INSTITUTO DE ECONOMÍA

DOCUMENTO de TRABAJO

399

2011

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www.economia.puc.cl · ISSN (edición impresa) 0716-7334 · ISSN (edición electrónica) 0717-7593

Versión impresa ISSN: 0716-7334
Versión electrónica ISSN: 0717-7593

PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
INSTITUTO DE ECONOMIA

Oficina de Publicaciones
Casilla 76, Correo 17, Santiago
www.economia.puc.cl

THE EFFICIENCY COST OF THE *KAFALA* IN DUBAI: A STOCHASTIC FRONTIER ANALYSIS

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Documento de Trabajo Nº 399

Santiago, Noviembre 2011

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The Efficiency Cost of the *Kafala* in Dubai: A Stochastic Frontier Analysis†

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Tuesday, November 22, 2011

Abstract

The *Kafala* (or sponsorship) system is the key instrument behind the economic development of the United Arab Emirates (UAE) and most Middle East economies. The system governs both labor migration and foreign investment by assigning a native-UAE sponsor to each migrant worker and each foreign investor. Sponsors enjoy significant command over these factors and extract sizable economic rents. Firms in free-zones, in contrast, are exempt from the *Kafala* system. Therefore, they provide an appropriate counterfactual to study the effect of policy regulations on technical efficiency. Using a representative sample of 600 firms of Dubai we estimate stochastic frontier models to identify and compare the degree of technical inefficiency between firms operating under the *Kafala* system and those in free zones. Our results suggest that on average technical inefficiency resulting from the *Kafala* amounts to 6.6% of total costs (or 11% of profits). Inefficiency is also greater among firms in Main Dubai in all economic sectors.

Keywords: Labor sponsorship (*Kafala*), Technical inefficiency, Economic rents

JEL – Classification: D2, L5, 053

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1. Motivation

Technical inefficiency can be defined as the failure to produce the maximal possible output, given input levels (Farrel, 1957). Comparing actual output to maximal possible output gives rise to an output-based inefficiency measure.[1] Literature on technical efficiency measurement is abundant (see Kumbhakar and Lovell 2000 for applications and Amsler et al. 2009 for a survey on econometric techniques). Beyond measurement issues lies the obvious economic interest in explaining the reasons for the observed differences in efficiency among firms. A classical explanation links efficiency and business environment: even in the same country and sector, firms can be confronted to constraints of very different kind and magnitude: asymmetric laws and taxes, labor regulations, reputation, networks, domestic and foreign competition, among others, all of which are likely to impact on innovation, production and, therefore, on technical efficiency (Schumpeter, 1943).

The United Arab Emirates (UAE) provides an interesting case to study the effects of policy regulations on technical efficiency. Like several countries in the Arab region, the UAE has implemented and based its development strategy upon a very particular scheme known as the sponsorship system (*Kafala*, in Arabic) that regulates labor immigration and foreign investment. In accordance with the *Kafala*, foreign investors can only set up their businesses if they enter into partnership with an Emirati local-business sponsor who retains at least 51% of property.[2] Likewise, the *Kafala* rules that migrant workers also require a national sponsor, are only allowed to work for the firm that sponsored his/her visa, must obtain a no-objection certificate from his sponsor to resign, and have to leave the UAE upon termination of the contract (usually 2 to 3 years) before being allowed to

[1] Duality indicates that technical inefficiency can also be thought of as the failure to use the minimal possible inputs to produce a given output level. Comparing the actual inputs to the minimal possible inputs gives rise to an input based inefficiency measure.

[2] An Emirati local-business sponsor (or partner) is defined as a person holding UAE citizenship or a corporate body with *all* directors in the board consisting of UAE nationals. The sponsor is required to represent the company in all legal matters. For 'Limited Liability Companies', the foreign investor must allocate at least 51% of the shares to the sponsor, although the sponsor is not expected to invest money in the business. The sponsor, nevertheless, does not have the right to share profits proportionally, frequently agreeing with the foreign investor to receive an annual fee. In the case of a sole proprietor or civil companies –i.e., firms operated by professionals in particular vocations– ownership is 100% for the foreign investor. However, it is compulsory to appoint a UAE national sponsor as 'the local service agent'. This local service agent is not involved in business operations and is paid an annual fixed fee or a share of profits. Nominally, the local service agent assists in obtaining licenses, visas and labor cards.

commence a new contract under a new sponsor.[3] The implication is that migrants are tied to the sponsor –and consequently immobile within the internal labor market– for the duration of the contract inasmuch as the movement of migrant workers between firms is not allowed. Labor relocation within firms is also unlikely if it entails contract and/or wage modifications. A key consequence is that sponsors benefit from non-competitive environments where they are allowed to extract substantial economic rents from both migrant workers and foreign investors, but at the expense of inducing significant inefficiencies in production.

Workers and firms in the numerous free-zones of Dubai, in contrast, are not subject to the *Kafala* and enjoy considerably more freedom. Foreign investment is neither bound by the 49%/51% property limitation nor required to appoint a local service agent. Migrants working in free zones, while not as free as in economies with modern labor markets, are allowed to switch among firms inside the same free zone if labor conditions are not in their favor and, consequently, have some bargaining power to affect their working stance. Finally, firms operating in free zones are not bounded by other employment policies established by the UAE Ministry of Labor for firms outside free zones. Among others, firms in free zones are exempt from the established minimum quota of Emirati workers that burden some sectors outside free-zones (banking and insurance companies). Rent extraction in free zones is thus more constrained than in Main Dubai.

