Note on a non-structural model using the disequilibrium approach: Evidence from Vietnamese banks

Roman Matousek
Kent Business School, University of Kent

Thao Ngoc Nguyen[1]
Nottingham Business School, Nottingham Trent University

Chris Stewart
School of Behavioural and Social Sciences, Kingston University

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 classification: C23, G21, L22

[1] Corresponding author: Thao Ngoc Nguyen, Nottingham Business School, Nottingham Trent University, Burton street, Nottingham NG1 4BU, *Email:* thao.nguyen@ntu.ac.uk or nnthao2k6@yahoo.com, *Tel:* +44 (0) 11 5848 3878.

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 the 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 of bank competition in Vietnam. The main novelty of our study is the application of the non-structural model using the 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) is 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 enhances our 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 Southeast 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 from investing 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 in the country was that the weakly-developed financial market did not attract much foreign capital in the first place (Kokko, 1999, p. 84).

Nguyen and Stewart (2013) discussed the development of Vietnamese commercial banks between 1990 and 2009. They suggested that while the number of joint stock commercial banks increased rapidly after 1990, state owned commercial banks still dominate the market.[2] Non-state owned commercial banks include joint stock commercial banks, branches of foreign banks, joint venture commercial banks and

[2] 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.

foreign commercial banks.[3] 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 (SBV, 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.

In general, loans, assets, deposits and capital in the Vietnamese banking system increased gradually between 1999 and 2009. 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 (Nguyen and Stewart, 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 in 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 of 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 a monopoly. The empirical refutation of monopoly constitutes a rejection of the assumption that the

[3] 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, the H-statistic 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.[4] 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 (Goddard et al., 2001).

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 cartelization 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, 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

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

the Vietnamese banking system operates in monopolistic competition. Bikker et al. (2012) analysed bank structure in the world (with a panel of 63 countries including Vietnam) from 1994-2004 using a non-structural model within the disequilibrium approach. However, due to data constraints, they only investigated the individual banking structure of Vietnam using the equilibrium approach for the period 1994 to 2004 for 23 banks.[5] Hence, they did not estimate a separate equation for Vietnam using the disequilibrium approach as we do here. 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.

4. Methodology and data

4.1. Model specification

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:

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

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 $LN\left(\frac{PE}{TE}\right)_{i,t-1}$ 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). ,

[5] The total number of observations for Vietnam that they use is only 131 whereas our maximum sample size is 376 observations.

$\left(\frac{TC}{TA}\right)_{i,t}$ 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 used to determine the degree of competition is calculated from **(1)** with:

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

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.[6]

Many previous empirical studies include the log of total assets, $LN(TA_{i,t})$, among the controls to measure 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, 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 (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 our 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).[7]

[6] 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.

[7] In Table 3 we summarise the results for models that both include and exclude assets for comparison purposes.

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. 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 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 3 generally indicate large differences in the coefficients on current and lagged input prices and H-statistics. Hence, we focus on the models employing lagged input prices in Tables 1 and 2 in order to ensure valid inference.

4.2. Model 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 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 or the two-step method.

We consider both the one-step GMM estimator (with robust coefficient standard errors) and the two-step GMM estimator (with Windmeijer, 2005, small sample corrected coefficient standard errors). A downward bias afflicts the coefficient standard errors calculated by the two-step method, however, using Windmeijer (2005) corrected standard errors with two-step GMM greatly reduces this problem. 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.[8] 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 panel bias and inconsistency (as N tends to infinity) when T is small.[9] 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.[10]

In the application of GMM, Hansen's J-statistic tests whether the instruments are exogenous allowing the residuals to be heteroscedastic and autocorrelated (we use robust standard errors that do not assume spherical disturbances). However, the test becomes 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 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 the criteria that we require for a model to be valid are:

- The coefficient on the lagged dependent variable estimated by GMM must fall in the range of the lagged dependent variable's coefficient estimated by the ordinary least squares (OLS) and fixed-effects estimators.
- There is no second-order autocorrelation or evidence of invalid instruments.
- The number of instruments is smaller than the number of cross-sectional units. In all of our reported models, this criterion is satisfied.

