FDI and Heterogeneity in Bank Efficiency: Evidence from Emerging Markets

Abstract

The inquiry into whether foreign firms are more productive than local firms has been one of the key research questions among international business scholars. We extend this line of research by addressing the heterogeneity among different performance measures. In this study, we examine the impact of foreign direct investment (FDI) on four internal measures of efficiency, i.e. overall technical, pure technical, scale and cost efficiencies, as well as an external measure of efficiency, i.e. revenue efficiency in the emerging markets banking sector. In contrast to previous studies that have perceived bank efficiency in a generic sense and have operationalized their efficiency measure with different measures of efficiency, we develop theoretical arguments to explain how the FDI-efficiency relationship can differ across these five types of efficiencies. We empirically test our hypotheses while accounting for endogeneity among efficiency, risk and capital under a three-stage least squares model. Our findings broadly suggest that foreign banks have an advantage in terms of overall technical efficiency and scale efficiency, but do not have an advantage in terms of pure technical efficiency, cost efficiency and revenue efficiency.

JEL classification: F23, G21
Keywords: Bank efficiency, Foreign Direct Investment, Emerging Markets

1. Introduction

The banking industry, as an important sector of the financial system, plays an essential role in the development of a country's economy. As the process of global economic integration accelerates, there is a tendency for the finance sector of every country to open up to the world. This means that foreign investors can bring in new/advanced product and process technologies, as well as managerial knowledge and skills, all of which can help in improving the efficiency of existing operations or enabling completely new operations within the host country (Moran, 2005). Therefore, the inquiry into whether foreign-owned banks are more efficient than local banks has attracted considerable research interest from scholars in both banking and international business research domains. However, their findings remain inconclusive. Some studies have found that foreign banks are more efficient than their local counterparts. In contrast, others have found that foreign banks have a lower level of efficiency or that there is no significant difference between foreign and local banks. Within this context, we examine the impact of foreign direct investment (FDI) on bank efficiency in emerging economies. We contribute to the empirical literature in three ways.

First, previous studies have perceived bank efficiency in a generic sense and have failed to account for the fact that FDI can have different effects on different performance measures. In contrast, we develop theoretical arguments to explain how the impact of FDI on bank efficiency can differ across five types of efficiencies, i.e. overall technical efficiency, pure technical efficiency, scale efficiency, cost efficiency and revenue efficiency. Some studies have cast doubts on the use of measures such as labour productivity and total factor productivity for investigating efficiency in the services sector (Grönroos and Ojasalo, 2004) because such measures only look at some internal aspects of efficiency. Ignoring external aspects of efficiency can be acceptable in a manufacturing context as revenue generating ability is largely dependent on the products/output. In the services context, external efficiencies such as revenue generating capacity should also be important as service quality and customer participation play a major role in the service context. To this end, we examine the impact of FDI on both internal and external measures of efficiencies.

Second, based on a three-stage least squares model, we explicitly address possible endogeneity among efficiency, risk and capital, an aspect which has been ignored by previous studies. The consideration of this endogeneity issue provides more accurate and robust results. Third, most of the previous studies have been conducted in the context of developed economies or a small number of specific developing/developed countries, while our sample represents eight emerging market economies.

The paper is structured as follows. Section 2 provides the background of the current research study and then we formulate our hypotheses on the impact of FDI on different efficiency measures. Section 3 discusses the data and methodology used to derive the efficiency scores as well as the three-stage least squares model to investigate the impact of FDI on bank efficiency. Section 4 presents and discusses the results, while the final section provides a summary and conclusion.

2. Background and hypotheses development

Theories of FDI demonstrate that foreign firms possess significant ownership advantages over domestic firms, without which they would not be able to engage in FDI (United Nations, 1992). In other words, foreign firms that are not more efficient than domestic firms may not be able to enter the host country due to higher entry costs and liability of foreignness (Moller et al., 2007). This supposition leads to the inference that foreign firms needs to be more efficient than domestic firms. Much of the foreign firms' higher efficiency stems from their advanced technological knowledge, superior marketing and management skills, extensive international contacts, and high reputation (United Nations, 1992; Aitken and Harrison, 1999). These firm-specific advantages help foreign firms to overcome the extra costs associated with doing business abroad arising from the spatial distance between host and home country (travel, transportation; coordination over distance/time zones), the firm's unfamiliarity with the local environment (due to institutional, cultural, language differences between host and home country), lack of legitimacy and isomorphism, and home country environment costs such as restrictions imposed by a firm's home government (Miller and Parkhe, 2002; Sethi and Judge, 2009; Zaheer and Mosakowski, 1997; Zaheer, 1995)

The inquiry into whether foreign firms are more productive than local firms has been one of the key research questions among international business scholars. Many studies expect foreign firms to have higher productivity, i.e. they expect advantages of being foreign to be much higher than the disadvantages of being foreign. Empirical studies based on manufacturing FDI have frequently found a higher level of efficiency associated with foreign firms (Vahter, 2004; Lipsey, 2004; among others). However, there are a few articles indicating the possibility of foreign firms having lower productivity than domestic firms (e.g. Vahter, 2004). In contrast, the services sector has not been subject to much rigorous investigation in terms of examining the impact of FDI on firm performance/efficiency – the banking sector is a notable exception. However, studies on the FDI-efficiency relationship in the banking sector have produced mixed findings.

There are a quite a number of empirical studies investigating the effect of foreign ownership on bank efficiency. On the one hand, some studies have found that foreign banks are more efficient than their local counterparts. In contrast, a few studies have found that foreign banks have a lower level of efficiency than local banks or that there is no significant difference between foreign and local banks. Table 1 provides a summary of relevant studies.

<<Table 1---about here>>

As summarized in table 1, previous studies on the relationship between FDI and bank efficiency have employed various definitions of efficiency, yet they have treated bank efficiency in a generic sense and thus promote a blanket view for all these different types of efficiency measures. The empirical results are mixed, and the underpinning theoretical arguments do not address the heterogeneity among these different measures of efficiency. It might be the case that the impact of FDI varies across these different efficiencies. In the next section, we develop theoretical arguments to explain how/why the impact of FDI can differ across five different efficiency measures.

