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PERFORMANCE OF THE BANKING SECTOR OF A DEVELOPING COUNTRY: A NON-STRUCTURAL MODEL USING THE DISEQUILIBRIUM APPROACH

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Abstract

Based on the non-structural model – disequilibrium approach (Goddard and Wilson, 2009), this paper presents an empirical assessment of the degree of competition within the Vietnamese banking system from 1999 to 2009. We examine a greater number of environmental covariates and different dependent variables compared to previous applications of this model. Moreover, we use lagged input prices (to avoid endogeneity) and exclude assets (to avoid specification bias) in our models. The results indicate that the Vietnamese banking system operates in a monopolistic environment.

Keywords: Banking; Performance; Non-structural model; Disequilibrium approach; Vietnam;

JEL codes: C23; G21; L22

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1. Introduction

In the last two decades there has been extensive research on banking reforms in Central and Eastern Europe (CEE) – see Fries and Taci (2005); Bonin et al. (2005) and Staikouras et al. (2008). The common theme of these studies was to examine bank efficiency and the role of bank ownership. Only a few studies analysed the market structure in which commercial banks operate (Nathan and Neave, 1989 and DeBandt and Davis, 2000). Particular emphasis was given to the privatisation and the role of foreign banks in the newly established banking system. However, there is limited research on the banking system in less developed economies. In particular, there are only a few studies on the Vietnamese banking system that provide a deep analysis and policy implications for the specific transformation process adopted by the Vietnamese government in the early 1990s. The specific approach applied by the Vietnamese authorities gives us an opportunity to compare the differences between the transition process in CEE and Vietnam. Such knowledge deepens our understanding of the optimal strategies that should be adopted by the authorities in other less developed economies.

Our study contributes to the research on competitiveness of the banking sector in emerging and developing economies (Claessens and Laeven, 2004; Gelos and Roldos, 2004). We endeavour to provide a broader picture about bank competition in Vietnam. The main novelty of our study is the application of the non-structural model – disequilibrium approach introduced by Goddard and Wilson (2009). We estimate H-statistics using models that exclude assets (to avoid specification bias) and include lagged input prices (to avoid endogeneity). We examine the 'system' and 'difference' generalised method of moments (GMM) estimators with both 'one-step' and 'two-step' specifications based on Arellano and Bond (1991) and Blundell and Bond (1998). The inclusion of time period dummy variables for all periods in addition to economic covariates affects the precision of coefficient estimates for some specifications. Hence, a general-to-specific method (GSM) will be applied to remove redundant time period dummy variables in each model in an attempt to improve the efficiency of estimation and obtain meaningful H-statistics. We also assess whether the H-statistics obtained from the dynamic specification motivated by the disequilibrium approach are valid for inference. Furthermore, we employ a unique database of 48 Vietnamese commercial banks from 1999 to 2009. Such a database enables us to assess the impact of the main structural changes of the last decade and the results of this analysis provide a better understanding of the main differences of the Vietnamese banking system from other (transition) economies.

The paper is structured as follows. The next section details developments in the Vietnamese banking system while Section 3 explores a brief review of the previous empirical literature of the non-structural model. Section 4 focuses on methodology and data. Empirical results are presented in Section 5 and Section 6 gives conclusions.

2. The Vietnamese banking system

The first stage of the banking reform in Vietnam was similar to those in other transition economies, that is, mono-banking was dismantled and replaced by a two-tier banking system in 1986. It is important to note that the reform in Vietnam was launched earlier than the reform in some CEE countries. However, Vietnamese banks operate in a different economic environment. In particular, the geographical location has been a limiting factor in the speed of its development. Although the Asian financial crisis in 1997 did not have such dramatic negative externalities as in other countries in south-east Asia it still reduced economic growth in Vietnam. The capital inflow was much lower compared with CEE countries in the 1990s. The capital account was fully controlled which discouraged foreign investors to invest in Vietnam in terms of FDI and portfolio investment. Furthermore, a number of Asia-Pacific countries liberalised their domestic financial sectors in the 1980s, making apparent the large interest differential between domestic and world interest rates; this provided an incentive to evade capital controls. In Vietnam, nevertheless, domestic interest rate ceilings supported stringent controls over foreign borrowings, enabling the State Bank of Vietnam (SBV) to regulate flows of short-term capital more efficiently (Leung and Le, 1998, p.125). Another explanation for the minor effect of the Asian financial crisis on the country was that the weakly-developed financial market did not attract much foreign capital in the first place (Kokko, 1999, p. 84).

In Table 1 we present information about the development of Vietnamese commercial banks (SBV, 2009). Nguyen and Stewart (2013) provide a detailed description of this development. It is evident that the number of joint stock commercial banks increased rapidly after 1990. Nevertheless, state owned commercial banks still dominate the market.[1] Non-state owned commercial banks include joint stock

[1] Nguyen and Stewart (2013) showed that 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.

commercial banks, branches of foreign banks, joint venture commercial banks and foreign commercial banks.[2] In Vietnam, as in other CEEs during the transition period, joint stock commercial banks perform better than state owned commercial banks. Joint stock commercial banks have achieved average returns on equity between 15% and 30% from 1999 to 2009 (SBV, 2009). The growth and expansion of foreign banks have also been solid. The number of branches of foreign banks increased from 18 banks in 1995 to 48 banks in 2009. However, the role of those banks in the Vietnamese banking system is rather marginal. The size of these foreign branches is relatively small compared to domestic banks. 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 are presented in Table 2. In general, loans, assets, deposits and capital increased gradually over the period. Vietnamese commercial banks had 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 (Matousek et al., 2013).

The global financial crisis of 2008 caused a sharp economic slowdown and property boom collapse in Vietnam and many small banks experienced serious liquidity and solvency problems during this period. This led to interventions by the SBV. The reduced lending capacity of the banking sector is one factor that contributed to a sharp slowdown of credit growth. Tighter regulation, for example by limiting interbank lending, has also contributed to this slowdown (Maddock, 2015).

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. The first market model that Panzar and Rosse investigate is monopoly. The empirical refutation of monopoly constitutes a rejection of the assumption that the

[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.

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 equilibrium, interdependence affects the structural revenue function, and the bank's profit finally becomes zero as the conditions of entry and withdrawal are unlimited; hence the H-statistic will be smaller than 1.[3] 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 increased cost and the H-statistic is 1 (Matousek et al., 2013).

Bikker et al. (2006b) used the Panzar-Rosse model to investigate more than 18,000 banks in 101 countries over 16 years. They showed that market power varies with bank size. Large banks have substantially more market power than small banks in many of the countries under consideration, including the world's major economies and covering more than 85% of all banks in the sample. Their results contradicted the common finding in the empirical Panzar-Rosse literature that competition increases with bank size. Furthermore, they also showed that misspecification (as discussed below) of the Panzar-Rosse model in the existing literature leads to an incorrect assessment of the relation between market power and bank size. Recent studies of non-structural models have used the Arellano and Bond (1991) and Blundell and Bond (1998) dynamic panel estimators. Goddard and Wilson (2009) identified the implications for the H-statistic of misspecification bias in the revenue equation arising when adjustment towards market equilibrium is partial and not instantaneous. In their simulations, the fixed-effect estimator produced a measured H-statistic that is severely biased towards zero. Empirical results for the banking sectors of the Group of Seven (G7) countries corroborated their principal finding, that a dynamic formulation of the revenue equation was required for accurate identification of the H-statistic. Daley and Matthews (2012) employed a dynamic version of the Panzar-Rosse model to examine the degree of competition of 11 Jamaican banks during the period 1998 to 2009. They found that Jamaica's banking market may have been characterised by cartelisation

[3] The H-statistic is the sum of the elasticities of the reduced-form revenue function with respect to factor prices (Panzar and Rosse, 1987).

in certain areas of the banking market. With the current trends and challenges in global markets, it is apposite that current policy decisions focus on levels of competition within Jamaica's banking sector.

