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MARKET STRUCTURE IN THE BANKING SECTOR: EVIDENCE FROM A DEVELOPING ECONOMY

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Abstract

This paper examines the market structure of Vietnam's banking system from 1999 to 2009 using the non-structural (Panzar-Rosse) model. We consider a more comprehensive range of specifications, in terms of a greater number of environmental covariates and different dependent variables, than in previous applications of this model. Further, this is the first study that uses lagged input prices (to avoid endogeneity) and excludes assets (to avoid specification bias) in such a study of the Vietnamese banking system. We find that the Vietnamese banking system operates in monopolistic competition with non-state owned commercial banks behaving more competitively than state owned commercial banks.

Keywords: Banking; performance; Non-structural model; Vietnam.

JEL classification: G21.

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1. Introduction

In this paper we provide a detailed analysis of the degree of market competition in the Vietnamese banking system using the Panzar and Rosse (1987) non-structural model. This model suggests that the market is a monopoly if the service offered by a particular bank is independent and originate. In contrast, the market is competitive if bank services are similar in the market. We apply the non-structural model to an extensive panel data set of 48 Vietnamese commercial banks, which includes state owned commercial banks and non-state owned commercial banks, from 1999 to 2009. Using this procedure we consider whether the Vietnamese banking market is best characterised by monopoly, perfect competition or the intermediate case of monopolistic competition.

We estimate H-statistics of models that include assets and that exclude assets with current or lagged input prices using the full sample (1999-2009) and sub-samples (1999–2003; 2004–2009; five state owned commercial banks and 43 non-state owned commercial banks). We also estimate E-statistics to test whether the long-run equilibrium conditions required for the H-statistics to be valid hold. The Wu-Hausman test and a comparison of models using current and lagged input prices are employed to assess whether input prices are endogenous. This is the first study that uses lagged input prices (to avoid endogeneity) and excludes assets (to avoid bias) in a study of the Vietnamese banking system. This study also extends the previous literature (Bikker *et al.,* 2006a, 2006b and Bikker and Spierdijk, 2009) by considering new additional variables such as total assets, capital/assets, loans/deposits and the number of branches in the model's specification. In addition, we compare inference using four alternative dependent variables being revenue/assets, interest income/assets, revenue and interest income. However, the main contribution of this paper is to determine the market structure in the recent period after the Vietnamese banking system has transformed into a less centralised two-tier system. Our study is the first to uniquely identify the market structure of this developing economy's banking system (using data only for Vietnam and not observations from other countries) in a post transition period.[1] Another novelty of the paper is to assess whether market structure changes through time or is different by bank type.

[1] The few previous studies that have sought to determine Vietnam's market structure have done so in an earlier period when less of the transition had taken place and assumed homogeneity of the Vietnamese banking system's market structure with the other countries analysed.

The rest of this paper is organised as follows: section 2 deals with developments in the Vietnamese banking system in the period from 1986 to 2009; section 3 provides a literature review of the non-structural model in banking; section 4 discusses methodology and data; section 5 presents our empirical results; and section 6 concludes.

2. The Vietnamese banking system during 1986-2009

From 1986 to 2009 the Vietnamese banking system was transformed from a mono to two-tier banking system. The two-tier banking system has the State Bank of Vietnam as the central bank (tier 1) and four specialised state owned banks (tier 2). Table 1 shows the number of Vietnamese commercial banks from 1990 to 2009. With extended networks in almost all provinces and larger cities, state owned commercial banks have a competitive edge in providing banking services. Although joint stock commercial banks increased their numbers immediately after their appearance in 1990 (in 2009 there were 37 joint stock commercial banks), the leading positions in the market still belong to state owned commercial banks. Three out of five state owned commercial banks accounted for 45% of customer deposits, 41% of total assets and 51% of customer loans of the banking system in 2009. State owned commercial banks were originally sector departments under the State Bank of Vietnam, with specified lending programmes to state owned enterprises which were based on government policies.

Non-state owned commercial banks consist of joint stock commercial banks, branches of foreign banks, joint venture commercial banks and foreign commercial banks[2]. Unlike state owned commercial banks a number of joint stock commercial banks make profits due to good performance. Joint stock commercial banks have achieved average returns on equity between 15% and 30%. Being less than 15 years old joint stock commercial banks are relatively young and they can be divided into three groups: (1) the top five large urban banks; (2) a smaller group of banks that are either growing rapidly or have established a niche; and (3) twelve small rural joint stock commercial banks. The top five urban banks are, Techcombank, Sacombank, VIBBank, Asia Commercial Bank, and East Asia Commercial Bank. The smaller urban joint stock commercial banks include, HabuBank, Viet A Bank and Saigon Bank. Small rural commercial banks were all transformed into city commercial banks at the end

[2] Foreign commercial banks normally transformed out of branches of foreign banks. Data on assets, loans and deposits of branches of foreign banks are very small compared to other banks. Therefore, in our application non-state owned commercial banks consist of joint stock commercial banks, joint venture commercial banks and one foreign commercial bank.

of 2010, such as, An Binh Bank, Saigon-Hanoi Bank, Petrolimex Group Bank, Dai A Bank, etc. These banks developed throughout the country, not just in rural areas and with help from big business and foreign investors they also performed well in the 2000s. The number of branches of foreign banks increased from 18 banks in 1995 to 48 banks in 2009. However, each foreign bank normally has one branch in either Hanoi or Ho Chi Minh City. Hence, their assets, loans and deposits are very small compared to state owned commercial banks, joint stock commercial banks and joint venture commercial banks. Despite Foreign Direct Investment in US dollar terms growing by a factor of eight between 1990 and 2005, foreign companies are still hesitant as whether or not to choose domestic banks when they enter this new market. The number of joint venture commercial banks has increased slightly from four to six banks between 1995 and 2009. The first foreign commercial bank (being HSBC) had a license to set up a wholly foreign-owned bank from 2008 (see Nguyen and Stewart, 2013).

Table 2 shows data on loans, assets, deposits, capital and non-performing loans of the Vietnamese banking system (state owned commercial banks and non-state owned commercial banks) from 1999 to 2009. On the whole, there was an increasing trend of loans, assets, deposits and capital over the period. Vietnamese banks were burdened by a high volume of non-performing loans, particularly during the 1990s, however these generally decreased from 1999 to 2009. Non-performing loans of non-state owned commercial banks are typically lower than those of state owned commercial banks.

In terms of regulation, the State Bank of Vietnam aims to create a banking supervision development (following Basel) from 2010 onwards. Meanwhile, the coverage, measures and procedures of banking supervision and monitoring are to be reformed in accordance with the development of internet technologies and banking technology. This will be done by applying key principles of international standards on banking supervision (Basel I and Basel II). The old capital adequacy ratio standards for banks in Basel I and Basel II are 8% and 12%, respectively. The capital adequacy ratio for the Vietnamese commercial banks is to be adjusted to 9% (as Circular No. 13/TT-NHNN dated 20th May 2010 of the State Bank of Vietnam).