2.1 FDI and overall technical efficiency

Overall technical efficiency measures how efficiently a bank transforms its input resources into outputs. We argue that firm specific advantages (FSAs) associated with foreign banks could help banks to achieve higher overall technical efficiency by helping them maximize their output to input ratio, particularly in the emerging markets context where domestic banks lack such superior FSAs. First, as per the global advantage hypothesis (Berger et al., 2000), foreign banks might benefit from competitive advantages relative to their domestically-owned peers. Foreign banks might also become more competitive due to the fact that there is an active market for corporate control in the home country and stiff home market competition. As emphasized in *The Competitive Advantage of Nations* (Porter, 1990), conditions in the firm's home market (such as level of competition, presence of strong related and supporting industries, and buyer sophistication) are key in determining its competitiveness. Foreign-owned banks also use more advanced technologies, particularly in the context of emerging economies. It is a well-known fact that multinational enterprises (MNEs), through their active role in research and development (R&D), produce, own and control the majority of world's advanced technology (Blomström and Kokko, 2003). They also have access to an educated labour force that is able to adapt to new technologies. Similarly, Havrylchyk (2006) suggests that foreign banks might benefit from better risk management as they rely more on modern information technologies. Using a number of Korean banks over the period 1998-2002, Choi and Hasan (2005) find that the level of foreign ownership has a positive and statistically significant impact on bank returns and risk. Based on the aforementioned arguments we conclude that:

> Hypothesis 1: In the context of emerging markets, foreign banks have a higher overall technical efficiency compared to local banks, ceteris paribus.

2.2 FDI and pure technical (managerial) efficiency

Pure technical efficiency measures the managerial ability of bank managers. There is a general consensus that foreign firms possess better managerial and organizational skills compared to local firms. Foreign firms also tend to undertake more in-house training programmes than domestic firms (Konara and Wei, 2017; Aitken and Harrison, 1999; Blomström and Kokko, 1998), which could further enhance the managerial capacity of foreign banks. Therefore, FDI can have a positive effect on pure technical efficiency.

Due to differences in culture and business practices across countries, the managerial patterns between foreign banks and domestic banks can differ, especially between banks from emerging market economies and western developed countries. In emerging markets, there tends to be a hierarchical structure in the bank management, where the authority will flow through different levels on a one by one basis, and decisions are purely made by the most senior person in the organization. In contrast, western culture is typically more open and the organizational structure is relatively flat with a participative approach to decision making (Jariya, 2012). These dynamics can also promote managerial efficiency in banks from western developed countries. Based on the aforementioned arguments we conclude that:

> Hypothesis 2: In the emerging markets' banking context, foreign banks have a higher pure technical

efficiency compared to local banks, ceteris paribus.

2.3 FDI and scale efficiency

Scale efficiency measures whether the bank is operating at its optimal scale. Foreign-owned banks, as part of a MNE network, have more opportunities to operate at their optimal scale for several reasons. First, compared to local banks, foreign banks have a range of options to serve the host country market, for example, establishing a fully-fledged banking operation versus opening branches in the host country. Second, foreign firms can leverage the opportunities for outsourcing, off-shoring, and subcontracting of business process operations that are usually available within MNE networks. Therefore, foreign banks are well placed to select the scale that fits their operations through selecting the optimal entry strategy. As part of a MNE network, foreign firms also have more opportunities to bridge their shortages in resources/capacities by borrowing from other parts of the MNE network. Similarly, MNEs easily utilize excess resources/capacities in some other part of their MNE network, without keeping them idle in the host country operation. Foreign-owned firms could also share resources/capacity with their sister subsidiaries. In contrast, local firms may not have such opportunities and they may have to invest in a whole unit of resources/capacity even when they need only a part of that unit for the current scale of its operations, whereas MNEs can easily divert resources from one subsidiary to another depending on the demand conditions in different host countries. Therefore, foreign firms have more opportunities to operate at their optimal scale.

In addition, compared to domestic banks, foreign banks may have more experienced staff and experts in conducting research; indeed, large multinational banks usually have fully-fledged research departments. Therefore, foreign banks are better able to analyze their current scale of operations and forecast future scale of operations and then fit/adjust their operations to the optimal scale. In contrast, banks in emerging economies may lack such sophisticated research departments, and because of weaker governance, bank managers may have the freedom of expanding the banks without much scrutiny. In such situations, the personal agendas of bank managers may override the interests of the banks, and may lead to operating at a sub-optimal size. Based on the aforementioned arguments we conclude that:

Hypothesis 3: In the context of emerging markets, foreign banks have a higher scale efficiency compared to local banks, ceteris paribus.

2.4 FDI and cost efficiency

Liability of foreignness, a phrase coined by Hymer (1955), is one of the key theoretical considerations used in describing foreign operations. Liability of foreignness has largely cost-based origins (Miller and Parkhe, 2002). MNEs operating in a host country often face liability of foreignness and this may result in extra administration and transaction costs in relation to their domestic counterparts. Such costs of doing business abroad could arise from a variety of sources. Foreign firms need to coordinate their activities from a distance, therefore incur additional costs on travel/transportation and to monitor/coordinate operations over distance and different time zones. Foreign firms' unfamiliarity with the local environment due to institutional, cultural and language differences between host and home countries can also increase the risks and costs of cross

border operations, particularly in the context of emerging markets (Shirodkar and Konara, 2017). They could also be discriminated against by various host country actors such as customers, suppliers, trade unions, pressure groups and the government. For example, the government could treat domestic firms differently from foreign ones; nationalistic buyers could be reluctant to buy from foreign firms and pressure groups may demand that foreign firms adhere to stricter standards than local firms (Miller and Parkhe, 2002). There is a strong consensus that foreign firms pay higher wages than local firms, even above that which should be paid for a given skill level. This happens for various reasons such as to overcome local workers' preferences to work in local forms, minimize staff turnover, imperfect knowledge about the local labour market, host and home country pressures, or for better public relations (Lipsey, 2004, Urban, 2010). Compared to manufacturing operations, service operations can be quite complex, information-intensive and knowledge-intensive, and may involve a strong human content (Biege, et al., 2013; Dunning, 1989; Weche Gelübcke, 2012). In addition, language tends to be more important for service operations than for non-service operations. Therefore, foreign banks are likely to incur additional costs compared to their domestic counterparts.

