Concentration, Regulation and Competition in European Banking

by

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PRELIMINARY VERSION

Abstract:

Amidst a huge raft of regulatory reform in banking, little research has focused on how it might affect market structure or competition in banking. We examine five dimensions of regulation in the context of Sutton's framework for endogenous market structure. We use a panel of European banking markets to examine the relationship between concentration, various dimensions of regulation (which differ considerably across national markets) and market size. We further examine how investment in branch networks, which is a measure of quality for customers, is associated with market size and regulation. We find that different types of regulation affect market structure in opposite directions, but tighter regulation more generally channels competition into branch networks. More limited evidence is suggestive of tougher price competition being associated with higher concentration. Our background results are compared with those of Dick (JMCB, 2007) who investigates local concentration and branch networks for a cross-section of US MSAs (though she is unable to consider regulatory effects).

JEL: G21 (banks), L11 (market structure)

Keywords: Market Concentration, Competition, Banks, Endogenous Market Structure

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1. Introduction

Banks are at the heart of the sequence of financial crises that has affected particularly the USA and Europe since 2007. The focal policy concern has been systemic instability. In response, national governments and international organizations have made numerous regulatory proposals and begun to legislate (e.g. Dodd-Frank Act in the USA). Two of the highest profile measures are restrictions on risky trading activities (e.g. Volcker rule, UK ICB proposal to isolate certain activities from retail banking, Liikanen expert group for the EU) and higher capital requirements (e.g. Basel III). Most countries consider these as complementary but others see them as substitutes (e.g. the Swiss have adopted stricter capital requirements while not imposing new regulations on risky investment business). Other proposals include strengthening the official supervisory powers to intervene in troubled banks at an early stage. These new regulations affect bank business models and may have differential effects for banks of different size. Consequently, they are likely to affect bank market structures in ways that have not been properly considered.[1]

In this paper, we draw on national differences across EU Member States to identify the influence of types of regulation on the structure of the banking market. In order to do so, we use Sutton's (1991) theoretical and empirical framework. This is particularly suitable for examining an international panel of markets which have very different histories and numerous idiosyncrasies. This approach allows us to investigate competition in quality enhancing investments and how this may be affected by enhanced regulation. More tentatively, it also provides a framework to compare price competition across European countries.

Bank concentration differs substantially across EU member states. For example, in 2009 the combined market shares of the five largest banks in Estonia and the Netherlands were 93% and 85% respectively, while in Germany and Italy this concentration ratio (C5) was only 25% and 34%.[2] A second feature of bank market structure is that average concentration levels in European national banking markets have been rising in recent years. The average five firm concentration ratio for EU15 (i.e. the 15 member states of the EU prior to the 2004 enlargement) rose fairly steadily from 49% in 1997 to 54% in 2006. Weighted by market size, the rise over the same period was from 38% to 43%. Further consolidation has taken

[1] Bank market structure has already been battered by the crisis, particularly through 'rescue' mergers and massive government aid. For example, 39% of EU GDP was committed to supporting banks from October 2008 to October 2010, though half of this was unused. €2.3 trillion in aid for banks was used in two years 2008-09, with a subsidy element of €0.6tr. Three-quarters of this was systemic support and a quarter was for the rescue and restructuring of individual banks. See Lyons and Zhu (2012) for an analysis of the regulation of state aid to banks in the EU.

[2] Concentration ratios are taken from the European Central Bank database.

place during the financial crisis, but this has had only a modest overall effect, taking unweighted average concentration to 55% in 2009.

A simple interpretation of this pattern of concentration would be that some countries (e.g. Germany and Italy) have a more competitive market structure than others (e.g. Estonia and the Netherlands) and that the trend may have caused a general decline in competition. However, the dangers of such an unconditional interpretation are well understood. Market concentration evolves in relation to changes in competitive conditions. Tougher competition may be driving out weaker banks (i.e. those which are less attractive to customers) in some countries, and collusion or regulation may be shielding weaker banks in others, with the result that concentrated markets would be associated with tough competition.

Bresnahan and Reiss (1991) and Berry (1992) introduced an important and widely used methodology for identifying the toughness of competition in well-defined markets supplied by few firms. Their method has proved highly effective when data are available on a large number of markets in which the mode of competition is predominantly in price and where a similar toughness of price competition can be expected in each market.[3] However, it cannot be used when the available data are for markets across which the competitive culture is expected to be very different (e.g. histories and traditions of regulators and firms). This is the case for banking across member states of the EU. Shaked and Sutton (1987) and Sutton (1991) develop a bounds approach to retain focus on the underlying regularities without having to take full account of the presence of numerous institutional details that make each country unique. They also develop important predictions about quality enhancing investment and how this is affected by market size. Both approaches share the insight that much can be learnt about the toughness of competition by examining concentration in markets that differ in size.

We follow the theoretical framework of Sutton (1991) with a view to gaining understanding of the relationship between competition and market structure across European banks. Distinctive features of our approach include that we use a panel of national banking markets and we correct for various dimensions of regulation when investigating the relationship between concentration and market size. Following Berry and Waldfogel (2010), Dick (2007) and Ellickson (2007) we also investigate measures of service quality in order to understand

[3] E.g Cetorelli (2002) and Cohen and Mazzeo (2007) who use US MSAs (metropolitan statistical areas) as independent market observations. Cohen and Mazzeo (2007) develop the approach to quantify the effects of product differentiation on competition among retail depository institutions. They find greater substitutability within bank categories (e.g. large multiples, thrifts) than between categories and demonstrate that this product differentiation generates additional profits for retail depository institutions. These profits help to maintain smaller banks and thrifts, even as larger banks expand their operations.

the quality competition mechanism underlying the concentration – market size relation.[4] Finally, we draw on independent measures of price and price competition to aid interpretation of our earlier findings.

In the next section, we review the theory to bring out what implications for competition can be drawn from investigating the relationships between concentration and market size, and measures of investment in quality and market size. Section 3 presents the data and some descriptive statistics. We estimate the lower bound to concentration in section 4 and identify the influence of regulation. Investment in branch networks as a measure of quality is investigated in section 5. Section 6 relates our work to the Panzar-Rosse H-index of price competition and some more limited data on the price of core banking services. Section 7 concludes.

2. Competition and endogenous market structure theory

It has long been appreciated that a more concentrated market can facilitate market power, achieved either by unilateral strategies or through tacit collusion (e.g. Bain, 1951). Technological, demand and other factors determine the predominant mode of competition between firms (e.g. Bertrand, Cournot) in a particular market, and these result in different prices for any given market structure. Following Sutton (1991), we define competition as being tougher when a given number of competitors is associated with a lower price.[5]

At least since Demsetz (1973) there has also been an appreciation that a simple correlation between concentration and profits may be due to efficient firms growing to dominate the market. Inasmuch as efficiency is manifested by lower marginal costs in a homogeneous product industry, prices fall as efficiency rises.[6] At any given price and some degree of economies of scale, a sufficiently larger market facilitates entry which results in a negative relationship between concentration and market size. For a given toughness of competition, this implies prices that are decreasing in market size. Also, for a given market size, tougher price competition results in a more concentrated market. Horizontal product differentiation

[4] Each of these papers uses geographical submarkets within the USA.

[5] For example, Bertrand competition is tougher than Cournot, which is tougher than collusion.

[6] In a Bertrand homogeneous product market, only the efficiency of the second lowest cost firm matters, but with horizontal product differentiation or Cournot competition, lower marginal cost for any active producer results in lower prices. To save on 'weak inequality' type cautions, the following paragraphs ignore homogeneous product Bertrand as an extreme case.

moderates these effects by reducing the toughness of price competition, but does not change the basic relationship.[7]

Vertical product differentiation can have a deeper effect on market structure. If firms differ in qualities, only a finite number of firms may survive in the market (Shaked and Sutton, 1983). This number is further reduced in the presence of investments that enhance productive efficiency or product quality (Dasgupta and Stiglitz, 1980; Shaked and Sutton, 1987). Competition in quality-enhancing sunk costs, such as network density, advertising or R&D, leads to the emergence of a market structure that sustains a few large firms each investing heavily in quality enhancement. If investment improves the perceived quality of its product sufficiently to attract substantial custom from its rivals, it becomes profitable for one firm to invest more than its rivals. It is not profitable for a large number of firms to do this but a small number may be able to compete in quality. The escalation of sunk costs results in a market structure that is more concentrated than with fixed quality. A fringe of lower quality firms may survive by selling to less quality-sensitive customers. The negative association between market size and the number of firms is at least reduced, and may be eliminate or even reversed. Nevertheless, a robust finding is that investment in quality rises with market size when it takes this fixed cost form.

Returning to the theoretical predictions in relation to price and the toughness of competition, these are modified in the presence of sunk cost investments in quality. Comparing two markets with similar toughness of price competition, the effect of market size on price depends on whether there is also a marginal cost element to quality enhancement and what happens to concentration. For example, quality unadjusted price may rise if there is a marginal cost component to quality at the same time as the fixed cost escalation limits the effect on concentration. Alternatively comparing two similar sized markets, the one with tougher price competition may have lower prices, higher concentration and lower sunk cost investment in quality than the market with less tough competition.[8]

Empirical relationships are also influenced by numerous other factors that are hard to quantify. Even in apparently similar markets, small differences in history, sequence of entry, regulation or entry barriers can lead to different modes of competition and different market structures emerging. Banking markets have long had a rich diversity in Europe, despite attempts economically to integrate the member states of the EU. Nevertheless, Shaked and

[7] For example, more differentiated markets may be both less concentrated and higher priced, but both price and concentration fall with market size.

[8] See Symeonidis (2002, ch.5) for an example which supports the view that this may be the most likely outcome. However, Symeonidis argues that the only fully general result is that a 'tougher competition' market cannot both be less concentrated and have higher investment in quality.

Sutton (1987) show that certain regularities can still be expected, even if we expect observed markets to differ in important ways (e.g. regulation, mode of competition). Economies of scale ensure that there will always be a minimum level of concentration associated with each market size. If the source of scale economies is exogenous, this lower bound to concentration falls with market size without limit. For reasons discussed above, this changes if there is active competition in quality enhancing sunk costs and results in a lower bound that is flatter and which may even rise with market size. Sutton (1991, 1998) provides extensive evidence of advertising and R&D intensive industries using this approach.[9] Dick (2007) was the first to apply the bounds approach to banking. She uses a cross-section of US MSAs for market definition and finds that the lower bound to concentration is insensitive to market size. She proceeds to provide evidence that banks invest more in local branch networks (service quality) when the local population is larger.[10] Her results are further discussed following our own findings.

We adopt a three stage empirical approach:

First, we use data on the evolution of bank concentration in a panel of EU member states to estimate a lower bound to the concentration - market size relationship. An important novelty is that we allow for international differences in regulation to influence how far an individual country is above the lower bound.

Second, following Dick (2007) we calculate two measures of investment that should affect the quality of customer service – branch density and the number of bank employees – and relate these to market size to investigate the endogenous sunk cost mechanism.

Third, unlike previous studies, we use independent measures of price and price competition to further interpret the relationship between concentration and competition. These include the Panzar-Rosse (1987) H-index which has been frequently applied to measure competition in banking markets, and a measure of the price of core banking services.[11]

[9] See Sutton (Handbook3) for a review of the more recent literature.

[10] Her motivation to use the Sutton approach appears to be due more to an interest in investment in quality, and less with the historical diversity of markets in her dataset.