[8] 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, and so dynamic panel (endogeneity) bias will not be a major issue.

[9] 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.

[10] We do this in our analysis because T is small so both OLS and fixed-effects estimators are expected to be biased.

- 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 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 within the disequilibrium (rather than equilibrium) approach.

4.3. 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.[11]

5. Empirical results

Table 1 reports the estimated revenue equations and associated H-statistics for the Vietnamese banking system over the full sample period of 1999 to 2009. We use the 'system' and 'difference' estimators with both 'one-step' and 'two-step' procedures. In the table, 1D (2D) denotes the one (two) step difference estimator and 1S (2S) indicates the one (two) step system estimator. The time dummy variables from D1999 to D2009 are added to explicitly incorporate period fixed-effects.[12] The rows

[11] 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. 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.

[12] For all models reported in Table 1 and 2, the two dummies D1999 and D2009 are automatically dropped by the Stata software due to collinearity.

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 (denoted AR(2)) and Hansen's test for instrument validity (Hansen) are also presented in the table.[13] '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 OLS 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.[14] We also report the Wald test of whether the model has significant explanatory power (Wald test) and the number of observations (Obs.) in the table.

The models using LN(INT) as the dependent variable are reported in Table 1. The coefficient on the lagged dependent variable (where L1 denotes the first lag of the variable it prefixes) based on the one-step difference estimator (column headed 1D) is 0.8525 which is outside of the range of the corresponding variable's coefficient estimated by OLS (0.8420) and FE (0.7642). This model is, therefore, rejected for inference according to our criteria. Further, the models using both system estimators and the two-step difference estimators (1S, 2D, 2S) are also rejected because their H-statistics (ranging from -3.86 to -2.86) are not significantly different from both zero and one, meaning that the H-statistics are poorly determined and so uninformative.

Therefore, we 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 sequentially delete dummies based upon their degree of statistical insignificance. The only model that could not be rejected according to our criteria uses the two-step system estimator and excludes the insignificant time dummy variable D2006 is

[13] 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.

[14] To calculate t-statistics testing whether the H-statistics are statistically different from to zero or one, we compute coefficients, and their standard errors, in static long-run equilibrium, where the standard errors are constructed using the formula given in De Boef and Keele (2008).

reported in the column headed “Favoured” of Table 1.[15] Hence, we favour this model for inference when LN(INT) is the dependent variable.[16] 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 insignificant except for the number of branches (LN(BR)), which is positive and significant.

The models estimated using ‘LN(REV)’ as the dependent variable are reported in Table 2. The probability value for the Hansen tests (both being 0.048) of both models using the ‘difference’ estimators (columns headed 1D and 2D) show that the instruments are invalid; hence, these models are rejected according to our criteria. The coefficient on the lagged dependent variable (0.6926) of the model using the two-step system estimator (column 2S) is outside the range of this variable’s coefficient estimated by OLS (0.8256) and FE (0.7168) and so this model is also rejected. However, the model estimated using the one-step system estimator cannot be rejected according to any of our criteria and could be used for inference.[17]

However, consistent with our approach applied when LN(INT) was the dependent variable and to see if an improved model can be obtained we also apply the GSM-type procedure to specifications where LN(REV) is the dependent variable. Three models (all using the one-step system estimator) that exclude dummy variables could not be rejected according to our criteria. We report the favoured model (that excludes D2006) in the column headed “Favoured” of the table.[18] This is favoured because it has the lowest coefficient standard error for the dependent variable (being 0.075). Thus, it is the model using LN(REV) as the dependent variable that we use for inference. The H-statistic is -1.36 which is not significantly different from zero if it is significantly different from one. This indicates that the Vietnamese banking system was in monopoly between 1999 and 2009. 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

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[15] The row denoted “H_0 redundant period dummies” reports the joint test for the exclusion of the time dummy variables from the models.
[16] The results of specifications using both difference and one-step system estimators that exclude insignificant period dummy variables are available from the authors on request.
[17] This model’s H-statistic is -1.28 and is significantly different from one, if not zero, suggesting a monopolistic banking system.
[18] The unreported specifications that exclude period dummy variables with LN(REV) as the regressand are available from the authors on request.