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.[4] They calculated the H-statistic for the Vietnamese banking system as 0.74. They applied only one model for all 101 countries, including Vietnam. 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. Matousek et al. (2013) examined the performance of the Vietnamese banking system between 1999 and 2009 using a non-structural model assuming an equilibrium approach. This is also 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. The H-statistics are between 0.45 and 0.43 indicating that the Vietnamese banking system operates in monopolistic competition. However, none of these studies applied the non-structural model to the Vietnamese banking system using the disequilibrium approach.

4. Methodology and data

4.1. Calculation of the H-statistic under the disequilibrium approach

We consider non-structural models based on the Panzar-Rosse specification extended to include a lagged dependent variable (according to the disequilibrium approach) of the following empirical form:

$$LN(ROA_{i,t}) = \delta_0 + \delta_1 LN\left(\frac{PE}{TE}\right)_{i,t-1} + \delta_2 LN\left(\frac{IE}{FF}\right)_{i,t-1} + \delta_3 LN\left(\frac{CE}{FA}\right)_{i,t-1} + \delta_4\left(\frac{TC}{TA}\right)_{i,t} + \delta_5\left(\frac{CL}{CD}\right)_{i,t} + \delta_6 LN(BR_{i,t}) + \delta_7 LN(ROA_{i,t-1}) \quad (1)$$

where, $LN(ROA_{i,t})$ is bank i's revenue in period t, which is measured in two ways: the natural logarithm of revenue $LN(REV_{i,t})$ and the natural logarithm of interest income $LN(INT_{i,t})$. Also included is

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

$LN\left(\frac{PE}{TE}\right)_{i,t-1}$ the natural logarithm of the unit price of labour lagged one period, $\frac{PersonalExpenses}{TotalEmployees}$;

$LN\left(\frac{IE}{FF}\right)_{i,t-1}$, the natural logarithm of the unit cost of funds lagged one period, $\frac{InterestExpenses}{FundableFunds}$;

$LN\left(\frac{CE}{FA}\right)_{i,t-1}$ the natural logarithm of the unit cost of fixed assets lagged one period, $\frac{CapitalExpenses}{FixedAssets}$ (Claessens and Laeven, 2004; Gelos and Roldos, 2004, p. 50 and Nathan and Neave, 2001, p. 580).
,

$\left(\frac{TC}{TA}\right)_{i,t}$ is the capital to total assets ratio; $\left(\frac{CL}{CD}\right)_{i,t}$ is the loans to deposits ratio; and $LN(BR_{i,t})$ is the natural logarithm of the number of branches.

Based upon the disequilibrium approach the H-statistic that is used to determine the degree of competition is calculated from **(1)** using:

$$H = \frac{\delta_1 + \delta_2 + \delta_3}{1 - \delta_7} \qquad \textbf{(2)}$$

From equation **(2)**, if H ≤ 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.[5]

4.2. Models with and without assets

Many previous empirical studies include among the controls the log of total 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 ($TA_{i,t}$), that is: $LN\left(\frac{REV}{TA}\right)_{i,t}$ and $LN\left(\frac{INT}{TA}\right)_{i,t}$. 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,

[5] Bikker et al. (2012) discussed the problems associated with interpreting H according to these rules. However, they concluded that an appropriately specified revenue equation can be used to test the degree of market power using the sign of H. Spierdijk and Shaffer (2015) demonstrated that H > 0 is not inconsistent with substantial market power as the traditional interpretation suggested and cautioned over such an interpretation of the H-statistic. However, our results show that $H \leq 0$ and is therefore not in the H > 0 category.

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 (δ_1, δ_2, δ_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 are $LN(REV_{i,t})$ and $LN(INT_{i,t})$ instead of $LN\left(\frac{REV}{TA}\right)_{i,t}$ and $LN\left(\frac{INT}{TA}\right)_{i,t}$, respectively. Further, $LN(TA_{i,t})$ is not included on the right hand side of our models following Goddard and Wilson (2009) and Bikker et al. (2012).[6]

4.3. 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. 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). One means of assessing whether or not one or more of the input prices (LN(IE/FF), LN(PE/TE) and LN(CE/FA)) suffers from endogeneity is to compare regressions using current input prices with those including lagged input prices - see Shaffer (2004) and Goddard and Wilson (2009). Large differences in the estimated coefficients (and therefore H-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. Results summarised in Table 7 generally indicate large differences in the coefficients on current and lagged input prices and therefore H-statistics. We, therefore, focus on the models employing lagged input prices in Tables 3 – 6 in order to ensure valid inference.

4.4. Estimation

Econometric problems may arise from estimating equation **(1)** using panel data. These include the process being dynamic, with current realisations of the dependent variable being influenced by its past values, and that the idiosyncratic disturbances may have individual-specific patterns of

[6] In Table 7 we summarise the results for models that both include and exclude assets for comparison purposes.

heteroscedasticity and serial correlation. To address these issues a GMM estimator, such as that introduced by Arellano and Bond (1991) and those discussed by Roodman (2009), may be used. The difference and system GMM estimators can be applied using either the one-step method (with robust coefficient standard errors) or the two-step method (with Windmeijer, 2005, small sample corrected coefficient standard errors).[7]

We consider both the one-step GMM estimator (with robust coefficient standard errors) and the two-step GMM estimator. A downward bias afflicts the standard errors calculated by the two-step method, however, using Windmeijer (2005) corrected standard errors with two-step GMM greatly reduces this problem with biased coefficient standard errors.[8] A feasible approximation of Windmeijer's small sample correction for two-step GMM's coefficient standard errors has been shown to perform well in simulations (Roodman, 2009).

The following properties of standard estimators applied to a dynamic model (incorporating a lagged dependent variable) that should include cross-sectional fixed-effects will guide the evaluation of our estimated models. The (pooled) OLS estimator (without fixed-effects) will suffer from dynamic panel bias and will be inconsistent for small T (the number of time periods) in the sense that increasing N (the number of cross-sectional units) will not make the estimator consistent.[9] The coefficient on the lagged dependent variable will be biased upwards if pooled OLS is applied to a dynamic model without accounting for fixed-effects in finite samples. The fixed-effects estimator will also suffer from dynamic

[7] The efficient GMM estimator is equivalent to two-stage least squares (2SLS) when the residuals are homoscedastic (with no autocorrelation or cross-correlation). If the residuals do not satisfy these assumptions then using some initial consistent estimate of the residuals' variance-covariance matrix (allowing for heteroscedasticity, for example) in the GMM estimator yields the one-step GMM estimator. This coefficient estimator will be asymptotically efficient and consistent as long as the initial estimates of the coefficients are consistent (even when the number of time-series observations is small). Coefficient standard errors will not be robust to autocorrelation and heteroscedasticity however, by using the variance-covariance matrix based upon the one-step estimator's residuals in the appropriate standard error formula, will yield robust standard errors. Using the residuals obtained from the one-step GMM estimator to construct a new variance-covariance matrix to be used with the GMM formula yields the two-step GMM estimator. The two-step coefficient estimator is asymptotically efficient and robust to whatever heteroscedasticity, autocorrelation and cross-correlation that is modelled by the new variance-covariance matrix. Hence, the two-step estimator should yield superior coefficient estimates relative to the one-step estimator.