[11] The latter must be interpreted with great caution as it is extremely difficult to compare banking prices internationally. The usual problems of international comparisons are aggravated by the multiple dimensions in which banks charge customers and the very different patterns of charges that we observe across countries.

3. Data and descriptive statistics: market size, concentration and regulation

We adopt a geographic market definition at the Member State (i.e. national) level. This can be justified by reference to competition investigations of retail banks by the European Commission which normally adopt this level for their core analysis.[12] The European Central Bank (ECB) collects systematic data on banking activities for each EU member state. It does not disaggregate by type of activity (e.g. retail versus investment banking). The ECB data are for 'credit institutions' defined as businesses which either (i) receive deposits or other repayable funds from the public and grant credit on their own account, or (ii) issue means of payment in the form of electronic money. We call these banks for short. Total assets are calculated on a residence basis so this includes the activities of foreign banks in a particular Member State and excludes the foreign activities of domestic banks. The number of banks is similarly measured to include all credit institutions under the jurisdiction of each country, regardless of ownership.[13] Bank size is measured by total assets, which is the measure used by the ECB to construct five-firm concentration ratios (C5) and Herfindahl indices (HHI).

We construct a panel for the years 1997-2009 and for the fifteen EU member states at the start of the period, increased to 27 from 2001, including the new members who acceded in 2004. Market size is measured alternatively by total assets and population. Population provides a measure which is clearly exogenous to banking activities. Total assets provides a measure which is consistent with our measures of market structure, but which is likely to be endogenous and may result in econometric identification problems. As it happens, total assets and population are highly correlated in our data with the exception of one outlier – Luxembourg has a very small population but large domestic assets in banking.[14] For this reason, we omit Luxembourg from our estimation when using population to measure size, but show it in the diagrams for completeness.

Following Barth et al (2001) we examine five World Bank indices of regulatory restrictiveness. Activity restriction measures the limitations on a bank to engage in underwriting and dealing in securities, insurance and real estate. Conglomerate restriction measures the limits on a bank owning non-financial businesses and vice versa. Entry

[12] E.g. Case No COMP/M.5384 - BNP PARIBAS / FORTIS (pp.15-17) which also refers to precedents. Other European Competition authorities may sometimes adopt a lower level geographic market (e.g. the UK OFT identified SMEs in Scotland as a separate market in its preliminary consideration of Lloyds-HBOS). Data are not generally available at the sub-national level.

[13] Thus, the ECB data is quite different to the widely used BankScope database, which includes the global activities of domestically owned banks but which cannot be disaggregated by location of activities and so is inconsistent with our market definition.

[14] This is presumably due to its central location and tax advantages that have resulted in a disproportionately large banking sector.

restrictions indicate the number of legal submissions necessary for a new bank to enter. Capital regulation refers to the (pre-crisis) restrictions on assets allowable for capital requirements. Official supervisory power measures the authority of a regulator to intervene in a troubled bank.

Full descriptions of all variables, their measurement and sources are given in Appendix 1.

Insert Fig. 1 near here

The relationship between the concentration ratio (C5) and market size in 2009 is shown in Fig.1. Panel (a) measures market size by population and panel (b) by total assets. Panels (c) and (d) show the similar relationship between the HHI and market size. There is a very wide range of market sizes with Germany having a population some 200 times larger than Malta. Even markets of a similar size demonstrate a considerable disparity of experiences of concentration. Luxembourg is confirmed as an outlier with very low concentration and very small population, but this is much less so when size is measured by assets. With this exception, there appears to be a broad negative relationship between concentration and market size, and a fairly well defined lower bound. We discuss estimation of the lower bound and trends in the following section.

Insert Table 1 near here

The regulation variables are summarised in Table 1. Each is a sum of a varying number of qualitative indices and so the mean values have no particular meaning. However, the coefficient of variation provides insight into the differences in regulatory strength between Member States. We find little variability in entry restrictions, with most clustered around the maximum. Aggregating the five indices, we find a similarly low variation. The most regulated are the new Members and the least regulated Member States are in Scandinavia and northern Europe.

4. Regulation and the lower bound to concentration

Estimation methodology

The first step is to choose a functional form for the lower bound. Following Sutton (1991), our ex ante preferred model is $y = \alpha + \beta/\ln S$, where y is the logistic transform of the concentration ratio and α and β are coefficients to be estimated. This has the attractive property that $y \to \alpha$ as $S \to \infty$, allowing concentration to remain bounded away from zero if the endogenous sunk cost mechanism is important. We test for robustness using various combinations $\ln S$ (rather than its reciprocal) on the RHS and log concentration as the dependent variable. We also use the HHI as an alternative to C5 to measure concentration.

The literature has fitted both deterministic and stochastic frontiers. Sutton (1991) adopts the former estimation strategy and treats concentration ratios as extreme values. Following Gumbel (1958) the lower bounded extreme values follow a Weibull distribution. The lower bound is fitted such that the sum of the difference between the lower bound and the observed values is minimized subject to the non-negativity constraint.[15]

A deterministic frontier does not allow for markets to be in disequilibrium, which is a strong assumption particularly given the observed trends. A stochastic frontier allows the possibility that some observations fall below the lower bound. It requires the specification of a composite error term, for example, a normal plus half-normal term. Consistent with a lower bound, the half-normal error term allows only non-negative residuals, and the normal error term accounts for standard statistical noise. The model is estimated using MLE.[16]

Giorgetti (2003) proposes quantile estimation as an alternative way to allow for statistical noise and outliers. Quantile regressions minimise the absolute residuals. The method does not impose any distributional assumptions but requires a percentile or weighting assumption to take greater account of the influence of the negative residuals. For example, if we want to estimate the 5th percentile, we weight the negative residuals by 0.95 and the positive residuals by 0.05. We also run quantile regressions to check the robustness of our SFA estimates.

Results

Table2 shows the results from SFA estimation under the specification of three different functional forms, i.e. log-log, logit-log, and our preferred logit-nonlinear (i.e. reciprocal of log size on the RHS). The negative relationship between concentration and market size is statistically significant in all three cases. The logit-nonlinear fits best and this is our preferred specification. The last column in Table 2 reports the results of quantile regression

[15] The nonnegative residuals (differences) are then used as the sample derived from the Weibull distribution to obtain estimates of the parameters using MLE. Following Smith (1984, 1994) it is considered that the above approach is preferable to the approach of fitting the whole model, i.e. regression and Weibull parameters, by single maximum likelihood estimation. Robinson and Chiang (1996) also use this method but remove 1% of observations with the lowest market size and 1% with the lowest concentration in order to reduce the impact of outliers.

[16] Both fixed and random effects give very similar results in terms of our results on the lower bound reported below. We report the RE results. SFA was firstly proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) independently. It was first used to estimate lower bounds to concentration by Lyons and Matraves (1996).

estimates (5th percentile) for the logit-non linear functional form.[17] The qualitative results are unchanged.

Insert Table 2 near here

Evaluated for 2009, a doubling of market size reduces C5 on the lower bound from 54% to 49% the smallest markets and from 26% to 24% for the largest markets (within the observed range). The limit as market size approaches infinity is bounded away from zero with a limit C5 of 4%. This suggests that the endogenous sunk cost mechanism is operational in European banking, though not to the extent found in highly advertised consumer goods.[18] Our results contrast with Dick (2007), who found no consistent negative slope to the lower bound relationship between market size and concentration in a cross-section of U.S metropolitan statistical areas.[19] We return to her results in the next section.
The time trend is significantly positive, confirming that the lower bound has been shifting upward over the estimation period. The econometric specification attributes a single trend to all markets, so caution is necessary in interpretation. We return to this after allowing for the effects of regulation.

Insert Table 3 near here

Next, we condition the lower bound on the regulatory environment using the five dimensions of regulation discussed in section 3. Entry restrictions are, perhaps surprisingly, insignificant. This may be due to the lack of variability across the sample, or it may be that the legal requirements are not particularly onerous relative to the incentives for entry. Capital regulation and official supervisory powers also do not influence concentration, which is an interesting finding in the context of the substantial strengthening of both following the great financial crisis. Two regulatory variables do turn out be significant. Activity restrictions are negatively related to concentration. In other words, if banks are more restricted from expanding into relatively risky areas including securities, real estate and insurance, they are less likely to develop large market shares. This may be because these activities provide an additional source of funds for standard banking activities. Conglomerate restrictions work in the opposite direction, tending to increase concentration. In other words, if banks are unrestricted from owning shares in real business sectors (and

[17] Functional forms of log-linear, logit-linear are also specified using quantile regressions, producing similar results to those in Table 1 that use SFA estimation.

[18] For comparison, Sutton (1991) estimates a lower bound C4 of zero for (non-financial) markets without endogenous sunk costs and of 13.8% for advertising intensive industries. Other estimates (e.g. Robinson and Chiang, 1996; Lyons, Matraves and Moffatt, 2001) are of a similar order of magnitude. We discuss Beck (2007) below.

[19] She measured size by population, but it makes no difference to our results when we use population to measure size (i.e. excluding Luxemburg).

vice versa) banking markets are less concentrated. This could be because direct share ownership restricts leverage of scarce funds, or limits their ability or willingness to provide banking services to downstream rivals in the real sector. Finally, we note that the coefficients and significance of market size and the time trend remain essentially unchanged with the introduction of the regulatory variables.

To enable a clearer picture across different countries, we divide the sample into 4 groups. Members of each group are listed in ascending order by distance from the lower bound. Group 1 are those countries that lie closest to the lower bound, including Luxembourg, Germany, Italy, Austria and United Kingdom. Group 2 lie roughly in the middle range including Ireland, Spain, Porgual, France and Greece. Group 3 lie farthest from the lower bound including Demark, Sweden, Belgium, Finland and Netherlands. Group 4 are the mainly Eastern European accession countries whose data did not become available from the ECB until 2001 onwards, including Bulgaria, Romania, Hungary, Latvia, Slovenia, Cyprus, Poland, Slovakia, Czech republic, Malta, Lithuania and Estonia.

Insert Figs. 2a & 2b near here

Fig.2a shows the trend in concentration over time. The trends are not uniform and are more subtle than simple regression towards the mean. There is no clear trend in the high concentration group and the increase in the middle group is faster than that in the low concentration group. The transition economies, which might be moving towards a new equilibrium, experienced a substantial decrease in concentration. Fig.2b shows the distance to the estimated lower bound over time and so adjusts for market size and regulation. The bound is moving more tightly against Group 1. Group 4 is much closer to the lower bound than the raw concentration figures suggest. The apparent convergence of Group 3 is entirely due to the rise of the bound.[20]

5. Branch networks as an element of service quality

Dick's (2007) explanation for the absence of a relationship between market size and concentration in US MSAs follows Sutton's endogenous sunk cost reasoning. In support, she investigates the association between various measures of quality, including branch density and local advertising intensity, and market size. She finds positive effects of market size for all her five measures, though only branch density, employees per branch and geographic diversification remain significant at the 5% level once controls are introduced. The conclusion is that larger markets generate intense competition in investments that enhance quality and this increase in fixed costs eliminates the effect of market size on significant

[20] Appendix Tables A2 and A3 report the estimated distance to the lower bound for each country and over time.

entry – the fringe of small banks may increase but the average share of the largest remains at close to 30% for all market size classes.

We have already shown that market size has a negative effect on concentration for European national markets. We next turn to the evidence for the endogenous sunk cost mechanism. We have comparable data on only two measures for our ECB sample: branch density and employees per branch.[21] Dick provides the reasoning for why branch density is a good measure of quality. It is also an important part of the competitive assessment of European mergers.

