The evolution of competition in banking in a transition economy: an application of the Panzar-Rosse model to Armenia

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Abstract

The structure of the banking industry typically undergoes fundamental changes during the transition to a market economy. This research employs the method suggested by Panzar and Rosse (1987) to evaluate the empirical evidence on the evolution of competitive structure in the Armenian banking industry during its recent transition and on the possible forces—market power or efficiency/contestability—that underlie that evolution. The results point to monopolistic competition.The reduction of bank numbers and the simultaneous increase in concentration is accompanied by a decline in competition intensity, which supports the market-power hypothesis

JEL Classification: L1, L8

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1. Introduction

The Armenian banking system has experienced fundamental changes in recent years as it is making the transition to a market economy. The very liberal regulatory approach during 1990-1993 resulted in the proliferation of risky short lived banks and, ultimately, a large number of deceived depositors. The more recent strict regulatory approach to Armenian banking, implemented since 1993, seeks to strengthen the banking system and improve its soundness which in practice has meant the elimination of about half of the pre-existing banks.

At the initial stage of the reforms, the Armenian banking system comprised only small local banks and a few big former Soviet banks. These were too weak to support the development of industry and commerce on the scale necessary for rapid development. Hence, new rules of the game were adopted aimed at modernizing the banking sector. The new framework has permitted the trend toward internationalization to continue and has thus led to a greater involvement of foreign banks in the Armenian banking system. This, in turn, has intensified the competitive pressure on the local Armenian banks. It is for this reason that the Central Bank of Armenia (CBA) has adopted a policy of strengthening local banks by means of forced capitalization, i.e., increasing minimum capital requirements, and consolidation. In this light, two questions naturally arise. The first asks what sort of industrial structure the Armenian banking

system is evolving toward. The second asks what kind of regulatory policy should be adopted in light of this evolutionary process.

This paper reviews the structure of the Armenian banking industry using data from the years 1998-2002 and employing the tests developed by Panzar and Rosse (1987) (PR below; See also Gelos and Roldos, 2002. Subsequently, the issues of competition and concentration are linked to test the validity of either the market-power or efficiency/contestability hypothesis in Armenian banking.

To preview the results briefly, we find that the Armenian banking system can be characterized as monopolistically competitive. I show that the reduction in the number of banks and the associated increase in concentration during 1998-2002 was accompanied by a decline in the intensity of competition, thus supporting the market power hypothesis.

This result contrasts with that of other emerging countries where consolidation has, largely, not yet been translated into a decline in competitive pressures. However, the Armenian experience is more consistent with those of European countries where consolidation is accompanied with decline in the fierceness of competition. The policy implication is that the "infancy" period is over and that bank regulatory officials should be wary of permitting the process of consolidation and increasing concentration to proceed much further.

Section 2 provides a literature overview. In section 3, we offer an overview of structural changes in the Armenian banking system during 1995-2003. In section 4, we describe the data and estimation procedures. Section 5 then presents the main results. Concluding remarks follow in Section 6.

2. Literature Overview

In the academic literature, studies designed to estimate the competition may be divided into two groups: structural studies that focus on market structure parameters and cost studies that estimate firm's input-output cost relationship (Bresnahan model and Panzar-Rosse model).

In the early 1950s, Mason (1939) and Bain (1951) developed the so-called Structure-Conduct-Performance (SCP) paradigm (e.g., Hannan, 1991). Within this approach, three main structural hypotheses evolved. Bain (1951) suggested the market power hypothesis, which proposed that in highly concentrated markets firms could act collusively and thus achieve high profits. Therefore, to stimulate rivalry the government should control the number and the size of firms. However, Stigler (1964) and Demsetz (Shaffer, 1994) challenged the market-power hypothesis by suggesting the efficiency hypothesis. It states that high concentration may be the result of superior efficiency of larger firms rather than a collusive behavior. During the 1980s Baumol, Panzar and Willig (1983) proposed the contestability hypothesis (see also Cetorelli, 2002; Spence, 1983). According to it if market entry–exit conditions are relatively free, then a monopolist would be interested in preventing entry by setting prices as if in a competitive market. Therefore, proponents of the efficiency hypothesis claim the best option for the government is to allow market forces to run their course, while proponents of contestability hypothesis suggest that the entry-exit barriers should be lowered.

Bresnahan's method uses historical data to estimate a market demand and cost equations indicating the banks' price setting equation and their implicit markup over

marginal costs (see also Shaffer, 1994). In turn, these estimates may be combined to yield a parameter λ whose value indicates the market's structure. If $\lambda=0$, perfect competition exists; if $\lambda=1$ a perfect cartel with substantial market power; intermediate indicates an oligopoly solution.

Panzar and Rosse (1987) use a different but conceptually similar approach to measure the competitive nature of the market and market power of firms. This method is rooted in the theoretical prediction that the price response to a cost change differs systematically depending on whether or not a firm has a monopoly. Panzar-Rosse then construct an "H statistic" from reduced-form revenue equations and measure the sum of the elasticities of total revenue of the bank with respect to bank input prices. The H statistic is a decreasing function of demand elasticity. Thus H increases with the degree of the market's competitiveness. If H=1, then the market is in perfect competition. $H \leq 0$ indicates the presence of monopoly, colluding oligopoly, or at least a short-term oligopoly in tacit cooperation. If H satisfies $0<H<1$ then the setting is one of monopolistic competition. (see also Shaffer, 1994).