In parallel with the speed of the country's economic development, the loan growth rate rose dramatically. One of the reasons was that many banks had greatly increased their credit growth through real estate loans, due to the over-heating of the real estate market. The credit growth rate of the banking system increased to 37.8% in 2007 and peaked at an alarming 63% in the first quarter of

2008 (WB, 2008: 3). This has been the highest growth rate within the past decade. When the inflation rate and trade balance deficit had become more serious, the government applied a traditional tightening of monetary policy in order to reduce money supply circulation, which affected the banking system. Compulsory measures were necessary for banks to reorganise and strengthen their organisations.

3. Literature review

Empirical studies that use the non-structural model to establish the extent of contestability in banking markets are concerned with drawing inferences about market structure indirectly from observing conduct. This is because contestability, which depends on the extent of potential competition, is not observable directly (Goddard *et al.*, 2001). Panzar and Rosse (1987) formulated simple models for monopolistic, oligopolistic and perfectly competitive markets, and develop a test to discriminate between these market structures. Bikker and Bos (2008) explained this non-structural model as based on the properties of a reduced-form revenue equation at the firm or bank level and using the H-statistic, which, under certain assumptions, can serve as a measure of how competitive banks are. The test is from a general banking model, which determines equilibrium output and the equilibrium number of banks by maximizing profits at both the bank level and the industry level. This implies, first, that bank i maximises its profits, where marginal revenue equals marginal cost. The profit maximising condition is:

$$R'_i(Y_i, n, Z_i) - C'_i(Y_i, n, T_i) = 0 \quad \textbf{(1)}$$

R_i refers to revenue, C_i to cost, Y_i to output, w_i to a vector of m factor input prices, and Z_i and T_i to vectors of exogenous variables that shift the bank's revenue and cost functions, respectively. The sub index i refers to bank i; n is the number of banks; and the prime symbol denotes a first derivative with respect to output. Second, at the market level, it means that, in equilibrium, the zero supernormal profit constraint holds:

$$R^*_i(Y^*, n^*, Z_i) - C^*(Y^*, w_i, T_i) = 0 \quad \textbf{(2)}$$

Variables marked with an asterisk (*) represent equilibrium values. Market power is measured by the extent to which a change in factor input prices ($dw_{k,i}$) for k = 1,..., m is reflected in changes in equilibrium revenue (dR^*_i), earned by bank i. Panzar and Rosse (1987) defined a measure of competition H as the sum of the elasticities of the reduced-form revenue function with respect to factor prices:

$$H = \sum_{k=1}^{m} \left(\frac{\partial R_i^*}{\partial w_{k,i}}\right)\left(\frac{w_{k,i}}{R_i^*}\right) \quad \textbf{(3)}$$

The first market model that Panzar and Rosse investigates is monopoly. In their analysis, monopoly includes the case of price-taking competitive banks, as long as the prices they face are truly exogenous, that is, as long as their equilibrium values are unaffected by changes in the other exogenous variables in the model. The empirical refutation of monopoly constitutes a rejection of the assumption that the revenue of the banks in question is independent of the decisions made by their actual or potential rivals. The Panzar and Rosse model demonstrates that under monopoly, an increase in input prices will increase marginal costs, reduce equilibrium output and subsequently reduce revenue; hence H will be zero or negative. In the case of monopolistic competition, the analysis is based on the comparative static properties of the Chamberlain equilibrium model. In the equilibrium condition, interdependence affects the structural revenue function, and the bank's profit finally becomes zero as the conditions of entry and withdrawal are unlimited; hence H will be smaller than 1. In the case of perfect competition, under certain conditions both marginal cost and average cost increase without changing the optimum amount of the individual bank's output. If this condition occurs and some banks withdraw from the market, the remaining banks would individually face increased demand. This increased demand leads to higher prices and revenue, which is equal to the increase of cost, and H will become 1. In summary:

- $H \leq 0$: indicates a monopoly.
- $0 < H < 1$: indicates the intermediate case of monopolistic competition.
- $H = 1$: indicates a perfectly competitive industry.

Shaffer (1982) obtained $0<H<1$ for a sample of unit banks in the New York banking sector, suggesting monopolistic competition. Nathan and Neaven (1989) confirmed this result for New York banks even when the effect of loan losses is considered. Nathan and Neaven (1989) tested for contestability for a

group of Canadian banks, trust companies and mortgage companies with data for the period from 1982 to 1984. The result indicated 0<H<1. DeBandt and Davis (2000) provided a significant improvement on the specification of variables employed in the model and its functional form. They emphasised that the banking industry is not a general industry, like manufacturing but instead an industry with individual characteristics, which is in line with the argument of Panzar and Rosse (1987). They obtained 0<H<1 for France, Germany, Italy and the US. Competition appears to be most intense in the US while small banks are found to enjoy some monopoly power in the German and French markets.

The model used for calculating the H-statistic has taken a variety of specific forms in the general banking literature. Molyneux *et al.* (1994) and Bikker and Groeneveld (2000) employed the ratio of interest revenue to the total balance sheet as an endogenous variable. Molyneux *et al.* (1994) investigated major European banking markets between 1986 and 1989 and they suggested that banks in Germany, the UK, France and Spain were in monopolistic competition during this period whereas banks in Italy behave as if in monopoly. Bikker and Groeneveld (2000) used data on 892 banks from 15 EU countries over the sample period 1989-1996. Their results show that European banking sectors operate under conditions of monopolistic competition. On the other hand, Nathan and Neave (1989) used the logarithm of interest revenue as the dependent variable. According to DeBandt and Davis (2000) this is the most appropriate measure since the ratio of interest revenue to total assets might be interpreted as yielding a price equation rather than a revenue function. There is an issue homogeneity might be induced even in the logarithmic specification. DeBandt and Davis (2000) insisted that in empirical studies on banking competition, although cross-sectional results are generally employed, the implicit assumption is that all banks have access to the same factor market and only the scale of operations differ. They argued that the dimension of the time-series is crucial, and that irregular results might arise from estimating a cross-sectional regression of the equation with Ordinary Least Square for every year (t=1, …T). As a result they asserted that it is desirable to focus on the pooled sample regression.

In Vietnam, three previous studies have applied the Panzar-Rosse model to the Vietnamese banking system. Bikker *et al.* (2006a, 2006b) and Bikker and Spierdijk (2009) analysed bank structure in the world (with 101 countries including Vietnam) from 1986-2004. Due to data constraints, they only

investigated banking structure in Vietnam from 1991 to 2004 for 24 banks.[3] They calculated the H-statistic for the Vietnamese banking system as 0.74. However, they applied only one model for all 101 countries, including Vietnam, and this model did not reflect the actual business in Vietnam where state owned commercial banks still dominate the whole banking system. Further, they could not observe the three input prices directly. Therefore, they used the ratio of annual personal expenses to total assets as an approximation for the price of personal expenses, and the ratio of other non-interest expenses to fixed assets as a proxy for the price of capital expenditure. Moreover, Bikker *et al.* (2006a, 2006b) and Bikker and Spierdijk (2009) preferred interest income as the dependent variable, while other researchers, such as Nathan and Neave (2001), favour using revenue in the Panzar-Rosse model. Hence, for comparison purposes we will use both interest income and revenue as the dependent variables in this paper.

