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## **Cost and profit efficiency of banks in Haiti: do domestic banks perform better than foreign banks?**

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**Raulin Lincifort Cadet**

Center for Research in Management and  
Economic Development (CREGED),  
Faculty of Economics and Administrative Sciences,  
Quisqueya University,  
118, av. Jean Paul II, Port-au-Prince, Haiti  
Email: raulin.cadet@uniq.edu.ht  
and  
Daro Consulting,  
12, rue Tunnel – Diquini 63, Carrefour, Haiti  
Email: raulin.cadet@dariconsult.com

**Abstract:** This paper is, to my knowledge, the first to estimate a stochastic frontier model in which foreign bank ownership interacts with both the frontier and the inefficiency effects. Few studies in this field have focused on countries with a low income level, such as some African and Caribbean nations. This paper considers the case of Haiti, which is an excellent example of a developing economy with a low income level. The results reveal that foreign banks significantly impact both the frontier and the inefficiency effects. Although they enjoy technological progress, compared with domestic banks, foreign banks are less profit efficient.

**Keywords:** bank; cost efficiency; profit efficiency; foreign ownership; Haiti.

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**Biographical notes:** Raulin Lincifort Cadet is the Dean of the Faculty of Economics and Administrative Sciences at Quisqueya University. He is the Founder of Daro Consulting. He received his PhD in Economics at the University of Rennes 1. His research interests are in the fields of banking and microfinance.

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## 1 Introduction

Efficiency measurement is an essential research topic regarding firms' performance. For the banking industry, studies have assessed a wide range of aspects of banks' efficiency in different economies (Berger et al., 1993, 1997; DeYoung et al., 1998; Kumbhakar et al., 2001; Bonin et al., 2005; Carbo et al., 2007). One topic of interest is whether foreign banks are more efficient than domestic banks in developing economies.

Developing economies have a certain discrepancy in efficiency between foreign and domestic banks. Roa (2005) and Sensarma (2006), for instance, find that foreign banks are less efficient than domestic banks in the UAE and in India. On the other hand, Bonin et al. (2005) and Staikouras et al. (2008) find that foreign banks are more efficient than domestic banks in transition countries and in South Eastern Europe. Because these results in the literature are contradictory, it is essential, when considering a specific economy, to test empirically which banks are more efficient.

In addition, the literature fails to account for foreign versus domestic ownership in both the frontier and the inefficiency effects. As suggested by Bos et al. (2009), heterogeneity factors may impact both the frontier and the inefficiency effects. Because it does not make sense to consider that the banks are heterogeneous and to compare all of them to the same frontier, one should account for heterogeneity not only in the inefficiency effects but also in the frontier. Actually, when heterogeneity is not accounted for in the frontier, a bank may appear, for example, to be profit inefficient because the frontier to which it is compared is higher than its own frontier. On the other hand, when one accounts for heterogeneity only in the frontier, the effect of heterogeneity on inefficiency is missing. Thus, it is essential to account for heterogeneity in both the frontier and the inefficiency effects.

This paper is, to my knowledge, the first to estimate a stochastic frontier model in which foreign bank ownership interacts with both the frontier and the inefficiency effects. The literature also lacks studies about low-income countries such as Haiti and some African countries. Since the social and economic settings of low-income countries differ from those of transition and developed countries, it is essential to explore whether foreign and local banks differ in efficiency, as the focus of this study, Haiti, provides an excellent example of a small, developing economy with a low income level.

This paper contributes to the literature by showing that foreign banks impact both the frontier and the inefficiency effects of cost and profit. According to the results, although they enjoy technological progress that domestic banks do not, foreign banks are less profit efficient. The profit frontier of foreign banks is inferior to that of domestic banks. The profit of domestic banks, however, is closer to their frontier than it is for foreign banks. Profit scale economies exist for foreign banks, whereas scale economies do not exist for domestic banks.

The main implication of this paper is that, when one assesses foreign banks as a variable of heterogeneity, foreign banks should be allowed to affect both the frontier and the inefficiency effects. Another implication is that in developing economies where country risk is high, foreign banks may be less efficient than domestic banks.

This study uses quarterly data from 12 banks, from the first quarter of 2001 to the first quarter of 2007, to estimate the frontier. The values of scale economies and technological progress are derived from the profit frontier function. To account for heterogeneity, this paper uses the general specification, following Bos et al. (2009).

Regarding the form of the functions, the translog form is specified because of its flexibility, compared with the Cobb-Douglas form.

The rest of the paper is organised as follows. The second section presents the methodology, and the third section presents the data. The fourth section presents and discusses the results. Lastly, the conclusion summarises the study's main findings.

## 2 Methodology

To estimate banks' cost and profit efficiencies, this study uses stochastic frontier analysis (SFA), a parametric approach. Unlike non-parametric approaches, a parametric one accounts for random error. In addition, it enables the consideration of environmental variables that affect inefficiencies. When firms produce several outputs, Berger and Mester (1997) recommend using a parametric approach to compare those firms. This is the case in Haiti, where banks produce several outputs.