Panzar and Rosse show that the H statistic can also reflect market competitiveness of the banking sector. The environment in which the bank functions need not be competitive; this is true for whole economy, but particularly for internationally active big banks.[2] Compared to local banks, these banks are faced by competition abroad. But for the countries with comparatively closed banking systems, the H statistic more truly reflects the competitive environment in the local banking system. From this persective, transition economies' banking systems can be considered almost closed since banks are not active in the international arena, especially at the beginning of transition.

Empirical research has been devoted mostly to examining the market-power hypothesis through the examination of the profit rate–market concentration relationship and, to a lesser extent, the efficiency, i.e., the price–market concentration relationships (e.g., Gilbert, 1984; Berger, 1995), and contestability (Shaffer, 1994) hypotheses. Moreover, empirical investigations of competitive conditions and of the concentration of the banking industry in transition countries' are quite rare (e.g., BIS papers, 2001; Gelos and Roldos, 2002). The outcomes of empirical studies of public policy toward market structure, either in the banking industry or in general, have so far been inconclusive. Furthermore, among those studies that appear to show a link between structure and conduct or performance, most have been recognized as methodologically flawed, rendering their findings unsuitable as a basis of public policy (Shaffer, 1994).

The advantage of the Bresnahan and Panzar-Rosse techniques is that, because they are rooted in theory, they can in principle distinguish between market power and efficiency as a source of concentration and profitability. The alternative, reduced form approaches focusing simply on market structure and its relation say, to profitability, is hampered by the need to identify the appropriate geographic region, i.e., to identify the

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[2] To cite Shaffer (1994): "…A major advantage of the technique (PR) is that no geographic market need be defined a priori; even data from a single bank can suffice for the test. This avoids much potential bias from misspecified market boundaries. If the bank operates in more than one market, the measured conduct will reflect an average of the bank's conduct in each of its markets-which may tell us less than we would like to know to evaluate a particular merger involving one market, but it's at least useful in studying the validity of structural indices or the overall degree of competition in the banking industry…".

boundaries of the market. This is not to say that the Bresnahan and Panzar-Rosse tests are without problems of their own. In particular, these tests typically assume that the firms are in a long-run equilibrium. If the market is still in transition, then these tests can give misleading results. However, in the case of Panzar-Rosse, the direction of bias in this case is always toward a finding of market power. Hence if the test indicates a competitive outcome, we can be relatively sure that monopoly power is not being exercised (Shaffer, 1994). Bresnahan's test is not subject to the same sort of anticompetitive bias, though other conditions can cause a similar bias. For instance, the test would overstate the degree of monopoly power if applied to a subset of banks in a market (Shaffer, 1994). Another shortcoming of the Bresnahan model is that it requires industry aggregate time series data which, for transition economies, are too short to get reliable results. This problem does not exist in the Panzar-Rosse method, because it relies on individual banks' data, for which there are sufficient observations.

Several studies have used the Panzar-Rosse method to measure the level of competition in the banking sector. Nathan and Neave (1989) applied this technique to Canadian banks, Gelos and Roldos (2002) to banks in emerging markets, and Bikker and Groeneveld (1998) to the European Union as a whole and to individual countries in it. In general, all of these studies find that banking markets are best described as monopolistically competitive. Because of its strong theoretical roots, and because it does not require the time series data necessary for the Bresnahan test, this paper uses the Panzar-Rosse technique to examine Armenian banking.

3. Overview: Structural Changes in the Armenian Banking System, 1995-2002

Since the beginning of its transition in 1992, the Armenian banking system has experienced radical structural changes. In 1990-93, under a very liberal regulatory regime, a vast number of short-lived banks were established while at the same time foreign capital started to enter the market. In 1993 the regulatory regime was tightened as the government and the economy entered a period of macroeconomic stability and some austerity. As noted above, these changes ushered in a period of consolidation. Those banks that had made profits only on high spreads and forex speculative transactions found it difficult to survive. Faced with stricter capital requirements and intensified foreign competition, many of these banks either failed and exited or were merged into stronger firms.

The trend towards consolidation that started in 1995 continues to the present but in a much weaker form. Whereas about 73 banks existed in 1992, 20 did so in 2002. Not surprisingly, a major casualty group has been the former big Soviet banks who were weak and unable to adapt to the new market challenges. Instead, the banks with significant foreign capital were growing significantly and were expanding their reach.

Table 1 shows the evolution of market structure for six different submarkets of [deposits are not assets but liabilities, those separate banking services markets] the Armenian banking sectors during the transition years. Here structure is measured using conventional concentration ratios. HHI is the Herfindahl-Hirschman index and is calculated as $\sum S_i^2$, where S_i is i bank's share and lies between 0 and 1. The other concentration data presented are 4-firm, 7-firm, and 10-firm concentration ratios. All the latter indices lie between 0 and 100. For all these indices, high concentration is associated with a higher index.

