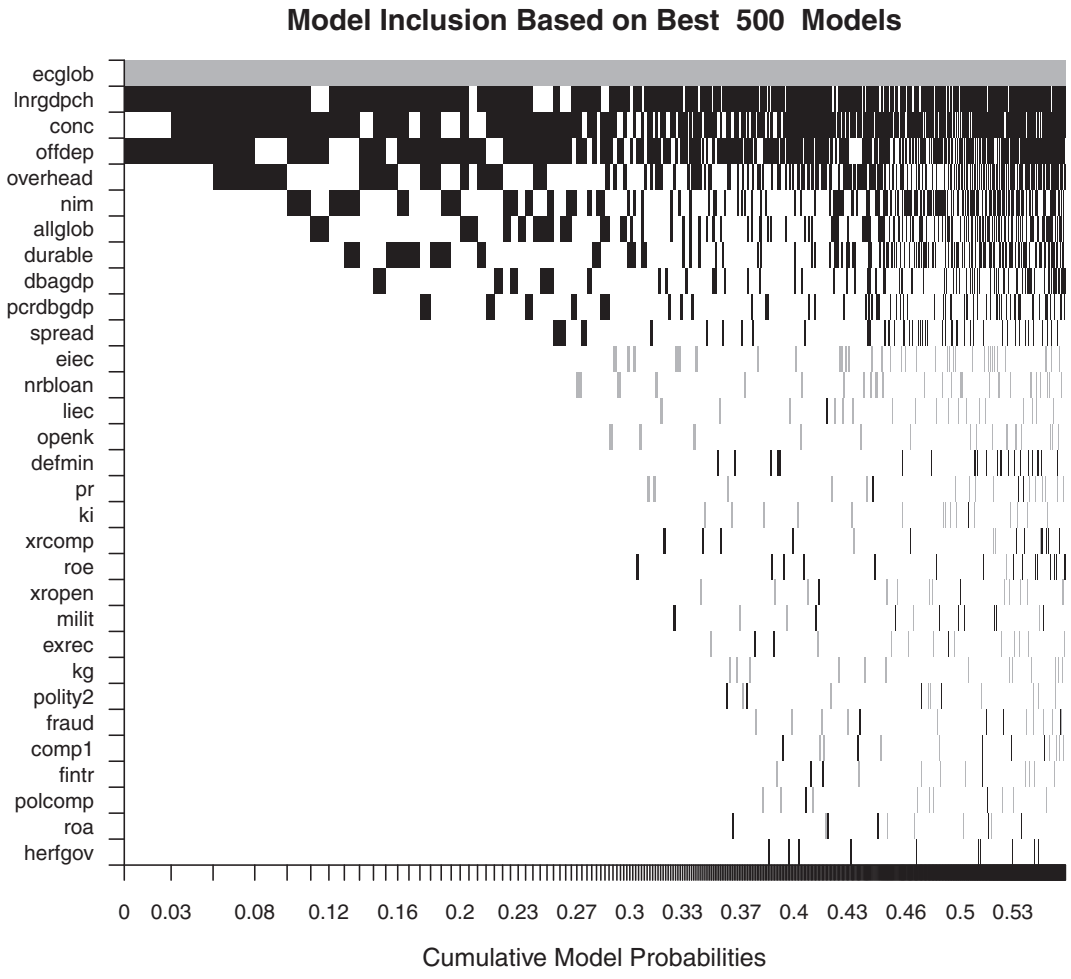

Fig. 1. Image plot (inclusion and coefficient signs) for FLS priors.

the financial sector (as reflected in the interest rate spread) will only visibly matter for growth when a certain degree of financial sector development resp. size of the banking sector has been attained. On the other hand, I find only two instances of significant negative jointness, namely between openness and political competitiveness within the legislature, and also between openness and the investment share. The relationship between openness and political competitiveness can be rationalized by noting that both variables possess a high PIP and are therefore important factors possibly representing competing explanations for growth.

To summarize the findings across the three dataset versions, the evidence for the competition variables suggests that these variables are related to other covariates which have been identified as significant determinants of growth in the present study (namely economic integration and regulatory quality). Specifically, the strongest evidence is for financial sector competition variables, esp. banking concentration, and takes the form of significant positive jointness i.e. complementarity. To a much weaker extent, this also applies to political competition and goods market competition.

6.3. Synopsis of findings

As regards the impact of competition areas on aggregate economic growth, financial sector competition – as reflected in static measures of market structure and conduct – emerges as important, but other areas of competition (goods market and political) do not play a major role in the process of growth. This result is reasonably robust across different dataset versions, measures of competition, prior structures, as well as EBA and REBA, too, i.e. model averaging approaches other than BMA. While the competition effects analysis taken alone suggests a role for financial sector competition in determining growth already, the jointness results lend further support to this conclusion because the growth impact emerges to be stronger when jointness is taken into account. Consequently, given that the international evidence for a significant impact of competition on growth at the aggregate level is far from compelling, policy agendas built upon a presumed general link between competition and growth should be handled with care. Also, existing results for national contexts do not appear to generalize to the international level.