First, consider branch density (number of branches per square kilometre). This will clearly be increasing in population density. As a baseline, if each branch was a standard size and capacity and there were no competition effect, we would expect a coefficient of one if we regress branch density on population density. Beyond this, if market size increases competition in branch networks, we expect a positive effect of population. In addition, we control for a number of demographic variables that may affect demand. These include median income, schooling, age profile, urbanisation, internet usage (as a substitute for visiting branches) and propensities for consumer spending, credit finance and stock market capitalisation (as an alternative to bank finance).

The first four columns in Table 4, report the results from OLS regressions (with robust standard errors) with branch density as the dependent variable.[22] All RHS variables are logged. The first column shows as strong correlation with market size and column 2 brings out the importance of population density. The population density coefficient is not significantly different to one but there remains a highly significant additional effect of market size. The results indicate a significantly positive relationship between quality measures and market size, consistent with evidence of quality competition. These findings are robust to the inclusion of our set of control variables in column 3. In fact, the elasticity of branch density with respect to population is exactly the same as found by Beck (2007) for US MSA markets (to two significant figures).

Regression 4 includes our set of regulation variables, four of which are statistically significant, with each having a positive effect on branch density. Note in particular that,

[21] Consistent with higher quality banks gaining market share, Dick also finds service quality is higher for dominant banks. Unfortunately the ECB does not publish bank specific data so we cannot investigate inter-bank differences.

[22] Pooled OLS is preferred to random effects as it produces consistent estimates even without the strict exogeneity assumption that the error term is uncorrelated with the explanatory variables in all time periods . The reported standard errors are corrected for heteroskedasticity and intra-group (within each market) correlation. Fixed effects estimation would produce imprecise results because the key variables do not vary much over time.

unlike for the lower bound, both official supervisory powers and capital regulation are significant as are activity and conglomerate restrictions. This is consistent with restrictions of all kinds raising the relative importance of local customer loans and deposits, and so channelling competition into the branch network. The regulation variables do not alter the impact of our other variables, though the elasticity with respect to population is substantially increased to 0.19.

Insert Table 4 near here

The control variables in regressions 3 and 4 are also of interest and can mostly be interpreted as demand factors. Income and education increase the demand for branch access as does the proportion of the population of working age (i.e. the complement of age dependency). Internet usage is consistent with the internet beginning to substitute for bricks-and-mortar branches. Urbanisation has no additional effect alongside population density except when the regulation variables are included.The propensity to consume does have an additional effect alongside median income but domestic credit has no additional effect. Finally, equity finance seems to reduce the need for local branches, though this effect disappears alongside the regulation variables.

The staffing of local branches is the dependent variable in columns 5-8. On its own, market size has no significant effect. Regression 6 needs careful interpretation as population is significantly negative and population density is significantly positive. Taken together, the population effect is not significantly different from zero but staffing per branch is lower in countries with a larger geographic area. We conclude that there is no evidence of a quality escalation effect on branch staffing in larger markets. This contrasts with Dick (2007) who finds a positive effect of population, and no significant effect of population density. The control variables included in regression 7 do not change our conclusions on market size, but fewer of the controls are significant.[23]

The regulation variables in regression 8 have the opposite signs to those in the branch density equation. In most cases, the absolute size of the coefficients is also similar, so the staffing is reduced approximately pro rata with the increased number of branches associated with the various types of regulation. Only in the case of activity restrictions is the absolute size of the staffing coefficient much larger than that for branch density. This implies that customer service may not be improved overall by reforms requiring the separation of banking activities.

[23] Dick (2007) uses a set of controls that partially overlap ours. For those that are comparable, her findings are very similar. For example, she finds median income significant for branch density but not for staffing, and the same (significant) sign reversal on schooling.

6. Price competition

The theory of market structure identifies two key mechanisms determining concentration: the escalation of investments in quality and the toughness of price competition. The latter is hard to quantify.[24] Sutton (1991) provides case studies of markets where the mode of competition has changed over time, mostly due to changing government intervention. Symeonidis (2000, 2001) investigates the cross-section consequences of a 'natural experiment' in the UK when cartels were made illegal. Robinson and Chiang (1996) argue that undifferentiated products and those characterised by large orders are likely to be characterised by tougher price competition. They find that such industries within the USA do have a higher lower bound than others.

We adopt a different approach. The Panzar-Rosse (1987) H-index has been widely used in bank studies to classify markets according to their predominant mode of price competition. Their H-index is the sum of the elasticities of revenue with respect to input prices. For a cartel achieving the monopoly outcome, $H < 0$, for perfect competition, $H = 1$, and for monopolistic competition, $0 < H < 1$. Intuitively, a monopolist's revenues fall when marginal costs rise because marginal revenue is positive and the cost rise reduces optimal output. A similar logic applies to oligopoly. For perfectly competitive firms with U-shaped cost curves, a rise in input prices shifts up both marginal and average cost curves and price rises to match minimum average cost. The individual firm's elasticity of revenue with respect to marginal cost is unity and adjustment takes place by exit. Monopolistic competition combines these two effects.

In a recent paper, Bikker, Shaffer and Spierdijk (forthcoming) observe that most previous calculations of H have been biased by controlling for scale during estimation of the input price elasticities. The control can take the form of dividing revenue by assets or by including assets alongside input prices on the RHS of the revenue equation. In effect, including quantity (assets) in either way converts the revenue equation into a price equation. Denote the index summing the input elasticities from a quantity adjusted estimation model as H^p. An important implication is that a monopolist will have $H^p > 0$ as price must be expected to rise with costs. This eliminates any discriminatory power in identifying monopoly in the Panzar-Rosse approach.

The perfect competition result is unaffected by scaling the revenue equation. However, Bikker et al highlight two qualifications that apply to competitive markets even with the correctly estimated H. $H < 1$ or even $H < 0$ are possible if either there are constant average costs or the market is not in long run equilibrium. Intuitively, quantity adjustment is possible by competitive firms in these cases, so the quantity element of revenues is likely to fall with input prices. Input prices should not affect return on assets in competitive

[24] Dick (2007) does not investigate differences in the toughness of price competition across markets.

equilibrium, though higher input prices will reduce return in the short run or in other market structures. This suggests estimating the elasticity of return on assets with respect to input prices in order to test for competitive disequilibrium.

They provide a full set of estimates including for 23 EU Member States. For each country, the aggregate up from individual banks (ranging from 14 in Finland to 2337 in Germany) and estimate over the period 1986-2004. They use BankScope data which provides consolidated accounts for each bank's global activities. Note that this is a different market definition to that used by the ECB. We classify countries into three groups according to whether we can reject the hypothesis that $H \leq 0$ (group 1: monopoly), or that $H \geq 1$ (group 3: competitive), and the remainder (group 2: intermediate).

According to the H-index, price competition is weakest in group 1 and toughest in group 3. In the short run, if high concentration facilitates collusion, we might expect to observe relatively more group 3 countries to be highly concentrated; but the H-index focuses on longer run equilibrium. It is intended to summarise the state of competition in the equilibrium market structure. For example, monopolisitic behaviour in a small country may still result in high concentration (and a low H-index), but it would result in fragmented monopolistic competition in a large country (and an intermediate H-index). That may result in an evolution in the mode of competition to something more competitive and so higher concentration (at the same time as a high H-index).

Insert Fig. 3 near here

The logit transform of C5 for members of each group are plotted in Fig.3 against market size. Our estimated lower bound is also shown for reference. There is no evidence of any simple relationship such as that group 1 has high concentration and group 3 low. The only discernible pattern is that there are more observations of group 1 in smaller markets. The evidence is far from convincing, but it is not inconsistent with the example used in the previous paragraph.

Insert Figs. 4a and 4b near here

Finally, we have independent measures of the average price of core banking services for a subset of 14 mostly larger countries, for one or two years each, 2004 and 2005. These indices were created by a reputable independent consultancy but we have no way of checking them. The price level differs conceptually from the H-index in many ways but most obviously it takes no account of international differences in costs. Given the small number of observations, our statistical analysis is very basic and should not be interpreted as in any way causal. In Figures 4a and 4b, price is plotted against the measured distance to the lower bound and the concentration ratio. There is a clear negative relationship. Using OLS regression output as descriptive statistics, Table 5 shows the negative relationship is stronger between the measured distance to the lower bound and price than between

concentration and price. Our very tentative conclusion is that this pattern of association is consistent with tougher price competition leading to both low prices and high concentration.

7. Conclusion [INCOMPLETE]

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Table 1 Summary statistics

	Mean	St dev	Max	Min	Range	Coef.var
C5	57.6	19.7	99.2	17	82.2	0.34
HHI	1078.1	763.4	4067	114	3953	0.71
Population (,000)	18055.3	22356.4	82541	391	82150	1.24
Total Assets €b	1273	2066	10100	4361	10095	1.62
Entry restriction	7.4	1.3	8	1	7	0.17
Activity restriction	6.3	1.6	10	3	7	0.26
Conglomerate restriction	2.2	0.7	3	1	2	0.39
Capital regulation	2.1	0.8	3	0	3	0.39
Supervisory power	10.0	2.5	14	5	9	0.24
Branch density (per km2)	0.06	0.07	0.36	0.00	0.36	1.02
Staffing (per branch)	21.8	17.0	119	4	115	0.78
No. of institutions	384	534	3420	7	3413	1.39
No. of branches	8297	13223	49155	106	49049	1.59
Price €	107.3	66.4	252	31	221	0.62

Table 2(a) Estimating the lower bound—Market size measured by total assets

Dependent variable: Concentration	SFA estimation			Quantile regression
	Log-log	Logit-log	Logit-non linear	Logit-non linear
Total Assets	-0.04* (0.0254)	-0.22*** (0.0417)	34.83*** (4.8690)	40.02*** (3.6627)
Time trend	0.23*** (0.0334)	0.55*** (0.0783)	0.52*** (0.0777)	0.33*** (0.1213)
Constant	3.13*** (0.4090)	-0.81 (0.5968)	-4.72*** (0.4146)	-4.64*** (0.3651)
No. of Obs.	298	298	298	298

Note:

1. Standard errors are in the brackets.
2. Functional forms of log-linear, logit-linear are also specified using quantile regressions, producing similar results to those that use SFA estimation
3. While logit-non linear functional form is used, the coefficients are positive but they indicate a negative relationship as the inverse of the log (total assets) is used.