Table1. Concentration ratios in main banking markets (beginning of period)*

	01.1996	01.1997	01.1998	01.1999	01.2000	01.2001	01.2002	01.2003
Total assets								
HHI	0.15	0.13	0.12	0.08	0.06	0.06	0.08	0.10
C4	60	61	59	50	43	39	47	48
C7	75	79	72	66	62	58	64	66
C10	79	87	80	76	74	70	77	79
Loans to the economy								
HHI	0.18	0.19	0.22	0.11	0.08	0.07	0.09	0.08
C4	72	70	65	58	45	43	48	45
C7	80	85	76	72	65	63	68	63
C10	83	91	84	79	77	73	81	78
T-bills								
HHI	-	0.31	0.19	0.09	0.00	0.15	0.11	0.13
C4	-	85	73	47	50	65	57	62
C7	-	95	88	66	68	78	74	80
C10	-	97	93	82	82	87	86	93
Time deposits: Natural persons								
HHI	0.15	0.12	0.09	0.09	0.09	0.09	0.09	0.09
C4	65	62	54	55	48	50	49	50
C7	77	84	75	69	66	70	75	71
C10	82	91	86	80	80	83	87	86
Time deposits: Enterprises								
HHI	0.21	0.22	0.27	0.09	0.10	0.08	0.09	0.09
C4	85	85	77	48	55	44	50	47
C7	97	93	85	66	73	67	70	74
C10	99	97	92	79	84	79	83	90
Demand deposits								
HHI	0.16	0.15	0.11	0.10	0.10	0.13	0.23	0.23
C4	60	70	60	54	52	56	70	68
C7	74	88	76	73	69	72	81	81
C10	77	94	86	85	82	83	89	89
Number of banks	38	34	30	31	31	30	22	19
HHI for equal shares	0.026	0.029	0.033	0.032	0.032	0.033	0.045	0.053

* Source: Author's calculations based on bank statements provided to the CBA. Data for all active banks are included.

All indices, except C10, show a similar pattern. The general pattern across all six markets and each of the different concentration measures is one of initial declining concentration followed in more recent years by either stability or increasing concentration. However, the increases of the last few years have not been sufficient to offset the initial decrease in concentration except for demand deposit.

As noted above, the pattern revealed in Table 1 reflects the interaction of two main forces. The first is the failure and decline of the large Soviet banks. As these have withdrawn, market concentration has declined. The second force has been the entry of large foreign banks and the stricter capital requirements that have been imposed. This has led to the exit or consolidation of many small banks and has tended to increase concentration. It is this latter effect that has been more dominant in recent years. For

example, using the measure of total assets, two-thirds were concentrated into the hands of large Soviet banks in 1995. As they have shrunk, the standard concentration indices have also fallen.

However, especially since 1998, other structural changes have also been taking place, especially among those banks that are not among the largest six or seven. Here, consolidations and mergers have led a number of the smaller banks to gain considerable market share. This is why the ten-firm concentration ratio (C10) often shows no decline in 2003 against 1996: very small banks have been combining and kept this measure of industrial structure constant despite the de-concentration at the top.

It is worth noting that this structural evolution has been accompanied by a nearly continuous decrease in the prices of financial services, as well as continuous changes in the list of those banks that comprise the largest four firms, the largest seven or the largest ten firms. The price declines and high turnover among the largest firms suggests that much of the pressure for consolidation has been brought about by increased competition—most likely through the entry of foreign banks—that has made it impossible for inefficiently small banks to survive.[3]

In this light, the stabilization of concentration, and possibly even a beginning of a new, trend of rising concentration, raises some concern that the era of intense competition is ending and that banks may now be finding ways to exploit their rising market power. What is particularly worrying is that the concentration level has been growing in those markets where foreign banks are most active (like T-bills, demand deposits[4], and natural persons' time deposit markets). Thus, as globalization proceeds, the markets may become more oligopolistic. Yet all this is simply speculation in part because we do not yet know the source of the concentration pressures. Are the larger banks large because they are more efficient? Or, is size a reflection of the drive to acquire and maintain market power?

4. Methodology and Data

To understand more completely the evolution of the Armenian banking sector I use panel estimation with fixed effects covering the years 1998-2002 to construct the Panzar-Rosse H statistic. Having identified the concentration level and the H statistic, I estimated the relationship between them. This enables us to test between the efficiency/contestability vs. the market power hypotheses. If the H statistic decreases along with the increase in concentration ratios, then the market-power hypothesis is supported. Otherwise, if the H statistic is increasing while the concentration ratio is decreasing or is staying stable then the efficiency or contestability hypothesis may be relevant and should be examined (in future research). To take into account of individual bank effects, I let the intercept vary for each bank but assume the slope coefficients are

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[3] All main big banks have significant shares of foreign participation.

[4] The Civil Code of Armenia considers deposits of individuals, even time deposits, as demand deposits. Which means that their owners can withdraw any sum at any time, even if they had signed a contract obliging them to keep the deposit for a given period. Some banks register their time and saving deposits as demand deposits on terms of time deposits and, to attract new depositors, pay high interest rates on all deposits. We have unfortunately no separate time series data and can not monitor separately these two liabilities. However, the share of individuals in demand deposits was approximately 40% in 2002. Thus, the conduct of concentration ratios of demand deposit and individuals' time deposit markets are interconnected.

constant across banks. Dummies for each year were introduced to account for time effects. Monthly data are used to avoid the effects of cyclical and accidental factors[5].

This method has several advantages. First, it makes it possible to take into account the special features of each bank, such as managerial style, and thereby to control for unobserved heterogeneity. Gelos and Roldos (2002) adopt a similar strategy with respect to their study of emerging market banking. The inclusion of time effects allows the consideration of the possible influence of such factors as changes in the regulatory or tax policy, technological changes and external effects such as Russian crises. A third advantage from using the panel estimation framework is that even if we cannot estimate the market with certainty[6] in terms of the level of H, the time element permits us nonetheless to gain insight into how H is changing over time. Separate estimates of two sub samples, January 1998-January 2001, and February 2001-January 2003 will give some indication of the movement of H over time.