FDI, however, could also have positive effects on cost efficiency. Because of their experienced staff, foreign banks have higher skills and abilities to engage in a variety of businesses. Such a diversification could lead to scope efficiencies which could further increase cost efficiency (Berger et al., 2010). Moreover, foreign firms, as MNEs, can leverage their international alliances and networks to achieve scale and scope economies (Sethi and Judge, 2009). Foreign banks can not only benefit from their better access to international funding markets and access to their parents funds, they can also enjoy a lower cost of deposits due to their superior reputation (Degryse, et al., 2012). This will decrease their cost of funds and improve cost efficiency. In addition, because of their experienced staff and superior management skills, foreign banks are supposed to have higher risk management skills. This could result in a reduction in the volume of non-performing loans which could further lead to an improvement in cost efficiency. Using a sample of Chinese commercial banks over the period 1997-2010, Hasan and Xie (2013) find that foreign participation in the Chinese banking industry has a significant and positive impact on the prudent behaviour of Chinese banks.

Based on these conflicting theoretical arguments, we do not have any a priori expectation with regard to the impact of FDI on cost efficiency. Overall whether FDI has a positive or negative impact on the cost efficiency is an empirical question.

2.5 FDI and revenue efficiency

Revenue efficiency is related to how efficiently resources are transformed into revenue. In addition to cost-based origins, liability of foreignness often has revenue-based origins. This could put foreign banks at a disadvantage when it comes to exploiting local customers (Miller and Parkhe, 2002), which could limit the foreign banks' ability to generate revenue. First, communication barriers due to language and cultural differences can have a negative effect on customer satisfaction and lead to difficulties in acquiring and maintaining relationship with customers. In contrast to manufacturing firms, banks sell customized and non-standardized products that demand intense communication with customers, and so foreign banks might be

disadvantaged by communication difficulties (Weche Gelübcke, 2012). Since banking products are experience goods, customers may prefer banking services with predictable service quality and this may put foreign banks at a disadvantage (Weche Gelübcke, 2012). Foreign banks' unfamiliarity with the local culture and other peculiarities of the local market and local customers' nationalistic sentiments could put foreign banks at a disadvantage compared to local banks, which could significantly affect foreign banks' revenue efficiency (Zaheer and Mosakowski, 1997). When it comes to supplying credit, foreign banks can face a higher degree of information asymmetry compared to domestic banks, and therefore may prefer to target more transparent and less risky clients (Degryse, et al., 2012). In contrast, domestic banks are better placed to lend to risky borrowers and to rely on soft information due to their superior knowledge about domestic customers (Degryse, et al., 2012). Foreign banks may have to offer more attractive deals (discounts, lower interest rates, additional services) than local banks in order to mitigate the liability of foreignness, and this may also contribute to revenue inefficiencies (Miller and Parkhe, 2002).

Foreign firms, however, could also have certain advantages over local firms in terms of revenue generation. Foreign banks, through their superior investment and risk management skills, are better placed to provide their customers with a variety of options and opportunities for diversifying their risks (Degryse, et al., 2012). Present day front-end banking is characterized by a greater use of IT resources, for example, use of customer relationship management (CRM) software to manage customer relationships, and internet banking. Multinational banks are expected to be in the forefront in terms of the use of IT, and this could help them in generating more revenue. Moreover, due to the advantages of multinationality, foreign firms have a higher reputation and more extensive international contacts than local firms. These advantages could also help them in generating revenue. Banks' revenue is derived from traditional loan services as well as non-interest revenues from non-traditional activities. The substantially larger amount of non-interest revenue earned by the foreign banks can significantly improve revenue efficiency.

In light of these mixed effects, and due to the significant issues with the liability of foreignness discussed above, we cannot predict a priori whether foreign firms have higher or lower revenue efficiency than local firms, ceteris paribus. Overall whether FDI has a positive or negative impact on the revenue efficiency is an empirical question.

3. Data and methodology

Our data is compiled from annual figures from banking sectors in eight emerging market economies namely Columbia, Hungary, Indonesia, Malaysia, Poland, Russian Federation, South Africa and Turkey[1]. The data period spans 1999-2013. Since not all banks in all the countries have the required information for every year, we opt for an unbalanced panel dataset in order to preserve the degrees of freedom. Table 2 provides the measurements and sources of the variables used in the current study. We estimate five types of efficiency measures, that is, overall technical efficiency, pure technical efficiency, scale efficiency, cost efficiency and

[1] These countries were selected based on the classification of emerging markets by four sources – FTSE, Goldman Sachs, Grant Thornton, and the International Monetary Fund – and data availability.

revenue efficiency. Firm specific data comes from the Bankscope database maintained by Fitch/IBCA/Bureau van Dijk, a comprehensive database for research in banking.

<<Table 2---about here>>

There are two basic estimation approaches for measuring efficiency: 1) parametric stochastic frontier analysis (SFA) (Al-Gasaymeh, 2016; Phan et al., 2016); 2) non-parametric Data Envelopment Analysis (DEA) (Sufian, 2009; Du and Sim, 2016; Triki et al., 2017). There are various extensions such as meta-frontier analysis (Johnes et al., 2014) and the technique for order of preference by similarity to ideal solution (TOPSIS) analysis (Abdul-Majid et al., 2017; Wanke et al., 2016) which have been applied in the banking context. In general, DEA has advantages over SFA as it is able to handle multiple inputs and outputs stated in different measurement units, and it does not necessitate knowledge of any functional form of the frontier (see Charnes et al., 1995). Most empirical papers show that using DEA to estimate the efficient frontier can yield robust results (see Seiford and Thrall, 1990). Thus, we use DEA to measure the efficiencies. DEA originated from the work by Charnes et al. (1978), which is known as the CCR model and is a linear programming technique. The CCR model measures the efficiency of each decision making unit (DMU) as the maximum of a ratio of weighted outputs to weighted inputs. This denotes that the less the input invested in producing a given output, the more efficient the production. The CCR model presupposes that there is no significant relationship between the scale of operation and efficiency by assuming constant returns to scale (CRS). The CRS assumption is only suitable when all DMUs are operating at an optimal scale.

Banker et al. (1984) extended the CCR model by relaxing the CRS assumption. The resulting BCC model is used to assess the efficiency of DMUs characterized by variable return to scale (VRS). The VRS assumption provides the measurement of pure technical efficiency (PTE), which is the measurement of technical efficiency devoid of the effect of scale efficiency.

The input-oriented CCR model can be expressed as follows:

$$
\begin{aligned}
&\min_{\theta,\lambda} \theta, \\
&\text{subject to} \\
&-y_i + Y\lambda \geq 0, \\
&\theta x_i - X\lambda \geq 0, \\
&\lambda \geq 0
\end{aligned}
$$

Where θ is a scalar and λ is a N×1 vector of constants, Y represents all output data for N firms, X represents all input data for N firms, x_i are individual inputs and y_i the outputs for DMU i. The efficiency score for each DMU is given by θ, which takes a value between 0 and 1.