Empirical evidence indicates that firms in free zones tend to perform better than firms outside free zones. Using data from the Emirate of Dubai, Vazquez-Alvarez (2011) estimates that firms in free zones have higher average labor productivity, they also pay much higher wages and they tend to invest more in both physical capital and training of their workers. Observed differences in labor market outcomes, however, do not provide causal evidence to suggest that firms in the free zones are more or less *efficient* than their counterparts operating under the *Kafala* system.

This paper provides quantitative estimates of technical inefficiency at the plant level using a firm-level survey representative of all key economic sectors of the Emirate of Dubai.

[3] Starting from January 2011, new rules allow migrants classified as high-skill workers which have spent at least two years in the UAE to move to a new sponsor without a letter of consent from the previous sponsor and without the need to leave and re-enter the country. Workers holding a university degree and in management positions are able to move companies without a no objection letter.

The survey covers both free zones (FZ) and the non-free zone areas of the Emirate (hereafter Main Dubai or MD). We document that most of the differences in business environment between MD and the FZ relate to the sponsorship (*Kafala)* system, so that a comparison in performance between firms in these two environments provide insights as to the efficiency costs of the sponsorship system. In this sense, our analysis belongs to the strand of the literature that studies how business environment influences directly firm performance (as opposed, for example, to affecting the choice of technology).

The measurement of technical inefficiency is done applying stochastic frontier analysis to a cross-section of about 600 firms surveyed in Dubai in 2010. This widely used econometric technique allows us to separate systematic inefficiency from random fluctuations in production by the different firms. One advantage of stochastic frontier models is their ability to model the production relationship and, simultaneously, the determinants of inefficiency. A second advantage is in their generality: a large family of production relationships (from the standard Cobb-Douglas to the CES function) can be accommodated easily into the stochastic frontier model.

Despite its importance in shaping labor markets in the Middle East, the *Kafala* has not been the subject of quantitative analysis and only a few papers have studied its nature or effects. Early work on this topic can be found in Beauge (1986) and Levergne (2003) which provide descriptions of the migratory flows from less developed countries to the GCC economies and the living conditions of the workers. These studies, as well as more recent work collected in a volume by the Middle East Institute (2010), do not provide a formal evaluation of the operation of the *Kafala* in the labor market nor of its impact on efficiency or industrial development; instead, they provide a wealth of information on the living conditions of migrant workers.

Recent research by Baldwin-Edwards (2011) provides, to our knowledge, the only systematic account of the *Kafala* in the GCC region. The comparative analysis include the UAE as well as Bahrain, Kuwait, Oman, Qatar and Saudi Arabia and concentrates on the outcome of the *Kafala* in terms of migratory flows, participation rates, unemployment, and other dimensions of the labor market. Lack of data precluded the author from any quantitative assessment.

Section 2 of this paper describes the differences in business environments between firms in MD and the FZ. We make the case that the main differences in operation between firms inside and outside the FZ refer to the sponsorship system, affecting both labor and property (and implicitly access to land). Because firms operating in the Emirate of Dubai must register and obtain a license in either the free zone authority (hereafter FZA) or the local licensing authority in MD, we can use such license as the identifying instrument that makes possible to study the effects of the *Kafala* in efficiency and at productivity levels.

Section 3 of the paper provides a brief description of stochastic frontier models, stressing those elements that are important for our case: first, the existence of significant heterogeneity in firms and its possible impact in terms of heteroscedasticity which, in stochastic frontier models, can bias the estimated parameters; second, the difficulties in doing inference about parameters and specification tests due to the dual nature of uncertainty in the model (random shocks and firm inefficiency) and, third, the importance of sample size vis-à-vis the size of random shocks relative to the measure of firm's inefficiency.

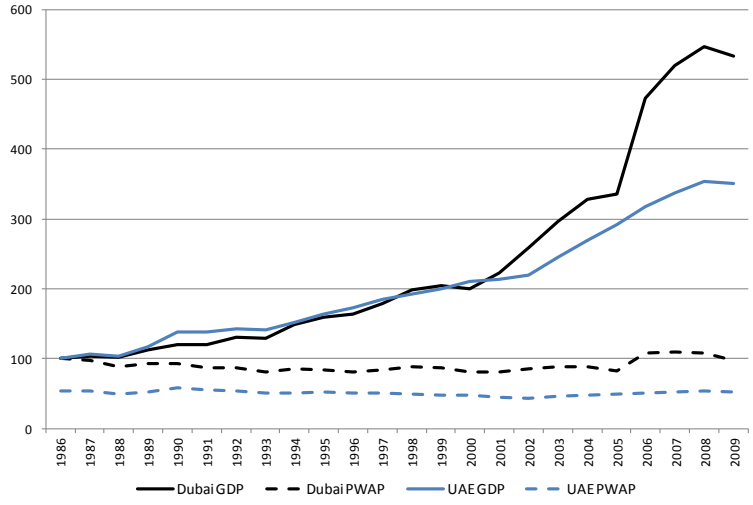
Section 4 of the paper presents the econometric analysis and the estimates of technical inefficiency by sector and business environment. The classic model of cost-efficiency as determined by a scale variable (sales) and the cost of inputs (labor, capital) is extended to consider the actual level of capacity utilization, the age of firms, and the number of hours worked (to control for industries operating with multiple shifts). We also model the heteroscedasticity of both inefficiency and innovations. This is an important consideration to avoid biasing the econometric results and the estimated inefficiency levels (as discussed in Caudill et al., 1995). Finally, Section 5 collects the main results and conclusions. A set of appendices complements the paper.