For the case at hand, the Panzar-Rosse H statistic for the Armenian banking system may be derived from the following regression:

$$\ln IIASS = a + b_w \ln W + b_k \ln K + b_f \ln F + c \ln ASS + d \ln X + u \qquad (1)$$

Where: IIASS is the ratio for revenue; W represents unit labor price; F represents unit fund costs and K is a unit capital costs; ASS and X represent bank specific factors that reflect the differences in size and riskiness (efficiency) of banks respectively; u is a stochastic error term, and a, b_w, b_f, b_k, c, and d are coefficients to be estimated. H is equal to the sum of the related elasticities: H= b_w+ b_f+ b_k .

Here, the dependant variable (IIASS) is the relation of the *i*th bank's interest income to total assets at time *t*. I focus on interest income because the underlying notion of the PR model is that financial intermediation is the core business of banks (Bikker and Groeneveld, 1998). This is true especially for transition economies, where banking activities other than traditional financial ones are not very well developed.[7]

I used the ratio of the bank's labor costs to the number of employees to represent unit labor cost (W). Data for number of employees are available for 1996-1998 and 2002, but 36 observations per bank are missing for the three in-between years. As a proxy for this variable other authors use mainly the ratio between total salaries and assets. However, by using such a proxy much information on the efficiency of banks, especially in transition economies, is lost. To overcome this problem, I also employed a trend estimation of the number of employees for the missing period[8].

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[5] E.g., tax inspections can lead to some "corrections" of quarterly data.

[6] Some assumptions of the Panzar-Rosse model have to be spelled out. First, Panzar-Rosse model implies long-run equilibrium, while in transition economies the economic environment is volatile. Second, we need to assume that banks can be treated as single product firms, acting exclusively as financial intermediaries. Banks produce interest revenues using labor, capital and intermediate funds (deposits) as inputs. However, product differentation is allowed for in the monopolistic competition (Gelos and Roldos, 2002). These problems are overcome, or their impact is lessened, when panel estimation is used and we focus on changes over time in the H statistic.

[7] This notwithstanding, the share of non-interest income in total income has been rising in Armenian banks in recent years.

[8] The former big Soviet banks have approximately the same salary and assets volume as the new small banks, yet their figures for salary/number of employees are quite different. The estimation of the number of employees was done by calculating separately the trend for each bank. The trend was adjusted by some quarterly data of the number of employees from banks strategic plans.

The proxy for costs per unit of capital (K) is the ratio of the bank's non-interest costs[9] over fixed assets. These include equipment, information technology, taxes, premises, advertisement, and other non-interest costs, excluding labor costs.

Bank specific factors were captured in a number of ways. For scale effects, each bank's share in total assets (ASS) was used. A positive coefficient value is expected since size should provide economies of scale, hence higher returns. For riskiness, I used the ratio of loan loss reserves[10] to total loans (X). For X a negative coefficient value is expected since more reserves (higher losses) mean a lower efficiency of the loan portfolio.

All variables are taken in natural logarithm. The variables used in this paper and by the other authors are presented in Appendix 1. As noted, the data is monthly and is available for 01.1998-01.2003 at the Central Bank of Armenia. All banks operating in Armenia are included and this brings the total number of banks observed to 33.[11] Hence, there are nearly 1700 observations. Also, each variable was investigated for stationarity using the Dickey-Fuller unit root tests. These tests consistently rejected the presence of unit roots in any of the data.

5. Estimation results of the reduced-form revenue model

The Panzar-Rosse H statistic is equal to the sum of the related elasticities: $H = b_w + b_f + b_k$. As noted above, Panzar-Rosse show that this statistic (the sum of the elasticities of a firm's revenue with respect to the firm's input prices) can be used to identify the structure of the market in which the firm operates. The value H=1 indicates perfect competition, in which an increase in costs causes some firms to exit, price to increase, and the revenue of survivors to increase at the same rate as increase in costs (Goddard et al., 2001). H will be negative for a collusive oligopoly or a monopoly in which an increase in costs causes output to fall and price to increase. An upward shift in the marginal cost curve will be associated with a reduction of revenue as a result of the optimality condition for the monopolist. 0<H<1 indicates monopolistic competition, in which an increase in costs causes revenues to increase at a lower rate than that of costs. Panzar-Rosse also show that, if the elasticity of demand is constant, then there is a monotone relationship between the mark-up over marginal costs and the H index.

The econometric results of the fixed effects estimation of the reduced form revenue equation (1) are shown in Table 2 below. Basically, these indicate that the market structure of Armenian banking system during 1998-2002 can be described as monopolistically competitive. This means that the individual banks have some ability to post higher prices due to their unique features (like image, brand, unique services, etc.).

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[9] Excluding salaries.

[10] Loan loss reserves include the provisions for possible loan losses, which by Armenian legislation are realised and are reflected on both the asset and liability sides of the balance sheet.

[11] The panel is unbalanced since the number of banks was changing over time. Some banks that had a very short series were excluded from the sample by the software. The ultimate number for observed banks stands at 33.