SFA assumes that the error term, in a cost or profit function estimation, has two components,  $v$  and  $u$ . One of the components,  $v$ , is an independent and identically distributed (i.i.d.) normal random variable. In fact,  $v$  is the random error component,  $v \sim N(0, \sigma_v^2)$ . The other component,  $u$ , measures the difference between the cost or the profit of the best-practice firm and another firm. This difference results from inefficiency, according to the SFA approach. The component  $u$  is assumed to be i.i.d half-normal,  $u \sim N^+(\mu, \sigma_u^2)$ . Following, the stochastic frontier model proposed by Aigner et al. (1977) and Meeusen and van den Broeck (1977), an extended cost function can be written as follows:

$$\ln C = \ln f(y, p) + v + u \quad (1)$$

In equation (1),  $C$  is the total of cost,  $f$  is a functional form, and  $y$  and  $p$  are outputs and input prices respectively. In the literature about SFA, the three functional forms usually used to estimate efficiency are the Cobb-Douglas form, the translog form and the Fourier-flexible (FF) form. In this paper, I use the translog form to estimate banks' cost and profit efficiency scores because of its flexibility. Because the Cobb-Douglas function imposes restrictions on returns to scale, it is not a flexible functional form, whereas the translog and FF forms are flexible functional forms.

The FF form, unlike the translog form, does not impose any restriction on the form of the estimated function. For this reason Mitchell and Onvural (1996) argue that it is preferable to estimate an FF functional form instead of a translog form. Berger and Mester (1997), however, find that although the coefficients of Fourier terms are jointly significant, the differences between average efficiencies of the translog form and the FF form are small. They find that the rank of individual bank efficiency is almost identical for the translog form and the FF form. In addition, Altunbas and Chakravarty (2001) conclude that the FF form's predictive ability is lower than that of the translog form.

The cost and the profit frontier functions are estimated using a model developed by Battese and Coelli (1995). Their model estimates the frontier and the inefficiency effects simultaneously, by maximum likelihood. Many studies have used this single-step approach (Cavallo and Rossi, 2002; Fries and Taci, 2005; Kasman and Yildirim, 2006; Lensink et al., 2008; Koutsomanoli-Filippaki et al., 2009; Pasiouras et al., 2009;

Lozano-Vivas and Pasiouras, 2010).<sup>1</sup> To account for heterogeneity, two variables are included in the frontier and in the inefficiency effects.<sup>2</sup> This is what Bos et al. (2009) call the general specification. Actually, a variable used to account for heterogeneity may affect both the frontier and inefficiency effects. The advantage of taking heterogeneity into account in such a manner is the opportunity to test if heterogeneity affects both the frontier and inefficiency effects or only one of them. Without accounting for heterogeneity in both the frontier and the inefficiency effects, bank rankings may be biased.

For two outputs and three input prices, the translog form of the cost function is specified as follows.<sup>3</sup>

$$\begin{aligned}
\ln C_{kt} = & \alpha_0 + \sum_{i=1}^2 \alpha_i \ln y_{ikt} + \sum_{l=1}^2 \beta_l \ln p_{lkt} + \delta_1 \ln E_{kt} + \phi T \\
& + \frac{1}{2} \left[ \sum_{i=1}^2 \sum_{j=1}^2 \alpha_{ij} \ln y_{ikt} \ln y_{jkt} + \sum_{l=1}^2 \sum_{m=1}^2 \beta_{lm} \ln p_{lkt} \ln p_{mkt} \right. \\
& \left. + \delta_2 \ln E_{kt} \ln E_{kt} + \phi T^2 \right] \\
& + \sum_{i=1}^2 \sum_{l=1}^2 \phi_{ij} \ln y_{ikt} \ln p_{lkt} + \sum_{i=1}^2 \delta_{3i} \ln y_{ikt} \ln E_{kt} + \sum_{l=1}^2 \delta_{4l} \ln p_{lkt} \ln E_{kt} \\
& + \sum_{i=1}^2 \phi_i T \ln y_{ikt} + \sum_{l=1}^2 \phi_l T \ln p_{lkt} + \sum_{s=1}^2 \eta_s z_{skt} + v_{kt} + u_{kt} \\
u_{kt} = & \gamma_0 + \sum_{s=1}^2 \lambda_s z_{skt} + e_{kt}
\end{aligned} \tag{2}$$

$$u_{kt} = \gamma_0 + \sum_{s=1}^2 \lambda_s z_{skt} + e_{kt} \tag{3}$$

The total cost of bank  $k$  is denoted  $C_{kt}$ ;  $y_{ikt}$  is the output  $i$  and  $p_{lkt}$  is the price of the  $l^{\text{th}}$  input of bank  $k$  in period  $t$ . For the profit frontier function, profit before tax,  $P_{kt}$ , replaces the total cost,  $C_{kt}$ . In addition, in the profit function the error term is the difference between  $v_{kt}$  and  $u_{kt}$ ,  $v_{kt} - u_{kt}$ , instead of their sum. Following Mester (1996), who first accounted for risk in efficiency measurement, I include equity ( $E_{kt}$ ) in the model to account for a bank's risk-preferences. Berger and Mester (1997) underline that if financial capital is ignored, banks' efficiency will be mismeasured. The model also includes a time trend ( $T$ ) to account for technological progress that may affect the frontier functions (Altunbas and Chakravarty, 2001; Tadesse, 2006).

The variables  $z_{skt}$  are used to account for heterogeneity. Two variables are used to account for heterogeneity:

- 1 a dummy variable that measures foreign banks
- 2 the natural logarithm of a bank's total assets, which measures the size of the bank.