[8] This arises when the number of instruments is large and can render the two-step estimator useless for inference. Thus, even though GMM will be more efficient than 2SLS asymptotically, when errors are non-spherical it may not be so in finite samples because reweighting the estimators using the estimated residual variance/covariance matrix may result in over fitting the sample (data mining) using GMM. That is, GMM may give too much weight to observations that fit the model and too little to observations that do not fit the model.

[9] Because it is assumed that T is small in panels with small T and large N consistency typically refers to what happens when N tends to infinity. When T is large dynamic models retain their consistency property, as occurs when using time-series models. Indeed, when T is large the bias and inconsistency will decline and so dynamic panel (endogeneity) bias will not be a major issue.

panel bias and inconsistency (as N tends to infinity) when T is small.[10] In contrast to pooled OLS, the coefficient on the lagged dependent variable will be biased downwards if the fixed-effects estimator is applied to a dynamic model in finite samples. Interestingly the bias of the pooled OLS and fixed-effects estimators work in opposite directions. We estimate our models with both estimators and use the estimated coefficient on the lagged dependent variable to provide a range within which one would normally expect the true coefficient to fall.[11]

In the application of GMM, Sargan and Hansen tests test whether the instruments are exogenous. If the residuals are homoscedastic and non-autocorrelated (spherical) the variance covariance matrix is essentially a scalar and the two tests are equivalent. However, if the residuals are not spherical the Sargan test is inconsistent and Hansen's J-statistic provides a superior test.[12] Further, both tests become weaker, in the sense that inference is biased towards accepting the null that the instruments are exogenous, as the number of instruments increases. As a guide, if the number of instruments exceeds the number of cross-sections (N) in the panel then there are arguably *far* too many instruments (Roodman, 2009). We report the number of instruments and ensure that this number does not exceed the number of cross-sectional units (banks).

In our application, we consider both difference and system GMM estimators using both the one-step (with robust standard errors) and two-step (with Windmeijer correction) procedures. By using robust standard errors we do not assume spherical disturbances and so the Hansen test is our favoured method for assessing the validity of instruments. The criteria that we require for a model to be valid are:

- The coefficient on the lagged dependent variable estimated by GMM (denoted L1 in the tables) must fall in the range of the lagged dependent variable's coefficient estimated by Ordinary least squares (L1 OLS) and by the fixed-effects estimator (L1 FE).
- There is no second-order autocorrelation, denoted AR(2), or evidence of invalid instruments, denoted Hansen (these tests' probability values should be higher than 0.05).

[10] Similar to pooled OLS, as T increases the bias and inconsistency of the fixed-effects estimator disappears. However, Roodman (2009) noted that even when T = 30 substantial bias (20%) can still remain in the estimator.
[11] We do this in our analysis because T is small so both OLS and fixed-effects estimators are expected to be biased.
[12] Arellano and Bond (1991) showed that the one-step (two-step) Sargan test over- (under-) rejects the null of valid instruments in the presence of heteroscedasticity. Hence, if heteroscedasticity is present the Sargan test applied with the one-step (two-step) estimator may indicate the invalidity (validity) of instruments when the instruments are truly valid (invalid).

- The number of instruments is smaller than the number of cross-sectional units. In all of our reported models, this criterion is satisfied.
- The H-statistics should be sufficiently well determined, in the sense that they are not insignificantly different from both zero and one, to be usefully informative on the hypothesis of interest.

If more than one model satisfies these criteria we choose our favoured specification for inference as follows:

- If the test of the null hypothesis that there are no period fixed-effects (H_0 period FE) is rejected at the 5% level we favour the model including period dummy variables. Otherwise, we prefer the one without period dummies.
- We prefer the model with the smallest coefficient standard error on the lagged dependent variable as recommended by Roodman (2009).

We note that the coefficient on the lagged dependent variable is significant in all of our reported models which justifies our application of GMM using a dynamic specification.

4.4. Data

In this paper, annual individual balance sheets and income statements of 48 Vietnamese commercial banks from 1999 to 2009 have been collected from the SBV, 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.[13]

5. Empirical results

[13] 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.

Table 3 reports the estimated revenue equations and associated H-statistics for the Vietnamese banking system over the full sample period of 1999 to 2009.[14] We use the 'system' and 'difference' estimators with both 'one-step' and 'two-step' procedures. In the table, 1S (2S) denotes the one (two) step system estimator and 1D (2D) indicates the one (two) step difference estimator. The time dummy variables from D1999 to D2009 are added to explicitly incorporate period fixed-effects in addition to accounting for (eliminating) cross-sectional fixed-effects in the model.[15] The rows labelled instruments and groups give the number of instruments and cross-sectional units respectively – in all cases the number of instruments is below the number of cross-sectional units. The Arellano and Bond test for second-order autocorrelation (AR(2)) and Hansen's test for instrument validity (Hansen) are also presented in the table.[16] 'H_0 period FE' denotes the F-test of the null hypothesis that all included period fixed-effects dummy variables are jointly redundant. All of the F-tests (in all tables) reject the exclusion of the period fixed-effects suggesting that period dummy variables should be kept in the models and so the '2-way-FE' specifications are appropriate. The rows labelled L1 OLS and L1 FE give the coefficients on the first lagged dependent variable based on the Ordinary Least Squares and fixed-effects estimates of **(1)**, respectively. The H-statistics are reported in the row labelled "H-statistics" along with two t-tests of the hypotheses that the H-statistic is significantly different from both zero (H=0) and one (H=1), respectively.[17] We also report the Wald test of whether the model has significant explanatory power (denoted "Wald test") and the number of observations (Obs.) at the bottom of the table.

The models estimated using 'LN(REV)' as the dependent variable are reported in columns 2 to 5 of Table 3. The Hansen tests of the 'difference' estimators (both being 0.048) show that the instruments are invalid. Furthermore, the coefficient on the lagged dependent variable of the model using the two-step system estimator (0.6926) lies outside the range of this variable's coefficient estimated by OLS (0.8256) and FE (0.7168). Thus, this model is also considered invalid. However, the model estimated

[14] We also summarise the full sample (1999-2009) results in Table 7 as follows: (1) with assets and current input prices; (2) with assets and lagged input prices and (3) without assets and with current input prices. Further, the results of the models estimated over the sub-samples (1999–2003; 2004–2009; five state owned commercial banks and 43 non-state owned commercial banks) using current and lagged input prices both with and without assets are also presented in Table 7.

[15] For all models reported in Table 3 (Tables 4 – 6) the two (one) dummies (dummy) D1999 and D2009 (D1999) are (is) automatically dropped by the Stata software due to collinearity.

[16] The Hansen test has a null hypothesis of "the instruments as a group are exogenous". The Arellano – Bond test for autocorrelation has a null hypothesis of no autocorrelation and is applied to the differenced residuals. The test for AR(2) in first differences is important because it will detect autocorrelation in levels. These models are regarded as valid when these tests' p-values are higher than 0.05.

[17] To estimate t-statistics that test whether the H-statistics are statistically different from to zero or one, we need to calculate the coefficients in static long-run equilibrium and their standard errors. The standard error for this t-test is calculated using the formula given in De Boef and Keele (2008).

using the one-step system estimator is valid according to all of our criteria. Hence, we use the model based on the one-step system estimator for inference. The H-statistic (being -1.28) is significantly different from one if not significantly different from zero (and is therefore regarded as well determined). This suggests that the Vietnamese banking system was in monopoly between 1999 and 2009 when LN(REV) is the dependent variable.

As for the other variables' coefficients in this favoured model using LN(REV), the logarithmic interest expense per total funds (LN(IE/FF)) has a negative and significant coefficient while personal expense per person (LN(PE/TE) and capital expense per fixed asset (LN(CE/FA)) have insignificant coefficients. The number of branches (LN(BR)) has a positive and significant coefficient while all other variables are insignificant.