Secondly, turning to the question of jointness among competition variables and other covariates, my analysis suggests that financial sector competition variables, esp. banking concentration, are significant complements to important determinants of growth — namely the degree of globalization and, to a lesser extent, regulatory quality. The absence of a strong case for jointness involving political variables can be linked to their low PIPs. In particular, the fact that these variables do not exhibit significant negative jointness i.e. substitutability strengthens the conclusion that they do not affect growth. On the other hand, significant positive jointness also has important *quantitative* implications: namely, the posterior means resp. the estimated coefficients increase in magnitude i.e. the impact on growth is revealed to be stronger after jointness is taken into account (see Doppelhofer and Weeks (2009)). This

Table 3
Jointness results, baseline case.

Rank	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	*ecglob*	.																														
2	*lnrgdpch*	**3.2**	.																													
3	*offdep*	*-2.8*	*-1.2*	.																												
4	*conc*	1.8	-0.1	*-1.3*	.																											
5	*overhead*	**2.4**	0.6	*-1.4*	1.0	.																										
6	*nim*	1.8	0.4	*-1.3*	0.7	*-2.7*	.																									
7	*allglob*	0.2	*-4.3*	0.9	0.6	-0.5	-0.1	.																								
8	*durable*	2.0	0.1	-0.8	-0.6	-0.1	1.0	-0.4	.																							
9	*dbagdp*	0.5	-1.0	-0.3	0.6	0.6	0.5	0.4	-0.7	.																						
10	*pcrdbgdp*	1.1	-0.4	-0.5	0.7	0.5	0.5	0.2	-0.9	*-1.7*	.																					
11	*eiec*	0.5	-0.1	-0.9	-0.4	0.1	0.6	0.1	0.5	-0.2	0.0	.																				
12	*spread*	0.3	-0.7	0.8	0.1	-0.7	-0.6	0.7	-0.1	0.0	0.1	-0.1	.																			
13	*pr*	**4.4**	-0.6	0.4	-0.4	-0.4	-0.1	0.1	0.2	-0.1	-0.1	1.1	0.2	.																		
14	*nrbloan*	-0.6	0.3	0.6	0.1	-0.3	-0.2	-0.3	-0.2	0.2	0.3	0.0	0.0	-0.6	.																	
15	*liec*	0.2	0.2	-0.9	-0.3	0.2	0.4	0.0	0.4	-0.1	-0.1	-0.7	-0.2	0.3	0.1	.																
16	*openk*	*-4.0*	0.0	0.5	0.0	-0.4	-0.2	-0.3	-0.4	0.0	-0.1	-0.3	-0.2	-0.3	-0.5	0.0	.															
17	*xrcomp*	0.2	-0.6	0.4	0.0	-0.3	-0.2	0.4	-0.1	-0.1	-0.1	0.7	0.0	-0.5	-0.3	0.3	-0.1	.														
18	*polity2*	1.7	-0.1	-0.2	0.0	-0.1	0.1	0.0	0.1	0.0	-0.1	0.4	-0.1	0.6	-0.3	-0.4	-0.1	-0.1	.													
19	*defmin*	-0.7	-0.5	0.0	0.2	0.1	-0.4	0.5	-0.3	0.4	0.0	-0.5	-0.2	0.0	0.0	-0.2	-0.1	-0.2	-0.2	.												
20	*exrec*	0.5	0.1	-0.4	0.1	0.1	0.1	-0.2	0.1	-0.1	0.0	-0.1	-0.2	0.4	-0.3	-0.4	-0.2	0.3	-0.5	-0.2	.											
21	*roe*	0.7	0.2	0.0	-0.5	0.0	-0.3	-0.1	-0.2	-0.1	-0.2	0.0	0.0	-0.3	-0.1	0.0	-0.1	-0.3	-0.2	-0.2	-0.4	.										
22	*xropen*	1.5	0.2	-0.6	0.0	0.2	0.1	-0.4	0.2	-0.1	-0.1	-0.4	-0.1	-0.3	-0.3	-0.3	-0.3	0.2	-0.6	-0.1	-0.4	-0.1	.									
23	*ki*	0.6	0.3	-0.6	0.3	0.1	0.3	-0.3	-0.2	0.1	0.2	-0.1	-0.2	-0.3	-0.3	-0.1	-0.2	-0.5	-0.2	-0.3	-0.2	0.0	-0.2	.								
24	*milit*	**2.2**	0.1	-0.4	0.1	0.2	-0.1	-0.1	0.0	-0.2	0.0	-0.1	-0.2	-0.4	-0.2	-0.3	-0.3	-0.4	-0.3	-0.1	-0.4	-0.2	-0.3	-0.4	.							
25	*polcomp*	0.4	0.1	-0.4	0.0	0.1	0.2	0.0	0.0	-0.1	0.1	-0.2	-0.2	0.6	0.1	-0.3	-0.2	0.0	-0.2	-0.7	-0.3	-0.5	-0.2	-0.3	-0.2	.						
26	*fraud*	0.6	-0.4	0.1	0.1	-0.1	-0.1	0.3	-0.1	-0.1	0.0	-0.1	0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-0.3	-0.4	-0.4	-0.3	-0.1	-0.4	-0.2	-0.2	.					
27	*kg*	-0.9	-0.3	0.1	0.2	-0.1	0.1	0.3	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	0.1	-0.3	-0.2	-0.4	-0.3	-0.4	-0.5	-0.2	-0.4	-0.2	-0.4	-0.2	-0.1	.				
28	*comp1*	**2.7**	-0.5	0.1	0.1	0.1	-0.1	0.3	0.0	0.1	0.0	-0.1	-0.1	-0.4	-0.2	-0.3	-0.3	-0.2	-0.5	-0.2	-0.1	-0.5	-0.1	0.1	-0.7	-0.4	-0.1	-0.4	.			
29	*roa*	1.6	0.0	-0.1	0.0	-0.1	0.2	0.1	0.1	-0.1	0.0	-0.2	-0.3	-0.2	-0.2	-0.2	-0.3	-0.1	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.1	-0.1	-0.3	-0.4	.		
30	*fintr*	0.2	0.1	-0.2	0.0	0.1	0.1	-0.1	0.1	-0.1	0.0	0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.2	-0.2	-0.2	0.0	-0.1	-0.5	-0.4	-0.1	-0.3	-0.1	-0.1	-0.4	-0.1	.	
31	*herfgov*	2.0	0.1	0.0	0.1	0.0	0.0	-0.1	-0.2	0.0	0.0	-0.1	-0.3	-0.2	-0.3	-0.2	-0.1	-0.2	0.1	-0.5	-0.3	-0.4	-0.3	0.0	-0.1	-0.6	-0.3	-0.4	-0.3	-0.2	-0.4	.