Our data set includes 48 Vietnamese commercial banks over the period 1999 to 2009. This is the first time that such an extensive panel data set has been employed to uniquely identify the Vietnamese banking system's market structure using the non-structural model (our maximum sample period is 376 observations). No previous study has used lagged input prices (to avoid endogeneity) and excluded assets (to avoid bias) in a study of the Vietnamese banking system. Further, we estimate models for the whole banking system as well as for the following sub-samples: state owned commercial banks; non-state owned commercial banks; 1999–2003; and 2004–2009. The consideration of these sub-samples is also a contribution of our paper. Environmental factors such as total assets, capital/assets, loans/deposits and the number of branches are incorporated in our models and have not all been employed in previous studies of Vietnam. In addition, for comparative purposes, we use the following four different dependent variables: revenue divided by total assets (REV/TA); interest income divided by total assets (INT/TA); revenue (REV); and interest income (INT). We use the non-structural model to determine whether the Vietnamese banking system is best characterised by monopoly, monopolistic competition or perfect competition.

4. Methodology and data

4.1. The calculation of H-statistics

[3] The total number of observations for Vietnam that they use is only 135 whereas our maximum sample size is 376 observations.

We estimate non-structural models based on the Panzar-Rosse specification using the following empirical form:

$$LN(ROA_{i,t}) = \delta_0 + \delta_1 LN(\frac{PE_{i,t}}{TE_{i,t}}) + \delta_2 LN(\frac{IE_{i,t}}{FF_{i,t}}) + \delta_3 LN(\frac{CE_{i,t}}{FA_{i,t}}) + \delta_4 \frac{TC_{i,t}}{TA_{i,t}} + \delta_5 \frac{CL_{i,t}}{CD_{i,t}} + \delta_6 LN(TA_{i,t}) + \delta_7 LN(BR_{i,t}) \quad \textbf{(4)}$$

where, $LN(ROA_{i,t})$ is bank i's revenue, which is measured in two ways: the natural logarithm of revenue divided by total assets $LN(\frac{REV_{i,t}}{TA_{i,t}})$ and the natural logarithm of interest income divided by total assets $LN(\frac{INT_{i,t}}{TA_{i,t}})$. Also included is $LN(\frac{PE_{i,t}}{TE_{i,t}})$ the natural logarithm of the unit price of labour, $\frac{PersonalExpenses}{TotalEmployees}$; $LN(\frac{IE_{i,t}}{FF_{i,t}})$, the natural logarithm of the unit cost of funds, $\frac{InterestExpenses}{FundableFunds}$; $LN(\frac{CE_{i,t}}{FA_{i,t}})$ the natural logarithm of the unit cost of fixed assets, $\frac{CapitalExpenses}{FixedAssets}$, (see Claessens and Laeven, 2004; Gelos and Roldos, 2004: 50 and Nathan and Neave, 2001: 580). $\frac{TC_{i,t}}{TA_{i,t}}$ is the capital to assets ratio; $\frac{CL_{i,t}}{CD_{i,t}}$ is the loans to deposits ratio; $LN(TA_{i,t})$ is the natural logarithm of total assets and $LN(BR_{i,t})$ is the natural logarithm of the number of branches.

The H-statistic, which is used to determine the degree of competition, is calculated from **(4)** using:

$$H = \delta_1 + \delta_2 + \delta_3 \quad \textbf{(5)}$$

From equation (5), if $H \leq 0$ the market is a monopoly, if $0 < H < 1$ the market is in monopolistic competition and if $H = 1$ the market is in perfect competition.

4.2. Models with and without assets

Many previous empirical studies include among the controls the log of assets, $LN(TA_{i,t})$, to measure size or some other similarly defined measure of bank size; and many studies also scale the dependent

variables with total assets, that is: $LN(\frac{REV_{i,t}}{TA_{i,t}})$ and $LN(\frac{INT_{i,t}}{TA_{i,t}})$. However, Bikker *et al.* (2006a) pointed out that it is incorrect to estimate a revenue elasticity using a specification that includes a quantity-type variable among the controls, or using a specification which, through rescaling, converts a revenue variable into a price-type variable. In fact, if $LN(TA_{i,t})$ appears among the controls, then it is immaterial whether the dependent variable is unscaled (not divided by total assets) or scaled (divided by total assets). In either case the coefficients on the factor input prices ($\delta_1, \delta_2, \delta_3$) should be interpreted as output price elasticities and not as revenue elasticities. The model is misspecified if assets are included and inference regarding market structure is invalid. Hence, on the left hand side of the models, the dependent variables should be $LN(REV_{i,t})$ and $LN(INT_{i,t})$ instead of $LN(\frac{REV_{i,t}}{TA_{i,t}})$ and $LN(\frac{REV_{i,t}}{TA_{i,t}})$, respectively. Further, $LN(TA_{i,t})$ should be removed from the right hand side of the models (Goddard and Wilson, 2009).[4] The valid unscaled model is obtained from **(4)** with $\delta_6 = 0$ and using the unscaled dependent variables, $LN(REV_{i,t})$ and $LN(INT_{i,t})$.

4.3. Calculating the E-statistics (testing equilibrium)

For the H-statistic to be a valid test it must be calculated on observations that are in long-run equilibrium. This suggests that competitive capital markets will equalise risk-adjusted rates of return across banks such that, in equilibrium, rates of returns should not be significantly correlated with input prices (Shaffer, 1982; Molyneux and Forbes, 1995; Lloyd-Williams *et al.*, 1994; Classens and Laeven, 2004 and Matthews *et al.*, 2007). Thus, in the context of the theory of competitiveness and contestability set out in **(4)** we specify a model for the determination of whether equilibrium holds. This is obtained by replacing the dependent variable in **(4)** with profit before tax on assets (1+PBT/TA) thus:[5]

$$LN(1+\frac{PBT_{i,t}}{TA_{i,t}}) = \gamma_0 + \gamma_1 LN(\frac{PE_{i,t}}{TE_{i,t}}) + \gamma_2 LN(\frac{IE_{i,t}}{FF_{i,t}}) + \gamma_3 LN(\frac{CE_{i,t}}{FA_{i,t}}) + \gamma_4 \frac{TC_{i,t}}{TA_{i,t}} + \gamma_5 \frac{CL_{i,t}}{CD_{i,t}} + \gamma_6 LN(TA_{i,t}) + \gamma_7 LN(BR_{i,t}) \quad \textbf{(6)}$$

[4] In this study, we estimate models that both include and exclude assets for comparison purposes.
[5] Because profit before tax can take on small (negative) values, we compute the dependent variable as (1+PBT/TA).

A version of **(6)** without $LN(TA_{i,t})$ is also estimated by setting $\gamma_6 = 0$.

The E-statistic that is used for testing whether the market is in equilibrium is defined as:

$$E = \gamma_1 + \gamma_2 + \gamma_3 \qquad \textbf{(7)}$$

We test whether E = 0 using an F-test. If rejected, the market is not in equilibrium (Claessens and Laeven, 2004), whereas if E = 0 the market is in equilibrium and the H-statistic calculated using **(4)** and **(5)** is valid.