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 3 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).[19] 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 two sub-samples through time: 1999-2003 and 2004-2009; and the following two 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 smallest coefficient standard error on the dependent variable in models that cannot be rejected according to the criteria discussed above. 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

[19] We also experimented to find improved specifications 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 excluding insignificant input prices. However, these experiments did not improve the results.

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 3. 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.[20]

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 allows for dynamic effects. The results of separately estimated equations for Vietnam reported by Bikker et al. (2012) are for H-statistics using the equilibrium approach only. They only consider the disequilibrium approach (GMM) for countries where there are enough banks for the number of cross-sections to exceed the number of instruments. This excludes Vietnam where their data has 23 Vietnamese banks (and a total of 131 observations). Further, in the countries where the number of banks is large they find little evidence that the lagged dependent variable is significant. Hence, for these countries GMM is not required and the use of the equilibrium approach is justified. However, our results for Vietnam using a larger sample and with more banks (48 banks) enable the use of GMM and shows that the lagged dependent variable is significant. This means that results of separate equations for Vietnam based on the equilibrium approach are not valid (as reported by Bikker et al., 2012, and Matousek et al., 2013) and the disequilibrium approach must be used. Hence, our results for Vietnam use the correct estimation method whereas those reported by Bikker et al. (2012) and Matousek et al. (2013) will not be valid.[21]

[20] The H-statistics are generally higher for models where revenue is the dependent variable in our favoured models. Therefore, the market is more competitive when based on revenue.

[21] Regarding Bikker et al., (2012), they preferred results based on the within estimator (Table 4) and the unscaled revenue equation (these are reported in the columns headed log(II) and log(TI)). Hence the H-statistics from these columns in Table 4 are our reference (comparison) point for Vietnam and the H-statistics reported for Vietnam are, respectively, -0.071 and -0.084. T-test statistics (our calculations based on their reported estimates) for whether the H-statistics are significantly different from zero are -0.316 and -0.385, respectively, suggesting that they are not significantly different from zero. T-test statistics (our calculations) for whether the H-statistics are significantly different from one are -4.760 and -4.977, respectively, suggesting that they are significantly different from one. The results that H-statistics are not significantly different from zero and are significantly different from one are consistent with ours – despite Bikker et al.'s (2012) use of the equilibrium approach in estimating separate models for Vietnam.

Our finding 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 a small number of banks (most of them are SOCBs) still dominate the Vietnamese 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 (very) large banks in the system in 2009. 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. This provides a robustness that makes this inference convincing and should help reduce any concerns that there are exceptions to the standard interpretation of the Panzar-Rosse H-statistic that can call into question inferences based upon it - see Spierdijk and Shaffer (2015).

6. Conclusion

We are the first to employ the non-structural model using the disequilibrium approach (Goddard and Wilson, 2009) to examine the Vietnamese banking system (separately from other countries). 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 use 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 of the Vietnamese banking system's competitiveness that considers 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). We also properly specify the revenue equation by excluding assets (to avoid bias) and including lagged input prices (to avoid endogeneity). 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.[22] 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 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).

[22] In 2011, Saigon Thuong Tin Commercial Bank, Tin Nghia Commercial Bank and First Commercial Bank merged resulting in a 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.