The variable foreign banks relates to this paper's objective, which is to compare cost and profit efficiency of foreign and domestic banks in Haiti. Because several studies suggest that a bank's size may affect its efficiency level, the variable size is used to account for

heterogeneity in the paper. Other studies also use this variable, including Cavallo and Rossi (2001), Roa (2005), Kwan (2006), Sensarma (2006), and Ariff and Can (2008).

To verify if scale economies exist, one needs to calculate the partial derivatives of cost and profit with respect to the outputs, following Jagtiani and Khanthavit (1996), Altunbas et al. (2001), Carvallo and Kasman (2005), and Margono et al. (2010). If the value of cost scale economies is less than one, there are increasing returns to scale (cost scale economies exist), and if this value is larger than one, there are decreasing returns to scale. A value equal to one indicates constant returns to scale. For profit scale economies, if the value is larger than one, there are increasing returns to scale (profit scale economies exist). If the value of profit scale economies is less than one, however, there are decreasing returns to scale. Again, a value equal to one indicates constant returns to scale. The measure of cost scale economies is calculated as follows:<sup>4</sup>

$$SE_c = \sum_{i=1}^2 \frac{\partial \ln C_{kt}}{\partial \ln y_{ikt}} = \sum_{i=1}^2 \alpha_i + \sum_{i=1}^2 \sum_{j=1}^2 \alpha_{ij} \ln y_{jkt} + \sum_{i=1}^2 \sum_{l=1}^2 \phi_{il} \ln p_{lkt} + \sum_{i=1}^2 \delta_{3i} \ln E_{kt} + \sum_{i=1}^2 \phi_{3i} T \quad (4)$$

A bank's technological progress is also derived from the frontier functions. It is measured by the partial derivative of cost with respect to the time trend. When it comes to the profit frontier function, technological progress is measured by the formulation of the partial derivative of profit with respect to the time trend measures. Thus, technological progress is calculated as follows:<sup>5</sup>

$$TP_c = \frac{\partial \ln C_{kt}}{\partial T} = \phi + \phi_2 T + \sum_{i=1}^2 \phi_{3i} \ln y_{ikt} + \sum_{l=1}^2 \phi_{4l} \ln p_{lkt} \quad (5)$$

To verify if inefficiency effects exist in the cost function and in the profit function, the one-sided generalised likelihood ratio test is performed. Coelli (1995) points that when maximum likelihood estimation is involved, the one-sided generalised likelihood ratio test is the appropriate test to verify the presence of inefficiency effects in the model. The null hypothesis of this test is that  $\gamma = 0$ . Because the value of LR exceeds the critical value found in Table 1 of Kodde and Palm (1986), the null hypothesis, for all the regressions, is rejected. As a result, inefficiency effects exist in the estimations. The value of  $\gamma$ , which is equal to one, also indicates that inefficiency effects exist in the models.

### 3 Data

All the data come from quarterly reports that banks with operations in Haiti submit to the Bank of the Republic of Haiti (BRH). Those reports follow a standard format set by BRH. The interest rate on treasury bills is published by BRH. This paper uses unbalanced panel data of 12 banks and 25 quarters, from the first quarter of 2001 through the first quarter of 2007. Appendix lists the names of these banks. Table 1 presents the variables used in this paper.

To identify the banks' outputs, this study uses the value-added approach. Three main approaches are used in the literature to assess financial firms' efficiency: the asset or

intermediation approach, the value-added approach, and the user-cost approach. In the asset approach, a financial firm is an intermediary that raises funds, which are inputs, to produce credit and other assets, which are outputs. The value-added approach considers that all assets and liabilities have some characteristics of output. According to the value-added approach, when an asset or a liability has a large value-added, it is an output. The user-cost approach considers that an asset is an output if the financial returns associated with this asset are superior to its opportunity cost. Inversely, a liability is an output if the financial cost associated with this liability is inferior to the opportunity cost.

**Table 1** Variables used in the stochastic frontier model

<i>Symbol</i>	<i>Variable name</i>	<i>Definition</i>
$P$	Total of profit	Profit before taxes
$C$	Total cost	Total operating costs plus interest expenses
$y_1$	Net loan portfolio	Total amount of net loan portfolio
$y_2$	Deposits	Total deposits
$p_1$	Price of labour	Personnel expenses divided by the number of employees
$p_2$	Price of physical capital	Expenses for buildings plus depreciation, divided by fixed assets
$p_3$	Price of funds	Interest expenses divided by total deposits
$E$	Financial capital	Equity to assets ratio
$T$	Time-trend	Time
$z_1$	Dummy variable for foreign banks	The variable has the value 1 for foreign banks, and 0 for the other banks
$z_2$	Size of the bank	Logarithm of total assets

Berger and Humphrey (1992) point out that for deposits, banks pay interest rates that are inferior to the market interest rate. This difference constitutes the implicit cost of deposits supported by depositors. Thus, deposits can be considered outputs. Berger and Humphrey (1992) emphasise that the problem of implicit cost is particularly essential when one estimates cost efficiency. Because it estimates a cost frontier function in addition to a profit frontier function, this study uses the value-added approach to define outputs. This approach is also used by Humphrey and Pulley (1997), Carvallo and Kasman (2005), Fries and Taci (2005), and Berger et al. (2009). To estimate the cost frontier, two outputs are identified: the loan portfolio and deposits. The same approach is used to estimate profit efficiency, except that the endogenous variable,  $C$ , is replaced by  $P$ , for estimating the profit frontier function.