2 Economic Performance and the *Kafala* system in Dubai

Since the foundation of the UAE in 1971, economic activity in the Emirate of Dubai has expanded dramatically, not just in comparison with the other six Emirates in the

Federation but also in relation to other high-growth, city-states such as Hong Kong or Singapore (see Elbadawi and Soto (2011) for a comparative assessment). Whereas the UAE as a whole expanded by a factor of three in real terms between 1986 and 2010, Dubai expanded by a factor of five (see Figure 1). Such fast economic growth has been largely the result of massive investment and a substantial inflow of migrant workers. Average labor productivity (measured by real GDP per worker), on the other hand, has remained virtually stagnant in the last two decades indicating a severe limitation in the development path of the UAE; we return to this issue below and link it to the incentives given by the *Kafala*.

Figure 1
Real Gross Domestic Product and estimated Average Productivity per Worker (PWAP) [4]
(normalization: Dubai in 1986=100)



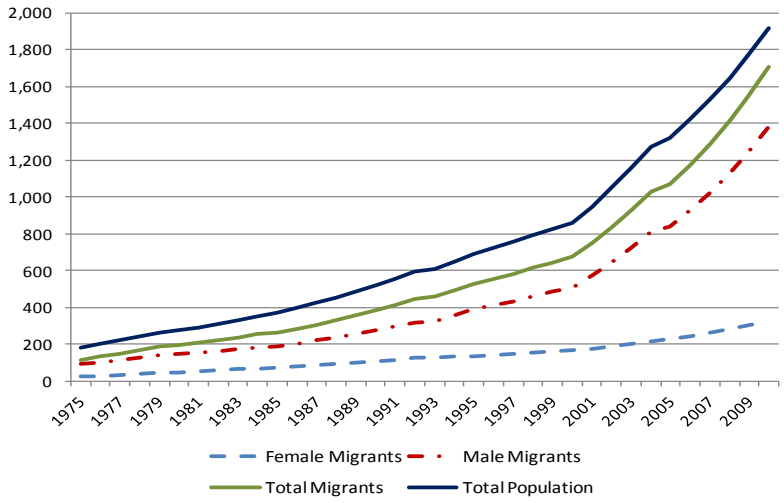
Source: Own estimates, based on data from the Dubai Statistics Centre and UAE National Bureau of Statistics

One key determinant of the remarkable growth of the UAE –and in particular, Dubai– is the continuous import of large volumes of low-cost workers to be employed in unskilled and semi-skilled positions in the construction, manufacturing and service sectors. The first waves of migrants arrived in the UAE in the 1960s from poorer neighboring Arab

[4] As customary, GDP stands for real Gross Domestic Product. PWAP stands for real GDP per worker computed as real GDP over working-age population at each point in time.

economies. Later, they were replaced by workers from South East Asia and the Indian sub-continent.[5] Figure 2 shows the evolution of the population in Dubai. According to the Dubai Statistics Centre, total population in the Emirate reached 1.9 million in 2010 and of these only 11% were native Emirati. Notably, among the 1.7 million of non-Emirati population, 81% were males.[6] One reason for the gender imbalance among migrants is that workers earning less than AED 10 thousand per month (US$ 2,650) are forbidden to bring their families to live in the UAE. The continued expansion in the stock of migrants is largely due to the systematic growth in the demand for workers and is not the result of an accumulation of migrants settling among the natives in the population. Most migrants remain in the UAE for short periods of time (two to three years) and, as a rule, they are not considered by the UAE authorities to be eligible for permanent residency. Children born in Dubai to non-UAE citizens are not given nationality and remain as expatriates.

Figure 2
Population in Dubai by gender and origin
(in thousands)



Source: Own projections, data from census data of the Dubai Statistics Centre and UAE National Bureau of Statistics.

[5] Migrants arrived first after the 1948 Arab-Israeli war. In the 1970s Arab migrants represented 60% of all expatriate workers in the GCC economies and 40% in the UAE (Doper, 2006). Nowadays the Arab community accounts for only 13% of the UAE expatriate community as result of the massive immigration of workers from Bangladesh, India, Iran, Pakistan and Philippines (2009 UAE Labor Force Survey).

[6] These estimates do not differ from those of the UAE as a whole. The UAE National Bureau of Statistics (2011) estimated that in 2010 the UAE had a total population of 8.3 million of which only 25% were females and 7.4 million where immigrants.