The models using LN(INT) as the dependent variable are reported in columns 6 to 9 of Table 3. The coefficient on the lagged dependent variable based on the one-step difference estimator is 0.8525 which is outside of the range of the corresponding variable's coefficient estimated by OLS (0.8420) and FE (0.7642). However, the models using the 'system' and two-step difference estimators are valid for inference according to all of our criteria except that their H-statistics (ranging from -3.86 to -2.86) are not significantly different from both zero and one. Hence, these H-statistics are poorly determined and are arguably uninformative. We therefore use a general-to-specific (GSM) type procedure to eliminate redundant time period dummy variables in all of the models to find valid specifications with well determined H-statistics. Our procedure is loosely based upon the GSM in that we consider the models by sequentially deleting dummies based upon their degree of statistical insignificance.

Tables 4 and 5 report the estimated revenue equations and associated H-statistics when LN(INT) is the dependent variable after employing the GSM-type procedure to eliminate insignificant time dummy variables. The results of the models based on the one-step system estimator are presented in Table 4. We eliminate time dummy variables with t-ratios below one in absolute value (D2006 and D2009) and report the resulting models in columns 2 (excluding D2009), 3 (excluding D2006) and 4 (excluding D2006 and D2009).[18] These models are valid according to all of the criteria we employ except that the

[18] The row denoted "H_0 redundant period dummies" reports the joint test for the exclusion of the time dummy variables from the models.

H-statistics are not significantly different from both zero and one and so these results remain uninformative for inference.[19]

The specifications using the two-step difference estimator with LN(INT) as the dependent variable is reported in Table 5. We exclude time dummy variables with t-statistics below 0.8 in magnitude (being D2007 and D2009) and report the results in columns 2 (excluding D2009), 3 (excluding D2007) and 4 (excluding D2007 and D2009). These models are valid according to all of our criteria except for the H-statistics being insignificantly different from both zero and one in all three cases and so these results are considered imprecisely estimated and uninformative.

In the specification using the two-step system estimator we exclude time dummy variables with t-ratios less than one in absolute value, being D2006 and D2009, and report the models in columns 5 (excluding D2009), 6 (excluding D2006) and 7 (excluding D2006 and D2009) of Table 5. These three models are valid according to all of our criteria except the models reported in column 5 and 6 feature uninformative and imprecisely estimated H-statistics that are insignificantly different from both zero and one. However, the H-statistic of the model that excludes both D2006 and D2009, reported in column 7, is precisely estimated in the sense that it is not insignificantly different from both zero and one. Overall, we favour this model for inference when LN(INT) is the dependent variable because it is the only valid model that is sufficiently precisely estimated to be informative. The H-statistic (being -2.61) is not significantly different from zero if it is significantly different from one. This indicates that the Vietnamese banking system operated in monopoly during the period 1999 to 2009 when LN(INT) is the dependent variable. As for the other variables, the logarithmic price cost of funds (LN(IE/FF)) is negative and significant. The logarithmic costs of labour (LN(PE/TE)) and fixed assets (LN(CE/FA)) are insignificant. All other control variables are generally insignificant except for the number of branches (LN(BR)) which is positive and significant.

For comparison purposes and consistency we also apply the GSM-type procedure to specifications where LN(REV) is the dependent variable. Table 6 reports these models based on the one-step system

[19] No specifications using the one-step difference estimator that exclude time dummy variables that are valid for inference could be found. In particular, all of the coefficients on the first lagged dependent variables (available from the authors on request) fall outside of the ranges of the corresponding variable's coefficients estimated by OLS and FE and so all of these models are regarded as invalid.

estimator.[20] We exclude time dummy variables with t-ratios less than one in magnitude (being D2006 and D2009) and present the resulting models in columns 2 (excluding D2009), 3 (excluding D2006) and 4 (excluding D2006 and D2009) of Table 6. These models are valid according to all of our criteria. The H-statistics of these three models are not significantly different from zero, although they are all significantly different from one (so are precisely estimated). We prefer the model reported in column 4 (excluding D2006 and D2009) of Table 6 because it has the lowest standard error for the dependent variable of all the models (being 0.075). The H-statistic is -1.36 which is not significantly different from zero if it is significantly different from one. This confirms the inference drawn from the results reported in Table 3 that the Vietnamese banking system was in monopoly between 1999 and 2009. As for the other variables, the logarithmic price cost of fund (LN(IE/FF)) is negative and significant. The logarithmic costs of labour (LN(PE/TE)) and fixed assets (LN(CE/FA)) are insignificant. All of the other control variables are insignificant except for the number of branches (LN(BR)) which is positive and significant.

In summary, the favoured models from our full sample results give an H-statistic that is -1.36 when LN(REV) is the dependent variable and -2.61 in the model where LN(INT) is the regressand. Thus, we can conclude that the Vietnamese banking system was monopolistic between 1999 and 2009.

Table 7 presents a summary of further results obtained from the non-structural model using the disequilibrium approach (full results are available from the authors on request).[21] The results are for models using, alternatively, current and lagged input prices both with and without assets included. Results are summarised for the full sample, the following sub-samples through time: 1999-2003 and 2004-2009; and the following sub-samples by bank type: the five state owned commercial banks and the 43 non-state owned commercial banks.

We apply the GSM-type procedure to the time period dummy variables in each model in an attempt to secure valid specifications and H-statistics. We report the favoured model in each case as that with the

[20] No specifications that are valid for inference with LN(REV) as the regressand that use the 'two-step' estimators and one-step difference estimator excluding time dummy variables (following the GSM-type procedure) could be found. In particular, all of the coefficients on the first lagged dependent variables (0.6926, 0.722, 0.9245, 0.8406 and 0.9236), available from the authors on request, fall outside of the ranges of the corresponding variable's coefficients estimated by OLS and FE and so all of these models are regarded as invalid.

[21] We also experiment to find valid specifications (and H-statistics) by excluding insignificant control variables (TC/TA, CL/CD and LN(BR)); treating input prices (LN(PE/TE), LN(IE/FF) and LN(CE/FA)) as endogenous variables and lastly excluding insignificant input prices. However, these experiment did not improve the results.

smallest coefficient standard error on the dependent variable in models that are valid for inference (according to the criteria discussed above) and well determined (in the sense that H-statistics are not insignificantly different from both zero and one). The models using current input prices and including assets suggest for the full sample and sub-samples that the Vietnamese banking system is in monopolistic competition. The removal of total assets from these models transforms our inference to suggest that the market is not significantly different from perfect competition except for the sub-sample for state owned commercial banks, which suggests monopolistic competition (if it is not significantly different from being monopolistic). In the models using lagged input prices and including assets for the full sample with LN(REV/TA) as the dependent variable and for most samples when LN(INT/TA) was the regressand valid specifications and H-statistics could not be found. In the sub-samples where valid results are available (these are the only ones reported) they generally suggest that the Vietnamese banking system operates in monopolistic competition (if it is close to monopoly). When assets are excluded from the models, our inference indicates monopoly for all samples. The substantial difference in the estimated coefficients (as reflected in the H-statistics) between the models with current and lagged input prices suggests endogeneity of current input prices. Hence we prefer the models using lagged input prices for inference. Further, the substantial difference in inference obtained from the models that include assets and those that exclude assets confirms the need to appropriately specify the revenue equations to exclude assets. Hence, in our analysis of sub-samples we favour the results that include lagged input prices (to avoid endogeneity) and exclude assets (to avoid bias), reported in the last two columns of Table 7. The results for all of these (sub) samples confirms that the Vietnamese banking system operated under monopoly and that there is no significant change through time or in comparing state owned and non-state owned banks.