Regarding input prices, it is difficult to obtain data relative to market prices. To address this problem, in the literature about SFA, researchers calculate prices using data from firms' balance sheets. Because these prices are endogenous to the banks, they may cause a biased estimation of the function. To obtain exogenous prices, Bos and Kool (2006) sort the banks according to their geographic region in the Netherlands and according to the degree of urbanisation of each region. They then calculate the average prices for each category and include those prices in their estimation. Because they use data from banks' balance sheets to calculate the prices, however, Bos and Kool (2006) explain that these prices are not strictly exogenous. Nevertheless, their procedure attenuates the problem of endogenous prices.

**Table 2** Descriptive statistics of variables used in the model

Statistics	C	P	E	y <sub>1</sub>	y <sub>2</sub>	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>
<i>The whole sample</i>								
Mean	94,210.14	17,108.71	0.06	1,375,373.80	3,667,591.46	101.55	0.07	0.01
Median	64,108.50	9,719.20	0.06	877,041.00	1,920,344.00	76.66	0.05	0.01
Maximum	455,287.30	157,124.80	0.36	6,364,921.70	20,603,346.90	644.98	0.40	0.06
Minimum	1,110.00	-86,230.70	-0.28	1,996.20	8,201.00	22.33	0.01	0.00
Std. dev.	88,256.34	29,785.18	0.04	1,312,961.95	4,286,313.25	77.87	0.06	0.01
Coeff. var.	93.68%	174.09%	73.26%	95.46%	116.87%	76.68%	77.78%	66.67%
Observations	292	292	290	291	291	289	291	291
Cross-sections	12	12	12	12	12	12	12	12
<i>Domestic banks</i>								
Mean	103,480.39	17,224.55	0.06	1,448,115.24	4,083,348.67	78.31	0.05	0.01
Median	72,269.50	8,443.05	0.06	867,776.00	2,322,280.00	73.80	0.05	0.01
Maximum	455,287.30	157,124.80	0.36	6,364,921.70	20,603,346.90	186.48	0.23	0.06
Minimum	1,110.00	-86,230.70	-0.28	1,996.20	8,201.00	37.44	0.01	0.00
Std. dev.	94,131.96	32,074.05	0.05	1,421,715.18	4,600,014.69	24.40	0.03	0.01
Coeff. var.	90.97%	186.21%	79.64%	98.18%	112.65%	31.15%	53.95%	67.44%
Observations	242	242	240	241	241	239	241	241
Cross-sections	10	10	10	10	10	10	10	10
<i>Foreign banks</i>								
Mean	49,342.14	16,548.05	0.06	1,024,760.08	1,663,641.72	212.60	0.16	0.01
Median	48,387.00	13,077.20	0.05	1,026,286.00	1,689,469.50	186.05	0.14	0.01
Maximum	82,179.00	44,737.00	0.09	2,212,269.00	2,972,999.00	644.98	0.40	0.03
Minimum	24,230.00	-16,770.00	0.03	534,896.00	1,023,847.00	22.33	0.07	0.00
Std. dev.	14,098.27	14,439.41	0.01	388,470.47	381,687.47	132.40	0.07	0.01
Coeff. var.	28.57%	87.26%	26.10%	37.91%	22.94%	62.27%	42.05%	63.56%
Observations	50	50	50	50	50	50	50	50
Cross-sections	2	2	2	2	2	2	2	2

Note: Data are in thousands Gourds, except for E which is the equity to asset ratio.

The context of the banking sector in Haiti makes it quite difficult to use the same procedure as Bos and Kool (2006) to deal with the problem of availability of market prices. In this study, the input prices used in estimating the cost and profit functions are obtained through the common approach in the literature. The price of labour equals personnel expenses divided by the number of employees. When data concerning number of employees are not available, however, researchers define another proxy for the price of labour. For instance, Vennet (2002) and Carvallo and Kasman (2005) divide personnel expenses by total assets. The price of physical capital equals the sum of capital expenses and depreciation, divided by total fixed assets. The price of funds is calculated as the total interest expenses divided by total deposits. The approach used herein to measure input prices has been used by most studies on banking efficiency (Mester, 1996; Havrylchuk, 2006; Berger et al., 2009).

To account for symmetry and homogeneity restrictions, I normalise the endogenous variables and two input prices, the price of labour, and the price of physical capital, dividing them by the price of funds. In addition, the outputs are divided by the total of assets to avoid problems of heteroscedasticity.

Table 2 reports the descriptive statistics of the variables used in the model. Domestic banks have higher average costs than foreign banks. The average profit of domestic banks, however, is higher than that of foreign banks. Additionally, the average of the equity-to-asset ratio is the same value, 0.06, for both foreign and domestic banks. This value of 6% is slightly superior to the prudential capital requirement of 5% imposed on banks by BRH. This finding is in line with Rochet (2004) who proves that banks maintain capital to the exact minimum requirement in economies where deposit insurance prevails. Actually, there is implicit deposit insurance in Haiti.

#### **4 Results and discussion**

Table 3 reports the results of the estimations. To test the robustness of these results, the specifications are modified so that the foreign dummy shifts the frontier but not the inefficiency effects, and vice versa (see Tables 4 and 5). The results are robust for the profit estimations, and they are ambiguous for the inefficiency effects of the cost estimations. Considering the impact of foreign banks on the frontier, the results reveal that the profit frontier of foreign banks is lower than that of domestic banks. Thus, foreign banks have fewer possibility to maximise their profit than domestic banks. In addition, the results show that foreign banks are less profit efficient than domestic banks. This finding may result from the risk-mitigating restrictions set for foreign banks by their headquarters.