The CRS linear programming problem can be easily modified to account for VRS by adding the convexity constraint, N1'λ=1, to provide:

$$\min_{\theta,\lambda} \theta,$$
$$\text{subject to}$$
$$-y_i + Y\lambda \geq 0,$$
$$\theta x_i - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

Where $N1$ is an $N \times 1$ vector of ones. This approach forms a convex hull of intersecting planes which envelop the data points more tightly than the CRS conical hull. The pure technical efficiency scores are greater than or equal to those obtained using the CRS model. A DMU with a CRS efficiency score greater than the VRS is scale inefficient, and the precise measure of scale efficiency (SE) can be calculated from the VRS technical efficiency (TE) score and the CRS TE score as follows:

$$TE_{CRS} = TE_{VRS} \times SE$$

In selecting the input and output variables, our study follows the suggestions made by Berger and Humphrey (1997). They argue that deposits have the dual role and should be regarded as both input (which is used to fund loans) and output (banks seek to maximize deposits due to strategic reasons).Thus we use three inputs which include personnel expenses, total non-interest expenses as well as total interest expenses, while the related input prices are the price of labour (measured by the ratio of personnel expenses over total assets); the price of capital (measured by the total non-interest expenses over fixed assets); the price of funds (measured by the ratio of total interest expenses over total funding). Three outputs used in this study are total customer deposits, loans, and other earning assets. The selection of outputs and inputs follows the study of Fiordelisi et al. (2011). Table 3 describes the measurement of input and output variables in the estimation of five types of efficiencies.

<<Table 3---about here>>

We include in our model bank, industry and country specific variables that could potentially affect bank efficiency. In order to account for the endogeneity among efficiency, capitalization and risk, we specify the following model and estimate it using a three-stage least squares (3SLS) model:

$$EFF_{it} = \beta_0 + \beta_1 Risk_{it} + \beta_2 Capital_{it} + \beta_3 Foreign\ ownership_{it} + \beta_4 Bank\ size_{it} + \beta_5 OFFBAL_{it} + \beta_6 Listed\ bank_{it} + \beta_7 GDP_{jt} + \beta_8 GDPG_{jt} + \beta_9 Lerner\ index_{jt} + \beta_{10} Foreign\ competition_{jt} + \beta_{11} Financial\ crisis_{t} + \beta_{12} Infrastructure_{jt} + \beta_{13} Trade\ openness_{jt} + host\ dummies \quad (1)$$

$$Risk_{it} = \delta_0 + \delta_1 EFF_{it} + \delta_2 Capital_{it} + \delta_3 Foreign\ ownership_{it} + \delta_4 Bank\ size_{it} + \delta_5 Listed\ bank_{it} + \delta_6 GDPG_{jt} + \delta_7 Lerner\ index_{jt} + \delta_8 Foreign\ competition_{jt} + \delta_9 Inflation_{jt} + \delta_{10} Financial\ crisis_{t} + \delta_{11} Exchange\ rate_{jt} + host\ dummies \quad (2)$$

$$Capital_{it} = \alpha_0 + \alpha_1 EFF_{it} + \alpha_2 Risk_{it} + \alpha_3 Foreign\ ownership_{it} + \alpha_4 Bank\ size_{it} + \alpha_5 OFFBAL_{it} + \alpha_6 Listed\ bank_{it} + \alpha_7 GDPG_{jt} + \alpha_8 Inflation_{jt} + \alpha_9 Financial\ crisis_{t} + host\text{-}year\ dummies \quad (3)$$

Where subscripts i, j, and t denote bank, country and the observation year, respectively. EFF is the bank

efficiency. Risk is the bank insolvency risk measured by Z-score (the ratio of the sum of ROA and equity-to-asset ratio over the volatility of ROA). Capital is the bank's total regulatory capital ratio. Foreign ownership is a dummy variable identifying whether a bank is foreign owned or not, which adopts the value of 1 if the bank is foreign owned. Bank size is the firm size represented by the natural logarithm of firm's total assets. Listed bank is a dummy variable that adopts the value of 1 if the bank is a listed bank. GDPG is the gross domestic product (GDP) growth of the host country. Financial crisis is a dummy variable capturing the effects of financial crisis and takes the value of one for the years 2007, 2008 and 2009. We expect these variables to affect all three of our endogenous dependent variables, and therefore, we include them in all three equations.

In order to employ a 3SLS model in our analysis, we need a set of unique variables for each equation which are assumed to be exogenous and not correlated with the error term. We expect the following variables to only affect one or two dependent variables and therefore not appear in all three equations.

Equation 1 only

Infrastructure is used in the efficiency equation, and is measured by the number of mobile cellular subscriptions per 100 people. We expect that a larger value of this indicator reflects the fact that the country has a higher level of IT/telecommunication infrastructure. The resulting advancement in mobile banking will significantly reduce the level of cost and further lead to an improvement in the level of efficiency.

Trade openness is the second unique variable in the efficiency equation, and is measured by the ratio of the sum of exports and imports to GDP. We expect that the higher the degree of trade openness, the higher the volumes of trading activities with different countries, which increases the volumes of businesses engaged in by the banks. The resulting reduction in costs derived from economies of scale will further lead to an increase in the level of efficiency.

We include the size of the host-market (measured by GDP) as the third additional variable in the efficiency equation, as a larger market can help banks to be more efficient due to economies of scale.

Equation 2 only

Exchange rate (defined as the local currency against the US dollar) is included in the second (risk) equation as exchange rate policy and movements can often reflect the macroeconomic risks in the host country (Honohan, 2003). A lower exchange rate can indicate that host country currency is cheaper, which could lead to a trade surplus. The resulting increase in the volumes of production requires economic expansion and increase in the volumes of credit granted by the banks in the economy, and this may lead to an increase the volumes of non-performing loans, and further lead to an increase in the level of risk.

Equation 3 only

We use a host-year dummy variable to capture the effect of different regulations in each country in different years, since changes in regulations over time will have an impact on the level of capitalization held by the banks.