Matousek et al. (2013) used the fixed-effects estimator that does not allow for dynamics in the model (the equilibrium approach) and reported H-statistics (being 0.45 and 0.43) for the full sample period 1999 – 2009 that indicate monopolistic competition. This contrasts with our H-statistics that suggest a highly monopolistic market (-1.36 and -2.61) based upon the disequilibrium approach that does allow for dynamic effects.[22] As we mentioned earlier, the GMM estimator is preferred for inference if the coefficient on the lagged dependent variable is significantly different from zero otherwise the fixed-

[22] The H-statistics are generally higher for models where revenue is the dependent variable in our favoured models. The H-statistics for the full sample of data is -1.36 for the model when LN(REV) is the dependent variable and -2.61 when LN(INT) is the regressand. Therefore the market is more competitive when based on revenue. This is consistent with the results from the equilibrium approach (Matousek et al., 2013) and our expectation.

effects estimator (used in the equilibrium approach) should be used for inference (Roodman, 2009). The disequilibrium approach is preferred for inference in the Vietnamese banking system as the t-ratios on the lagged dependent variables are statistically significant in our favoured models. Hence, the Vietnamese banking system behaved as if in monopoly from 1999 to 2009.

That the Vietnamese banking system was in monopoly from 1999 to 2009 is consistent with Nguyen and Stewart (2013) and our expectation. Nguyen and Stewart (2013) found that only a few banks in Vietnam (most of them are SOCBs) still dominate the banking system. Although the concentration ratio decreased from 1999 to 2009 it still represented a high proportion of the total system in 2009 (the 5-bank-concentration ratios for loans, assets and deposits were, respectively, 0.64, 0.57 and 0.60 in 2009). While small banks may have performed better in the 2000s they still found it difficult to compete against the large and very large banks in the system in 2009. That all of these different assessments of the degree of competition are consistent in suggesting that the Vietnamese system operated under monopoly during the 1999 – 2009 period provides a robustness that makes this inference convincing. This should help reduce any concerns that there are exceptions to the standard interpretation of the Panzar-Rosse H-statistic that can call in to question inferences based upon it - see Spierdijk and Shaffer (2015) who derived these for the case when H > 0 (whereas our results suggest $H \leq 0$).

6. Conclusion

We are the first to employ the non-structural model – disequilibrium approach (Goddard and Wilson, 2009) to examine the Vietnamese banking system. This study also extends the previous literature by considering environmental factors such as capital/assets, loans/deposits and the number of branches which have not been employed in previous studies of Vietnam. Further, we employ the two different dependent variables: revenue divided by total assets (REV/TA) and interest income divided by total assets (INT/TA). This is also the first study that properly specifies the revenue equation by excluding assets (to avoid bias) and including lagged input prices (to avoid endogeneity) in a study of the Vietnamese banking system's competitiveness. In addition, we consider the 'system' and 'difference' GMM estimators with both 'one-step' and 'two-step' specifications based on Arellano and Bond (1991) and Blundell and Bond (1998). Whilst the inclusion of time period dummy variables is supported by the data their presence for all periods, in addition to economic covariates, can undermine the precision of coefficient estimates. Hence, in the spirit of the general-to-specific method we remove the most redundant time period dummy variables in an attempt to improve the efficiency of estimation and obtain well determined H-statistics. Results are analysed for the full sample and 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). Our results use a larger sample both in terms of the number of banks and number of time periods compared to any previous analysis of the Vietnamese banking system.

Our empirical results show that the disequilibrium approach is more appropriate than the equilibrium approach for inference due to the significance of the lagged dependent variable in our models. The H-statistics from our favoured specifications for the full sample and all sub-samples are negative and insignificantly different from zero if they are significantly different from one. This indicates that the Vietnamese banking system was monopolistic between 1999 and 2009. As for the input prices, the unit cost of funds (LN(IE/FF)) is generally negative and significant, which suggest that the unit cost of funds has the most direct impact on revenue and interest income. The unit price of labour (LN(PE/TE)) and unit cost of fixed assets (LN(CE/FA)) are generally insignificant. The number of branches (LN(BR)) is positive and significant in all the models except for the sub-sample for state owned commercial banks suggesting that banks that open more branches increase their revenue and interest income. The other control variables are generally insignificant.

A number of policy implications arise out of this paper. Given our finding that the Vietnamese banking system is monopolistic the State Bank of Vietnam (SBV) should have policies for restructuring the system and promoting competition in the banking sector of Vietnam. This also aligns with recent policies from the SBV to promote mergers and acquisitions, increasing the financial autonomy of banks.[23] The SBV targeted 6 to 7 mergers and acquisitions in the banking sector in 2014, and a 50% reduction in the number of commercial banks in the period of 2015-2017 (WB, 2014). As large and very large banks are more efficient than small and medium-sized banks (Stewart et al., 2016), the SBV had encouraged big banks such as Bank for Foreign Trade of Vietnam, Bank for Investment and Development of Vietnam or Vietnam Bank for Industry and Trade to merge with smaller banks. This is

[23] In 2011, Saigon Thuong Tin Commercial Bank, Tin Nghia Commercial Bank and First Commercial Bank merged resulting in positive performance. Habubank was approved to merge with Saigon Hanoi Commercial Bank in 2012 while Hanoi Building Commercial Bank also teamed up with Great Asia Commercial Bank in 2013.

not only to increase their size and promote economies of scale it is also to "support" each other in development. All weak banks with little recovery prospects will be drastically restructured even if it means dissolution, bankruptcy or other strong interventions (SBV, 2014).

Our results also indicate that banks that open more branches enjoy increased revenue and interest income except for state owned commercial banks. Hence, the SBV should have policies to enhance the development of non-state owned commercial banks (also see Stewart et al., 2016). The recent restructuring plan allows the SBV to intervene in weak credit institutions, leading to the quick and thorough handling of these credit institutions. The SBV also focuses on non-performing loans of state owned commercial banks with various measures, including deciding the real estate market, solving inventories for enterprises and promoting the restructuring of state enterprises (SBV, 2014).[24]

The results suggest that banks are less monopolistic when revenue is used as the dependent variable than when interest income is. Sources of revenue might be securities, credit cards, derivative products, etc while sources of interest income are almost entirely from customer loans. With lending limited, banks have used a variety or principles to allocate credit. Some have been allocated through personal relationships, some through political connections, and some by price-gauging (Maddock, 2015). We believe that this suggests that the SBV should introduce more regulations and policies to enhance competition in terms of customer loans.

We argue that the tightening monetary policies that started in 2008 still have a large impact on the banking system in terms of compulsory reserves, loans and deposits. Macroeconomic policies from the SBV should be used simultaneously and reasonably to meet the high demand of loans from the public and to control increased inflation due to a rapid increase in credit growth. The transition Vietnam is undertaking is complex. The role of the state is changing and so is the use of markets in the evolution of the society. Some combination of pushing ahead with underlying reforms while allowing growth to resolve some of the issues may be the appropriate path (Maddock, 2015).

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[24] In July 2013, the Vietnamese government established the Vietnam Asset Management Company to take bad loans off banks' balance sheets through the issuing of bonds to local lenders. In addition, on 21st January 2013, the government issued Circular No. 02/2013/TT-NHNN which took effect from 2015 to further alleviate the problems of non-performing loans (NPLs). This Circular aimed to implement a uniform standard on treatment of NPLs through the regulation of asset classifications, method of risk provision and the use of provisions to further improve risks of credit institutions.

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Table 1 The number of commercial banks from 1990 to 2009[25]

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: SBV (2009).

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[26]	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: Financial statements of 48 Vietnamese commercial banks in the period of 1999-2009.