4.4. Models with current and lagged input prices

Simultaneity is a dual direction of causality in a system of equations which violates the assumption that the explanatory variables and equation's error term are uncorrelated. Variables in a regression can violate this assumption for several reasons, including omitted variable bias, measurement error and simultaneity/reverse causation. In our regression, the models including the current values of input prices might suffer from simultaneity (endogeneity) bias between input prices and the dependent variables (revenue and interest income). We use two methods to determine whether or not one or more of the input prices (LN(IE/FF), LN(PE/TE) and LN(CE/FA)) suffers from endogeneity. The first is the Wu-Hausman test[6] while the second compares regressions using current and lagged input prices - see Shaffer (2004) and Goddard and Wilson (2009). To obtain models using lagged input prices current price variables are replaced by their values lagged one time period in **(4)** and **(6)**. Large differences in the estimated coefficients (and therefore H-statistics and E-statistics) using models with current input prices and using models with lagged input prices is taken as an indication of the endogeneity of input prices.

4.5. Data

[6] The Wu-Hausman test tests for weak exogeneity. We use it to test whether the input price variables in our models may be treated as if they are exogenous for the purpose of estimation such that Ordinary Least Squares produces valid estimates.

In this paper, annual individual balance sheets and income statements of 48 Vietnamese commercial banks from 1999 to 2009 have been collected from the State Bank of Vietnam, National Library of Vietnam and individual banks. Although the number of banks for which there is data is only half of the total in the Vietnamese banking system they account for more than 90% of total customer loans, total customer deposits and total assets.[7]

5. Empirical results

Table 3 reports the non-structural model estimated for the full sample.[8] The results include estimated revenue (in the column headed "H-statistics") and profit (in the column headed "E-statistics") equations using all measures of the dependent variable with current or lagged input prices both with and without assets for the full sample. H_0^1 refers to the F-test of the null hypothesis that cross-sectional fixed-effects are redundant. H_0^2 refers to the F-test of the null hypothesis that both cross-sectional and time-period fixed-effects are redundant. All of the F-tests reject the exclusion of cross-sectional and period fixed-effects, therefore, the '2-way-FE' model is favoured and reported in the table.[9] We also report R^2, the adjusted R^2 (Adj R^2), the statistic for testing the null hypothesis that R^2 = 0 (F-statistic) and the number of observations.

The H-statistic is reported in the row labelled H-sta. in the table. The H-statistics are 0.59 (with LN(REV/TA) as the dependent variable) and 0.62 (with LN(INT/TA)) in the models with assets and with current input prices. The rows below the H-statistics show the result of t-tests for the null hypotheses that H = 0 and H = 1. The H-statistics are significantly different from both zero and one in these models. When the H-statistic is between zero and one (as in this case), it indicates monopolistic competition. In the models without assets and with current input prices, the H-statistics are 0.96 for the equation where LN(REV) is the dependent variable and 0.98 for the specification with LN(INT) as the regressand. They are both significantly different from zero and insignificantly different from one.

[7] Five of the 48 banks are state owned commercial banks, five are joint stock commercial banks, one is a foreign commercial bank and the remaining 37 are joint stock commercial banks. Several banks established in 2008 and 2009 are included in the data. The number of records ranged from a low of 17 banks in 1999 to a high of 46 in 2009. Banks also have differing frequencies of years in the data – see Table 1. There are sixteen banks with data for all years; twelve banks with 4–8 years of data; fourteen banks with 5–7 years of data and five banks with 2–4 years of data (of which three banks were established in 2008 and one bank was founded in 2006). Only one bank (which was transformed from a branch of a foreign bank to a foreign commercial bank in 2008) has one year of data.

[8] The results of the sub-samples 1999–2003; 2004–2009; five state owned commercial banks and 43 non-state owned commercial banks are presented in Table 5.

[9] '2-way-FE' incorporates both cross-sectional and period fixed-effects.

Since $H \cong 1$ this indicates that the Vietnamese banking system is a competitive industry.[10] Comparing the models with and without assets we notice that excluding total assets from the revenue equations has transformed our inference of the Vietnamese banking market from monopolistic competition to perfect competition. This is consistent with the prediction of Bikker *et al.* (2006a) and Goddard and Wilson (2009) because the downward bias in H is removed when assets are excluded.

In the models with assets and with lagged input prices, the H-statistic is 0.16 when LN(REV/TA) is the dependent variable and 0.13 when LN(INT/TA) is the regressand. The null hypotheses that the H-statistic is zero or one are both rejected. This indicates that the industry is in monopolistic competition, if close to monopoly. Lastly, the H-statistics based upon revenue equations excluding assets that include lagged input prices as regressors are 0.45-0.43 (both are significantly different from zero and one, indicating monopolistic competition). These H-statistics are notably smaller than the corresponding equations that use current input prices, being 0.96-0.98. This difference is most likely due to simultaneity bias. Hence we favour the results using lagged input prices and without assets for inference and conclude that the Vietnamese banking system is in monopolistic competition.[11]

Table 4 report results from the Wu-Hausman test for endogeneity using the full sample. The instrument set is the same for all three input price variables being instrumented. The results show that all F-tests for the significance of the explanatory power of the instrumented input price equations are significant at the 1% level. The Wu-Hausman test suggests that there is general evidence of endogeneity in the models with assets although there is less evidence of endogeneity in the models without assets. Nevertheless, the large differences in coefficients in the estimated models both with and without assets are suggestive of endogeneity for models both with and without assets. With this in mind we will use the models employing lagged input prices in order to secure valid inference[12].

[10] An increase in costs causes some banks to exit, prices to increase, and the revenue of the survivors to rise at the same rate as the increase in costs.

[11] Regarding the other control variables, capital/assets (TC/TA) is positive and significant in the models with assets using current and lagged input prices, and it is negative and significant when assets are excluded. The first implies that there is a positive relationship between both revenue and interest income with the capital/asset ratio in the models with assets. The second shows that increasing the capital/asset ratio causes a reduction in revenue in the models excluding assets, which is consistent with our expectations. The number of branches (LN(BR)) is positive and significant in all the models except for the models with assets using lagged input prices. This implies that revenue and interest income generally increase when banks open more branches. Loan/deposit (CL/CD) is generally insignificant, except for the models with lagged input prices (with and without assets) when revenue is the dependent variable. This means there is generally no significant increase of revenue and interest income even if banks offer more loans to customers. This is consistent with our expectation. Total assets (LN(TA)) is negative and significant in the models with assets using current and lagged input prices.

[12] We also applied the Wu-Hausman test on the sub-samples 1999–2003; 2004–2009; five state owned commercial banks and 43 non-state owned commercial banks. The results also show that all F-tests for the significance of the explanatory power of the instrumented input price equations are significant at the 1% level except for LN(CE/FA) in the sub-sample for state owned commercial banks (without

Table 3 also shows the results of the profit equations and their E-statistics for the full sample (in the column headed "E-statistics"). The E-statistic is used to determine whether the long-term equilibrium condition of the market is met. If the E-statistic is equal to zero the market is in long-term equilibrium whereas when the E-statistic is not equal to zero the market is not in long-term equilibrium. If the market is not in equilibrium, the value of the H-statistic (obtained from the corresponding revenue equation) is temporal and the degree of competitiveness is changing through time. In this case the estimated models are not valid for inference and it is appropriate to employ a dynamic model to determine the equilibrium value of the market. We use the '2-way-FE' specification for inference because both cross-section and time-period fixed-effects are jointly significant according to the H_0^2 F-test. The E-statistic in the '2-way-FE' models are 0.007 (with assets and with current input prices), 0.006 (without assets and with current input prices), 0.007 (with assets and with lagged input prices) and 0.003 (without assets and with lagged input prices). They do not reject the null hypothesis that the Vietnamese banking system is in equilibrium. Hence, all the corresponding H-statistics are valid. Due to simultaneity bias in the models using current input prices (according to the Wu-Hausman test reported in Table 4) and the misspecification of the models that include assets (see, Bikker *et al.*, 2006a; Goddard and Wilson, 2009) we favour the model without assets and with lagged input prices. We therefore conclude that the Vietnamese banking system is in long-run equilibrium ($E \cong 0.003$) and characterised by monopolistic competition ($H \cong 0.43 - 0.45$) during the period 1999 to 2009.