Equations 1 and 2

Lerner index indicates the level of bank competition (as measured by the Lerner index). We follow Tan (2016) for the specification and estimation of the Lerner index. We expect the competition level to affect both efficiency and risk, but do not expect it to affect the level of capitalization held by the bank. Foreign competition reflects foreign presence in a country's banking sector and is measured as the ratio of assets of foreign banks to assets of total banks. We expect this variable to affect both efficiency and risk.

We also include a series of host country dummies in the efficiency and risk equations to capture any other country-specific features that can affect these variables. We argue that different countries are in different stages of economic development, they have different cultures, and they also have different types of regulation in the banking industry, all of which are likely to be related to the level of efficiency and risk.

Equations 1 and 3

OFFBAL is the ratio of off-balance sheet items to total assets. We expect that it will affect the efficiency levels and the level of capitalization held by the bank.

Equations 2 and 3

Inflation is included in the risk equation due to the consideration that excess circulation of currency in the economy may reflect the fact that the economy is going through a credit boom, during which excessive grants of loans to different types of individual and businesses may lead to an increase in the volumes of non-performing loans and further result in an increase in the level of risk. Inflation may also be related to the level of capitalization as banks will increase the level of capital to absorb this negative shock. Therefore, we also include inflation in equation 3.

The validity of instruments was checked by conducting an over-identification test and the test statistic confirms the validity of instruments used.

4. Empirical results

Table 4 presents the descriptive statistics for all the efficiency measures and other variables used in the proposed model. The descriptive statistics show that among all the efficiency measures, the banking sectors of emerging market economies have larger differences with regards to pure technical (managerial) efficiency as reflected by a relatively larger standard deviation of this variable compared to other efficiency indicators. This suggests that there are larger differences with regards to bank managers' abilities to allocate inputs and outputs in the banking operation. We also observe that banking sectors have smaller differences in terms of revenue efficiency compared to other efficiency indicators.

<<Table 4---about here>>

We further notice that scale efficiency is typically considerably higher than pure technical efficiency. When

we look at individual countries[2], this pattern persists in all the emerging economies for both domestic and foreign banks. This indicates that scale efficiency contributes more than pure technical efficiency to the overall technical efficiency of both domestic and foreign banks.

Table 5 shows the results of the estimated 3SLS model examining the impact of FDI on different efficiency measures (overall technical, pure technical and scale). In terms of our variables of interest, we find that foreign competition has a significant and positive impact on overall technical efficiency and scale efficiency. These results therefore provide strong support for our hypotheses 1 and 3. We do not find any support for our hypothesis 2.

<<Table 5---about here>>

Table 6 displays the results of the estimated 3SLS model for cost efficiency and revenue efficiency. The results show that foreign competition does not have a significant effect on either cost efficiency or revenue efficiency.

<<Table 6---about here>>

The findings also suggest that insolvency risk is significantly and negatively related to overall technical efficiency, pure technical efficiency and cost efficiency, but positively related to scale efficiency. This result is partly in line with the finding of Tan and Floros (2013). The negative impact of insolvency risk on technical, pure technical and cost efficiencies is in line with the bad luck hypothesis put forward by Berger and DeYoung (1997), who argue that increase in the level of risk cannot be attributed to the manager's skill or risk-taking appetite but mainly results from external exogenous events, and the resulted increase in the level of risk leads to a decline in the level of efficiency. This finding can be explained by the fact that banks with higher insolvency risk have more incentives to reduce and better manage inputs in the banking operation which leads to an increase in the technical, pure technical, and cost efficiencies.

We find that there is a significant and positive impact of capital on pure technical, cost and revenue efficiencies which indicates that higher capitalization leads to higher pure technical, cost and revenue efficiencies. This finding can be explained by the fact that capitalization is an indicator of creditworthiness. Therefore, higher levels of capitalization indicate that the banks have higher creditworthiness which will reduce the cost of borrowing, and the resultant reduction in input precedes an improvement in efficiency. However, the results indicate that higher level of capital leads to a decrease in scale efficiency. This means that higher level of capital held by the banks is not good for the banks to achieve the optimal scale of operation.

In addition, our findings suggest that the variable Lerner index is significantly and positively related to overall technical, pure technical, cost and revenue efficiencies, but significantly and negatively related to scale efficiency. This means that a higher level of competition leads to lower overall technical, pure technical, cost and profit efficiencies. This is in in line with the competition-inefficiency hypothesis (Boot and Schmeits,

[2] For brevity, we do not report the statistics for individual countries; however, they are available upon request.

2005; Chan et al., 1986). However, we find that a higher level of competition leads to higher scale efficiency. This suggests that increasing competition can encourage banks to move closer to their optimal scale.

Moreover, the results show that there is a significant and negative impact of cost efficiency on risk, while this impact on risk is significant and positive for scale efficiency. The negative impact of efficiency on risk is in line with the bad management hypothesis labelled by Williams (2004), who argues that higher costs will be incurred for the banks in which the credit is inadequately monitored and expenses are not well controlled, and the resulting decline in the level of efficiency leads to an increase in the level of risk. In contrast, the positive impact of (scale) efficiency on the level of risk is in accordance with the skimping behavior hypothesis from Berger and Mester (1997), who argue that increase in the level of risk (volumes of non-performing loans) is derived from banks making decisions to cut down short-term expenses on loan origination and monitoring resources. Although the banks can increase the level of efficiency from the reduction in the volumes of cost, it increases the level of risk from the accumulation of non-performing loans.

The findings also suggest that banks with higher levels of revenue efficiency have higher levels of capitalization. We further notice that there is a significant and negative impact of bank size on the level of capitalization, indicating that large banks normally have low levels of capital. This finding can be explained by the fact that capital is used as a cushion to absorb risk, while large banks normally benefit from economies of scale as well as economies of scope. The cost advantage obtained by large banks is supposed to increase the profitability. Therefore, rather than using higher levels of capital, these banks can use their profits to absorb shocks or unexpected losses, thus larger banks do not necessarily need to hold higher levels of capital. In the context of emerging market economies, the government may pay greater attention to the development of larger banks which may need to be bailed out in the case of insolvency. De Nicolo et al. (2003) argue that large banks may pose a threat to the stability of the financial system, as, if they were to fail, the negative effect on the economy will be considerably higher than the failure of small banks. Thus, it is not necessary for larger banks to hold higher levels of capital.