[25] Beside these commercial banks, there are also the Social Policy Bank and Vietnam Development Bank which are operating as non-profit institutions.
[26] We could not collect data of the North Asia Commercial Bank and Vinasiam Bank in 2009.

Table 3. GMM estimations for the full sample

	LN(REV)				LN(INT)			
	2S	2D	1S	1D	2S	2D	1S	1D
L1 LN(REV)	0.6926***	0.745***	0.7498***	0.8408***				
	(8.723)	(6.541)	(9.705)	(10.12)				
		{0.077}						
L1 LN(INT)					0.7965***	0.8068***	0.8274***	0.8525***
					(9.309)	(6.419)	(8.215)	(9.393)
					{0.0855}	{0.1257}	{0.1007}	
L1 LN(PE/TE)	0.0027	-0.3431	-0.0755	-0.3613*	-0.1494	-0.3526**	-0.1709	-0.3743***
	(0.0173)	(-1.367)	(-0.5435)	(-1.931)	(-1.311)	(-2.143)	(-1.201)	(-2.936)
L1 LN(IE/FF)	-0.2195*	-0.2657**	-0.2404***	-0.3339***	-0.345***	-0.3986***	-0.3327***	-0.4546***
	(-1.774)	(-2.298)	(-3.077)	(-4.073)	(-3.416)	(-3.134)	(-3.651)	(-4.095)
L1 LN(CE/FA)	-0.0218	0.0062	-0.005	0.0255	-0.035	0.0048	-0.0114	0.0481
	(-0.4818)	(0.1125)	(-0.146)	(0.527)	(-0.8346)	(0.0819)	(-0.3096)	(0.8576)
TC/TA	-0.2358	-0.5964	-0.1286	-0.2875	-0.0617	-0.2281	-0.03	-0.1817
	(-0.8641)	(-0.804)	(-0.6753)	(-0.6897)	(-0.2982)	(-0.615)	(-0.1454)	(-0.4959)
CL/CD	-0.0403	0.004	-0.0338	-0.0139	0.0025	0.004	-0.0061	-0.0116
	(-0.9068)	(0.0519)	(-0.7207)	(-0.2238)	(0.0551)	(0.0491)	(-0.1262)	(-0.1811)
LN(BR)	0.2505***	0.1241	0.2069***	0.1246	0.1679**	0.1478	0.1441	0.1655
	(3.481)	(0.7777)	(2.890)	(1.170)	(2.289)	(1.079)	(1.620)	(1.501)
D1999								
D2000	-0.4299*	-0.9493*	-0.4267**	-0.737*	-0.504***	-0.8448**	-0.4894***	-0.7102**
	(-1.815)	(-1.868)	(-2.308)	(-1.735)	(-2.626)	(-2.049)	(-2.747)	(-2.089)
D2001	-0.4293**	-0.9305**	-0.4702***	-0.7412*	-0.6436***	-0.9159**	-0.6152***	-0.8325***
	(-2.002)	(-2.050)	(-3.066)	(-1.963)	(-4.072)	(-2.403)	(-4.141)	(-2.712)
D2002	-0.485**	-0.9387**	-0.5208***	-0.75**	-0.5962***	-0.8793**	-0.6185***	-0.7977***
	(-2.403)	(-2.254)	(-3.357)	(-2.15)	(-3.992)	(-2.553)	(-3.801)	(-2.882)
D2003	-0.2968*	-0.7392*	-0.3784***	-0.5744*	-0.3765***	-0.6197**	-0.375***	-0.536**
	(-1.698)	(-1.802)	(-2.925)	(-1.74)	(-3.076)	(-2.052)	(-3.649)	(-2.053)
D2004	-0.2909**	-0.6551*	-0.3509***	-0.5163*	-0.3677***	-0.5513**	-0.383***	-0.5145**
	(-1.964)	(-1.878)	(-3.162)	(-1.811)	(-3.443)	(-2.105)	(-3.882)	(-2.336)
D2005	-0.1001	-0.4527	-0.1669	-0.3172	-0.1718	-0.3454	-0.182*	-0.3048
	(-0.7626)	(-1.417)	(-1.595)	(-1.243)	(-1.629)	(-1.463)	(-1.942)	(-1.532)
D2006	0.0833	-0.2349	0.0285	-0.0894	-0.0053	-0.1681	-0.0097	-0.1129
	(0.8696)	(-0.9327)	(0.3349)	(-0.4489)	(-0.0672)	(-0.8762)	(-0.1313)	(-0.7148)
D2007	0.2738***	0.0571	0.2732***	0.1804	0.2082***	0.0879	0.2369***	0.1377
	(3.373)	(0.291)	(4.025)	(1.153)	(2.628)	(0.5309)	(3.643)	(1.054)
D2008	0.2785***	0.1706	0.1981***	0.1309	0.2688***	0.1953**	0.2222***	0.1441*
	(3.165)	(1.561)	(3.080)	(1.499)	(3.370)	(2.000)	(3.670)	(1.842)
D2009								
constant	2.956***		2.659***		2.076**		1.925**	
	(3.499)		(3.964)		(2.375)		(2.182)	
Instruments	34	24	34	24	34	24	34	24
Groups	46	44	46	44	46	44	46	44
AR(2)	0.721 Valid	0.846 Valid	0.715 Valid	0.914 Valid	0.894 Valid	0.974 Valid	0.757 Valid	0.934 Valid
Hansen	0.110 Valid	0.048 Invalid	0.110 Valid	0.048 Invalid	0.107 Valid	0.127 Valid	0.107 Valid	0.127 Valid
H_0 period FE	82.83***	103.09***	130.87***	123.17***	186.74***	129.76***	169.11***	149.80***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject
L1 OLS	0.8256	0.8256	0.8256	0.8256	0.8420	0.8420	0.8420	0.8420
L1 period FE	0.7168	0.7168	0.7168	0.7168	0.7642	0.7642	0.7642	0.7642
H-statistic			**-1.2825**		**-2.6010**	**-3.8623**	**-2.9842**	
H=0			-1.1217		-1.3888	-1.2154	-1.0133	
			Accept		Accept	Accept	Accept	
H=1			-2.000***		-1.9228	-1.5301	-1.3529	
			Reject		Accept	Accept	Accept	
Wald test	8647.12***	2272.69***	12389.79***	3786.45***	8320.55***	2154.35***	13839.51***	3386.83***
Obs.	327	280	327	280	327	280	327	280

*Note: Coefficients, t-statistics (round brackets), standard errors (braces) and probabilities (square brackets) are reported in the table; *** indicates significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Sources: Financial statements of 48 Vietnamese commercial banks from 1999 to 2009; 2S denotes the two-step system estimator; 2D the two-step difference estimator; 1S the one-step system estimator; 1D the one-step difference estimator. Sources: Financial statements of 48 Vietnamese commercial banks in the period of 1999-2009.*

Table 4. GMM estimations for the full sample (LN(INT), one-step system estimator)