Table 2(b) Estimating the lower bound—Market size measured by population

Dependent variable: Concentration	SFA estimation			Quantile regression
	Log-log	Logit-log	Logit-non linear	Logit-non linear
Population	-0.11*** (0.0354)	-0.34*** (0.0423)	83.53*** (19.6948)	90.68*** (11.1437)
Time trend	0.22*** (0.0398)	0.41*** (0.0826)	0.42*** (0.1003)	0.34*** (0.0969)
Constant	4.50*** (0.6780)	3.99*** (0.8013)	-6.82*** (0.9781)	-6.95*** (0.7132)
No. of Obs.	285	285	285	285

Note:

1. Standard errors are in the brackets.
2. Functional forms of log-linear, logit-linear are also specified using quantile regressions, producing similar results to those that use SFA estimation
3. While logit-non linear functional form is used, the coefficients are positive but they indicate a negative relationship as the inverse of the log (total assets) is used.
4. Luxembourg is excluded as an outlier

Table 3 Estimating the lower bound—Controlling for regulatory environment

	Total Assets as market size		Population as market size	
Dependent variable: Concentration	Logit-non linear (SFA)	Logint-linear (SFA)	Logit-non linear (SFA)	Logint-linear (SFA)
Total Assets	35.17*** (5.3124)	-0.24*** (0.0548)	50.22 (33.0469)	-0.37*** (0.0497)
Time trend	0.54*** (0.0811)	0.59*** (0.0844)	0.54*** (0.1104)	0.44*** (0.0851)
Entry restrictions	-0.07 (0.0897)	-0.08 (0.0937)	-0.01 (0.0996)	0.04 (0.0985)
Activity Restrictions	-0.23** (0.1020)	-0.26*** (0.1045)	-0.33*** (0.1158)	-0.32*** (0.1182)
Conglomerate Restrictions	0.29*** (0.0846)	0.27*** (0.0864)	0.28*** (0.0889)	0.29*** (0.0901)
Capital Regulation	0.02 (0.0255)	0.01 (0.0259)	0.02 (0.0266)	0.02 (0.0267)
Official supervisory power	0.15 (0.1167)	0.09 (0.1203)	0.09 (0.1265)	0.07 (0.1271)
Constant	-4.95*** (0.5485)	1.07 (0.8978)	-5.27*** (1.6853)	4.39*** (1.0690)
No. of Obs.	298	298	285	285

Note:

1. When logit-non linear (SFA) is specified, the coefficient on population (50.22) is significant at 12% level.
2. Luxembourg is excluded as an outlier when population is used as market size

Table 4 Branch density, staffing and market size

	Branches per km^2				Employees per branch			
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7	Regression 8
Population	0.37*** (0.0813)	0.12*** (0.0307)	0.12*** (0.0273)	0.19*** (0.0332)	-0.04 (0.0290)	-0.07** (0.0279)	-0.07** (0.0289)	-0.17*** (0.0295)
Population density	--	1.05*** (0.0324)	0.95*** (0.0405)	0.87*** (0.0428)	--	0.10*** (0.0340)	0.10** (0.0402)	0.18*** (0.0499)
Median income	--	--	0.24** (0.1084)	0.32*** (0.1112)	--	--	0.09 (0.0701)	0.003 (0.0706)
Secondary school enrolment (% gross)	--	--	1.71*** (0.3504)	1.59*** (0.3811)	--	--	-1.07*** (0.4051)	-1.03*** (0.3667)
Age dependency (% working age)	--	--	-1.72*** (0.6543)	-1.84*** (0.6983)	--	--	0.84 (0.6514)	1.10* (0.6568)
Urban population (% total)	--	--	0.15 (0.2414)	0.47* (0.2496)	--	--	0.39* (0.2295)	-0.02 (0.2138)
Consumer expenditure (as % of GDP)	--	--	1.73*** (0.3917)	1.46*** (0.4949)	--	--	-1.81*** (0.3468)	-1.52*** (0.40)
No. of internet user (per thousand population)	--	--	-0.11** (0.0467)	-0.11** (0.0473)	--	--	0.04 (0.0392)	0.06* (0.0348)
Domestic credit provided by banking (as % of GDP)	--	--	0.09 (0.1169)	0.08 (0.1130)	--	--	-0.00 (0.0395)	-0.01 (0.0326)
Stock market capitalisation (as % of GDP)	--	--	-0.12** (0.0517)	-0.07 (0.0525)	--	--	0.02 (0.0474)	-0.03 (0.0464)
Entry restrictions	--	--	--	0.01 (0.1008)	--	--	--	-0.07 (0.0724)
Activity Restrictions	--	--	--	0.19* (0.1093)	--	--	--	-0.52*** (0.1041)

Conglomerate Restrictions	--	--	--	0.35*** (0.1010)	--	--	--	-0.41*** (0.0904)
Capital Regulation	--	--	--	0.06** (0.0235)	--	--	--	-0.03 (0.0197)
Official supervisory power	--	--	--	0.35** (0.1493)	--	--	--	-0.30** (0.1325)
No. of Obs.	187	187	187	187	183	183	183	183
R-sq	0.18	0.83	0.87	0.89	0.01	0.04	0.38	0.55

Notes: (i) All variables are in natural logs; (ii)or Luxembourg is excluded for the same reasons as in estimating the lower bound..

Table 5 Distance to the lower bound, concentration and banking price

	Average price of core banking service		
Distance to the lower bound	-0.56*** (0.0938)	--	-0.41** (0.2124)
Concentration	--	-0.45*** (0.0861)	-0.14 (0.1812)
No. of obs.	22	22	22
R-sq	0.64	0.58	0.65

Note:

1. Distance to the lower bound estimated using logit-non linear functional and total assets as market size is used. To enable the comparison of the magnitude of the coefficients, the logit transformation of concentration ratio is used with correspondingly estimated distance to the lower bound (i.e the log of those in Table 5 and 6)
2. CPI and GDP per capita were controlled for but dropped as neither was significant.

Figure 1 (a) Concentration ratio and market size -population (year 2009)

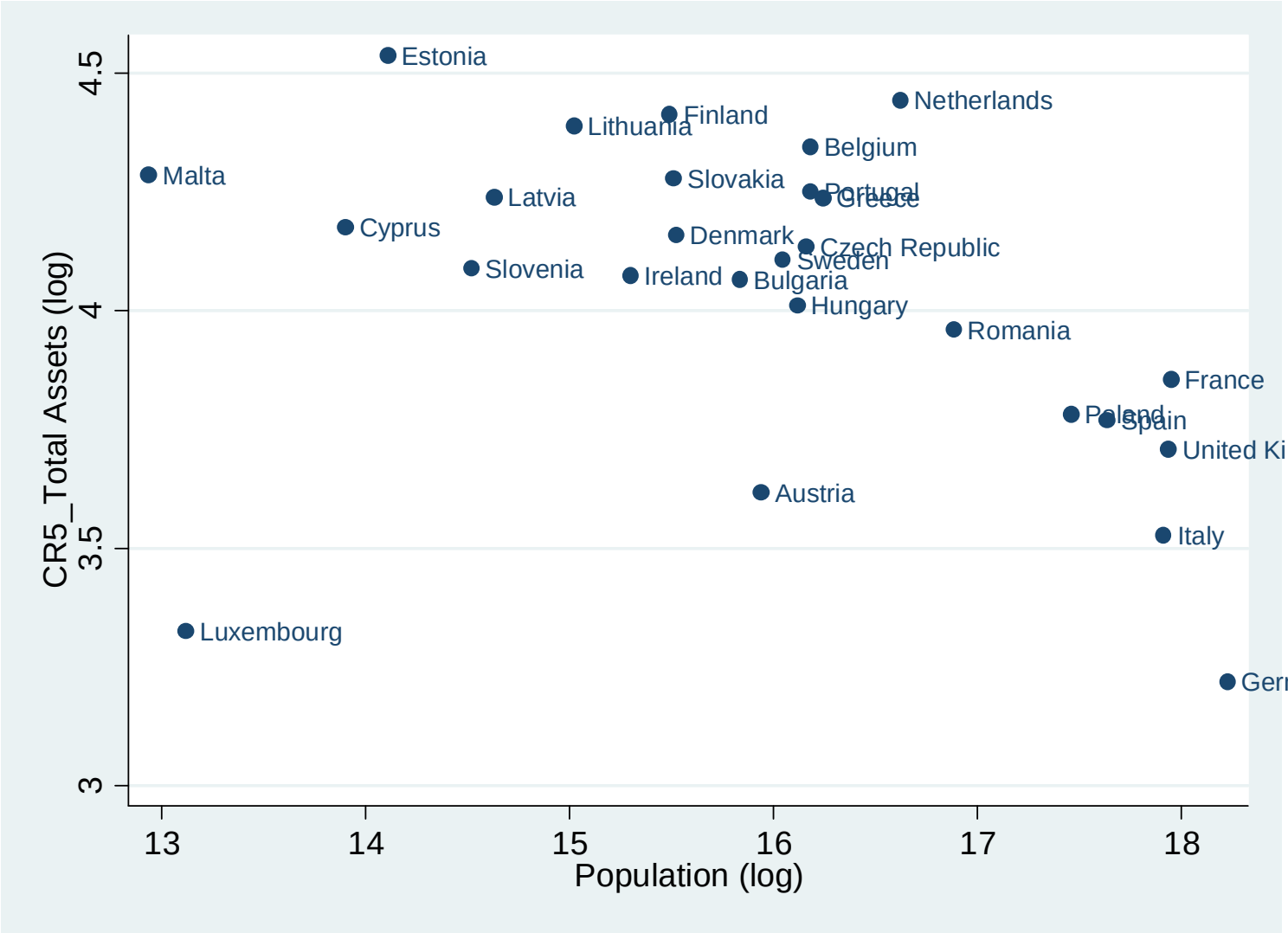


Figure 1(b) Concentration ratio and market size-total assets (year 2009)

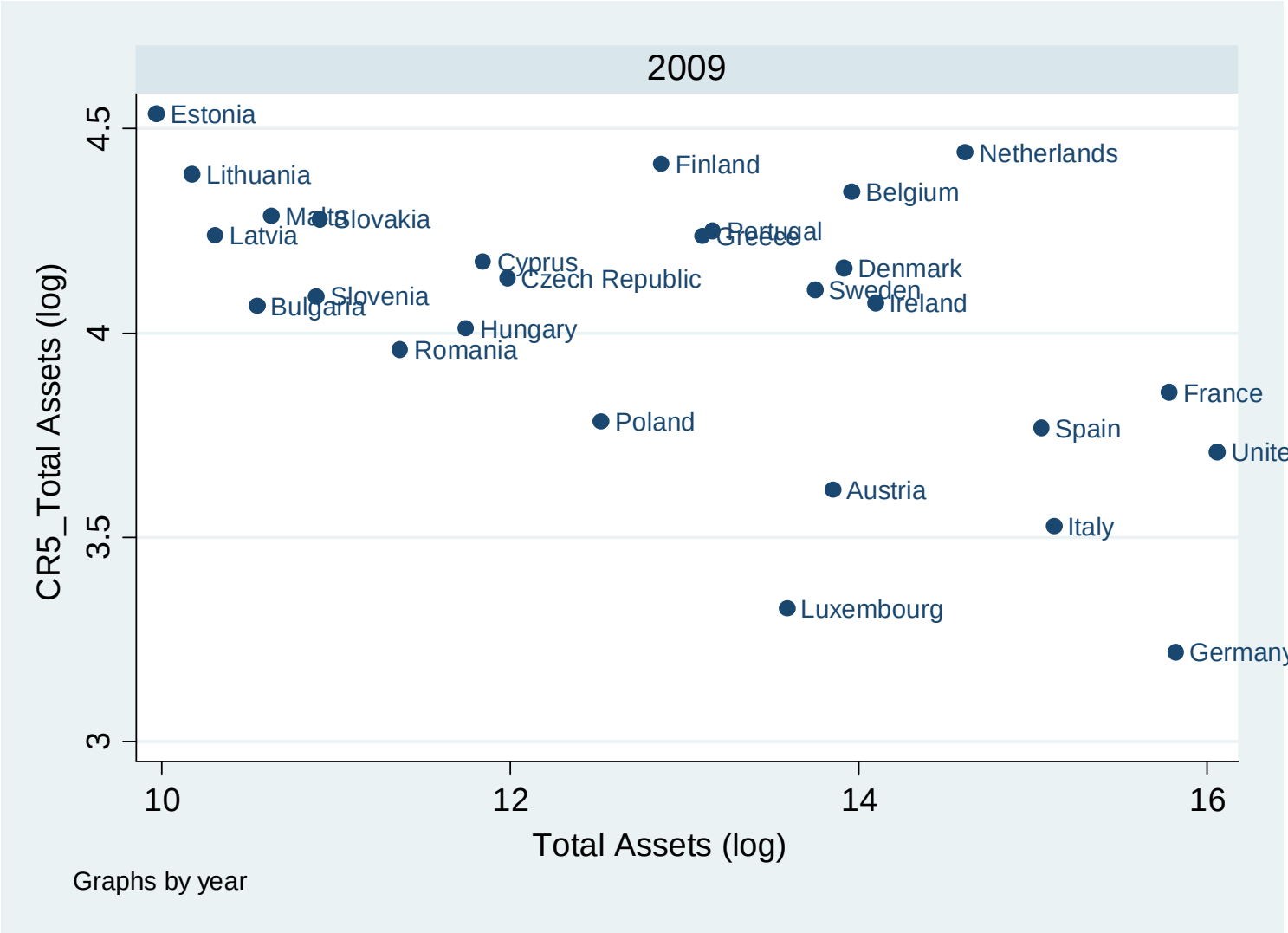


Figure1(c) HHI and market size population (year 2009)