As for the three input prices, the unit cost of funds (LN(IE/FF)) is positive and significant at the 1% level for both dependent variables over the full sample. The unit price of labour (LN(PE/TE)) is positive and significant at the 10% level in the model where revenue is the dependent variable and insignificant when interest income is the regressand. The unit cost of fixed assets (LN(CE/FA)) is insignificant in the models with both dependent variables. These results suggest that the unit cost of funds has the most significant impact on revenue and interest income of the three input prices. Regarding the other

assets) which is significant at the 5% level. Further, the F-statistic exceeds 10 in 5 of the 6 cases (in the one case that it is below 10 the F-statistic is 9,360), see Stock and Watson (2012). Given these results the instruments are considered valid (not weak). Regarding the Wu-Hausman test, the results show that there is evidence of endogeneity in the revenue and interest income equations when assets are included in the models. However, when assets are excluded from the revenue equations there is no endogeneity in the revenue equations. Hence, these results suggest that we can employ current input prices for the revenue and interest income models (without assets). In contrast, these results also suggest that we should employ lagged input prices for the revenue and interest income models which include assets. With the profit equations there is always evidence of endogeneity. Therefore, it would be safest to produce all E-statistics based on the profit equations using lagged input prices.

variables in our favoured models estimated over the full sample, customer loans over customer deposits (CL/CD) and total capital over total assets (TC/TA) are negative and significant while the number of branches (LN(BR)) is positive and significant.

Summary of results for the sub-samples:

Table 5 summarises unreported results obtained using sub-samples of the data (available from the authors on request). The results are for models using current and lagged input prices both with and without assets included. All of the F-tests reject the exclusion of cross-sectional and period fixed-effects and so the '2-way-FE' model is favoured and used for inference. All the models are in equilibrium except the sub-sample 1999-2003 using lagged input prices and with LN(REV/TA), LN(REV) and LN(INT) as the dependent variables. There are differences between the models using current and lagged input prices. The models based on current input prices suggest that the full sample and sub-samples are generally in monopolistic competition. However, the models using lagged input prices including assets indicate that the full sample and sub-samples behave as if in monopoly except for the full sample when LN(REV/TA) is the dependent variable. When assets are excluded from the models, the full sample and non-state owned commercial banks sub-sample indicate monopolistic competition while the other sub-samples suggest monopoly. The Wu-Hausman test indicates endogeneity in most of the models including assets if in only a few models that exclude assets. However, the difference in the estimated coefficients of the models with and without assets suggests evidence of endogeneity in both. Therefore we prefer the models using lagged input prices for inference.

In the favoured models using lagged input prices, the H-statistics are generally higher for models where revenue is the dependent variable than when it is interest income (except for the state owned commercial banks sub-sample). Hence the market appears more competitive when based on revenue. Revenue includes interest income plus fee and commission income where interest income accounts for most of revenue. In contrast, the models based upon current input prices generally show that the H-statistics are generally higher for the models when interest income is the dependent variable than when it is revenue except for the sub-sample 2004-2009 without assets.

Another finding relates to the exclusion of the natural logarithm of total assets from the model. The removal of total assets from all the models transforms our inference regarding the market toward being more competitive as predicted by Bikker *et al.* (2006a) and Goddard and Wilson (2009). In the models using lagged input prices, the H-statistics for the full sample are between 0.16 and 0.13 when assets are included while the corresponding range is 0.45 to 0.43 when total assets are excluded from the models. On the other hand, the H-statistics of the models with current input prices are 0.59 and 0.62 with assets included and when we eliminate assets from the models the corresponding range is 0.96 and 0.98. Given that inference in the models including total assets is inappropriate and the models using lagged input prices are preferred for inference we would conclude from these results that the Vietnamese banking system and non-state owned commercial banks are in monopolistic competition over the whole period. Further, the Vietnamese banking system in the sub-periods 1999-2003 and 2004-2009 and state owned commercial banks operate in monopoly. These results are slightly different from Bikker *et al.* (2006a, 2006b) and Bikker and Spierdijk (2009). They investigated banking structure in Vietnam during the period of 1991-2004 for 24 banks (the number of observations was only 135) with current input prices but they could not observe the three input price directly. They provided an H-statistic of 0.74, using interest income as the dependent variable. This suggested that the Vietnamese banking system operates in monopolistic competition. Our H-statistic is 0.82 for LN(INT/TA) from 1999 to 2003 with assets and current input prices. This indicates that the Vietnamese banking system is in monopolistic competition but also suggests that the industry is not different from perfect competition.

Further, the empirical results of the models using lagged input prices and excluding assets show that non-state owned commercial banks are more competitive than state owned commercial banks. The H-statistics for non-state owned commercial banks are between 0.54 and 0.52 in the models that exclude assets. The corresponding range for state owned commercial banks is -0.14 to -0.15. Therefore, non-state owned commercial banks behave as if in monopolistic competition while state owned commercial banks behave as if in a monopoly environment.

Regarding the time period there is another interesting finding. The results (without assets and with lagged input prices) suggest that in the period 1999-2003 the market is slightly less competitive than during period 2004-2009. This is also consistent with our expectations about these two periods. Some banks were established in the period 2004-2009 and as new banks they offered loans with good rates

for customers. They are also not affected by non-performing loans as existing banks are. The H-statistics are 0.03 and -0.05 in the sub-period 1999-2003. The corresponding results for the sub-period 2004-2009 are 0.05 and 0.03. Hence, whilst the degree of competition has increased through time it has only increased slightly.

There is an apparent inconsistency because the full sample results (1999-2009) suggest that the market is in monopolistic competition while both sub-sample results (1999-2003 and 2004-2009) indicate that the industry is monopolistic. We are inclined to favour the full sample results that are based on more data (especially as equilibrium cannot be rejected) and infer that the market is characterised by monopolistic competition. The sub-sample results use less data and are regarded only as indicative of the change in the degree of competition. They suggest a possible slight increase in competition through time.

6. Conclusion

In this paper the Panzar-Rosse model has been applied in order to investigate the degree of competition faced by cooperative financial institutions in Vietnam.