Migration, Employment and the Kafala system

As in other oil-endowed economies in the Gulf Cooperating Council (GCC), the *Kafala* or *sponsorship system* defines the key institutional regulations that determine the inflow, behavior and permanence of the migrant workforce in the UAE. The sponsorship requires each migrant to be sponsored by a national Emirati that becomes his/her legal representative (some employers even retain the worker's passport). The migrant becomes tied to the sponsor for the duration of his/her contract –from one to three years– and cannot change sponsor unless they obtain written consent (no objection certificate). In principle, workers should leave the UAE immediately upon termination of the contract but there are renewals.[7] Until January 2011, expatriate workers that had terminated their contracts were banned from signing a new labor contract and return to the UAE for six months.[8]

The resulting labor dynamics of the *Kafala* are characterized by the lack of mobility of migrant workers among firms (internal mobility). International mobility is higher but also much costlier.[9] Internal mobility restrictions give significant monopsony power to sponsors, who pay workers an income slightly above their reservation wage (at their country of origin) and obtain economic rents equal to the difference between such earnings and the net marginal benefit of the migrant worker in the UAE. Workers, immobilized by labor restrictions, cannot command a higher wage even when there is demand for their services by rival firms willing to avoid the cost of hiring from abroad. Clearly, economic rents for the sponsor increase when the gap between the reservation wage of the migrant and his/her net marginal benefit increases, thus inducing a relatively higher demand for

[7] Although it is possible for an expatriate to sign an unlimited time contract in the UAE, resident visas are limited to two years thus effectively limiting the duration of labor contracts. Prior to January 2011 visas were issued for three years.

[8] It is commonplace in the UAE to include clauses prohibiting an ex-employee from joining the company's competitors or having any business dealings with the company's actual or prospective clients. Soliciting or enticing the company's clients or employees is also often included within the prohibited activities. Post termination non-competitive clauses are permitted under UAE law subject to minimal qualifications.

[9] Baldwin-Edwards (2010) discusses the presence of illegally resident workers that emerged in the 1990s as a result of fraudulent practices that "*were commonplace amongst private recruitment agencies, resulting in newly arrived migrant workers having to resort to irregular employment; employers were reluctant to expel their trained workers, simply because of some legal technicalities, and many migrants became semi-permanent*" (page 37). The evidence that employers have fostered irregularities is a clear indication of their reluctance to follow the regulation and that the sponsorship system is costly for some firms.

unskilled and low skills workers On aggregate, these rents can amount to a sizable transfer to the Emirati population since migrant workers account for 88% of the workforce of Dubai

Migrant workers, furthermore, are paid the initial nominal wage throughout the entire contractual period and are uncertain about the conditions of an eventual contract renewal. Vazquez-Alvarez (2010) found that the age-wage profiles in the UAE (including Dubai) are notoriously flat at all levels of education and skills, implying that the returns to experience and on-the-job training are negligible. The combination of short contracts, flat wages and lack of internal mobility imposed by the *Kafala*, subsequently destroys the incentives for migrant workers to exercise higher effort levels in production and, more importantly, to engage in activities that enhance their human capital. Any productivity gain would go to the sponsor in the form of rents.

Migrants in FZs, on the contrary, operate in far more flexible environments than their counterparts in MD, although not as free and safe as they would be able to do in labor markets of modern economies. Thus, workers in FZs can switch jobs and improve their working conditions but such movements are subject to administrative monitoring. The largest and most important free zone in Dubai (Jebel Ali), in fact, has regulated that it "*will accept requests to transfer employees between Clients within the Free Zone provided both Companies are agreeable*" (Jafza, 2005, p. 24). Other FZs in Dubai regulate labor mobility differently, i.e., there is no unified labor regulation between them so that each issues its own sponsorship options. In some free zones, a worker can either be sponsored by an individual company or by the free zone authority (FZA) itself. In others, the FZA is the only sponsor.

The empirical evidence supports our view of the effects of the *Kafala* on the incentives to rent-extraction and on the structure of the labor market. Using data from the 2008 UAE Employment, Hours and Wage Survey we study the structure of occupations of the workers in FZ and MD, total and by the country of origin of the migrant, and present the results in Table 1.[10] Skill categories are based on the International Standard Classification of Occupations (ISCO) of ILO at 4-digit levels and are grouped as unskilled, low skilled,

[10] The survey conducted by the UAE National Bureau of Statistics is representative at the establishment level. It comprises 4,700 firms providing information for approximately 1.1 million workers in the private and public sectors. Our estimates in Table 1 and for the remainder of the paper are based on responses from establishments in Dubai, *including* the public administration that takes up 40.7% of the workforce.

semi-skilled and high-skilled occupations (see appendix A for definitions). We also compute the years of education of the workers and later correlate it with their occupations.

It can be seen that in both the FZ and MD, the majority of migrants come from labor-abundant economies (Bangladesh, India, Iran, Nepal, Pakistan and Philippines, hereafter BIPP economies) characterized by very low opportunity costs, informality and, in some cases, high unemployment. Note that the share of BIPP workers in MD and FZ is roughly equivalent, but that of migrants from Western-type economies is much larger in the latter. Immigrants from MENA countries (excluding the UAE) work mainly in the public sector: these individuals tend to stay longer in the UAE and also have the comparative advantage of sharing similar cultural backgrounds and the language with the Emirati. An example of MENA nationals working in the government is school teachers, which comprised around 40% of total UAE teachers in 2010. For the other groups, participation in the public sector is relatively minor.