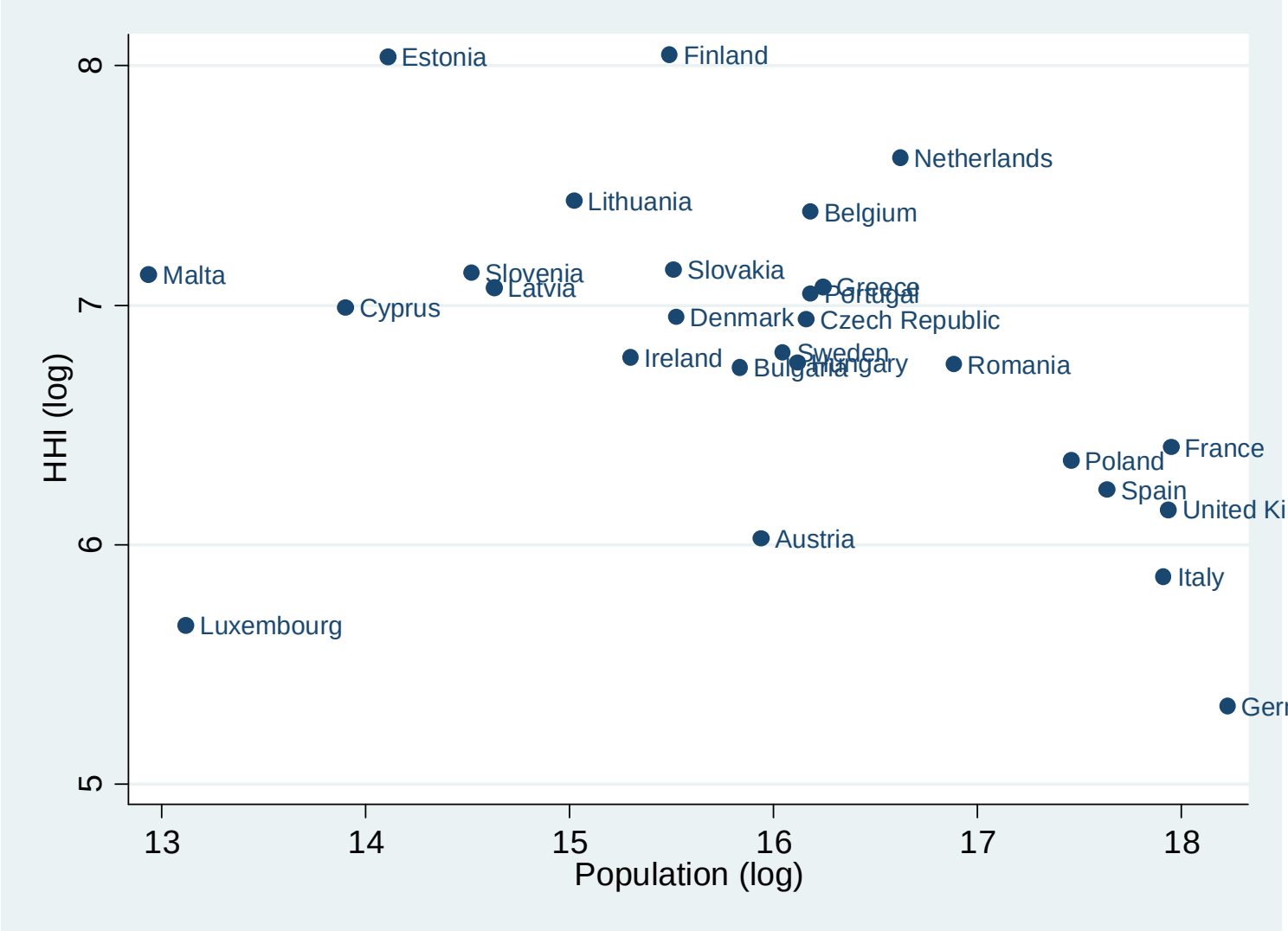


Figure 1(d) HHI and market size –total assets (year 2009)