	1S		
L1 LN(INT)	0.8274***	0.8274***	0.8261***
	(8.215)	(8.215)	(8.454)
	{0.1007}	{0.1007}	{0.0977}
L1 LN(PE/TE)	-0.1709	-0.1709	-0.1668
	(-1.201)	(-1.201)	(-1.343)
L1 LN(IE/FF)	-0.3327***	-0.3327***	-0.33***
	(-3.651)	(-3.651)	(-3.889)
L1 LN(CE/FA)	-0.0114	-0.0114	-0.0115
	(-0.3096)	(-0.3096)	(-0.3131)
TC/TA	-0.030	-0.030	-0.0325
	(-0.1454)	(-0.1454)	(-0.1591)
CL/CD	-0.0061	-0.0061	-0.0062
	(-0.1262)	(-0.1262)	(-0.1289)
LN(BR)	0.1441	0.1441	0.1456*
	(1.620)	(1.620)	(1.705)
D1999			
D2000	-0.4894***	-0.4797***	-0.4793***
	(-2.747)	(-3.456)	(-3.422)
D2001	-0.6152***	-0.6056***	-0.6056***
	(-4.141)	(-5.309)	(-5.235)
D2002	-0.6185***	-0.6089***	-0.6094***
	(-3.801)	(-5.015)	(-4.879)
D2003	-0.375***	-0.3653***	-0.3661***
	(-3.649)	(-6.165)	(-5.800)
D2004	-0.383***	-0.3733***	-0.3748***
	(-3.882)	(-6.581)	(-6.116)
D2005	-0.182*	-0.1723***	-0.1738***
	(-1.942)	(-3.637)	(-3.150)
D2006	-0.0097		
	(-0.1313)		
D2007	0.2369***	0.2466***	0.2437***
	(3.643)	(4.065)	(4.750)
D2008	0.2222***	0.2318***	0.2277***
	(3.670)	(4.386)	(5.313)
D2009		0.0097	
		(0.1313)	
constant	1.925**	1.916**	1.923**
	(2.182)	(2.163)	(2.180)
H_0 redundant		0.020	0.020
period		[0.8956]	[0.8956]
dummies	--	Accept	Accept
Instruments	34	34	33
Groups	46	46	46
AR(2)	0.757 Valid	0.757 Valid	0.752 Valid
Hansen	0.107 Valid	0.107 Valid	0.111 Valid
H_0 period FE	169.11***	169.11***	152.89***
	[0.0000]	[0.0000]	[0.0000]
	Reject	Reject	Reject
L1 OLS	0.8420	0.8420	0.8443
L1 period FE	0.7642	0.7642	0.7650
H-statistic	**-2.9842**	**-2.9842**	**-2.9227**
H=0	-1.0133	-1.0133	-1.0779
	Accept	Accept	Accept
H=1	-1.3529	-1.3529	-1.4468
	Accept	Accept	Accept
Wald test	13839.51	13839.51	13164.57
Obs.	327	327	327

See notes to Table 3.

Table 5. GMM estimations for the full sample (LN(INT), 'two-step' estimators)

	2D			2S		
L1 LN(INT)	0.8068***	0.8068***	0.7724***	0.7965***	0.7965***	0.7983***
	(6.419)	(6.419)	(6.239)	(9.309)	(9.309)	(9.156)
	{0.1257}	{0.1257}	{0.1238}	{0.0855}	{0.0855}	{0.0872}
L1 LN(PE/TE)	-0.3526**	-0.3526	-0.381**	-0.1494	-0.1494	-0.145
	(-2.143)	(-2.143)	(-2.23)	(-1.311)	(-1.311)	(-1.566)
L1 LN(IE/FF)	-0.3986***	-0.3986***	-0.3874**	-0.345***	-0.345***	-0.3457***
	(-3.134)	(-3.134)	(-2.421)	(-3.416)	(-3.416)	(-3.799)
L1 LN(CE/FA)	0.0048	0.0048	0.0226	-0.035	-0.035	-0.0362
	(0.0819)	(0.0819)	(0.4465)	(-0.8346)	(-0.8346)	(-0.8774)
TC/TA	-0.2281	-0.2281	-0.367	-0.0617	-0.0617	-0.0582
	(-0.615)	(-0.615)	(-0.8333)	(-0.2982)	(-0.2982)	(-0.2708)
CL/CD	0.004	0.004	-0.0234	0.0025	0.0025	0.005
	(0.0491)	(0.0491)	(-0.2965)	(0.0551)	(0.0551)	(0.1085)
LN(TA)						
LN(BR)	0.1478	0.1478	0.1406	0.1679**	0.1679**	0.1664**
	(1.079)	(1.079)	(0.9329)	(2.289)	(2.289)	(2.222)
D1999						
D2000	-0.8448**	-0.9328***	-1.017***	-0.504***	-0.4987***	-0.492***
	(-2.049)	(-3.481)	(-6.061)	(-2.626)	(-3.401)	(-3.533)
D2001	-0.9159**	-1.004***	-1.074***	-0.6436***	-0.6383***	-0.6335***
	(-2.403)	(-4.110)	(-6.267)	(-4.072)	(-5.241)	(-5.283)
D2002	-0.8793**	-0.9672***	-1.024***	-0.5962***	-0.591***	-0.5888***
	(-2.553)	(-4.846)	(-7.956)	(-3.992)	(-6.007)	(-6.379)
D2003	-0.6197**	-0.7077***	-0.7565***	-0.3765***	-0.3713***	-0.3672***
	(-2.052)	(-4.356)	(-6.317)	(-3.076)	(-4.467)	(-4.305)
D2004	-0.5513**	-0.6393***	-0.6768***	-0.3677***	-0.3625***	-0.3604***
	(-2.105)	(-5.002)	(-6.433)	(-3.443)	(-5.432)	(-5.264)
D2005	-0.3454	-0.4334***	-0.457***	-0.1718	-0.1665***	-0.1642***
	(-1.463)	(-4.663)	(-6.591)	(-1.629)	(-2.901)	(-2.768)
D2006	-0.1681	-0.2561***	-0.258***	-0.0053		
	(-0.8762)	(-4.556)	(-4.988)	(-0.0672)		
D2007	0.0879			0.2082***	0.2135***	0.2158***
	(0.5309)			(2.628)	(3.955)	(4.213)
D2008	0.1953**	0.1074	0.1613**	0.2688***	0.2741***	0.2723***
	(2.000)	(0.8954)	(2.156)	(3.370)	(4.510)	(4.853)
D2009		-0.0879			0.0053	
		(-0.5309)			(0.0672)	
constant				2.076**	2.071**	2.027**
				(2.375)	(2.389)	(2.271)
H_0 redundant		0.28	0.0000		0.0000	0.0000
period		[0.5955]	[0.9464]		[0.9464]	[0.9464]
dummies	--	Accept	Accept	--	Accept	Accept
Instruments	24	24	23	34	34	33
Groups	44	44	44	46	46	46
AR(2)	0.974 Valid	0.974 Valid	0.872 Valid	0.894 Valid	0.894 Valid	0.884 Valid
Hansen	0.127 Valid	0.127 Valid	0.115 Valid	0.107 Valid	0.107 Valid	0.111 Valid
H_0 period FE	129.76***	129.76***	107.61***	186.74***	186.74***	158.88***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	Reject	Reject	Reject	Reject	Reject	Reject
L1 OLS	0.8420	0.8420	0.8461	0.8420	0.8420	0.8443
L1 period FE	0.7642	0.7642	0.7251	0.7642	0.7642	0.7651
H-statistic	**-3.8623**	**-3.8623**	**-3.2771**	**-2.6010**	**-2.6010**	**-2.6128**
H=0	-1.2154	-1.2154	-1.1731	-1.3888	-1.3888	-1.4554
	Accept	Accept	Accept	Accept	Accept	Accept
H=1	-1.5301	-1.5301	-1.5310	-1.9228	-1.9228	--2.0124***
	Accept	Accept	Accept	Accept	Accept	Reject
Wald test	2154.35	2154.35	1775.93	8320.55	8320.55	8168.67
Obs.	280	280	280	327	327	327

See notes to Table 3.