Table 1: Occupations of the workforce by nationality in Dubai

	Origin of workers (%)	Works in the Public Sector (%)	Occupations (%)				Correlation between Education and Occupational skills
			Unskilled	Low skills	Semi and technical skills	High skills and managerial	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Migrant Workforce							
Main Dubai	100.0	***19.4***	***11.3***	***56.9***	***15.0***	***16.8***	***0.472***
BIPP	88.6	12.2	12.1	62.4	12.5	13.1	0.558
MENA (excluding UAE)	5.1	70.9	4.9	24.0	20.4	50.7	0.613
Western-type countries	2.1	23.4	2.1	11.6	21.5	64.9	0.491
Others	4.2	9.9	9.9	20.5	49.0	20.6	0.474
Free Zones	100.0	***0.0***	***7.7***	***50.4***	***16.4***	***25.5***	***0.594***
BIPP	83.3	0.0	8.0	53.9	18.7	19.4	0.390
MENA (excluding UAE)	2.8	0.0	4.2	18.2	10.3	67.4	0.730
Western-type countries	7.7	0.0	6.3	12.5	2.1	79.2	0.653
Others	6.2	0.0	6.9	66.0	5.8	21.2	0.451
Emirati Workforce							
UAE	100.0	***92.9***	***1.4***	***4.1***	***18.2***	***76.3***	***0.310***

Source: own elaboration based on 2008 UAE Employment, Hours and Wage Survey.
Note: **BIPP** include Bangladesh, India, Iran, Nepal, Philippines and Pakistan. **MENA** include all Middle East and North African economies. **Western economies** include the European Union, Australia, New Zealand, the Americas, South East Asian Tiger economies, South Africa and Japan. **GCC** includes Saudi Arabia, UAE, Oman, Kuwait, Bahrain and Qatar. Skill categories are described in Appendix A. All correlations are statistically significant at 95% confidence.

In terms of occupations, BIPP workers are assigned mainly to low or unskilled occupations. However, and congruent with our description of the incentives provided by the sponsorship scheme, workers under the *Kafala* –where rent extraction is easier— tend to be less skilled than in FZs: almost three-quarters of BIPP workers (74.5%) in MD are in low-skilled or unskilled occupations, while it is only 61.9% in FZs. Likewise, workers assigned to high-skills occupations come largely from Western-type economies and are significantly more in FZ than in MD. It is noteworthy that MENA migrants in FZ also concentrate on high-skills occupations.

Emirati workers, on the other hand, participate overwhelmingly in the public sector (92.9%). Furthermore, there seem to be non-market determinants in the participation of Emirati in the labor force: 76% of Emirati are employed in high skills or managerial occupations even though they may not have high qualifications: the correlation between occupations and educational attainment for the Emirati is 0.309, significantly lower than the correlation of any group of migrant workers (see Column 7 in Table 1). Thus, factors other than human capital drive the occupational distribution of native workers in Dubai. Migrants and Emirati are usually seen as pertaining to separate labor markets in view of the lack of legal limitations that apply to the latter, their concentration in the public sector, and the presence of non-market determinants of their occupations (Vazquez-Alvarez, 2010).

The evidence in Table 1 is congruent with the view that the sponsorship system provides incentives to entrepreneurs to concentrate on low-skills, labor-intensive industries where the extraction of economic rents is easier. This is, nevertheless, not the only labor market arrangement available for small economies lacking physical capital and population. Labor markets in city-states that share with Dubai geographical, political and economic similarities (and even labor sponsorship systems) perform in a very different way. In Singapore, the low skills and unskilled occupations accounted only for 23.2% of the workforce in 2010 (2011 Singapore Yearly Statistical Book) while in Honk Kong they accounted for 19.3% in the 2006 Census (2006 Population By-census Office).

It could be argued that because firms in FZ operate in external markets and those in MD serve mainly the domestic demand, they could be of different size and that this, in turn, could explain the differences in the skills structure of occupations. To test whether size

effects are important, we classified firms by employment levels and compute the average years of education of the workers in each firm in both the FZ and MD. The results in Table 2 indicate that, on average, firms in FZ tend to hire workers with higher levels of education than their counterparts in MD at every size of firms. In particular, note that smaller firms in FZ tend to hire workers with significantly higher levels of human capital than those in MD, reflecting the disproportionate burden of the *Kafala* on small and medium size companies. Consequently, the above results regarding the skills of occupations in MD vs. FZ and the capacity of sponsors to extract rents do not depend on the size structure of firms. In free zones where the *Kafala* is not applicable, average human capital is higher and the structure of occupations is less concentrated on unskilled and low-skills workers. The opposite verifies in MD.

Table 2: Education years of the workforce by firm size in Dubai

Firm size	Main Dubai (average, years)	Free Zones (average, years)
Less than 10 workers	9.8	12.2
Between 10 and 25 workers	9.9	11.6
Between 26 and 100 workers	9.7	10.9
Over 100 workers	9.2	9.4
Total	***9.6***	***10.8***

Source: own elaboration based on 2008 UAE Employment, Hours and Wage Survey.