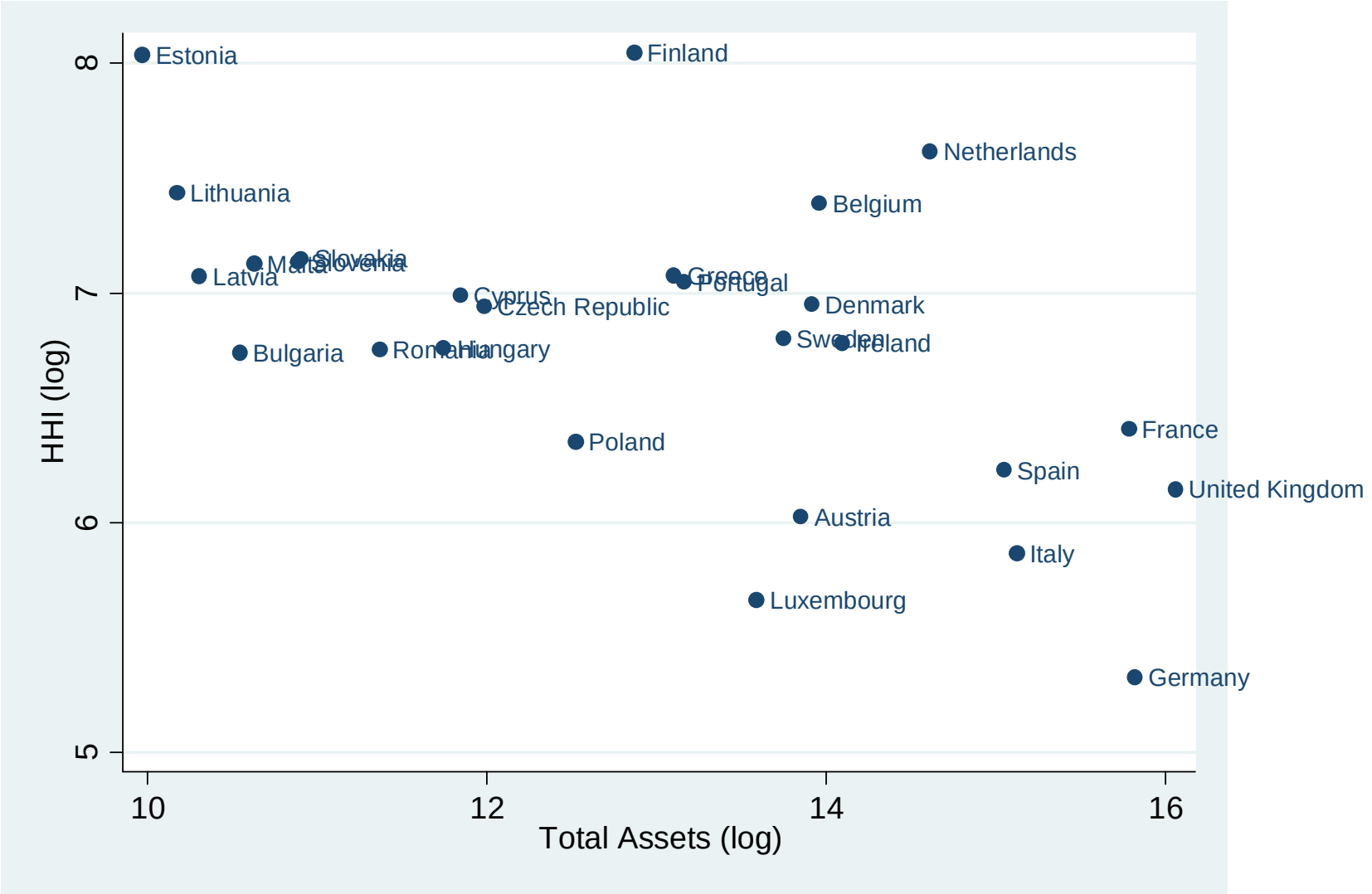


Fig 1e Lower bound: C5 (logit) and size measured by total assets

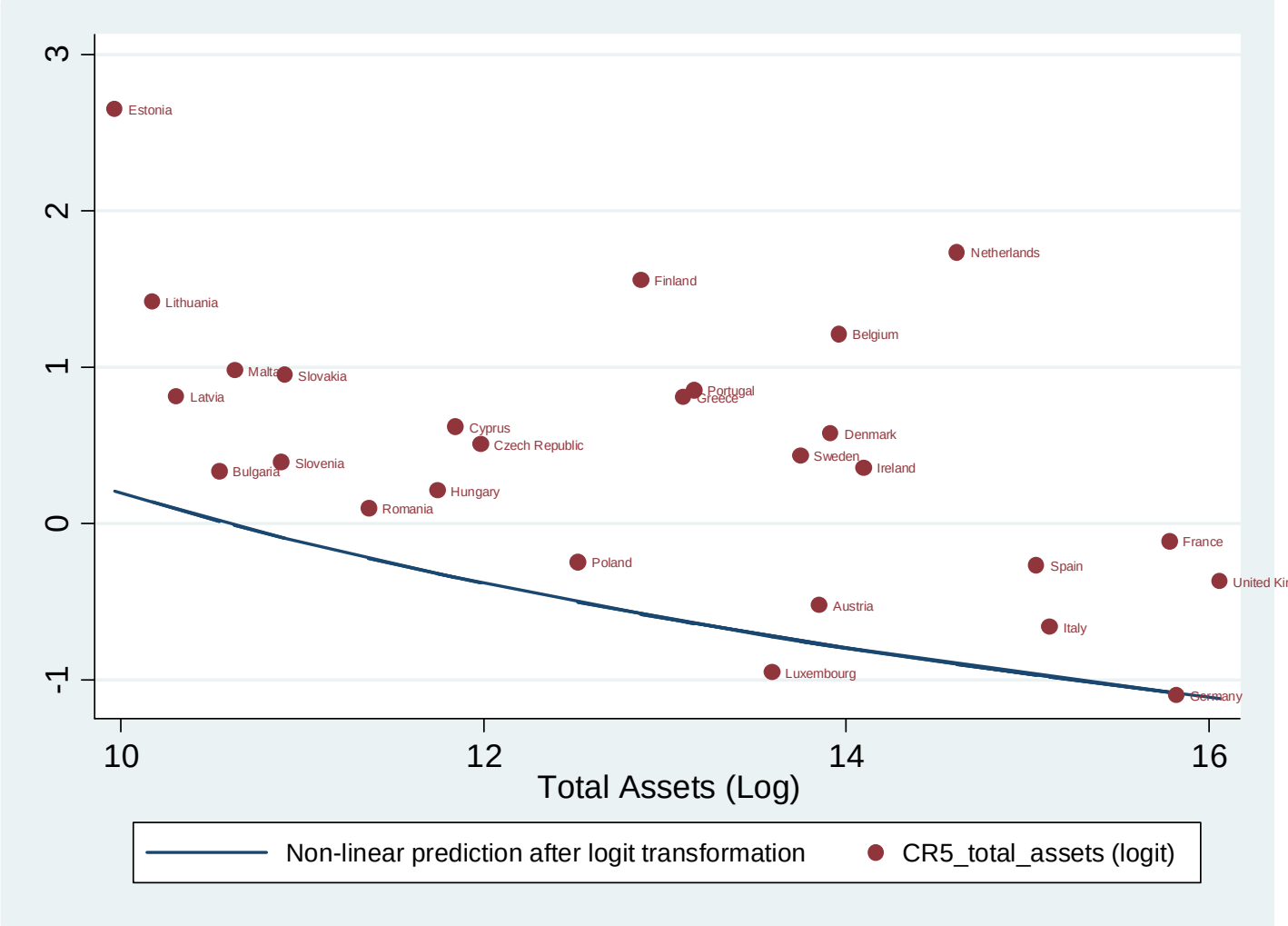


Fig 1f Lower bound: C5 (logit) and size measured population

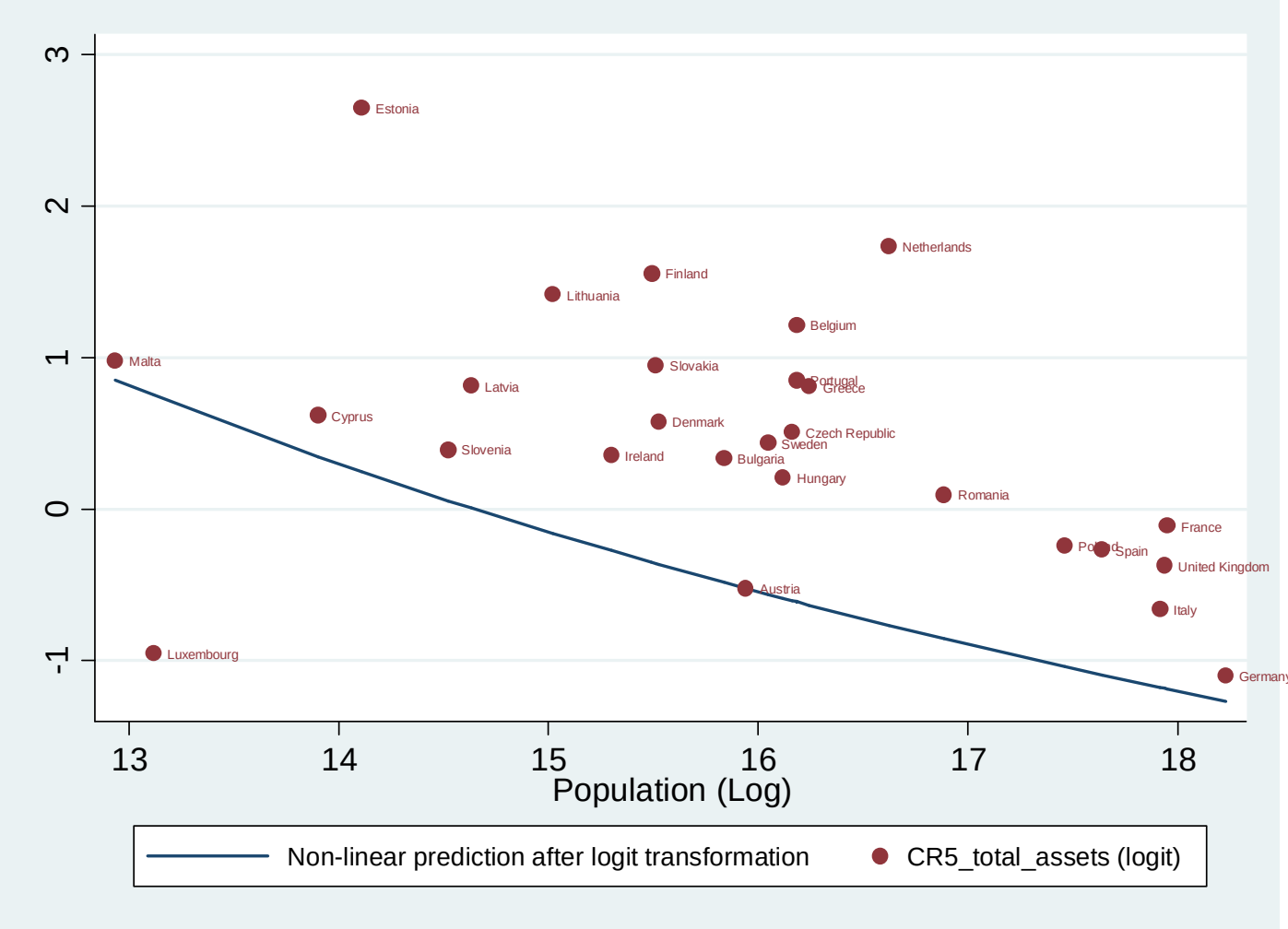


Figure 2 (a) Concentration ratio—movement over time

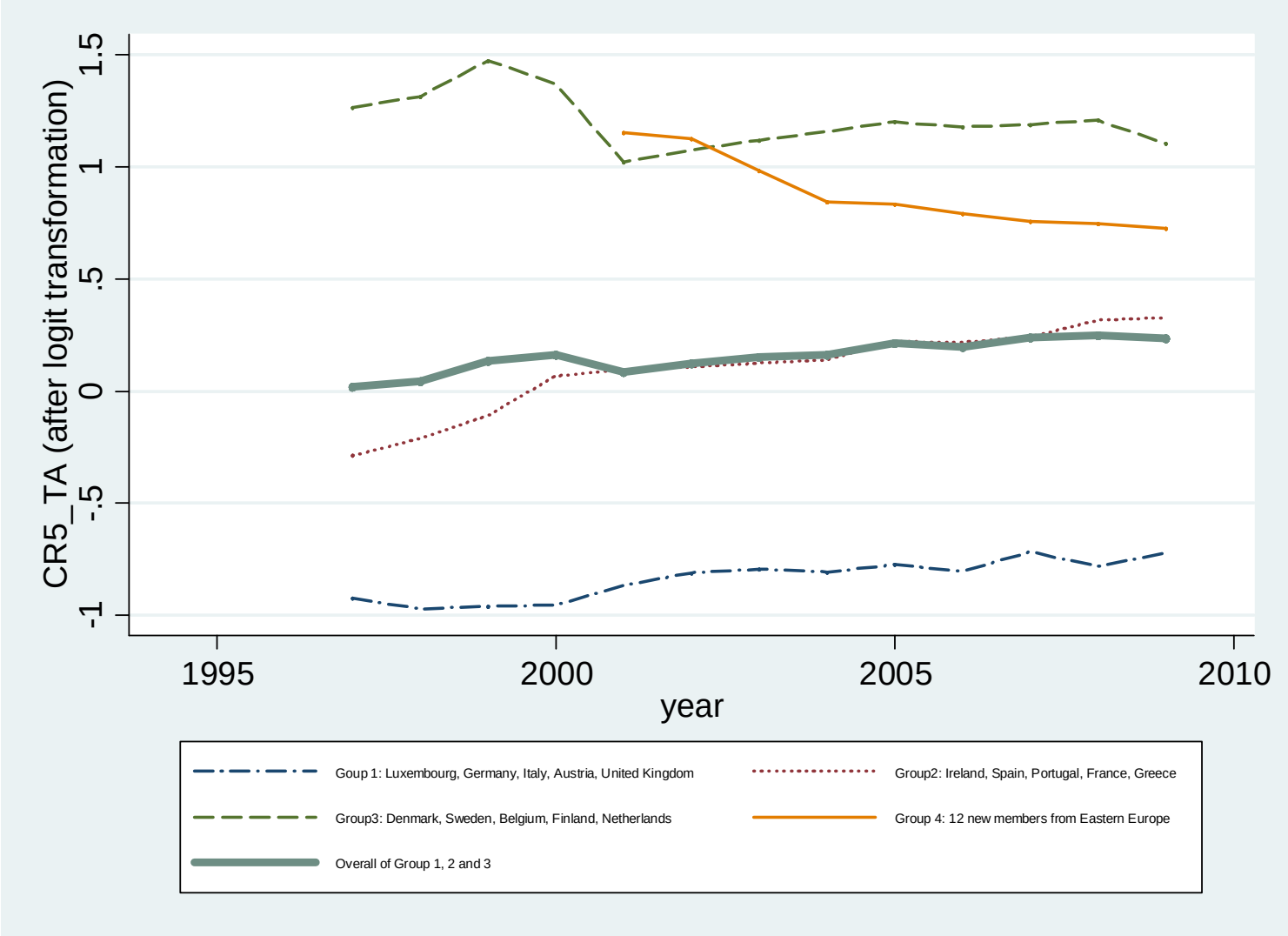