5. Discussion and Conclusion

The inquiry into whether foreign firms are more productive than local firms has been one of the key research questions among international business scholars. We extend this line of research by addressing the heterogeneity among different performance measures. In this study, we examine the impact of FDI on three internal measures of efficiencies, i.e. overall technical, pure technical, scale and cost efficiency, as well as an external measure of efficiency, namely revenue efficiency, in the context of emerging markets. We also endeavor to reconcile the previous mixed findings on the relationship between FDI and efficiency in the banking sector by directly addressing the heterogeneity among different efficiency measures, and employing a robust methodology to explicitly address endogeneity among efficiency, risk and capital.

Our findings suggest that foreign competition is associated with higher overall technical efficiency and scale efficiency, while there is no clear impact of foreign ownership on pure technical efficiency, cost efficiency and revenue efficiency. Furthermore, we find that banks with higher levels of capitalization have higher pure

technical efficiency, cost efficiency and revenue efficiency, but lower level of scale efficiency. Higher risk levels leads to lower overall technical, pure technical and cost efficiencies, but higher scale efficiency. Finally, a higher level of competition leads to lower overall technical, pure technical, cost and revenue efficiencies, but higher scale efficiency.

The current study has several implications for governments of emerging market economies to make relevant policies in order to improve the efficiency and enhance stability in the banking sector. First, governments in emerging market economies should consider opening up their financial sector further and encouraging foreign entry into the banking industry as foreign competition leads to improved overall technical and scale efficiencies across the sector. Second, relevant policies are recommended to improve the capital levels in banks because higher levels of capital lead to an improvement in overall technical, pure technical and cost efficiencies.

Our study also has many implications for both foreign and local banks. With regards to the local banks, it is recommended that they should focus more on improving their technologies through innovation. Local banks should be encouraged to increase investment in research and development, and also improve their risk management abilities. The achievement of these two aspects may lead to significant improvement in the overall technical efficiency of local banks. In terms of foreign banks, more effort should be focused on improving cost and revenue efficiencies as foreign banks are not better off in terms of these aspects of efficiencies.

We suggest that future research can consider applying a more advanced frontier estimation approaches such as meta-frontier analysis or TOPSIS analysis (the latter in the context of DEA) for the efficiency evaluation in emerging markets. In our study, we only observe the average effect of FDI on the bank efficiencies, however, the effect of FDI on these efficiencies could vary under different conditions. Related to this, not all foreign banks may be equally better (or worse) than local firms, and it is important to understand the nuances among the foreign-owned firms. Future research can look into these aspects to provide more insights on the effect of FDI on bank efficiencies.

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Table 1 Summary of empirical studies investigating the impact of FDI on efficiency in the banking sector

Author(s)	Data period	Country/countries investigated	Method used	Published journal	The impact of FDI on efficiency
Chang et al., 1998	1984-1989	US banking industry	SFA	Applied Financial Economics	Cost efficiency (-)
DeYoung and Nolle, 1996	1985-1990	US banking industry	SFA	Journal of Money, Credit and Banking	Profit efficiency (-)
Bhattacharyya et al., 1997	1986-1991	Indian banking sector	DEA	European Journal of Operational Research	Technical efficiency (?)
Berger et al., 2000	During 1990s	A sample of banks from France, Germany, Spain, UK and US	SFA	Brookings-wharton Papers on Financial Services	Profit efficiency (-)
Miller and Parkhe, 2002	1989-1996	A sample of banks from 13 countries	SFA	Strategic Management Journal	X-efficiency (?)
Berger et al., 2005	During 1990s	Argentina banking sector	SFA	Journal of Banking and Finance	Cost efficiency (?) Profit efficiency (?)
Berger et al., 2009	1994-2003	Chinese banking industry	SFA	Journal of Banking and Finance	Cost efficiency (+) Profit efficiency (+)
Lanine and Vander Vennet, 2007	1995-2002	a sample of banks in the Central Eastern European countries	Cost-to-income ratio and non-interest expenses	Economics and Transition	Cost efficiency (?)
Sturm and Williams, 2004	1988-2001	Australian banking industry	DEA, SFA and Malmquist indices	Journal of Banking and Finance	Technical, pure technical efficiency and scale efficiency (+)
Bonin et al., 2005	1996-2000	A sample of banks from 11 transition economies	SFA	Journal of Banking and Finance	Cost efficiency (+)
Fries and Taci, 2005	1994-2001	A sample of banks from 15 Eastern Europe countries	SFA	Journal of Banking and Finance	Cost efficiency (+)
Havrylchyk, 2006	1997-2001	Polish banking industry	DEA	Journal of Banking and Finance	Cost efficiency (?)
Kasman and Yildirim, 2006	1995-2002	Central and Eastern European banking sector	SFA	Applied Economics	Cost efficiency (+) Profit efficiency (+)
Matthews and Ismail, 2006	1994-2000	Malaysian banking sector	DEA	Cardiff working paper	Technical efficiency (+)
Sufian, 2007	2001-2004	Malaysia banking sector	DEA	Humanomics	Technical efficiency (-)
Garza-Garcia, 2012	2001-2009	Mexico banking sector	DEA	Applied Economic Letters	Technical efficiency (+), pure technical efficiency (+), scale efficiency (+)
Wezel, 2010	2002-2007	Central American banking sector	DEA and SFA	IMF working paper	Technical efficiency (?)
Sufian and Habibullah, 2010	1999-2008	Thailand banking sector	DEA	Journal of Applied Economic Research	Technical efficiency (-)
Lensink et al., 2008	1998-2003	A sample of banks from 105 countries	SFA	Journal of Banking and Finance	Cost efficiency (-)
Williams, 2012	1985-2010	A sample of 419 Latin American commercial banks	SFA	Journal of Banking and Finance	Cost efficiency (?)