Economic rents, it could be argued, are transfers and per-se should not directly create adverse effects in the labor market. In fact, earnings paid to migrants are sufficient to motivate them to migrate to the UAE –so that they are better off— and even if the sponsor does not share economic rents with the migrant that should not cause the migrant to leave. The problem is that a scheme devised to generate economic rents is bound to generate inefficiency. First, inefficiency arises because rent-extraction is only compatible with non-competitive labor markets that allocate resources on the basis of their capacity to generate rents and not on their productive ability and more efficient use. In particular, note that new technologies that imply lower levels of employment (labor saving) would not be as attractive because they would lower the rent-extraction from a smaller workforce. Second, inefficiency spreads because by virtue of the inflexibility of the sponsorship

system, it destroys the incentives for workers to optimize their effort, to invest in human capital, and to become more productive. Third, inefficiency results because by generating rents it induces rent-seeking on the part of entrepreneurs that find it more profitable to search for sponsorship rents than to increase productivity and offer efficiency wages. Perhaps such sponsor-worker behavior explains why despite the massive investments in Dubai, the economy-wide efficiency levels have not improved in the last two decades. As shown in Figure 1, average labor productivity in Dubai has remained consistently flat throughout much of the 1990s and 2000s. In comparison, the average productivity per working-age person in Hong Kong doubled in the period 1986-2010 while in Singapore it quadrupled.

Foreign investment under the sponsorship system

So far we have discussed how the sponsorship system affects the performance of migrant workers and labor markets. However, the sponsorship system also determines how Dubai attracts and retains foreign investment. The *Kafala* imposes rules and regulations that burden businesses in MD and strongly tie foreign entrepreneurs to a local sponsor –who does not necessarily partake in the business risks—at a relatively high cost.

Under the *Kafala*, foreigners wishing to set up an enterprise in MD require the mandatory involvement from a sponsor, i.e., a UAE national or UAE company where *all* members of the board are Emirati nationals. The sponsor represents the company in all legal matters. For 'Limited Liability Companies', the foreign investor must allocate at least 51% of the shares to the sponsor, although the latter is not expected to invest money in the business. The sponsor, nevertheless, does not have the right to share profits proportionally, frequently agreeing with the foreign investor to receive an annual fee. In the case of a sole proprietor or civil companies –i.e., firms operated by professionals in particular vocations– ownership is 100% for the foreign investor. However, it is compulsory to appoint a UAE national sponsor as 'the local service agent'. This local service agent is not involved in business operations and is paid an annual fixed fee or a share of profits. Nominally, the local service agent assists in obtaining licenses, visas and labor cards.

Clearly, there are two negative aspects in these provisions with regards to foreign investment. First, there is an implicit risk for foreign investors that cannot control the destiny of their investments. Second, and more important, the *Kafala* induces rent-seeking behavior on the part of local sponsors inasmuch as they can profit from the returns of foreign investors without risking their own capital.

The sponsorship system hampers investment in MD because it adds additional levels of uncertainty to normal business risks: even if the sponsor is a dormant partner, he or she effectively commands 51% of the company's share and could, in principle, overrule investment and business decisions by foreign partners. Because investment decisions under the sponsorship carry an additional risk premium, foreign investors expect higher returns from their investment. This has two intertwined effects: first, a higher risk premium implies that foreign investors demand higher returns from investment and, therefore, would prefer to invest in activities that bring higher returns in shorter periods of time, rather than invest in long-maturity projects of the sort that allow significant productivity gains (see Abel and Eberly, 1999). Second, the irreversibility nature of most investment decisions –especially those that bring long-run productivity gains– implies that at higher levels of uncertainty, foreign investors will have greater incentives to wait until they have sufficient information before committing to long run investment (Dixit and Pindyck, 1994; Caballero, 1999; Bloom et al., 2001). Such cautionary investment behavior due to the uncertainty effect of the sponsorship system implies that foreign investors respond slowly to positive demand shocks and consequently lag behind the optimal investment behavior that would otherwise occur in the absence of a sponsorship system.

In addition to these property limitations, the efficient use of resources in MD is further complicated for foreign firms by the lack of access to facilities. Foreign firms operating in MD are not allowed to buy land as landownership is reserved to UAE nationals. Ambiguous land-leasing regulations allow rent-extraction on behalf of the landowner (sometimes, the local sponsor) in the form of abusive rent increases, to the point that the land authority has stepped in the market in 2009 and 2010 to freeze rents (see Dubai Real Estate Regulatory Agency, 2011).

Finally, it is also important to mention that in addition to labor regulations imposed by the *Kafala*, some private sector firms operating in MD are subject to the "Emiratization

process", a mandatory employment scheme imposed in 1998 aimed at increasing the participation of Emirati nationals in the labor market. The Emiratization process dictates (a) minimum quotas of Emirati as percentage of each firm's workforce and (b) nationalization of particular occupations such as secretarial and human resource staff.[11] Although Emiratization could imply a further constrain for firms in MD – and could potentially be confounded with the *Kafala* regulations – it is now agreed that it has largely failed at attaining its goals (Godwin, 2006; Toledo, 2006). Among the reasons for its failure are the lack of effective sanctions for noncompliance and the low level of enforcement by government authorities. The latter could be the result of realizing the high costs for private and public sector firms when forced to replace high-skilled expatriates for less-educated and less motivated Emirati. To illustrate the failure of the process note that while the participation of the Emirati in private sector employment increased from 7% in 1997 to 11% in 2007, their participation in the labor market increased from 53% in 1997 to 64% in 2007 (see Vazquez-Alvarez, 2010, for further details). This indicates that most of the Emirati that entered the labor market went to work for the government and not the private sector. Thus, at best Emiratization has had a very minor impact on the labor market and on the firms, allowing us to be confident that our estimates identify the effects from the *Kafala* without confounding effects from the Emiratization process.