Figure 2 (b) Distance to the lower bound—movement over time

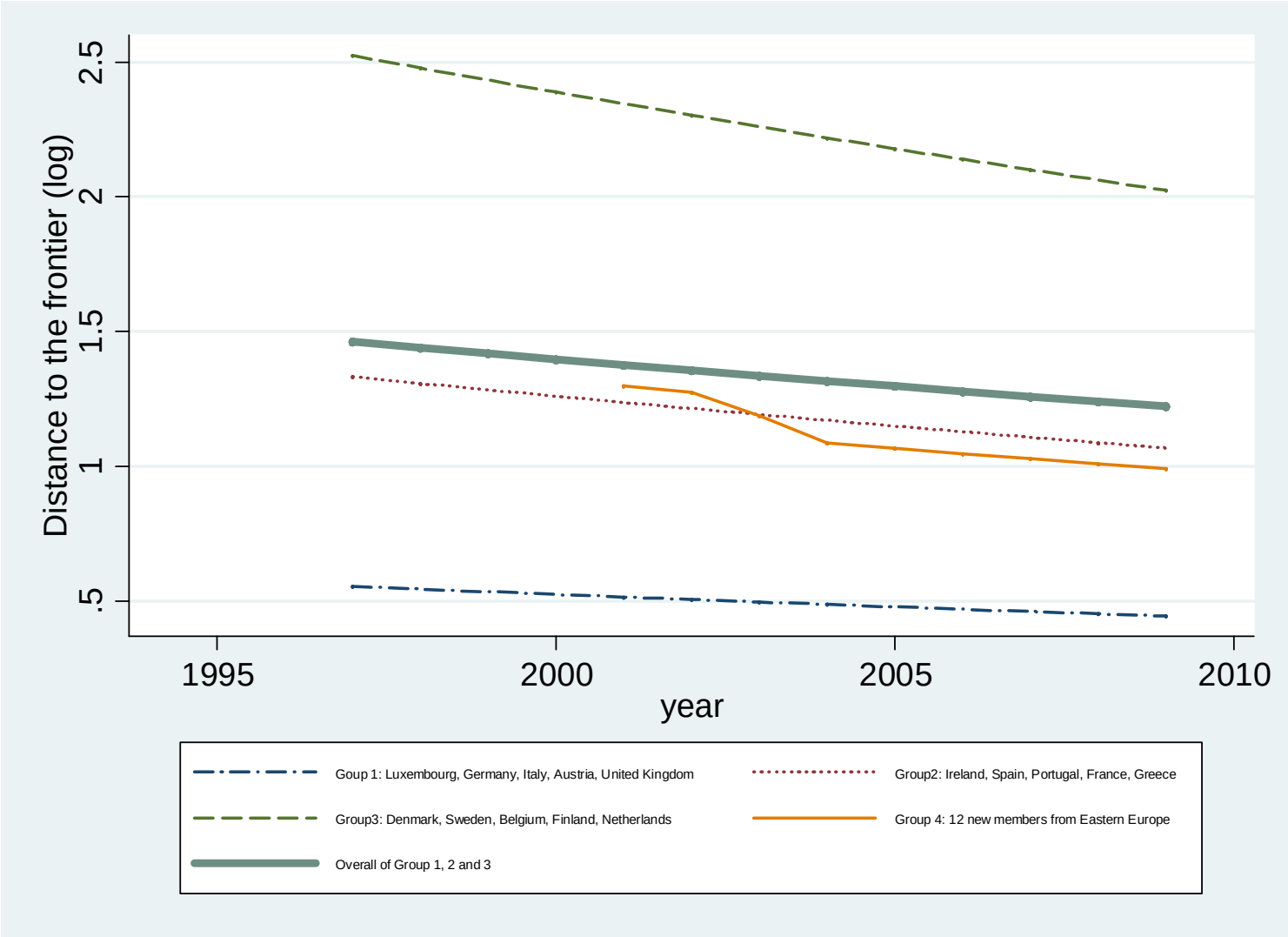


Figure 3 Relationship between H-statistics and the lower bound

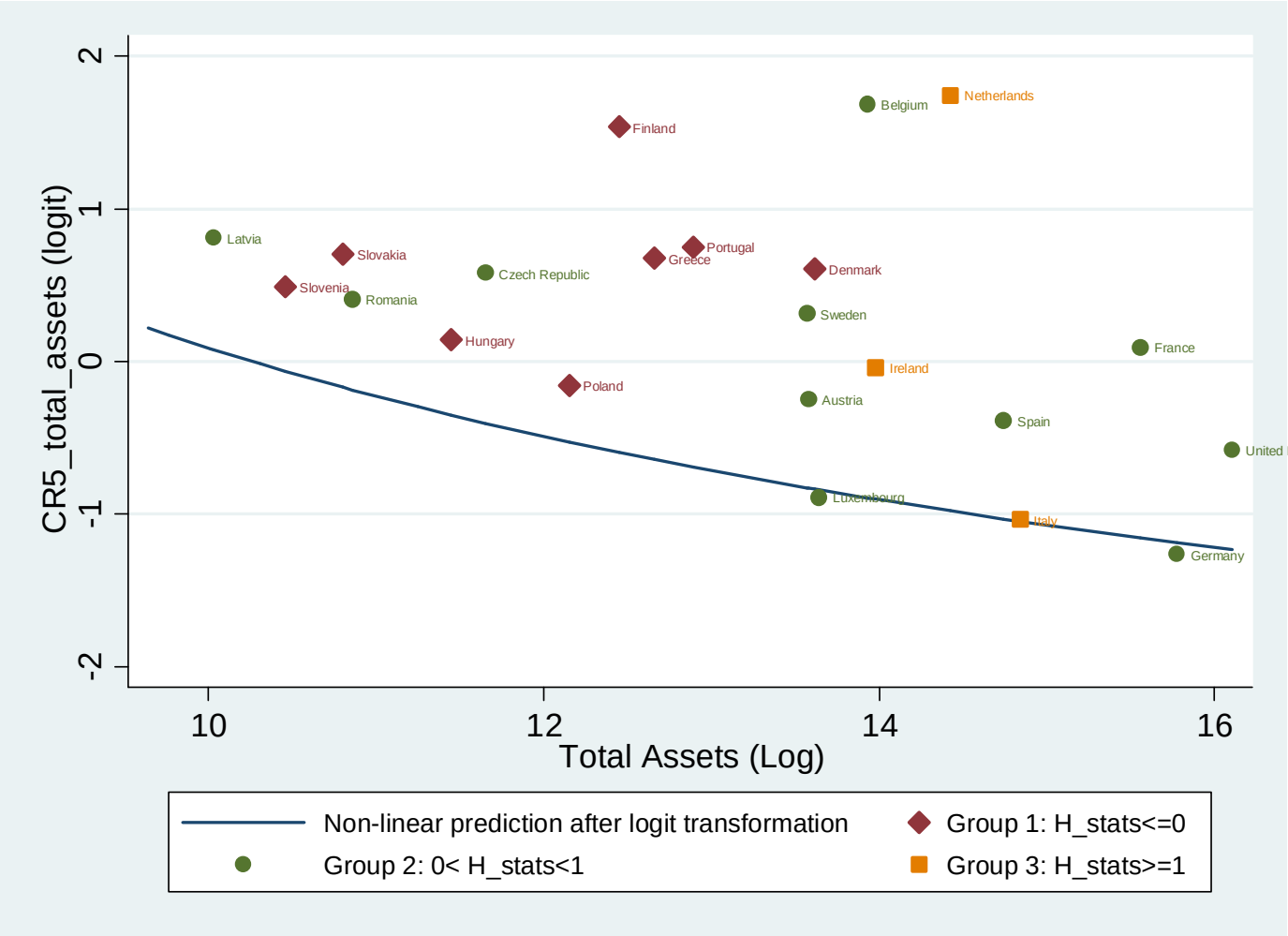


Figure 4a Distance to the lower bound and price

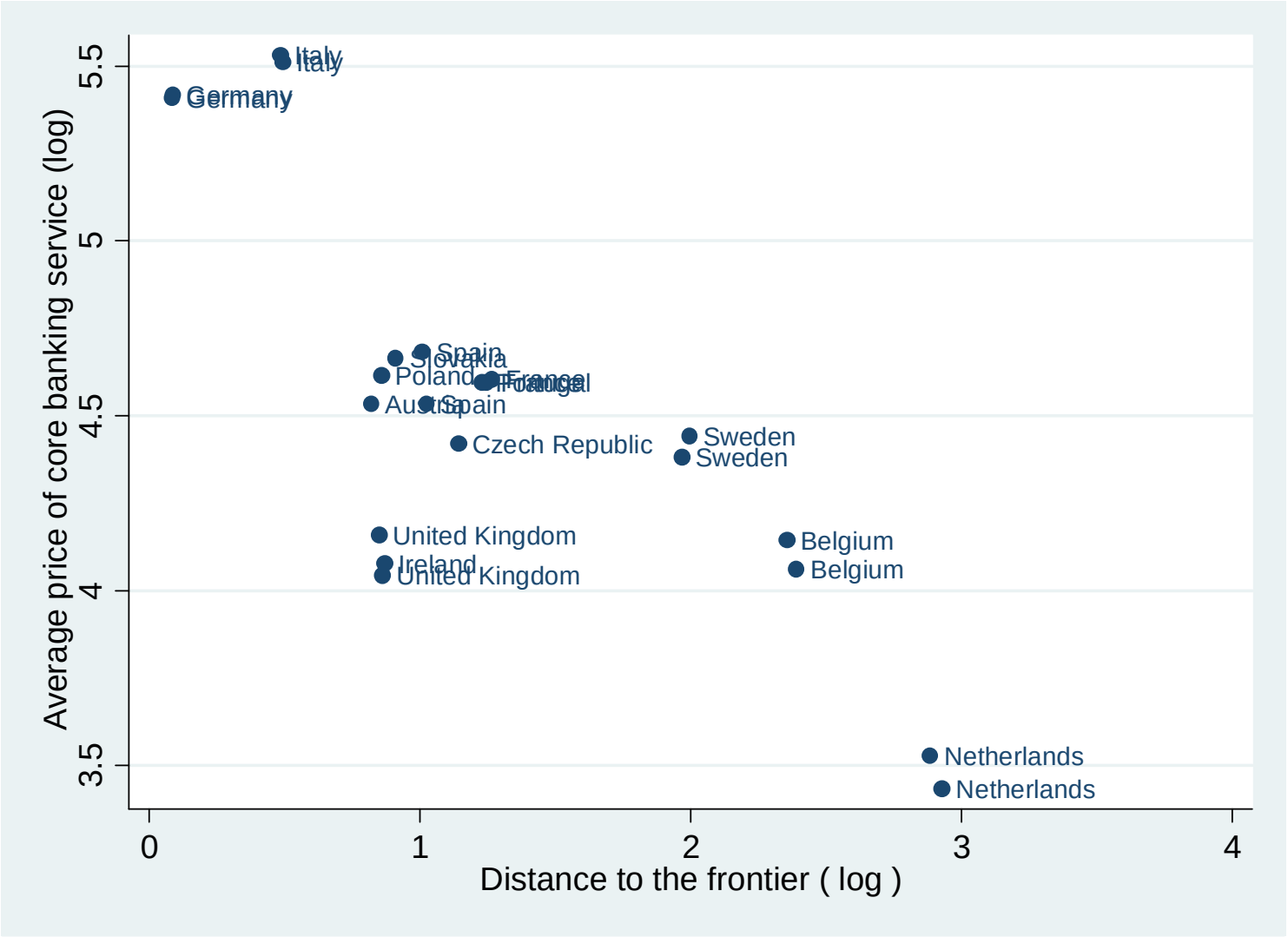
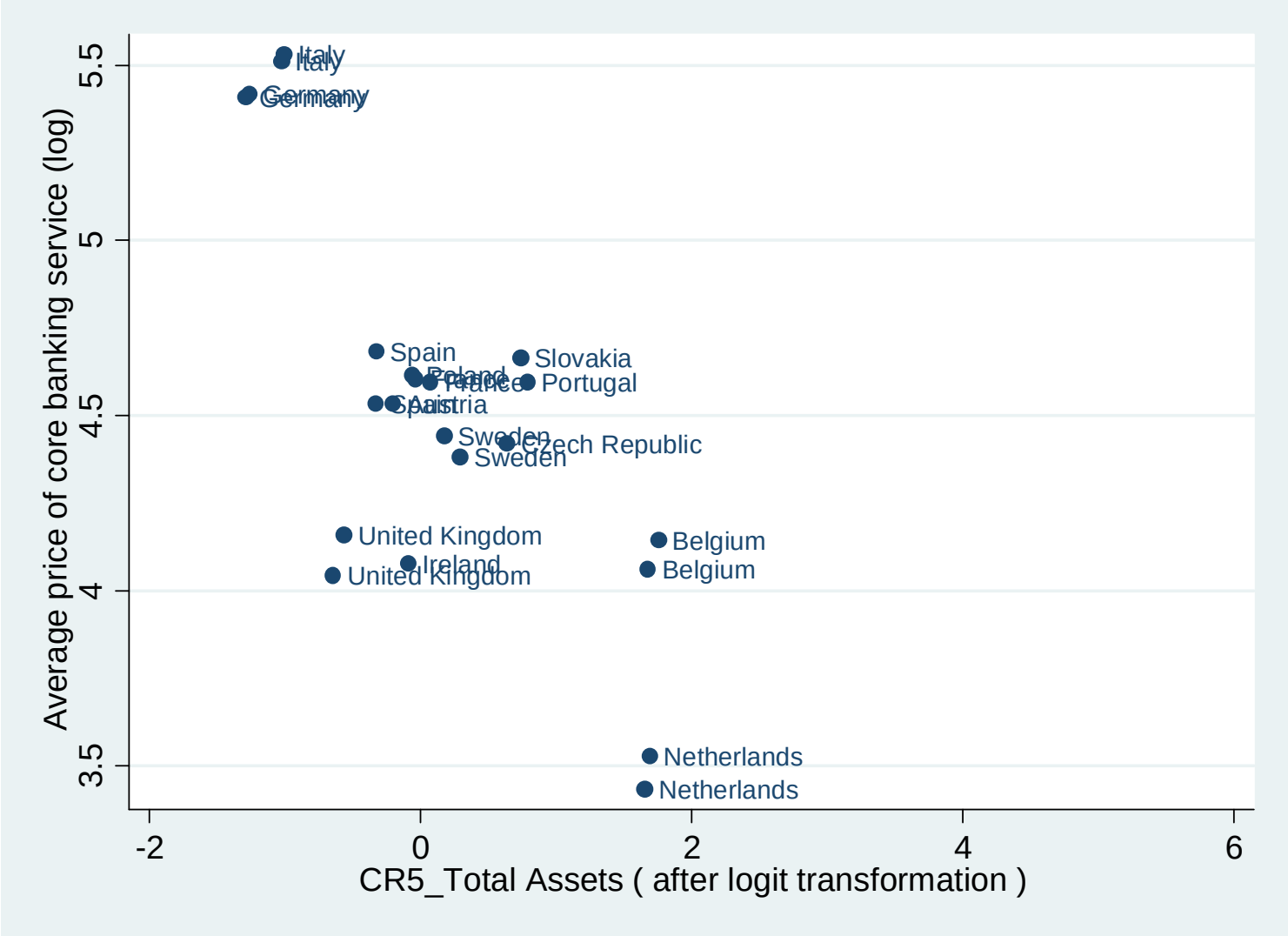