Table 2. The results of model with IIASS as dependent variable

Sample	1998-2001			2001-2003			1998-2003		
Variable	Coef.	*t-stat.*	*Prob. (t)*	Coef.	*t-stat.*	*Prob. (t)*	Coef.	*t-stat.*	Prob. (t)
Ln K b_k	0.28	5.49	0.0000	0.09	2.97	0.003	0.28	7.28	0.000
Ln F b_f	0.28	5.15	0.0000	0.23	6.23	0.000	0.33	7.99	0.000
Ln W b_w	0.16	5.84	0.0000	0.18	5.57	0.000	0.08	3.84	0.000
Ln X	-0.36	-5.15	0.0000	-0.06	-1.10	0.270	-0.26	-4.78	0.000
Ln ASS	-0.51	-5.71	0.0000	0.29	2.27	0.024	-0.24	-3.31	0.001
D98							0.67	8.93	0.000
D99							0.43	7.36	0.000
D00							0.23	4.15	0.000
AR()	Ar(1)			Ar(6)			Ar(1)		
H	**0.72**			**0.50**			**0.69**		
Num. of observations	1112			566			1701		
R-sq.	0.59			0.78			0.63		
Adj. R-sq.	0.56			0.65			0.61		
D.W.	2.08			2.03			2.09		
Prob (F-stat.)	0.000			0.000			0.000		

These results are in line with those for many other developing countries, particularly Brazil, Chile, the Czech Republic, Mexico, Poland, Turkey (Gelos and Roldos, 2002; Appendix 3).

The estimated coefficients (except the ASS) have the expected signs and are all statistically significant. To test total income as dependent variable we also estimated equation with total revenues/assets (TIASS) instead of interest revenues/assets (IIASS). The results are presented in Appendix 2. As we can see, the results do not differ very much from the equation with dependent IIASS. This allows us to verify that in transition economies, the banks major role is to act as traditional financial intermediation.

Given the fact that funds (deposits) are the main factor in the production function of banks, it is very surprising that its elasticity is not larger. This is in line with unit fund cost elasticities of the developing countries (Gelos and Roldos, 2002). However, it is very low compared to developed European countries (Bikker and Groeneveld, 1998). This can be explained by the somewhat fixed asset and liability structure of Armenian banks. Particularly, some parts of the attracted funds of some banks are low-cost fixed funds from stakeholders, Project Implementation Units (PIUs)[12]. This part of deposits of enterprises and individuals, are not elastic to changes in interest rates. Thus these parts of interest revenues (IIASS) do not depend on the interest paid (F). On the asset side, that part of attracted funds is also fixed-rate and inexpensive, which makes the asset structure too (total loans/assets) inelastic to revenues (both IIASS and TIASS).

On the other hand, the elasticity of unit capital costs is very large compared to both European developed and developing countries. This is probably due to the fact that Armenian banks do not yet enjoy returns to scales in a growing market with huge

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[12] PIUs are government funds offered to banks at low rate for special loans, e.g., to small business. Banks have to allocate these funds at low rates to the targeted borrowers.

potential of a yet unsatisfied demand. Thus a small increase in non-interest costs (e.g., advertisement, technological innovations) leads to large increase in bank services and in interest revenues. The the negative coefficient of ASS, the bank's share in totals assets, i.e., the finding that an increase in assets leads to decrease in interest income (as well as in total income, see Appendix 2), is even more puzzling.

I have also conducted several robustness tests. First, to test whether any explanatory variables have been left out we examined a few alternative variables for every control factor (e.g. for risk, size and structure). Thus, to test for the robustness of the banks' production function coefficients on the assets and liabilities sides we experimented using loans to the real sector/assets (LNASS)[13] and time deposits of enterprises and individuals (TDL)[14] (Appendix 1). However, neither of these variables has any effect, neither on IIASS nor on TIASS. This can be explained somewhat by the fixed component of the asset and liability structure of banks mentioned above.

Similarly, to test for difference in risk I included "loan loss reserves/total loans" (X) and exercised "high liquid assets/assets" (HLASS). While (X) is significant and has the expected sign, HLASS[15] surprisingly had no effect on revenues. This is probably because the treasury bills, included among the high liquid assets, are also very profitable, in spite of economic theory that says that an asset's riskiness should be proportionate to its profitability. Thus a part of highly liquid assets offsets the effects of other liquid assets (like correspondent account, cash, etc.).

During the observed period, such factors as technological changes, changes in CBA regulatory and government tax policies, external factors (e.g., Russian crises) took place. To account for time effect I introduced dummy variables for each year. Only the dummies for 1998, 1999 and 2000 were statistically significant. This makes economic sense. 1998 because of the Russian crisis that, however, did not have significant long-term impact on the Armenian banking system. 1999 and 2000 were notable for the huge fluctuations in interest rates[16]. 2000 also began the processes that led to significant concentration and structural changes in the banking system in 2001: the failure of eight banks, including the two largest ones, that started in late 2000, and the strengthening of a foreign bank's position that led to the reshaping of the market.

To identify whether individual banks features have a significant effect on the competitive structure, a standard pooled regression model[17] was also estimated. Compared to the standard model, the statistical significance of fixed methods

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[13] For Armenian banks assets comprise three big categories: loans to the economy, claims on other banks, and T-bills. Thus, once we have a bank's share of loans to the economy and claims on banks in total assets, the asset structure is captured. On the other hand, to reflect the specialization of the portfolio of loans to the real sector it is useful to have the ratio of consumer loans/total loans or of enterprises loans/total loans, which are not included in the analyses because of the non-availability of data. For LNASS a positive coefficient value is expected: the more loans, the more potential interest income.