The *Kafala* rules proved to be too rigid to attract the massive flows of foreign investment that Dubai's authority had expected in the early 1980s. Because the sponsorship system was enacted at the Federation level, the needed improvements required political negotiations deemed too difficult or slow to achieve. Bypassing such hurdle required adapting and developing a local regulatory framework that, while observing the rules at federal level, would allow the Emirate to follow its own diversification strategy. For Dubai, the solution was in the form of FZs, which was inaugurated with Jebel Ali (Jafza) in 1985.[12]

[11] In fact, since 2006 firms are obliged to hire Emirati secretaries, Emirati Human Resource Staff and Emirati Public Administration Representatives.

[12] As of 2011, there are 23 Free Zones in Dubai, including the largest duty-free retailer in the world located in the Airport Free Zone, the largest man-made port in the Middle East in Jebel Ali Free Zone, several technology parks with specific themes –biotechnology, health, education or internet services–, a Free Zone for gold and diamond and the well-known Dubai International Financial Centre (DIFC).

In most economies outside the GCC region, firms within a FZ benefit from tax exemptions. In Dubai, they benefit because they are exempt from the sponsorship system and government bureaucracy. In particular, entrepreneurs opening a business inside a FZ do not have to engage the services of a local sponsor. Once the FZA approves their business plan and the entrepreneur commits the required financial investment, such entrepreneur owns 100% of the physical installations, receives the full profits from the business and is able to repatriate profits without restrictions. Firms in FZs are exempt from paying import duties, except for goods imported from countries that are in rivalry with UAE produced goods: in this case the UAE general import duty of 5% has to be paid. Firms operating in FZs are not subject to the labor-related rules and regulations implied by the sponsorship as discussed above and, furthermore, they are not subject to the Emiratization process. Finally, foreign firms in the FZs are not allowed to buy land, however each FZA follows a well-established regulatory framework that allows investors to lease land for a period that can run into decades. Firms in FZs do not register with the authorities in MD and avoid much of the bureaucracy and red-tape faced by the firms under the sponsorship system in MD. Instead, once the foreign investor has his/her business approved by the FZA it is the latter that issues a license for the business to operate.

In summary, the above discussion provides a detailed account on how the regulations of the sponsorship system with regards to labor and capital investment have shaped the development of firms in Main Dubai and in free zones and hints at the potential efficiency costs of the *Kafala*. Our next section aims at modeling and estimating such costs.

3. Stochastic frontiers

Stochastic frontier (SF) models have become a popular tool for modeling a variety of problems, ranging from the productive efficiency of firms (industries, farms, etc.) to the efficient use of resources to provide services such as education and health (goal attainment). Amsler et al. (2009) provide a summary of applications. Berger and Humphrey (1997) survey 130 frontier efficiency studies of financial institutions from around the world and conclude that inefficiency is typically around 20% of costs and dominate scale and scope considerations.

SF analysis originated in two papers that appeared simultaneously: Aigner, Lovell and Schmidt (1977) and Meeusen and van der Broeck (1977). The standard presentation of the SF model considers initially a production function *f(.)* linking output (q) to the use of different inputs (x) by means of a set of unknown yet estimable parameters (β). In a world of certainty and efficiency, equation (1) would describe production by firm *i*.

(1) $q_i = f(x_i, \beta)$

SF analysis assumes that each firm potentially produces less than it might due to a degree of inefficiency (ξ_i). Consequently, production is governed by equation (2):

(2) $q_i = f(x_i, \beta)\xi_i$

The parameter indicating the level of efficiency must be in the [0,1] interval. If ξ=1, the firm achieves its potential and there is no inefficiency. If ξ<1, the firm is not producing the output it should conditional on the use of inputs and the technology embedded in the production function. An alternative view of ξ as a measure of technical efficiency (TE) is given by: $TE_i = \xi_i = \frac{q_i}{f(x_i,\beta)}$. Because this random variable $\xi_i \in [0,1]$ can only be positive, it is usually called the "one-sided" error component.

Production q_i is also subject to stochastic, zero mean shocks (ε_i) with distribution $N(0, \sigma_\varepsilon^2)$ usually called "two-sided" errors. Therefore a more complete specification for production is given by equation (3):

(3) $q_i = f(x_i, \beta)\xi_i e^{\varepsilon_i}$

The introduction of the second error component in exponential form is only a convenient transformation that allows us to log-linearize the production equation in (3) by taking logarithms of both sides leading to equation (4):

(4) $\log q_i = \log f(x_i, \beta) + \log \xi_i + \varepsilon_i$

In order to proceed we assume that the production function is log-linear in the k inputs (e.g., Cobb Douglas) so that $\log f(x_i, \beta) = \sum_{j=1}^{k} \beta_j \log x_{ji}$. Define $\mu_i = -\log \xi_i$, so that $\mu_i \geq 0$ since ξ is defined in the interval [0,1]. We denote the variance of the one-sided error term by σ_μ^2. Hence:

$$(5) \log q_i = \sum_{j=1}^{k} \beta_j \log x_{ji} + \varepsilon_i - \mu_i$$

Using the duality theorem, one can express equation (5) in terms of costs as follows (Kumbhakar and Lovell, 2000):

$$(6) \log C_i = \beta_0 + \beta_1 \log q_i + \sum_{j=1}^{k} \beta_j \log P_{ji} + \varepsilon_i + \mu_i$$

where C is the cost and P_j is the unitary price of inputs. In our case, both data availability and quality suggests using the cost specification in the forthcoming empirical analysis.