Mulyaningsih et al., 2015	1980-2010	Indonesia banking industry	Ratio of total expenditure to total revenue	Journal of Financial Stability	Cost efficiency (+)
Fujii et al., 2014	2004-2011	Indian banking sector	Weighted Russel directional distance model	Journal of Banking and Finance	Technical efficiency (+)
Yildirim and Phillippatos, 2007	1993-2000	A sample of banks from 12 transition countries	SFA and DFA	European Journal of Finance	Cost efficiency (+), profit efficiency (-)
Hasan and Marton, 2003	1993-1997	A sample of banks from Hungary	SFA	Journal of Banking and Finance	Profit efficiency (+); cost efficiency (+)
Kraft et al., 2006	1994-2000	A sample of banks from Croatia	SFA	Applied Economics	Cost efficiency (+)
Bonaccorsi di Patti and Hardy, 2005	1981-1997	A sample of banks from Pakistan	SFA	Journal of Banking and Finance	Cost efficiency (+) profit efficiency (+)
Detragiache and Gupta, 2006	1996-2000	A sample of banks from Malaysia	overhead cost	Journal of Financial Stability	overhead cost (-)
Mahajan et al., 1996	1987-1990	A sample of US banks	SFA	Journal of Banking and Finance	Corporate efficiency(+) operational efficiency (+)
Correa, 2009	1994-2004	A sample of banks from 170 developing and developed countries	ROA, ROE, cost to income ratio	Journal of Financial Services research	Cost to income ratio (-)
Jiang et al., 2013	1995-2010	49 Chinese commercial banks	SFA	Journal of Banking and Finance	Cost efficiency (+); interest income efficiency (+); profit efficiency (-); non-interest income efficiency (-)
Sufian et al., 2012	2012	Malaysian banking industry	DEA	JKAV: Islamic Economics	Revenue efficiency (+)
Pancurova and Lyoesa, 2013	2013	A sample of banks from 11 central and eastern European countries	DEA	Czech Journal of Economics and Finance	Revenue efficiency (-)

Notes:
+ Foreign banks are more efficient than local banks
- Foreign banks are less efficient than local banks
? Foreign banks' efficiency is not significantly different from that of local banks

Table 2: Variable description, measurement, and sources

Variable	**Description/Measurement**	**Data Source**
Overall technical efficiency	Overall technical efficiency derived from DEA (CCR model)	DEA (inputs and outputs from Bankscope)
Pure technical efficiency	Pure technical efficiency derived from DEA (BCC model)	DEA (inputs and outputs from Bankscope)
Scale efficiency	Scale efficiency derived from DEA	DEA (inputs and outputs from Bankscope)
Cost efficiency	Cost efficiency derived from DEA	DEA (inputs and outputs from Bankscope)
Revenue efficiency	Revenue efficiency derived from DEA	DEA (inputs and outputs from Bankscope)
Risk	The ratio of the sum of ROA and equity-to-asset ratio over the volatility of ROA	Bankscope
Capital	Total regulatory capital ratio	Bankscope
Foreign ownership	A dummy variable which adopts the value of 1 if the bank is foreign owned and 0 otherwise.	Bankscope
Bank size	Natural logarithm of total assets	Bankscope
OFFBAL	Ratio of off-balance sheet items over total assets	Bankscope
Listed bank	Dummy variable for the listed banks	Bankscope
GDP	Gross domestic product	World Development Indicators
GDPG	Gross domestic product growth	World Development Indicators
Inflation	Annual inflation rate	World Development Indicators
Lerner index	Bank competition	Bankscope
Foreign competition	The ratio of the total assets of foreign banks to total assets of the banking industry	Bankscope
Financial crisis	Dummy variable for the financial crisis 2007-2009	
Infrastructure	Mobile cellular subscriptions per 100 people	World Development Indicators
Exchange rate	Exchange rate (against US$) in the host country at time t	World Development Indicators
Trade openness	Trade openness of host country, represented by trade intensity (X+M/GDP), where X and M are exports and imports, respectively	World Development Indicators

Table 3: inputs and outputs used in the efficiency estimations

Efficiency measures	Inputs	Outputs
Technical efficiency Pure technical efficiency Scale efficiency	1. Personnel expenses 2. Total non-interest expenses 3. Total interest expenses	1. Total customer deposit 2. Loans 3. Other earning assets
Cost efficiency	<u>Inputs</u> 1. Personnel expenses 2. Total non-interest expenses 3. Total interest expenses <u>Input Prices</u> 1. Price of labour 2. Price of funds 3. Price of capital	1. Total customer deposit 2. Loans 3. Other earning assets
Revenue efficiency	1. Personnel expenses 2. Total non-interest expenses 3. Total interest expenses	1. Gross revenue

Price of funds is measured by total interest expenses divided by total funding; price of capital is measured by total non-interest income divided by total fixed assets; price of labour is measured by total personnel expenses divided by total assets.

Table 4: Descriptive statistics

	Observations	Mean	Std. Dev	Min	Max
Overall technical efficiency	968	0.397	0.183	0.099	1.000
Pure technical efficiency	968	0.454	0.212	0.106	1.000
Scale efficiency	968	0.896	0.138	0.263	1.000
Cost efficiency	968	0.336	0.185	0.048	1.000
Revenue efficiency	971	0.469	0.127	0.043	1.000
Risk	968	20.192	31.833	-9.489	346.486
Capital	968	16.984	8.391	-122.610	62.000
Foreign ownership	968	0.382	0.486	0.000	1.000
Bank size	968	15.693	1.609	11.202	20.137
OFFBAL	968	0.217	0.235	0.000	3.124
Listed bank	968	0.588	0.492	0.000	1.000
GDP	968	0.840	0.616	0.046	2.097
GDPG	968	4.228	3.482	-7.822	10.000
Lerner index	968	0.213	0.358	0.000	9.864
Foreign competition	968	22.062	19.554	0.000	100.000
Financial crisis	968	0.249	0.433	0.000	1.000
Infrastructure	968	102.507	45.981	1.078	165.501
Trade openness	968	69.445	35.736	32.667	210.374
Exchange rate	968	1370.052	3227.956	1.226	10461.240
Inflation	968	7.954	5.061	0.583	54.400

TABLE 5: Three stage least square estimation for the relationship among efficiency, risk and capital (for overall technical efficiency, pure technical efficiency and scale efficiency)