[14] For the Armenian banks interest costs are related to the following main activities: claims of other banks (a low interest item), time deposits of individuals and enterprises (for most banks a high interest costs), demand deposits of individuals and enterprises (at zero interest).

[15] High liquid assets include mainly cash and correspondent accounts, claims on banks, which are of low interest, as well as T-bills, which have high profitability (like loans). A negative coefficient is expected for HLASS, since more highly liquid assets (less risk) imply lower interest income.

[16] An increase in the deposits rates in 1999 and a decrease in 2000, and a general decrease of loans rates in 1999 and 2000)

[17] I.e., assuming that the intercept and slope coefficients of the equation stay constant across time and space and the error term captures all differences over time and over individual banks.

regression[18] was much higher. This means that the individual banks effects are statistically significant. This fact supports the assumption of a monopolisticaly competitive structure of the banking system. Under monopolistic competition some banks have unique features that allow them to raise their prices without losing too many customers.

Finally, I tested for pooling. Standard analyses show that while there is some cross-bank variation in slope and intercept coefficients, pooling cannot be rejected.

5.1   Changes in concentration and competition

Of course, the estimate of primary interest is the Panzar-Rosse H statistic. As Table 2 reports, the point estimate of this measure over the entire sample period is 0.69. Since H = 1 indicates perfect competition, the estimate of H = 0.69 suggests a significant departure from this ideal and, a highly monopolistically competitive banking sector. Moreover, this trend toward monopolistic competition intensifies over the sample. Table 2 also shows estimates of H for two subsample periods: 1998-2001, and 2001-2003. Across these two periods, H declines from 0.72 to 0.50.

Table 3 below shows the co-movement between H and various measures of concentration.

Table 3. Competition and concentration levels

Sub periods	H statistic[a] (IIASS)	H statistic[b] (TIASS)	HHI[c]	C4[c]	C7[c]	C10[c]
1998-2001	0.72	0.65	0.06	39	58	70
2001-2003	0.50	0.32	0.10	48	66	79

[a] H statistics from Table 2. [b] H statistics from Appendix 2. [c] Total assets concentration indices from Table 1 for end of sub period.

It is apparent that the decline in H (indicating a reduction in competition) is accompanied by a rise in concentration. Hence, the market-power hypothesis cannot be rejected. These results are in line with those of Bikker and Groeneveld (1998) for European countries where higher concentration is accompanied by lower degree of competition. However, they partly contradict the results of Gelos and Roldos (2002) for transition economies, where the H statistics falls in only one of eight emerging markets which were examined, while the number of banks falls in all emerging markets and this does not systematically result in concentration increase (Appendix 3)[19].

Although, market-power hypothesis is not rejected, a question arises why average prices for financial services have been falling continuously throughout the observed period. This fact complicates the interpretation of the outcomes. Is it plausible that the Armenian banking sector, although in monopolistic competition, is experiencing increasing competition, possibly due to foreign entry, which has led to declining price-cost margins? And that this has forced firms to operate on a larger

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[18] I.e., where the slope coefficients are constant but the intercept varies over individual banks.
[19] In particular, the concentration ratios are increased in most Latin American countries and in one Asian country (Gelos and Roldos, 2002).

scale?[20] This consolidation will, of course, result in increased concentration. If the increasing concentration reflects a move toward operating on a more efficient scale and is accompanied by falling prices, social concerns about imperfect competition should be relatively minor. However, the rates of price decline of financial services in Armenian banking sector in the second subperiod have declined significantly. Besides, the dispersion in prices of the biggest and the smaller banks is very large. This fact still leads me to favor the market-power hypothesis. Nevertheless, efficient scale issues remain an important subject for further research.

6. Concluding remarks

This paper has a used monthly panel data covering 33 banks over six years to examine the nature of competition in Armenian banking. Estimates from a panel regression were used to calculate the Panzar-Rosse H statistic. This statistic reveals that the Armenian banking system is best characterized as monopolistically competitive like in many other developing and developed European countries, and increasingly so in recent years. Additional data have been presented that document that this same time period has been characterized by increasing concentration, supporting the market-power hypothesis.

It is considered that the process of consolidation in emerging markets' banking systems has, to a larger extent, not yet been translated into a decline in competitive pressures, which may be due to the fact that the process is still in its infancy. One of the important factors that compensate for any decline in competition intensity stemming from consolidation is competition by foreign banks (Gelos and Roldos, 2002).

The econometric results for the Armenian banking system are in line with the trend of European countries, where consolidation is accompanied by a decline in competition. This means that the infancy period may soon be over. For policy makers this is a signal to review their policy of non-interference in changes in the market structure of the banking markets and to be wary of permitting the process of consolidation and increasing concentration to proceed much further.

References

Bain, J. S. (1951), 'Relation of Profit Rate to Industry Concentration', *Quarterly Journal of Economics*, **65**, 293-324.

Baumol, W.J., Panzar C.J., Willig R.D. (1983), 'Contestable markets: An Uprising in the Theory of Industry Structure: Reply', *The American Economic Review*, **73**, 491-496.

Berger, A. N. (1995), 'The Profit-Structure Relationship in Banking – Tests of Market-Power and Efficient-Structure Hypotheses', *Journal of Money, Credit and Banking*, **27**, 404-431.

Bikker, J.A., Groeneveld J.M. (1998), 'Competition and Concentration in the EU Banking Industry', *DNB Staff Reports*.

BIS Papers (2001), 'The Banking Industry in the Emerging Market Economies: Competition, Consolidation and Systemic Stability', August.