Our paper makes a number of contributions to the literature as follows. Our results are based upon the largest sample both in terms of the number of banks and total sample size compared to any previous study of non-structural models in the Vietnamese banking system and ours is the first to clearly distinguish the market structure for Vietnam from other countries. This study also extends the previous literature by considering new additional variables. Environmental factors such as total assets, capital/assets, loans/deposits and the number of branches that are incorporated in our models have not been employed in previous studies of Vietnam. Further, we use four different dependent variables to provide comparative inference. This is also the first study that considers the exclusion of assets (to avoid bias) and inclusion of lagged input prices (to avoid endogeneity) in a study of the Vietnamese banking system. In addition to drawing inference based on the full sample we also summarise results for models estimated on sub-samples of the data. In particular, we split the sample according to the type of bank (state owned commercial banks and non-state owned commercial banks) and through time (1999-2003 and 2004-2009). This represents a further contribution of our paper.

Our favoured models for inference use lagged input prices, exclude assets and employ the two-way fixed-effects estimator. The E-statistic suggests the banking industry is in equilibrium and so inference from H-statistics is valid. Our favoured results for the full sample indicate that the whole Vietnamese banking system is characterised by monopolistic competition with non-state owned commercial banks behaving more competitively than state owned commercial banks (the latter being monopolistic). There is some tentative evidence that the Vietnamese banking system has become slightly more competitive over our sample period.

A number of policy implications arise out of this paper. Our inference from the favoured models using the revenue dependent variable indicate a slightly greater degree of competition in the Vietnamese banking system than those that employ interest income. Sources of revenue might be securities, credit cards, derivative products, etc while sources of interest income are almost all from customer loans. There should be more regulations and policies from the State Bank of Vietnam to enhance competition in terms of customer loans. Hence, the degree of competition from interest income could be improved in comparison with revenue.

Another policy implication concerns the relationship between loans and bank revenue and interest income. We argue that tightening monetary policies starting in 2008 still have a big impact on the banking system in terms of compulsory reserves, loans and deposits. Generally, the banking system encounters many difficulties, resulting from the loss of balance in the source and use of funds, and the rapid increase in credit growth (see Nguyen and Stewart, 2013). Macroeconomic policies from the State Bank of Vietnam should be used simultaneously and reasonably to meet the high demand of loans from the public and to control increased inflation due to rapid increase in credit growth.

As mentioned above our favoured results show that non-state owned commercial banks are more competitive than state owned commercial banks and we find that banks that open more branches increase their revenue and interest income except for state owned commercial banks. Thus, the State Bank of Vietnam should have policies to enhance the development of non-state owned commercial banks to raise competition and revenue in the banking system.

References

Bikker, J.A. and Bos, J.W.B. (2008). *Bank performance.* Abingdon: Routledge.

Bikker, J.A. and Groeneveld, J.M. (2000). Competition and concentration in the E.U. banking industry. *Kredit and Kapital, 33*, 62-98.

Bikker, J.A. and Spierdijk, L. (2009). *Measuring and explaning competition in the financial sector.* Utrecht School of Economics Working Paper 09-01.

Bikker, J.A., Spierdijk, L. and Finnie, P. (2006a). *Misspecification in the Panzar-Rosse model: Assessing competition in the banking Industry.* DNB Working Paper 114.

Bikker, J.A., Spierdijk, L. and Finnie, P. (2006b). *The impact of bank size on market power.* DNB Working Paper 120.

Claessens, S. and Laeven, L. (2004). What drives bank competition? Some international evidence. *Journal of Money, Credit and Banking, 36*(3), 563-583.

DeBandt, O. and Davis, P. (2000). Competition, contestability and market structure in European banking sectors on the eve of EMU. *Journal of Banking and Finance, 24*, 1045-1066.

Dufhues, T. (2003). Transformation of the financial system in Vietnam and its implications for the rural market - An updated. *Journal of Institutional Innovation, 7*, 29-41.

Gelos, R.G. and Roldos, J,. (2004). Consolidation and market structure in emerging market banking systems. *Emerging Markets Review, 5*, 39–59.

Goddard, J.A. and Wilson, J.O.S. (2009). Competition in banking: A disequilibrium approach. *Journal of Banking and Finance, 33*, 2282-2292.

Goddard, J.A., Molyneux, P. and Wilson, J.O.S. (2001). *European banking: Efficiency, technology and growth.* Chichester: John Wiley & Sons, Ltd.

Lloyd-Williams, M., Molyneux, P. and Thornton, J. (1994). Market structure and performance in Spanish banking. *Journal of Banking and Finance, 18*, 433-443.

Matthews, K., Murinde, V. and Zhao, T. (2007). Competitive conditions among major British banks. *Journal of Banking and Finance, 31*, 2025-2042.

Molyneux, P. and Forbes, W. (1995). Market structure and performance in European banking. *Applied Economics, 27*, 155-159.

Molyneux, P., Lloyd-Williams, D.M. and Thornton, J. (1994). Competitive conditions in European banking. *Journal of Banking and Finance, 18*, 445-459.

Nathan, A. and Neave, E.H. (1989). Competition and contestability in Canada's financial system: Empirical results. *Canadian Journal of Economics, 22*, 576-594.

Nguyen, T.N. and Stewart, C. (2013). Concentration and efficiency in the Vietnamese banking system between 1999 and 2009: A structural model approach. *Journal of Financial Regulation and Compliance, 21*(3).

Panzar, J.C. and Rosse, J.N. (1987). Testing for monopoly equilibrium. *The Journal of Industrial Economics, 35*(4), 443-456.

SBV. (2005). *Annual Report.* Hanoi: SBV.

SBV. (2008). *Annual Report.* Hanoi: SBV.

SBV. (2009). *Annual Report.* Hanoi: SBV.

Shaffer, S. (1982). A non-structural test for competition in financial markets. *Bank Structure and Competition* (pp. 225-243). Chicago: Federal Reserve Bank of Chicago.

Shaffer, S. (2004). Pattern of competition in banking. *Journal of Economics and Business, 54*, 287-313.

Stock, J.H. and Watson, M.W. (2012). *Introduction to econometrics.* London: Pearson.

VCSC. (2008). *Vietnam banking system: Reality and forecast.* Ho Chi Minh city: VCSC.

WB. (2008). *Taking stock: An update on Vietnam's recent economic development.* Hanoi: Annual Consultative for Vietnam.

Table 1 The number of commercial banks from 1990 to 2009[13]

Type of banks	1990	1995	2000	2005	2009
State owned commercial banks	4	4	5	5	**5**
Non-state owned commercial banks					
Joint stock commercial banks	0	36	39	37	**37**
Branches of foreign banks	0	18	26	31	**48**
Joint venture commercial banks	0	4	5	5	**6**
Foreign commercial banks	0	0	0	0	**5**
Total	4	62	75	78	101

Sources: Dufhues (2003: 32); SBV (2005, 2008, 2009) and VCSC (2008).