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).[23]

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 of 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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[23] 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 a 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. GMM estimations for the full sample with LN(INT) as the dependent variable

	General models				Favoured
	1D	1S	2D	2S	2S
L1 LN(INT)	**0.8525***** (9.393)	0.8274*** (8.215) {0.1007}	0.8068*** (6.419) {0.1257}	0.7965*** (9.309) {0.0855}	0.7983*** (9.156) {0.0872}
L1 LN(PE/TE)	-0.3743*** (-2.936)	-0.1709 (-1.201)	-0.3526** (-2.143)	-0.1494 (-1.311)	-0.145 (-1.566)
L1 LN(IE/FF)	-0.4546*** (-4.095)	-0.3327*** (-3.651)	-0.3986*** (-3.134)	-0.345*** (-3.416)	-0.3457*** (-3.799)
L1 LN(CE/FA)	0.0481 (0.8576)	-0.0114 (-0.3096)	0.0048 (0.0819)	-0.035 (-0.8346)	-0.0362 (-0.8774)
TC/TA	-0.1817 (-0.4959)	-0.03 (-0.1454)	-0.2281 (-0.615)	-0.0617 (-0.2982)	-0.0582 (-0.2708)
CL/CD	-0.0116 (-0.1811)	-0.0061 (-0.1262)	0.004 (0.0491)	0.0025 (0.0551)	0.005 (0.1085)
LN(BR)	0.1655 (1.501)	0.1441 (1.620)	0.1478 (1.079)	0.1679** (2.289)	0.1664** (2.222)
D1999					
D2000	-0.7102** (-2.089)	-0.4894*** (-2.747)	-0.8448** (-2.049)	-0.504*** (-2.626)	-0.492*** (-3.533)
D2001	-0.8325*** (-2.712)	-0.6152*** (-4.141)	-0.9159** (-2.403)	-0.6436*** (-4.072)	-0.6335*** (-5.283)
D2002	-0.7977*** (-2.882)	-0.6185*** (-3.801)	-0.8793** (-2.553)	-0.5962*** (-3.992)	-0.5888*** (-6.379)
D2003	-0.536** (-2.053)	-0.375*** (-3.649)	-0.6197** (-2.052)	-0.3765*** (-3.076)	-0.3672*** (-4.305)
D2004	-0.5145** (-2.336)	-0.383*** (-3.882)	-0.5513** (-2.105)	-0.3677*** (-3.443)	-0.3604*** (-5.264)
D2005	-0.3048 (-1.532)	-0.182* (-1.942)	-0.3454 (-1.463)	-0.1718 (-1.629)	-0.1642*** (-2.768)
D2006	-0.1129 (-0.7148)	-0.0097 (-0.1313)	-0.1681 (-0.8762)	-0.0053 (-0.0672)	
D2007	0.1377 (1.054)	0.2369*** (3.643)	0.0879 (0.5309)	0.2082*** (2.628)	0.2158*** (4.213)
D2008	0.1441* (1.842)	0.2222*** (3.670)	0.1953** (2.000)	0.2688*** (3.370)	0.2723*** (4.853)
D2009					
constant		1.925** (2.182)		2.076** (2.375)	2.027** (2.271)
H_0 redundant period dummies					0.0000 [0.9464] Accept
Instruments	24	34	24	34	33
Groups	44	46	44	46	46
AR(2)	0.934 Valid	0.757 Valid	0.974 Valid	0.894 Valid	0.884 Valid
Hansen	0.127 Valid	0.107 Valid	0.127 Valid	0.107 Valid	0.111 Valid
H_0 period FE	149.80*** [0.0000] Reject	169.11*** [0.0000] Reject	129.76*** [0.0000] Reject	186.74*** [0.0000] Reject	158.88*** [0.0000] Reject
L1 OLS	0.8420	0.8420	0.8420	0.8420	0.8443
L1 period FE	0.7642	0.7642	0.7642	0.7642	0.7651
H-statistic		**-2.9842**	**-3.8623**	**-2.6010**	**-2.6128**
H=0		-1.0133 Accept	-1.2154 Accept	-1.3888 Accept	-1.4554 Accept
H=1		-1.3529 Accept	-1.5301 Accept	-1.9228 Accept	--2.0124*** Reject
Wald test	3386.83***	13839.51***	2154.35***	8320.55***	8168.67
Obs.	280	327	280	327	327

*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 2. GMM estimations for the full sample with LN(REV) as the dependent variable