Cetorelli, N. (2002), 'Entry and Competition in Highly Concentrated Banking Markets', *Economic Perspectives*, **26**, 18-28.

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[20] Compare to, e.g., Salop's (1979) well-known circle model of product differentiation.

Gelos G. R., Roldos J. (2002), 'Consolidation and Market Structure in Emerging Market Banking Systems', *IMF WP No.186.*

Gilbert, R. A. (1984), 'Bank Market Structure and Competition: A Survey', *Journal of Money, Credit and Banking*, **16**, 617-660.

Goddard, J., Molyneux Ph., Wilson J.O.S. (2001), *European Banking: Efficiency, Technology, and Growth*, JOHN WILEY & SONS. LTD Press.

Hannan, T. H. (1991), 'Foundation of the Structure-Conduct-Performance Paradigm in Banking', *Journal of Money, Credit and Banking,* **23**, 68-84.

Nathan, A., Neave E. (1989), 'Competition and Contestability in Canada's Financial System: Empirical results', *The Canadian Journal of Economics*, **22**, 576-594.

Mason, E. S. (1939), 'Price and Production Policies of Large-Scale Enterprise', *American Economic Review,* **29**, 61-74.

Molyneux, Ph., Thornton J., Lloyd-Williams D.M. (1996), 'Competition and Market Contestability in Japanese Commercial Banking', *Journal of Economics and Business,* **48**, 33-45.

Panzar, C.J., Rosse J.N. (1987), 'Testing for "Monopoly" Equilibrium', *The Journal of Industrial Economics,* **35**, 443-456.

Salop, S. (1979), 'Monopolistic Competition with Outside Goods', *Bell Journal of Economics,* **10**, 141-156.

Shaffer, S. (1994), 'Bank Competition in Concentrated Markets', *Business Review*, **3-4**, 3-17.

Spence, M. (1983), 'Contestable Markets and the Theory of Industry Structure: A Review Article', *Harvard Institute for Economic Research*, Discussion Paper No. 988.

Stigler, G. J. (1964), 'A Theory of Oligopoly', *Journal of Political Economy*, **72**, 44-61.

Appendix 1: Variables for the Panzar-Rosse model used in economic literature and in this paper

Variable	Variables used by other authors	Used variables
1. Bank's profitability variables:		
IIASS	- Total income-provisions for loans (Nathan and Neave, 1989; Molyneux et al, 1996)	- bank's total interest income/ total assets
	- Total interest revenue/ total balance sheet (Bikker and Groeneveld, 1998)	- bank's total income/ total assets *
	- Total interest revenue or ROA (Shaffer, 1982**)	
	- ROA, ROE (Molyneux, 1996)	
2. Bank's resource variables:		
W	Unit labor cost:	- bank's labor costs/ employment
	- Personnel expenses / total balance sheet (Bikker and Groeneveld,1998; Gelos and Roldos, 2002)	
	- Personnel expenses/ (deposits+loans) (Gelos and Roldos, 2002)	
	- Wages and salary expenses/ number of employees (Nathan and Neave, 1989; Shaffer, 1982**; Molyneux, 1996)	
K	Unit capital cost:	- bank's (non interest costs – salaries)/fixed assets
	- Physical capital and other expenses/ fixed assets (Bikker and Groeneveld, 1998)	
	- Other expenses/fixed assets (Gelos and Roldos, 2002)	
	- Annual expenses of premises, furniture, fixtures, equipment/balance sheet of these items (Shaffer, 1981, 1982**; Molyneux, 1996)	
	- Premises expenditures/number of branches (Nathan and Neave, 1989)	
F	Unit funds cost:	- bank's interest costs/ total liabilities
	- Annual interest expenses/ total funds (Bikker and Groeneveld,1998; Shaffer, 1981, 1982**; Molyneux, 1996)	
	- Interest expenses/ (deposits+interbank time and demand deposits) (Gelos and Roldos, 2002)	
3. Control variables that reflect banks' specific features		
3.1. For size (scale):		
ASS	- Total assets (Bikker and Groeneveld,1998; Gelos and Roldos, 2002; Nathan and Neave, 1989; Shaffer, 1981, 1982**; Molyneux, 1996)	- bank's share in total banking assets
	- Domestic branches number/total number of domestic branches (Nathan and Neave, 1989)	
	- Dummy for six largest banks (Nathan and Neave, 1989), dummy for 13 largest banks (Shaffer, 1981, 1982**; Molyneux, 1996)	
3.2. For risks:		
CAPASS	Capital or equity/ total assets (Bikker and Groeneveld,1998)	- bank's total capital/ risk weighted assets [21]
HLASS	-	- bank's highly liquid assets/ total assets*
LLRLN	- Size of non performing loans (Nathan and Neave, 1989)	- Loan loss

[21] The bank's total capital/ risk weighted assets is a more plausible proxy for risk. However, risk weights have been systematically changing within the observed period, thus this index cannot be compared over time. For CAPASS a negative coefficient is expected since lower equity implies more leverage and hence more interest income (Molyneux et al., 1996).