Regarding the regression named 'Cost 1' (Table 3), the results show that the cost frontier of foreign banks is lower than that of domestic banks. This means that foreign banks use technology that allows them to produce at lower cost than domestic banks. Probably, this result stems from the fact that foreign banks use advanced technology for credit screening. The literature regarding foreign bank entry reveals that most of the time, in developing and emerging economies, foreign banks finance profitable firms using better screening techniques (Gormley, 2010; Jeon et al., 2011; Lin, 2011).<sup>6</sup> Indeed, advanced technology can allow foreign banks to reduce cost, as suggested by Berger and DeYoung (2006). Detragiache et al. (2008) think that foreign banks are less risky than domestic banks in poor countries because they use advanced risk management



technology. The results regarding the impact of foreign banks on the inefficiency effects and on the cost frontier differ from one estimation to another. Thus, those results are ambiguous. The results are also ambiguous regarding the impact of bank size on inefficiency effects and on the cost frontier.

**Table 3** Effects of foreign banks and size on the frontiers and inefficiency effects (t-statistics in brackets)

Variables	Symbol	Regressions	
		Cost I	Profit I
<i>Heterogeneity in the frontier</i>			
Foreign bank	$z_1$	-1.059* (-12.368)	-0.381* (-5.477)
Size	$z_2$	0.995* (51.952)	0.147* (6.086)
<i>Heterogeneity in the inefficiency effects</i>			
Constant		3.393* (8.419)	-33.811* (-44.182)
Foreign bank	$z_1$	0.410* (4.773)	2.638* (4.171)
Size	$z_2$	-0.211* (-7.625)	0.947* (11.795)
$\sigma^2$		0.075* (12.900)	7.317* (22.080)
$\gamma$		0.999* (781,242.8)	0.999* (2,442.7)
Likelihood-ratio (LR)		27.921	501.068
Mean eff. scores		0.621	0.758

Note: \*Indicates significance at the 1% level.

The results show that the foreign banks variable affects both the frontier and the inefficiency effects of banks' profit and cost. No other study, to my knowledge, has accounted for bank ownership in both the frontier and the inefficiency effects. Because this finding shows that bank ownership affects both the frontier and the inefficiency effects, it is essential to the literature about bank efficiency.

My results also suggest that, in developing economies, foreign banks may be less efficient than domestic banks. Actually, Lensink et al. (2008) show that less similarity between home and host country institutional quality increases foreign banks' inefficiency. In the context of developing economies, foreign banks are expected to be more efficient than domestic banks, because the quality of host institutions tends to be inferior to the quality of home institutions. Berger (2007) comparing efficiency in the banking industry around the globe, notes that foreign-owned banks tend to be less efficient than domestic banks in developed nations, whereas the tendency is reversed in developing economies. Nevertheless, he admits that some studies show that foreign banks are less efficient than domestic banks in some developing countries. Berger (2007) points

out that probably, a foreign banks' objective is not to minimise its cost and maximise its profit but rather to diversify its risk. According to Lensink et al. (2008), in countries with poor governance, the relationship between foreign bank ownership and efficiency is negative. They explain that the reasons for this negative relationship include the difficulties that foreign banks face in dealing with local banking regulations and corruption. In Haiti, foreign banks are less profit efficient than domestic banks, likely because foreign banks' main objective is to diversify their risk, as explained by Berger (2007). It does not seem to me that in Haiti, corruption or difficulty in dealing with local banking regulations could explain the results analysed in this paragraph. Indeed, the two foreign banks have been established in Haiti for more than 25 years prior to the period considered in this paper.

Regarding the effect of bank size on the frontier, the results show that the larger a bank is, the more its profit frontier is shifted upward (see the results in Tables 3 and 5). Thus, the larger a bank, the greater its ability to maximise its profit. It is easier for larger banks than for smaller banks to diversify their assets and take higher risks to generate higher profits. Nevertheless, managing high risks requires high costs. Indeed, two regressions show that the larger a bank is, the higher its cost frontier is. A third regression, however, reveals an opposite result regarding the impact of the banks' size on their cost frontier.

**Table 4** The results of cost estimations are ambiguous (t-statistics in brackets)

<i>Variables</i>	<i>Symbol</i>	<i>Regressions</i>	
		<i>Cost 2</i>	<i>Cost 3</i>
<i>Heterogeneity in the frontier</i>			
Foreign bank	$z_1$		-0.007 (-0.974)
Size	$z_2$	0.353* (10.289)	-0.311* (-3.387)
<i>Heterogeneity in the inefficiency effects</i>			
Constant		-6.510* (-15.016)	10.210* (-23.653)
Foreign bank	$z_1$	0.723* (-10.631)	
Size	$z_2$	0.523* (16.481)	-0.003 (-0.144)
$\sigma^2$		0.476* (10.333)	1.608* (14.813)
$\gamma$		0.999* (147.40)	0.966* (231.37)
Likelihood-ratio (LR)		124.463	584.42
Mean eff. scores		0.246	0.863

Note: \*Indicates significance at the 1% level.