Figure 4b Concentration and price



Appendix A1: Variable measurement and sources

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
Concentration	• the percentage share of the five largest credit institutions, ranked according to assets, in the sum of the assets of all the credit institutions in that particular Member State; • calculation follows a host country residence approach and a non consolidated basis, meaning that banking subsidiaries and foreign branches of a particular credit institution are considered to be separate credit institutions resident in another EU Member State; • domestic banks' branches and subsidiaries resident outside the EU are not captured, while domestic branches and subsidiaries of credit institutions outside the EU are included.	ECB reports on EU banking structures since 1999	EU 15 from 1997 to 2009 EU 27 from 2001 to 2009	ECB data are preferred to BankScope data as BankScope data are not calculated on residential basis. For many large institutions only consolidated data are available from BankScope, which include activates in foreign countries.
Market size				
Total assets	• calculated on a residential basis, meaning that for each Member State, the credit institutions under the law of that Member State are included (independent of whether or not they are a subsidiary of a foreign bank);	ECB reports on EU banking structures since 1999	EU 15 from 1997 to 2009 EU 27 from 2001 to 2009	

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
	• the activities outside the EU of these credit institutions are not included.			
Population	• counting all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum; • the values are midyear estimates.	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Banking regulatory variables				
Entry restrictions	Whether various types of legal submissions are required to obtain a banking license: higher values indicating greater stringency	Barth, Caprio and Levine (2001)	Three surveys conducted in 1999, 2003 and 2007 covering all EU 27	
Activity Restrictions	The extent to which banks may engage in underwriting brokering and dealing in securities, in insurance underwriting and selling, and in real estate investment, development and management: higher values , more restrictive	Barth, Caprio and Levine (2001)	Three surveys conducted in 1999, 2003 and 2007 covering all EU 27	Disaggregate indicators were also tried regarding the three different types of activities and securities restrictiveness. Both securities and insurance restrictiveness appear to be significant. Only the overall restrictiveness (which is also significant) is reported in the final results.
Conglomerate Restrictions	The extent to which banks may own and control nonfinancial firms and the extent to which nonfinancial firms may own and control banks: higher values, more restrictive	World Bank: Barth, Caprio and Levine (2001)	Three surveys conducted in 1999, 2003 and 2007 covering all EU 27	The two disaggregate indicators are included separately initially and only restrictions on banking owning nonfinancial firms is significant in the model therefore the indicator of restrictiveness related to nonfinancial firms owning banks is dropped in the final estimation.
Capital Regulation	whether certain funds may be used to initially capitalise a bank and whether they are officially verified:	World Bank: Barth, Caprio and Levine (2001)	Three surveys conducted in 1999, 2003 and 2007 covering all EU 27	

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
	higher values indicating greater stringency			
Official supervisory power	Whether the supervisory authorities have the authority to take specific actions to prevent and correct problems: higher values indicating greater power.	World Bank: Barth, Caprio and Levine (2001)	Three surveys conducted in 1999, 2003 and 2007 covering all EU 27	
Branch density, staffing and market size				
Household demand	Market value of goods and services purchased by households, as % of GDP	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	Unlike Dick (2006) who uses retail deposit ratio and retail loan ratio to control for household demand, this variable is chosen to avoid potential endogeneity issues.
No. of institutions	The number of credit institutions in each Member State.	ECB reports on EU banking structures since 1999	EU 15 from 1997 to 2009 EU 27 from 2001 to 2009	
No. of Branches	A local unit or branch is an unincorporated entity (without independent legal status) wholly owned by the parent.	ECB reports on EU banking structures since 1999	EU 15 from 1997 to 2009 EU 27 from 2001 to 2009	
National income	GDP per capita	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Internet users	No. of internet user (per thousand population)	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Local cost	Consumer Price Index	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Banking sector development	Domestic credit provided by banking (as % of GDP)	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Stock market development	Stock market capitalisation (as % of GDP)	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Price, profitability and distance to the lower bound				

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
Average price of core banking services	• based on a pricing survey of the top banking institutions in each of a group of selected countries; • reflecting the average annual price a country's banks charge for core day-to-day retail banking products and services—account management, means of payment, cash utilization, and exceptions handling; • based on a common consumer price index.	Cap Gemini Ernst & Young World retail banking report 2004, 2005	2004: Belgium (4), France (10), Germany (7), Italy (6) , Netherlands (6), Spain (9), Sweden (6), UK (5). 2005: Austria (6), Belgium (4), Czech republic (3), France (11), Germany (7), Italy (6), Netherlands (6), Poland (11), Portugal (5), Slovakia (6), Spain (9), Sweden (6), UK (5). Number of banks surveyed is indicated in the brackets.	There are different approaches to charging for core banking services used by banks across the countries: account-based, transaction-based, package-based, and indirect revenue based
Bank profitability	Return on assets (profit before tax/total assets) and return on equity (profit before tax/equity)	OECD	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	Consistent data on profitability on residential basis are not available from ECB. OECD data are preferred as the majority of the countries exclude foreign subsidiaries of domestic banks while including all domestic banks and foreign subsidiaries operating in a member country. This is considered relatively consistent with calculation basis of the market structure data from ECB.
Liquidity ratio	cash, reserve and interbank deposit/total assets	OECD	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	
Average size	total assets/no. of institutions	OECD	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg,	This aggregate indicator of size is used as detailed and consistent data at bank level is not available.

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
			Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	
Capitalisation	equity /total assets	OECD	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	
Operating cost	operating cost/total assets	OECD	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	
Inflation	GDP deflator	World Bank Worldwide Development Indicators	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden from 1997 to 2009	
Banking sector development	Domestic credit provided by banking (as % of GDP)	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Stock market development	Stock market capitalisation (as % of GDP)	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
GDP growth	Annual real GDP growth rate	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
National income	GDP per capita	World Bank Worldwide Development Indicators	EU 27 from 1997 to 2009	
Institutional environment	Average of the six survey indicators: Voice and Accountability, Political	World bank: Kaufmann, Kraay and Mastruzzi	EU 27 from 1997 to 2009	Voice and Accountability: the extent to which a country's citizens are able to

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
	Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.	(2010)		participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Political Stability and absence of violence: the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. Regulatory quality: the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Government effectiveness: the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Rule of law: the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Control of Corruption: the extent to which public power is exercised for private gain,

Variables	Measurement	Sources	Coverage (in this paper according to availability)	Note
				including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.
Market interest rate	Libor 3-month	ECB	EU 27 from 1997 to 2009	
Bank regulations	See above.			

Table A2 Distance to the lower bound—cross country comparison

Country name	Distance to the lower bound_Total Assets as market size		Distance to the lower bound_Population as market size	
	Without regulatory variables	With regulatory variables	Without regulatory variables	With regulatory variables
Austria	2.020534	2.337382	1.290086	1.385836
Belgium	10.02377	11.48017	6.342092	6.956678
Bulgaria	1.146084	1.188994	1.646288	1.674284
Cyprus	2.134392	2.169917	1.184203	1.186181
Czech Republic	2.869341	3.143747	3.026313	3.202292
Denmark	5.23785	5.675726	2.954301	2.953241
Estonia	34.34392	34.47455	40.55265	35.52589
Finland	10.38948	11.8481	7.448612	8.737417
France	3.259224	3.634374	2.903824	3.120122
Germany	1.074579	1.093257	1.05518	1.06066
Greece	4.098893	4.790879	3.553355	4.030741
Hungary	1.652812	1.76986	1.907021	2.026651
Ireland	2.190018	2.455629	1.126955	1.148954
Italy	1.324181	1.6525	1.305296	1.568041
Latvia	1.645192	1.803832	1.926515	1.918266
Lithuania	3.418768	3.944803	5.168167	5.680288
Luxembourg	1.082365	1.076965	.	.
Malta	3.238666	3.453639	1.757628	1.71142
Netherlands	15.55179	19.92878	10.70929	12.21539
Poland	1.678463	2.361992	2.471109	3.383375
Portugal	3.540003	3.564795	2.708063	2.732472
Romania	1.497926	1.64341	2.656226	2.861466
Slovakia	2.429908	2.491891	2.783068	2.770319
Slovenia	1.873497	1.998717	1.646875	1.664607
Spain	2.202096	2.839562	2.049796	2.535967
Sweden	6.017643	7.665262	4.182885	4.888983
United Kingdom	1.892221	2.405632	1.595104	1.908532
Total	4.777473	5.399301	4.316513	4.490733

Note: a distance in the value of 1 stands for being on the lower bound exactly. Greater than 1 means the observation lies away from the lower bound.

Table A3 Distance to the lower bound—over time comparison

year	Distance to the lower bound_Total Assets as market size		Distance to the lower bound_Population as market size	
	Without regulatory variables	With regulatory variables	Without regulatory variables	With regulatory variables
1997	5.896938	6.601346	4.880374	5.170614
1998	5.635969	6.381236	4.557603	4.899989
1999	5.393257	6.172531	4.26984	4.652404
2000	5.167244	5.974511	4.012458	4.425458
2001	5.706115	6.146932	6.011742	5.704494
2002	5.429557	5.933225	5.469728	5.340997
2003	5.034995	5.575674	4.923706	4.939558
2004	4.673253	5.236497	4.427632	4.542526
2005	4.471654	5.068982	4.103169	4.294593
2006	4.28506	4.910431	3.820444	4.070305
2007	4.112084	4.760248	3.572837	3.866855
2008	3.95149	4.617886	3.354938	3.681823
2009	3.802171	4.482836	3.162302	3.513118
Total	4.777473	5.399301	4.316513	4.490733

Note: the unusual increase in the values in 2001 is mainly due to the inclusion of observations of new EU members from Eastern Europe.