- Loans/ total assets (Bikker and Groeneveld, 1998)		reserves/ total loans

3.3. For difference in activity (scope of economies)

3.3.1. Control for difference in assets structure:

LNASS	- Customer loans/total loans (Bikker and Groeneveld, 1998) - Loans/total assets (Gelos and Roldos, 2002) - Commercial and industrial loans/ total loans (Shaffer, 1982**; Molyneux, 1996)	- bank's loans to real sector/ total assets*
CBASS	Correspondent accounts + cash/ total assets	-

3.3.2. Control for difference in deposits structure.

IBLTL	Interbank deposits/total deposits (Bikker and Groeneveld,1998; Goddard et al, 2001)	-
TDL	- Interbank demand deposits/ total demand deposits (Bikker and Groeneveld,1998) - Cash and due from depository institutions (or banks)/total deposits (Bikker and Groeneveld,1998; Shaffer, 1982**; Molyneux, 1996) - Total market deposits in commercial banks (Shaffer, 1982**)	- Time deposits of individuals and enterprises/total liabilities [22]

* These variables were also estimated in the model, but not in the final model because of their insignificanc.

** These variables are used by Shaffer (1981 and/ or 1982) according to (Molyneux, 1996; Nathan and Neave, 1989).

Appendix 2. The results of the model with total income/assets (TIASS) as dependent variable

Sample	1998-2001			2001-2003			1998-2003		
Variable	Coef.	*t-stat.*	*Prob. (t)*	Coef.	*t-stat.*	*Prob. (t)*	Coef.	*t-stat.*	Prob. (t)
Ln K b_k	0.24	5.86	0.0000	0.13	2.57	0.011	0.21	*6.91*	*0.000*
Ln F b_f	0.20	4.24	0.0000	0.14	2.15	0.032	0.29	*7.53*	*0.000*
Ln W b_w	0.21	7.59	0.0000	0.06	1.74	0.083	0.12	*5.74*	*0.000*
Ln X	-0.21	-4.88	0.0000	-0.12	-2.09	0.037	-0.10	*-3.21*	*0.0 01*
Ln ASS	-0.57	-7.49	0.0000	-0.40	-4.37	0.000	-0.41	*-7.19*	*0.000*
D98							0.43	*7.99*	*0.000*
D99							0.23	*5.05*	*0.000*
D01							-0.15	*-3.46*	*0.001*
AR	Ar(1)			Ar(3)			Ar(1), Ar(3)		
H	0.65			0.32			0.63		
Num. of observations	1105			564			1636		
R-sq.	0.51			0.56			0.56		
Adj. R-sq.	0.48			0.47			0.53		
D.W.	2.04			2.02			2.01		
Prob (F-stat.)	0.000			0.000			0.000		
HHI* average by assets	0.087			0.077					
C4 by assets	51			44					

*Herfindahl-Hirschman index

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[22] No apriori expectations for the signs of the coefficient of this variable.

Appendix 3. Comparative results of different authors on H statistic and concentration ratios by countries

Countries [a]	H stat.	Type of market [b]	Concentration (%)	Time period	Method	Dependant variable
Argentina /1	0.84-0.97	MC or PC	39.1-39.8 [c]	1994-99	A panel estimation with fixed effects	Total interest income/total assets
Brazil /1	0.66-0.69	MC	49.9-55.2 [c]			
Chile /1	0.76-0.75	MC	39.5-39.5 [c]			
Czech /1	0.59-0.60	MC	72-39.7 [c]			
Hungary /1	0.83-0.77	MC or PC	57.9-51.5 [c]			
Mexico /1	0.50-0.51	MC	48.3-56.3 [c]			
Poland /1	0.54-0.53	MC	52.8-43.5 [c]			
Turkey /1	0.58-0.47	MC	40.7-35.9 [c]			
Austria /2	0.80-0.77	MC	75 [d]	1986-96	Pooled cross-section-time-series analysis, standard model	Total interest income/total assets
Belgium /2	0.92	MC or nearly PC	46 [d]			
Denmark /2	0.10-0.48	MC	77 [d]			
Finland /2	0.68-0.56	MC	70 [d]			
France /2	0.91	MC or nearly PC	48 [d]			
Germany /2	0.84-0.86	MC	50 [d]			
Greece /2	0.92	MC or nearly PC	70 [d]			
Ireland /2	0.39	MC	75 [d]			
Italy /2	0.99-0.94	MC or nearly PC	27 [d]			
Luxemburg /2	0.92	MC or nearly PC	30 [d]			
Netherlands/2	0.66	MC	84 [d]			
Portugal /2	0.79-0.73	MC	32 [d]			
Spain /2	0.60-0.55	MC	50 [d]			
Sweden /2	0.59	MC	41 [d]			
UK /2	0.72	MC	39 [d]			
Japan /3	-0.006	Mon. or CVO	-	1986	Cross-section	Total interest revenue
	-0.245	MC		1988		
Canada /4	1.06	PC	-	1982	Cross-section	Total revenues less loss reserves
	0.73	MC		1984		
Armenia	0.72-0.50	MC	39-48 [e]	1998-2002	Panel estimation with fixed effects	Interest income/total assets

a) Sources for countries differ. The H statistic is estimated by: 1/ Gelos and Roldos (2002); 2/ Bikker and Groeneveld (1998); 3/ Molyneux (1996); 4/ Nathan and Neave (1989).

b) Mon. = monopoly; CVO = Conjectural variations of short-term oligopoly; MC= monopolistic competition; PC= perfect competition.

c) The largest 3 banks share in total deposits in 1994 and in 2000 (Gelos and Roldos, 2002)

d) The largest 5 banks share in total assets in 1995 (Groeneveld and Bikker, 1998)

e) The largest 4 banks share in total assets in January 2001 and January 2003