**Table 5** The results of profit estimations are robust (t-statistics in brackets)

Variables	Symbol	Regressions	
		Profit 2	Profit 3
<i>Heterogeneity in the frontier</i>			
Foreign bank	$z_1$		-0.418* (-5.393)
Size	$z_2$	0.177* (7.648)	0.134* (5.380)
<i>Heterogeneity in the inefficiency effects</i>			
Constant		-27.744* (-19.305)	-32.220* (-6.584)
Foreign bank	$z_1$	10.003* (12.693)	
Size	$z_2$	0.421* (2.898)	1.020* (5.026)
$\sigma^2$		7.747* (21.734)	6.112* (9.558)
$\gamma$		0.999* (5,040.921)	0.999* (2,090.459)
Likelihood-ratio (LR)		496.597	498.345
Mean eff. scores		0.740	0.765

Note: \*Indicates significance at the 1% level.

The results show that larger banks increase profit inefficiency. Thus, small banks operate closer to their profit frontier than do large banks. With regard to cost inefficiency, the sign of the size variable differs from one regression to another. Thus, those results are ambiguous. Actually, regarding the variable bank size, results in the literature differ. For instance, Kwan (2006) and Sensarma (2006) find that large banks are less cost efficient than small banks. On the other hand, Roa (2005) finds that bank size has no effect on cost inefficiency in the UAE. As for banks in South Eastern European countries, Staikouras et al. (2008) find that medium-sized banks are more efficient than large or small banks.

**Table 6** Average profit scale economies for banks in Haiti

Bank	Scale economies
Foreign banks	1.35
Domestic banks	0.48
All	0.63

Note: Ital numbers indicate that there are scale economies.

**Table 7** Average profit technological progress for banks in Haiti

<i>Bank</i>	<i>Technological progress</i>
Foreign banks	0.11
Domestic banks	-0.32
All	-0.24

Note: Ital numbers indicate that there is technological progress.

The results of the present paper suggest that banks, on average, maximise their profit at 75.8%, relative to the best practice in the Haitian banking sector. This result, which is robust, outperforms the relative efficiency level of 69.40% found by Bonin et al. (2005) for transition countries, and 47.6% found by Berger et al. (2009) for China. This higher level may be explained by the fact that banks can profit more easily in developing countries than in advanced economies. In Haiti, even bank managers admit that banks are profiting easily through central bank bonds, which are risk-free assets.<sup>7</sup>

Table 6 presents the average scale economies for foreign banks, domestic banks, and the sample. The results suggest that during the period considered in the paper, profit scale economies exist for foreign banks but not for domestic banks. Thus, the results suggest that, in Haiti, foreign banks may increase their production to increase their marginal profit. According to the results related to technological progress (see Table 7), foreign banks do enjoy average technological progress during the period considered in this study.

## 5 Conclusions

Because inefficiency implies waste of resources and increasing risk of failure, an assessment of efficiency differences between foreign and domestic banks is of an essential interest from a policy perspective. This paper tests whether foreign banks affect the frontier and the inefficiency effects for banks in Haiti, which is an excellent example of a developing country with a low income level. The SFA approach is used to estimate a translog form of the cost and profit frontiers.

The results reveal that foreign ownership impacts both the frontier and the inefficiency effects of the banks' profit. They reveal the same for the banks' costs. Most of the results relating to cost efficiency, however, are ambiguous. Although foreign banks take greater advantage of technological progress, they are less profit efficient than domestic banks. In addition, the paper shows that profit scale economies exist only for foreign banks. Thus, because of profit scale economies, foreign banks may further increase their marginal profit by increasing their production.

Regarding profit estimation, the results are robust. Actually, most of the translog terms, not shown in the paper, are significant. Unlike cost estimations, the results are coherent through the estimations of profit efficiency. In addition, the one-sided generalised likelihood ratio test indicates the presence of inefficiency effects. Further research should assess the impact of foreign ownership on both the frontier and the inefficiency effects in both transition and developed economies.