Table 6. GMM estimations for the full sample (LN(REV), one-step system estimator)

	1S		
L1 LN(REV)	0.7498***	0.7498***	0.7523***
	(9.705)	(9.705)	(9.967)
	{0.077}	{0.077}	{0.075}
L1 LN(PE/TE)	-0.0755	-0.0755	-0.0857
	(-0.5435)	(-0.5435)	(-0.7076)
L1 LN(IE/FF)	-0.2404***	-0.2404***	-0.2467***
	(-3.077)	(-3.077)	(-3.448)
L1 LN(CE/FA)	-0.005	-0.005	-0.0048
	(-0.146)	(-0.146)	(-0.1388)
TC/TA	-0.1286	-0.1286	-0.1261
	(-0.6753)	(-0.6753)	(-0.6586)
CL/CD	-0.0338	-0.0338	-0.0331
	(-0.7207)	(-0.7207)	(-0.7076)
LN(BR)	0.2069***	0.2069***	0.204***
	(2.89)	(2.89)	(2.957)
D1999			
D2000	-0.4267**	-0.4553***	-0.4529***
	(-2.308)	(-3.338)	(-3.251)
D2001	-0.4702***	-0.4987***	-0.4953***
	(-3.066)	(-4.713)	(-4.553)
D2002	-0.5208***	-0.5493***	-0.5451***
	(-3.357)	(-4.943)	(-4.774)
D2003	-0.3784***	-0.4069***	-0.402***
	(-2.925)	(-5.338)	(-4.924)
D2004	-0.3509***	-0.3795***	-0.3725***
	(-3.162)	(-6.500)	(-5.75)
D2005	-0.1669	-0.1955***	-0.187***
	(-1.595)	(-3.659)	(-3.073)
D2006	0.0285		
	(0.3349)		
D2007	0.2732***	0.2447***	0.257***
	(4.025)	(3.515)	(4.644)
D2008	0.1981***	0.1696**	0.1829***
	(3.080)	(2.475)	(3.559)
D2009		-0.0285	
		(-0.3349)	
constant	2.659***	2.687***	2.675***
	(3.964)	(4.049)	(4.006)
H_0 redundant		0.11	0.11
period dummies		[0.7377]	[0.7377]
	--	Accept	Accept
Instruments	34	34	33
Groups	46	46	46
AR(2)	0.715 Valid	0.715 Valid	0.744 Valid
Hansen	0.110 Valid	0.110 Valid	0.081 Valid*
H_0 period FE	130.87***	130.87***	89.19***
	[0.0000]	[0.0000]	[0.0000]
	Reject	Reject	Reject
L1 OLS	0.8256	0.8256	0.8279
L1 period FE	0.7168	0.7168	0.7157
H-statistic	**-1.2825**	**-1.2825**	**-1.3613**
H=0	-1.1217	-1.1217	-1.2744
	Accept	Accept	Accept
H=1	-2.000***	-2.000***	-2.2106***
	Reject	Reject	Reject
Wald test	12389.79	12389.79	12340.62
Obs.	327	327	327

See notes to Table 3.

Table 7. Summary of results from the non-structural model (disequilibrium 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	Est.	1D	1D	1D	1S	N/A	N/A	1S	2S
1999-2009	L1	0.1679**	0.1572**	0.6178***	0.6135***			0.7523***	0.7983***
		(2.573)	(2.392)	(9.421)	(10.97)			(9.97)	(9.16)
		{0.0652}	{0.0657}	{0.0655}	{0.0559}			{0.075}	{0.0872}
	H-sta.	**0.8265**	**0.9449**	**1.0640**	**1.2725**			**-1.3613**	**-2.6128**
	H=0	4.1443***	6.8143***	3.7042***	5.0140***			-1.2744	-1.4554
		Reject	Reject	Reject	Reject			Accept	Accept
	H=1	-0.8698	-0.3972	0.2229	1.0737			-2.2106***	-2.0124***
		Accept	Accept	Accept	Accept			Reject	Reject
non-SOCBs	Est.	1D	1S	1S	1S	1S	N/A	1S	2S
1999-2009	L1	0.055	0.0821*	0.5791***	0.6093***	0.0454		0.7658***	0.7909***
		(0.7441)	(1.666)	(9.666)	(10.51)	(0.63)		(11.21)	(13.54)
		{0.0739}	{0.0492}	{0.0599}	{0.058}	{0.072}		{0.0683}	{0.058}
	H-sta.	**0.5471**	**0.6740**	**1.2902**	**1.4810**	**0.1145**		**-1.6834**	**-2.5720**
	H=0	3.0441***	8.6154***	6.1134***	5.4463***	1.3217		-1.3184	-1.7938
		Reject	Reject	Reject	Reject	Accept		Accept	Accept
	H=1	-2.5202***	-4.1676***	1.3750	1.7689	-10.219***		-2.1016***	-2.4912***
		Reject	Reject	Accept	Accept	Reject		Reject	Reject
SOCBs	Est.	2S	2D	1S	1S	2S	N/A	1S	2S
1999-2009	L1	0.0963	0.1819*	0.6066***	0.6207***	0.075		0.7545***	0.7957***
		(1.135)	(1.832)	(10.67)	(8.943)	(0.96)		(10.6)	(10.35)
		{0.0848}	{0.099}	{0.0568}	{0.0694}	{0.078}		{0.0711}	{0.077}
	H-sta.	**0.6125**	**0.4936**	**0.0868**	**0.2288**	**0.2866**		**-1.5271**	**-2.2966**
	H=0	4.3020***	2.1338***	0.2689	0.5936	3.3697***		-1.7739	-1.8146
		Reject	Reject	Accept	Accept	Reject		Accept	Accept
	H=1	-2.7217***	-2.1889***	-2.828***	-2.0006***	-8.3860***		-2.9355***	-2.6047***
		Reject	Reject	Reject	Reject	Reject		Reject	Reject
Sub-sample	Est.	1S	1S	2S	2S	2S	N/A	N/A	2S
1999-2003	L1	0.0185	0.0106	0.5845***	0.6000***	0.0315			0.7918***
		(0.1761)	(0.0589)	(8.94)	(8.39)	(0.42)			(14.94)
		{0.105}	{0.1331}	{0.0654}	{0.0715}	{0.075}			{0.053}
	H-sta.	**0.1539**	**0.4001**	**1.9898**	**2.5466**	**0.1378**			**-1.3478**
	H=0	1.1661	3.0838***	3.0198***	3.2122***	1.3475			-1.1735
		Accept	Reject	Reject	Reject	Accept			Accept
	H=1	-6.4120***	-4.6231***	1.5021	1.9508	-8.4281***			-2.0441***
		Reject	Reject	Accept	Accept	Reject			Reject
Sub-sample	Est.	2S	2S	1S	1S	2S	1S	2S	2S
2004-2009	L1	0.0385	-0.0494	0.5976***	0.6***	0.0315	-0.0076	0.7303***	0.7686***
		(0.7774)	(-1.634)	(10.21)	(10.25)	(0.42)	(-0.1075)	(11.06)	(13.49)
		{0.0495}	{0.030}	{0.0585}	{0.0586}	{0.075}	{0.0706}	{0.066}	{0.057}
	H-sta.	**0.6712**	**0.6600**	**0.6697**	**0.7812**	**0.1949**	**0.1941**	**-1.9988**	**-2.7293**
	H=0	9.8178***	9.7552***	2.1682***	2.6840***	2.1160***	3.3054***	-1.4462	-1.7821
		Reject	Reject	Reject	Reject	Reject	Reject	Accept	Accept
	H=1	-4.8092***	-5.0256***	-1.0692	0.7516	-8.7418***	-13.7224***	-2.1698***	-2.435***
		Reject	Reject	Accept	Accept	Reject	Reject	Reject	Reject

See note to Table 3.

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