	Model where EFF = overall technical efficiency			Model where EFF = pure technical efficiency			Model where EFF = scale efficiency		
	(1.1) Y=EFF	(1.2) Y=RISK	(1.3) Y=CAPITAL	(2.1) Y=EFF	(2.2) Y=RISK	(2.3) Y=CAPITAL	(3.1) Y=EFF	(3.2) Y=RISK	(3.3) Y=CAPITAL
Foreign ownership	0.0170*	-2.720	-0.258	-0.00593	-2.091	0.122	0.0421***	-0.00932	0.433
	(0.0101)	(1.934)	(0.603)	(0.0127)	(1.927)	(0.567)	(0.00928)	(2.157)	(0.920)
EFF		22.12	11.93		23.80	7.025		-46.71**	-13.41
		(21.84)	(10.58)		(16.52)	(6.343)		(18.98)	(14.47)
Risk	0.00141*		0.0846	0.00270***		0.130	-0.00295***		0.0300
	(0.000777)		(0.114)	(0.000967)		(0.107)	(0.000674)		(0.0859)
Capital	0.00108	-0.0989		0.00256**	-0.157		-0.00184**	-0.220	
	(0.000876)	(0.167)		(0.00110)	(0.176)		(0.000804)	(0.177)	
Bank size	0.0185***	1.483*	-1.200***	0.0280***	1.220	-1.280***	0.00360	2.029***	-0.887***
	(0.00374)	(0.785)	(0.271)	(0.00470)	(0.811)	(0.302)	(0.00340)	(0.658)	(0.210)
OFFBAL	0.0209		-2.384**	-0.00671		-2.049**	0.0411**		-1.306
	(0.0230)		(1.046)	(0.0286)		(0.997)	(0.0199)		(1.223)
Listed bank	-0.0632***	-3.127	0.434	-0.0661***	-2.953	0.404	-0.0175	-5.334**	-0.620
	(0.0121)	(2.628)	(0.884)	(0.0151)	(2.465)	(0.868)	(0.0110)	(2.227)	(0.667)
GDP	-0.0111			-0.0147			0.0249		
	(0.0214)			(0.0267)			(0.0186)		
GDPG	-0.00137	0.0444	-0.0355	-0.00261	0.0295	-0.0170	0.000926	-0.0709	-2.236**
	(0.00147)	(0.271)	(0.464)	(0.00185)	(0.271)	(0.454)	(0.00135)	(0.275)	(1.044)
Lerner index	0.0494***	-2.085		0.0923***	-3.175		-0.0421***	-2.915	
	(0.0127)	(2.674)		(0.0160)	(2.887)		(0.0117)	(2.599)	
Foreign competition	-0.00154	0.0234		-0.00387**	0.0978		0.00238**	0.134	
	(0.00123)	(0.240)		(0.00155)	(0.251)		(0.00113)	(0.245)	
Financial crisis	-0.0417***	-1.847	32.32***	-0.0366**	-1.701	33.75***	-0.0239**	-3.425	17.47**
	(0.0118)	(2.381)	(11.29)	(0.0148)	(2.302)	(9.625)	(0.0108)	(2.180)	(8.593)
Inflation		-0.167	0.111		-0.239	0.142		-0.361*	-0.526*
		(0.215)	(0.176)		(0.213)	(0.180)		(0.214)	(0.297)
Infrastructure	0.000124			-0.000509*			0.000784***		
	(0.000233)			(0.000290)			(0.000203)		
Trade openness	0.00257***			0.00303***			-0.00104		
	(0.000813)			(0.00101)			(0.000704)		
Exchange rate		0.00125			0.00146			0.00200	
		(0.00370)			(0.00370)			(0.00352)	
Constant	-0.148	-29.23	25.11***	-0.335	0	25.64***	1.156***	0	58.34***
	(0.166)	(36.99)	(6.524)	(0.207)	(0)	(6.676)	(0.145)	(0)	(18.30)
N	968	968	968	968	968	968	968	968	968
Chi2	707.4***	405.2***	934.9***	467.6***	959.6***	870.5***	273.6***	953.1***	1025***
Hansen-Sargan overidentification statistic ($\chi 2$)	122.514			114.586			107.970		

TABLE 6: Three stage least square estimation for the relationship among efficiency, risk and capital (for cost efficiency and revenue efficiency)

	Model where EFF = cost efficiency			Model where EFF = revenue efficiency		
	(4.1) Y=EFF	(4.2) Y=RISK	(4.3) Y=CAPITAL	(5.1) Y=EFF	(5.2) Y=RISK	(5.3) Y=CAPITAL
Foreign ownership	-0.00807	-1.684	0.143	0.00682	-2.239	-0.266
	(0.0116)	(1.942)	(0.589)	(0.00756)	(1.945)	(0.580)
EFF		40.87**	7.395		8.367	13.48***
		(18.89)	(6.886)		(25.44)	(4.614)
Risk	0.00291***		0.134	-0.000186		0.132
	(0.000871)		(0.109)	(0.000621)		(0.0841)
Capital	0.00263***	-0.209		0.00348**	-0.524	
	(0.00100)	(0.178)		(0.00165)	(0.387)	
Bank size	0.0279***	0.641	-1.304***	0.0164***	1.382	-1.393***
	(0.00427)	(0.885)	(0.327)	(0.00329)	(0.869)	(0.263)
OFFBAL	-0.0559**		-1.329	0.0300*		-2.262**
	(0.0258)		(1.111)	(0.0175)		(1.081)
Listed bank	-0.0414***	-2.583	0.295	-0.0120	-4.581**	-0.0539
	(0.0138)	(2.384)	(0.852)	(0.00911)	(2.209)	(0.774)
GDP	0.00638			-0.0660***		
	(0.0240)			(0.0162)		
GDPG	-0.00344**	0.0995	-0.00983	-0.00279**	-0.0259	0.206
	(0.00169)	(0.273)	(0.462)	(0.00117)	(0.290)	(0.926)
Lerner index	0.0861***	-4.441		0.337***	2.116	
	(0.0146)	(2.924)		(0.0235)	(10.56)	
Foreign competition	-0.00226	0.0978		-4.83e-05	-0.166	
	(0.00141)	(0.242)		(0.000995)	(0.258)	
Financial crisis	-0.0109	-1.878	1.145	-0.00330	-2.955	14.88*
	(0.0135)	(2.203)	(7.600)	(0.00887)	(2.180)	(8.283)
Inflation		-0.237	0.131		-0.0495	0.131
		(0.212)	(0.183)		(0.227)	(0.234)
Infrastructure	-0.000488*			0.000667***		
	(0.000261)			(0.000183)		
Trade openness	0.00172*			0.000669		
	(0.000911)			(0.000611)		
Exchange rate		0.00157			-0.000889	
		(0.00365)			(0.00401)	
Constant	-0.325*	-22.75	26.48***	0	0	26.02***
	(0.187)	(35.48)	(6.883)	(0)	(0)	(6.167)
N	968	968	968	971	971	971
Chi2	368.1***	407.1***	820.8***	20596***	927.3***	330.4
Hansen-Sargan overidentification statistic ($\chi 2$)	131.207			114.893		

t-statistics are in parentheses. *, **, and *** represent significance at the 10%, 5% and 1% level, respectively.