underlines the role of financial sector competition, supporting the results obtained in the first part of my analysis where I have focused on competition effects without reference to the jointness concept.

Importantly, the jointness results also have implications for economic policy. Positive jointness i.e. complementarity makes policy decisions more complex because in such a case, policymakers would have to keep many variables and their potentially complex and unknown interactions in view. However, as pointed out by Doppelhofer and Weeks (2009), the complexity of policy options is also determined by the number of instances of significant positive jointness. In the present study, the number of such cases involving competition variables is small, so that policy is not becoming too complex: that is, policymakers would focus on economic integration, regulatory quality, and banking concentration, where (depending on the specific policy instruments) all these targets can be consistently pursued together, presumably.

7. Further robustness checks

In a first step, subsamples of the data are considered and the aspect of potentially influential observations, also linking to issues raised by Ciccone and Jarocinski (2009) as well as Johnson et al. (2013). Secondly, note that the datasets used for estimation in the present paper do not contain missing values. This is common practice in the BMA literature but leads to small sample sizes which limits the scope of the analysis. I address this by imputing the missing values via the method developed by Stekhoven and Bühlmann (2012), thereby obtaining larger samples; I then redo my estimations.[22] Finally, I analyze the panel version of my data, focusing on country-fixed effects (see Feldkircher (2011)). The panel framework has been applied in the growth empirics context e.g. by Islam (1995) and the BMA methodology extended to panels by Moral-Benito (2010) who motivates the use of panels by the scope for increasing the number of observations and dealing with omitted country-specific effects.[23] Taken together, the outcomes of all checks confirm the results reported in Section 6.

8. Conclusions

Ongoing events around the globe have pushed the link between competition and growth into the limelight. In this context, the present paper has employed the BMA framework and related approaches to analyze the specific question of whether economic competition – especially in the financial sector – and political competition at the aggregate level is robustly associated with growth in a cross section of countries. My results consistently point towards the importance and positive impact on growth of financial market competition, specifically market structure and conduct in the banking sector. This view is strengthened by the outcome of the jointness analysis, which reveals significant complementarity between financial sector competition variables and other drivers of growth, such as the degree of globalization. While complementarity tends to make policy decisions more complex, in the present case the complexity is manageable if policymakers are able to pursue a small number of targets (most notably low concentration in the banking sector and more economic integration) in order to boost growth.

Apart from financial competition, no other competition area emerges as significant in determining economic growth. In this sense, based on international cross-country data, I obtain an agnostic picture, which likewise calls for caution when policy agendas claim a general, mostly positive link between competition and growth and/or simply transfer the results of analyses for national contexts to the international level.

[22] The Stekhoven and Bühlmann (2012) method has been explicitly designed to deal with a mix of continuous and categorical data plus potentially complex data structures, thereby recommending itself in the present setting. The authors have implemented their method in the R programming language and made it available as the missForest package.

[23] In the present context, the panel data analysis only serves as an additional check, keeping in mind that its annual frequency of the data is much less suited for the analysis of growth.

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