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## References

- Aigner, D.J., Lovell, C.A.K. and Schmidt, P. (1977) 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics*, Vol. 6, No. 1, p.21–37.
- Altunbas, Y. and Chakravarty, S.P. (2001) 'Frontier cost functions and bank efficiency', *Economic Letters*, Vol. 72, No. 2, pp.233–240.
- Altunbas, Y., Gardener, E.P.M., Molyneux, P. and Moore, B. (2001) 'Efficiency in European banking', *European Economic Review*, Vol. 45, No. 10, pp.1931–1955.
- Ariff, M. and Can, L. (2008) 'Cost and profit efficiency of Chinese banks: a nonparametric analysis', *China Economic Review*, Vol. 19, No. 2), pp.260–273.
- Battese, G.E. and Coelli, T.J. (1995) 'A model for technical inefficiency effects in a stochastic frontier production for panel data', *Empirical Economics*, Vol. 20, No. 2, pp.325–332.
- Berger, A.N. (2007) 'International comparisons of banking efficiency', *Financial Markets, Institutions & Instruments*, Vol. 16, No. 3, pp.119–144.
- Berger, A.N. and DeYoung, R. (2006) 'Technological progress and the geographic expansion of the banking industry', *Journal of Money, Credit and Banking*, Vol. 38, No. 6, pp.1483–1513.
- Berger, A.N. and Humphrey, D.B. (1992) 'Measurement and efficiency in banking', in Griliches, Z. (Ed.): *Output Measurement in the Service Sectors*, pp.245–279, University of Chicago Press, Chicago.
- Berger, A.N. and Mester, L.J. (1997) 'Inside the black box: what explains differences in the efficiencies of financial institutions?', *Journal of Banking and Finance*, Vol. 21, No. 7, pp.895–947.
- Berger, A.N., Hancock, D. and Humphrey, D.B. (1993) 'Bank efficiency derived from the profit function', *Journal of Banking and Finance*, Vol. 17, Nos. 2–3, pp.317–347.
- Berger, A.N., Hasan, I. and Zhou, M. (2009) 'Bank ownership and efficiency in China: what will happen in the world's largest nation?', *Journal of Banking and Finance*, Vol. 33, No. 1, pp.113–130.
- Berger, A.N., Leusner, J.H. and Mingo, J.J. (1997) 'The efficiency of bank branches', *Journal of Monetary Economics*, Vol. 40, No. 1, pp.141–162.
- Bonin, J.P., Hasan, I. and Wachtel, P. (2005) 'Bank performance, efficiency and ownership in transition countries', *Journal of Banking and Finance*, Vol. 29, No. 1, pp.31–53.
- Bos, J.W.B. and Kool, C.J.M. (2006) 'Bank efficiency: the role of bank strategy and local market conditions', *Journal of Banking and Finance*, Vol. 30, No. 7, pp.1953–1974.
- Bos, J.W.B., Koetter, M., Kolari, J.W. and Kool, C.J.M. (2009) 'Effects of heterogeneity on bank efficiency scores', *European Journal of Operational Research*, Vol. 195, No. 1, pp.251–261.
- Carbo, S., Humphrey, D.B. and del Paso, R.L. (2007) 'Do cross-country differences in bank efficiency support a policy of 'national champions?'', *Journal of Banking and Finance*, Vol. 31, No. 7, pp.2173–2188.
- Carvalho, O. and Kasman, A. (2005) 'Cost efficiency in the Latin American and Caribbean banking systems', *Journal of International Financial Markets Institutions and Money*, Vol. 15, No. 1, pp.55–72.

- Cavallo, L. and Rossi, S.P.S. (2001) 'Scale and scope economies in the European banking systems', *Journal of Multinational Financial Management*, Vol. 11, Nos. 4–5, pp.515–531.
- Cavallo, L. and Rossi, S.P.S. (2002) 'Do environmental variables affect the performance and technical efficiency of the European banking system? A parametric analysis using the stochastic frontier approach', *The European Journal of Finance*, Vol. 8, No. 1, pp.123–146.
- Coelli, T.J. (1995) 'Estimators and hypothesis tests for a stochastic frontier function: a Monte Carlo analysis', *Journal of Productivity Analysis*, Vol. 6, No. 3, pp.247–268.
- Coelli, T.J.Y.J., Rao, D.S.P., O'Donnell, C.J. and Battese, G.E. (2005) *An Introduction to Efficiency and Productivity Analysis*, 2nd ed., Springer, New York.
- Detragiache, E., Tressel, T. and Gupta, P. (2008) 'Foreign banks in poor countries: theory and evidence', *The Journal of Finance*, Vol. 63, No. 5, pp.2123–2160.
- DeYoung, R., Hasan, I. and Kirchhoff, B. (1998) 'The impact of out-of-state on the cost efficiency of local commercial banks', *Journal of Economics and Business*, Vol. 50, No. 2, pp.191–203.
- Fries, S. and Taci, A. (2005) 'Cost efficiency of banks in transition: evidence from 289 banks in 15 post-communist countries', *Journal of Banking and Finance*, Vol. 29, No. 1, pp.55–81.
- Gormley, T.A. (2010) 'The impact of foreign bank entry in emerging markets: evidence from India', *Journal of Financial Intermediation*, Vol. 19, No. 1, pp.26–51.
- Havrylychuk, O. (2006) 'Efficiency of the Polish banking industry: foreign versus domestic banks', *Journal of Banking and Finance*, Vol. 30, No. 7, pp.1975–1996.
- Humphrey, D.B. and Pulley, L.B. (1997) 'Banks' responses to deregulation: profits, technology, and efficiency', *Journal of Money, Credit and Banking*, Vol. 29, No. 1, pp.73–93.
- Jagtiani, J. and Khanthavit, A. (1996) 'Scale and scope economies at large banks: including off-balance sheet products and regulatory effects (1984–1991)', *Journal of Banking and Finance*, Vol. 20, No. 7, pp.1271–1287.
- Jeon, B.N., Olivero, M.P. and Wu, J. (2011) 'Do foreign banks increase competition? Evidence from emerging Asian and Latin American banking markets', *Journal of Banking and Finance*, Vol. 35, No. 4, pp.856–875.
- Kasman, A. and Yildirim, C. (2006) 'Cost and profit efficiencies in transition banking: the case of new EU members', *Applied Economics*, Vol. 38, No. 9, pp.1079–1090.
- Kodde, D.A. and Palm, F.C. (1986) 'Wald criteria for jointly testing equality and inequality restrictions', *Econometrica*, Vol. 54, No. 5, pp.1234–1248.
- Koutsomanoli-Filippaki, A., Margaritis, D. and Staikouras, C. (2009) 'Efficiency and productivity growth in the banking industry of Central and Eastern Europe', *Journal of Banking and Finance*, Vol. 33, No. 3, pp.557–567.
- Kumbhakar, S.C., Lozano-Vivas, A., Lovell, C.A.K. and Hasan, I. (2001) 'The effects of deregulation on the performance of financial institutions: the case of Spanish savings banks', *Journal of Money, Credit and Banking*, Vol. 33, No. 1, pp.101–120.
- Kwan, S.H. (2006) 'The X-efficiency of commercial banks in Hong Kong', *Journal of Banking and Finance*, Vol. 30, No. 4, pp.1127–1147.
- Lensink, R., Meesters, A. and Naaborg, I. (2008) 'Bank efficiency and foreign ownership: do good institutions matter?', *Journal of Banking and Finance*, Vol. 32, No. 5, pp.834–844.
- Lin, H. (2011) 'Foreign bank entry and firms' access to bank credit: evidence from China', *Journal of Banking and Finance*, Vol. 35, No. 4, pp.1000–1010.
- Lozano-Vivas, A. and Pasiouras, F. (2010) 'The impact of non-traditional activities on the estimation of bank efficiency: international evidence', *Journal of Banking and Finance*, Vol. 34, No. 7, pp.1436–1449.
- Margono, H., Sharma, S.C. and Melvin, P.D. II (2010) 'Cost efficiency, economies of scale, technological progress and productivity in Indonesian banks', *Journal of Asian Economics*, Vol. 21, No. 1, pp.53–65.
- Meeusen, W. and van den Broeck, J. (1977) 'Efficiency estimation from Cobb-Douglas production functions with composed error', *International Economic Review*, Vol. 18, No. 2, pp.435–444.