Table 2. Data on loans, assets, deposits, capital and non-performing loans of the Vietnamese commercial banks (state owned commercial banks and non-state owned commercial banks) from 1999 to 2009 (Unit: 1,000 Vietnamese Dong)

Year	Bank type	Loans	Assets	Deposits	Capital	Non-performing loans
1999	SOCBs	72,142,247	134,890,858	87,326,439	5,468,772	10.78%
	Non-SOCBs	35,899,360	58,871,839	30,293,986	9,284,887	N/A
2000	SOCBs	108,422,565	200,433,947	127,033,459	5,413,772	10.02%
	Non-SOCBs	41,231,535	75,856,994	43,321,781	10,139,627	9.42%
2001	SOCBs	135,647,621	247,151,769	160,738,302	5,421,134	8.83%
	Non-SOCBs	45,466,715	88,614,974	51,759,565	10,953,034	7.81%
2002	SOCBs	165,921,733	286,860,920	189,313,313	10,061,113	7.62%
	Non-SOCBs	55,296,802	102,590,591	63,658,203	11,152,585	5.41%
2003	SOCBs	214,481,096	367,813,825	237,485,761	14,516,916	5.13%
	Non-SOCBs	74,068,790	130,337,981	79,255,399	12,398,334	3.57%
2004	SOCBs	295,738,175	468,341,918	311,681,861	17,362,940	2.92%
	Non-SOCBs	103,563,777	183,404,071	109,681,322	14,860,054	2.26%
2005	SOCBs	380,850,503	603,540,889	406,957,181	18,429,980	3.81%
	Non-SOCBs	143,449,737	261,307,537	144,499,838	20,009,805	1.42%
2006	SOCBs	435,695,864	731,657,400	524,533,245	18,777,200	3.19%
	Non-SOCBs	212,097,344	430,755,234	229,411,786	35,578,494	1.29%
2007	SOCBs	564,677,195	904,004,852	652,913,108	30,091,997	1.87%
	Non-SOCBs	420,184,441	903,961,807	456,920,152	66,066,418	0.94%
2008	SOCBs	671,732,670	1,078,729,233	775,560,005	39,279,325	2.47%
	Non-SOCBs	534,692,051	1,097,675,565	593,628,040	103,923,040	1.62%
2009[14]	SOCBs	903,718,777	1,320,357,324	869,410,909	61,293,664	N/A
	Non-SOCBs	560,883,667	1,210,244,318	680,665,451	115,192,318	N/A

Note: SOCBs: State owned commercial banks; Non-SOCBs: Non-state owned commercial banks. Sources: SBV (2009); Financial statements of 48 Vietnamese commercial banks.

[13] Beside these commercial banks, there are also the Social Policy Bank and Vietnam Development Bank which are operating as non-profit institutions.

[14] We could not collect data of the North Asia Commercial Bank and Vinasiam Bank in 2009.

Table 3 Fixed-effects estimations for the full sample (Observations = 376)

	With assets and with current input prices			**Without assets and with current input prices**		
	H-statistics		E-statistics	H-statistics		E-statistics
	LN(REV/TA)	LN(INT/TA)	LN(1+PBT/TA)	LN(REV)	LN(INT)	LN(1+PBT/TA)
Intercept	0.733	1.051**	0.036	10.556***	10.904***	-0.005
	(1.558)	(2.207)	(1.047)	(21.510)	(22.090)	(-0.240)
LN(PE/TE)	0.130**	0.071	0.005	0.413***	0.355***	0.004
	(2.253)	(1.219)	(1.216)	(4.102)	(3.5035)	(0.953)
LN(IE/FF)	0.395***	0.500***	0.001	0.480***	0.586***	0.001
	(11.759)	(14.731)	(0.405)	(8.117	(9.849)	(0.261)
LN(CE/FA)	0.064***	0.045*	0.001	0.062	0.044	0.001
	(2.537)	(1.771392)	(0.728692)	(1.398)	(0.9714)	(0.731)
TC/TA	0.432***	0.432***	0.041***	-0.662***	-0.666***	0.0459***
	(5.065)	(5.005)	(6.688)	(-5.054)	(-5.0516)	(8.533)
CL/CD	-0.01342	-0.009	-0.001	-0.021	-0.016	-0.000
	(-1.429)	(-0.936)	(-0.737)	(-1.259)	(-0.982)	(-0.691)
LN(TA)	-0.195***	-0.193***	-0.003			
	(-6.275)	(-6.125)	(-1.471)			
LN(BR)	0.145***	0.152***	0.003	0.740***	0.749***	0.001
	(3.721)	(3.856)	(1.124)	(13.286)	(13.368)	(0.315)
R2	0.725	0.758	0.497	0.961	0.961	0.494
Adj. R2	0.669	0.708	0.394	0.953	0.953	0.392
H_0^1	3.961***	3.430***	1.680***	19.286***	18.679***	1.629***
	Reject	Reject	Reject	Reject	Reject	Reject
H_0^2	3.854***	3.166***	1.861***	17.022***	16.278***	1.819***
	Reject	Reject	Reject	Reject	Reject	Reject
H-sta. [E-sta.]	**0.589**	**0.617**	**[0.007]**	**0.956**	**0.984**	**[0.006]**
H_o: H=0	77.593***	83.076***	2.345	68.154***	71.480***	1.552
	Reject	Reject	**Accept**	Reject	Reject	**Accept**
H_o: H=1	37.645***	31.999***	---	0.146	0.018	---
	Reject	Reject		Accept	Accept	
F-statistic	12.827***	15.238***	4.812***	122.817***	122.926***	4.836***
	With assets and with lagged input prices			**Without assets and with lagged input prices**		
	H-statistics		E-statistics	H-statistics		E-statistics
	LN(REV/TA)	LN(INT/TA)	LN(1+PBT/TA)	LN(REV)	LN(INT)	LN(1+PBT/TA)
Intercept	0.681	0.683	0.029	11.233***	11.485***	-0.034
	(1.034)	(0.945)	(0.711)	(20.302)	(19.670)	(-1.504)
$LN(PE/TE)_{(t-1)}$	0.066	-0.004	0.009	0.218*	0.151	0.008*
	(0.913)	(-0.047)	(2.057)	(1.950)	(1.281)	(1.862)
$LN(IE/FF)_{(t-1)}$	0.082*	0.136***	-0.003	0.245***	0.303***	-0.004
	(1.932)	(2.934)	(-1.183)	(3.847)	(4.513)	(-1.579)
$LN(CE/FA)_{(t-1)}$	0.012	-0.002	-0.001	-0.009	-0.024	-0.001
	(0.376)	(-0.065)	(-0.569)	(-0.192)	(-0.467)	(-0.503)
TC/TA	0.240**	0.210*	0.033***	-0.893***	-0.949***	0.040***
	(2.242)	(1.787)	(4.882)	(-6.489)	(-6.541)	(7.042)
CL/CD	-0.072**	-0.041	-0.002	-0.120**	-0.090*	-0.002
	(-2.333)	(-1.203)	(-1.179)	(-2.538)	(-1.802)	(-1.028)
LN(TA)	-0.217***	-0.198***	-0.005*			
	(-5.304)	(-4.422)	(-1.832)			
LN(BR)	0.079	0.065	0.003	0.624***	0.622***	0.000
	(1.593)	(1.183)	(1.053)	(9.922)	(9.375)	(0.006)
R2	0.650	0.635	0.547	0.961	0.957	0.541
Adj. R2	0.569	0.550	0.442	0.952	0.948	0.437
H_0^1	3.363***	1.904	1.736***	16.318***	14.782***	1.684***
	Reject	Accept	Reject	Reject	Reject	Reject
H_0^2	4.299***	85.161***	2.044***	14.486***	13.2512***	1.986***
	Reject	Reject	Reject	Reject	Reject	Reject
H-sta. [E-sta.]	**0.160**	**0.130**	**[0.007]**	**0.453**	**0.430**	**[0.003]**
H_o: H=0	3.477*	1.904	0.909	12.136***	9.814***	0.401
	Accept	Accept	**Accept**	Reject	Reject	**Accept**
H_o: H=1	95.566***	85.161***	---	17.633***	17.207***	---
	Reject	Reject		Reject	Reject	
F-statistic	8.055***	7.545***	5.237***	109.849***	100.225***	5.222***