	General models				Favoured
	1D	1S	2D	2S	1S
L1 LN(REV)	**0.8408***** (10.12)	0.7498*** (9.705)	0.745*** (6.541) {0.077}	**0.6926***** (8.723)	0.7523*** (9.967) {0.075}
L1 LN(PE/TE)	-0.3613* (-1.931)	-0.0755 (-0.5435)	-0.3431 (-1.367)	0.0027 (0.0173)	-0.0857 (-0.7076)
L1 LN(IE/FF)	-0.3339*** (-4.073)	-0.2404*** (-3.077)	-0.2657** (-2.298)	-0.2195* (-1.774)	-0.2467*** (-3.448)
L1 LN(CE/FA)	0.0255 (0.527)	-0.005 (-0.146)	0.0062 (0.1125)	-0.0218 (-0.4818)	-0.0048 (-0.1388)
TC/TA	-0.2875 (-0.6897)	-0.1286 (-0.6753)	-0.5964 (-0.804)	-0.2358 (-0.8641)	-0.1261 (-0.6586)
CL/CD	-0.0139 (-0.2238)	-0.0338 (-0.7207)	0.004 (0.0519)	-0.0403 (-0.9068)	-0.0331 (-0.7076)
LN(BR)	0.1246 (1.170)	0.2069*** (2.890)	0.1241 (0.7777)	0.2505*** (3.481)	0.204*** (2.957)
D1999					
D2000	-0.737* (-1.735)	-0.4267** (-2.308)	-0.9493* (-1.868)	-0.4299* (-1.815)	-0.4529*** (-3.251)
D2001	-0.7412* (-1.963)	-0.4702*** (-3.066)	-0.9305** (-2.050)	-0.4293** (-2.002)	-0.4953*** (-4.553)
D2002	-0.75** (-2.15)	-0.5208*** (-3.357)	-0.9387** (-2.254)	-0.485** (-2.403)	-0.5451*** (-4.774)
D2003	-0.5744* (-1.74)	-0.3784*** (-2.925)	-0.7392* (-1.802)	-0.2968* (-1.698)	-0.402*** (-4.924)
D2004	-0.5163* (-1.811)	-0.3509*** (-3.162)	-0.6551* (-1.878)	-0.2909** (-1.964)	-0.3725*** (-5.75)
D2005	-0.3172 (-1.243)	-0.1669 (-1.595)	-0.4527 (-1.417)	-0.1001 (-0.7626)	-0.187*** (-3.073)
D2006	-0.0894 (-0.4489)	0.0285 (0.3349)	-0.2349 (-0.9327)	0.0833 (0.8696)	
D2007	0.1804 (1.153)	0.2732*** (4.025)	0.0571 (0.291)	0.2738*** (3.373)	0.257*** (4.644)
D2008	0.1309 (1.499)	0.1981*** (3.080)	0.1706 (1.561)	0.2785*** (3.165)	0.1829*** (3.559)
D2009					
constant		2.659*** (3.964)		2.956*** (3.499)	2.675*** (4.006)
H_0 redundant period dummies					0.1100 [0.7377] Accept
Instruments	24	34	24	34	33
Groups	44	46	44	46	46
AR(2)	0.914 Valid	0.715 Valid	0.846 Valid	0.721 Valid	0.744 Valid
Hansen	**0.048 Invalid**	0.110 Valid	**0.048 Invalid**	0.110 Valid	0.081* Valid
H_0 period FE	123.17*** [0.0000] Reject	130.87*** [0.0000] Reject	103.09*** [0.0000] Reject	82.83*** [0.0000] Reject	89.19*** [0.0000] Reject
L1 OLS	0.8256	0.8256	0.8256	0.8256	0.8279
L1 period FE	0.7168	0.7168	0.7168	0.7168	0.7157
H-statistic		**-1.2825**			**-1.3613**
H=0		-1.1217 Accept			-1.2744 Accept
H=1		-2.000*** Reject			-2.2106*** Reject
Wald test	3786.45***	12389.79***	2272.69***	8647.12***	12340.62
Obs.	280	327	280	327	327

See notes to Table 1.

Table 3. Summary of results for the full sample and sub-samples

		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 notes to Table 1.