- Mester, L.J. (1996) 'A study of bank efficiency taking into account risk-preferences', *Journal of Banking and Finance*, Vol. 20, No. 6, pp.1025–1045.
- Mitchell, K. and Onvural, N.M. (1996) 'Economies of scale and scope at large commercial banks: evidence from the Fourier flexible functional form', *Journal of Money, Credit and Banking*, Vol. 28, No. 2, pp.178–199.
- Pasiouras, F., Tanna, S. and Zopounidis, C. (2009) 'The impact of banking regulation on banks' cost and profit efficiency: cross-country evidence', *International Review of Financial Analysis*, Vol. 18, No. 5, pp.294–302.
- Roa, A. (2005) 'Cost frontier efficiency and risk-return analysis in an emerging market', *International Review of Financial Analysis*, Vol. 14, No. 3, pp.283–303.
- Rochet, J.C. (2004) 'Capital requirements and the behavior of commercial banks', *Credit, Intermediation and the Macroeconomy: Models and Perspectives*, Oxford University Press, Oxford.
- Sensarma, R. (2006) 'Are foreign banks always the best? Comparison of state-owned, private and foreign banks in India', *Economic Modelling*, Vol. 23, No. 4, pp.717–735.
- Simar, L. and Wilson, P.W. (2007) 'Estimation and inference in two-stage, semiparametric models of production processes', *Journal of Econometrics*, Vol. 136, No. 1, pp.31–64.
- Staikouras, C., Mamatzakis, E. and Koutsomanoli-Filippaki, A. (2008) 'Cost efficiency of the banking industry in the South eastern European region', *Journal of International Financial Markets, Institutions and Money*, Vol. 18, No. 5, pp.483–497.
- Tadesse, S. (2006) 'Consolidation, scale economies and technological change in Japanese banking', *Journal of International Financial Markets, Institutions and Money*, Vol. 16, No. 5, pp.425–445.
- Vennet, R.V. (2002) 'Cost and profit efficiency of financial conglomerates and universal banks in Europe', *Journal of Money, Credit, and Banking*, Vol. 34, No. 1, pp.254–282.

## Notes

- 1 Simar and Wilson (2007) and Coelli et al. (2005) show the disadvantages of the two-stage methodology.
- 2 An anonymous referee suggests considering Bos et al. (2009), which explores the effects of heterogeneity on bank efficiency scores.
- 3 To ensure linear homogeneity, two of the prices are divided by the other one. For this reason, only two prices are used in the model specification.
- 4 One has to replace  $\partial \ln C_{kt}$  with  $\partial \ln P_{kt}$  in equation (4), to calculate profit scale economies ( $SE_p$ ).
- 5 To measure technological progress resulting from profit function, one has to replace  $\partial \ln C_{kt}$  with  $\partial \ln P_{kt}$  in equation (5).
- 6 In Haiti, the two foreign banks considered in this study even screen the depositors, because the minimum balances required for savings and checking accounts are far higher than in domestic banks.
- 7 Because the government did not reimburse some bills, in Haiti, no more treasury bills were issued for many years. To manage liquidity in the economy, the central bank used to issue its own bonds. At the time of this writing, the government has started to issue treasury bills again.

## **Appendix**

### List of the banks of the sample

#### Domestic banks:

- 1 Banque Nationale de Crédit (BNC)
- 2 Banque Populaire Haïtienne (BPH)
- 3 Banque de l'Union Haïtienne (BUH)
- 4 Capital Bank
- 5 Banque de Promotion Industrielle et Commerciale S.A. (Promobank)
- 6 Société Caraïbienne de Banque S.A. (SOCABANK)
- 7 Socabel
- 8 Société Générale Haïtienne de Banque S.A. (SOGEBANK)
- 9 Sogebel
- 10 Unibank.

#### Foreign banks:

- 1 Citibank.
- 2 Scotia Bank.