*Note: R2 denotes the coefficient of determination, Adj. R2 the adjusted coefficient of determination, H_0^1 is an F-test for the significance of cross-sectional fixed-effects, H_0^2 is an F-test for the joint significance of cross-sectional and time-period fixed-effects and F-sta. tests the null that R2 is equal to zero. The variables' coefficients and t-statistics (in brackets) are reported in the table; *** indicates significance at the 1% level, ** significance at the 5% level and * significance at the 10% level. Source for the data are the financial statements of 48 Vietnamese commercial banks.*

Table 4 The instruments of input prices and the Wu-Hausman test for the full sample

		With assets			Without assets		
		Adj. R^2		F-test	Adj. R^2		F-test
Instrumented input price equations	LN(PE/TE)	0.902		47.141*** [0.000]	0.900		47.789*** [0.000]
	LN(IE/FF)	0.661		10.765*** [0.000]	0.618		9.360*** [0.000]
	LN(CE/FA)	0.723		14.105*** [0.000]	0.724		14.603*** [0.000]
		LN(REV/TA)	LN(INT/TA)	LN(1+PBT/TA)	LN(REV)	LN(INT)	LN(1+PBT/TA)
Wu-Hausman test							
	Res[LN(PE/TE)]	-0.270**	-0.204	-0.025***	-0.213	-0.165	-0.019**
		(-2.180)	(-1.618)	(-2.643)	(-1.014)	(-0.773)	(-2.029)
	Res[LN(IE/FF)]	-0.290***	-0.185**	-0.006	-0.170	-0.174	0.033***
		(-3.165)	(-1.987)	(-0.783)	(-0.870)	(-0.880)	(3.853)
	Res[LN(CE/FA)]	0.112	0.108	0.013**	0.058	0.072	0.007
		(1.325)	(1.263)	(1.966)	(0.399)	(0.482)	(1.030)
	F-All inputs	4.707***	2.282*	3.212**	0.533	0.432	7.578***
		[0.003]	[0.080]	[0.024]	[0.660]	[0.731]	[0.000]

Note (Also see note to Table 3): The variables which are included as the regressors in the instrument equations are LN(PE(-1)/TE(-1)), LN(IE(-1)/FF(-1)), LN(CE(-1)/FA(-1)), TC/TA, CL/CD, LN(BR), LN(TA), TC(-1)/TA(-1), CL(-1)/CD(-1), LN(BR(-1)) and LN(TA(-1)). The models without assets exclude LN(TA) and LN(TA(-1)). The instruments are the same for every single instrumented equation. The top panel of the table (highlighted in grey) gives the $\bar{R}^2$ and F-test (with probability values in squared parentheses) for the null hypothesis that all slope coefficients are equal to zero in the instrument equations for the three dependent variables LN(PE/TE), LN(IE/FF) and LN(CE/FA). The bottom panel of the table reports the coefficients and t-ratios (in parentheses) from the residuals of the three instrument equations, denoted Res[LN(PE/TE)], Res[LN(IE/FF)] and Res[LN(CE/FA)], when added simultaneously to the revenue and profit equations reported in Table 3.AnF-statistic (denoted F-All inputs) for the null that the coefficients on all three residual terms are jointly zero in any particular equation is also reported with associated probability values in squared parentheses. The Wu-Hausman test statistics are given by the t-ratios and F-statistics in the bottom panel of the table. If any of these statistics is significant in any particular equation it suggests violation of the assumption of the weak exogeneity of current period input prices in that equation.

Table 5 Summary of results from the non-structural model

Equilibrium approach		Current input prices				Lagged input prices			
		With assets		Without assets		With assets		Without assets	
		LN(REV/TA)	LN(INT/TA)	LN(REV)	LN(INT)	LN(REV/TA)	LN(INT/TA)	LN(REV)	LN(INT)
Full sample	H-sta.	**0.589**	**0.617**	**0.956**	**0.984**	**0.160**	**0.130**	**0.453**	**0.430**
1999-2009	H=0	77.593***	83.076***	68.154***	71.480***	3.477*	1.904	12.136***	9.814***
		Reject	Reject	Reject	Reject	Accept	Accept	Reject	Reject
	H=1	37.645***	31.999***	0.146	0.018	95.566***	85.161***	17.633***	17.207***
		Reject	Reject	Accept	Accept	Reject	Reject	Reject	Reject
non-SOCBs	H-sta.	**0.621**	**0.651**	**1.138**	**1.164**	**0.185**	**0.159**	**0.543**	**0.519**
1999-2009	H=0	60.623***	36.137***	91.7403***	97.335***	3.409*	2.128	15.318***	12.808***
		Reject	Reject	Reject	Reject	Accept	Accept	Reject	Reject
	H=1	22.656***	7.914***	1.3586	1.9482	65.523***	59.506***	10.883***	10.941***
		Reject	Reject	Accept	Accept	Reject	Reject	Reject	Reject
SOCBs	H-sta.	**0.5674**	**0.681**	**0.636**	**0.748**	**-0.149**	**-0.174**	**-0.136**	**-0.159**
1999-2009	H=0	30.566***	36.137***	18.634***	24.066***	0.741	0.694	0.377	0.380
		Reject	Reject	Reject	Reject	Accept	Accept	Accept	Accept
	H=1	17.762***	7.914***	6.081***	2.728**	44.061***	31.641***	26.234***	20.074***
		Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject
Sub-sample	H-sta.	**0.364**	**0.816**	**0.562**	**1.009**	**0.053**	**0.224** (OLS)	**0.031**	**-0.050**
1999-2003	H=0	3.511*	17.507***	5.234***	17.155***	0.017	2.510	0.004	0.008
		Accept	Reject	Reject	Reject	Accept	Accept	Accept	Accept
	H=1	10.683***	0.881	3.170*	0.001	5.578**	30.242***	4.546**	3.574
		Reject	Accept	Accept	Accept	Reject	Reject	Reject	Accept
Sub-sample	H-sta.	**0.618**	**0.609**	**0.751**	**0.736**	**0.003**	**-0.016**	**0.049**	**0.028**
2004-2009	H=0	58.468***	61.312***	26.7634***	27.985***	0.000	0.029	0.118	0.042
		Reject	Reject	Reject	Reject	Accept	Accept	Accept	Accept
	H=1	22.198***	25.237***	2.9208*	3.589*	105.540***	114.604***	43.291***	48.164***
		Reject	Reject	Accept	Accept	Reject	Reject	Reject	Reject

Note (Also see note to Table 3): SOCBs: State owned commercial banks; Non-SOCBs: Non-state owned commercial banks; All the models use 2-way-FE except the sub-sample 1999-2003 assuming lagged input prices for LN(INT/TA) which is pooled OLS (Ordinary Least Square). All are in equilibrium except the sub-sample 1999-2003 using lagged input prices for LN(REV/TA), LN(REV) and LN(INT).