As it is apparent in equation (6), inefficiency $\mu_i > 0$ would increase costs for a given set of input prices and a given production level. Alternatively, expression (5) suggests that inefficiency could decrease output for a given set of input prices and cost level. In this form, μ_i has a natural interpretation as "proportional or percentage inefficiency". Note that μ_i can be considered as a measure of technical inefficiency because $\mu_i = -\log \xi_i \approx 1 - e^{TE_i}$ (see Battese and Coelli, 1988 for considerations on this approximation).

The measurement (inference) of technical inefficiency is not straightforward and it cannot be estimated simply by subtracting q_i from the frontier in equation (5); likewise, we cannot use equation (6) to identify μ_i away from ε_i since the latter contains the statistical noise in additive form, i.e., $\varepsilon_i + \mu_i$ is additive and not observable. Let the estimated model be:

$$(7) \log C_i = \beta_0 + \beta_1 \log q_i + \sum_{j=1}^{k} \beta_j \log P_{ji} + \eta_i$$

where $\eta_i = \mu_i + \varepsilon_i$. We can estimate $\widehat{\eta}_i = \log C_i - \hat{\beta}_0 - \hat{\beta}_1 \log q_i - \sum_{j=1}^{k} \hat{\beta}_j \log P_{ji}$ but we need a way to separate ε_i from μ_i. The standard estimate, suggested by Jondrow et al. (1982), is the conditional expectation of μ_i given η_i, evaluated at the fitted values of η_i (i.e., $\widehat{\eta}_i$) and the estimated values of the parameters. With a half-normal assumption for the inefficiency variable:

$$(8)\ \hat{\mu}_i = E(\mu_i|\eta_i) = \mu_i^* + \sigma_* \left[\frac{\phi(-\mu_i^*/\sigma_*)}{1-\Phi(-\mu_i^*/\sigma_*)}\right]$$

where $\mu_i^* = -\eta_i\, \sigma_\mu^2/\sigma^2$, $\sigma_*^2 = \sigma_\mu^2 \sigma_\varepsilon^2/\sigma^2$, $\sigma^2 = \sigma_\mu^2 + \sigma_\varepsilon^2$ and $\phi(.)$ and $\Phi(.)$ are the standard normal density and cumulative distribution functions, respectively. Furthermore, we define $\lambda = \sigma_\mu/\sigma_\varepsilon$, i.e., the ratio between the standard deviation of the technical inefficiency component to the standard deviation of the idiosyncratic component. In the absence of technical inefficiency, $H_0: \sigma_\mu = 0$ so that $\lambda = 0$.

A large number of variants of the stochastic frontier model are based on different assumptions about the distribution of the 'inefficiency' term μ_i and the additive shocks ε_i. In general, the random variable ε_i is assumed to be normally distributed with zero mean. In the models we estimate below, we allow this two-sided error term to be heteroscedastic. The different specifications of SF models arise from distributional assumptions regarding the inefficiency component μ_i, ranging from relatively simple distributions (including typically half normal, exponential, and gamma distributions) to more complex specifications, such as the truncated normal with nonzero, heterogeneous mean in the underlying ξ. As in the case with the two-sided error term, one may allow for heteroscedasticity also in the inefficiency parameter. A common practice is to assume that both error terms are independently distributed.

A key question that often arises in SF analysis is that of how to model the effect of exogenous (background) variables since these can affect costs directly through production q_i but likewise can affect costs indirectly by affecting efficiency μ_i in production. Thus, one can think of two vectors of variables (z, k) such that $q(z_i)$ and $\mu(k_i)$ where (z, k) explain factors beyond the control of the firm. For example, in the case of the Dubai (UAE), we can think of these vectors containing government regulations such as those underlying the

sponsorship system. The sponsorship can directly affect the factor labor because the cost of visas impacts on the firm's size, but the sponsorship can also affect (worker's) efficiency level because the indirect effects that such system has on the motivation of the workforce. Overcoming the problem would require reasonable economic interpretations that are often missing when deciding how to treat background variables. In the absence of such economic reasoning to discriminate on the effect of background variables, the proposal is to use statistical discrimination.

Although the empirical evidence on SF does not provide clear guidelines for the use of background variables, there are two methods that have been considered. The first method is to use a two-step approach as in Pitt and Lee (1981) or Kalirajan (1981). The method consists on estimating the cost function in (6) assuming that μ_i is independently and identically distributed, and then estimate μ_i as function of firm specific factors in a second stage. However, the method is not consistent because the assumptions in the first stage imply that the efficiency term μ_i does not have a deterministic part, which is what the second stage implies. The second method is that proposed by Battese and Coelli (1995); in their paper the problem is solved by estimating both the deterministic part and the efficiency term in one step. However, such an alternative calls for the use of statistical tools in order to discriminate among alternative models. Thus, the idea of using a one-step model is to allow for a battery of specifications with different combinations of the variables $z \in Z$ and $k \in K$ alternating between the deterministic part and the efficiency term in equation (6). The best model is selected by means of likelihood ratio tests, i.e., testing each proposed model against an alternative model that nests all possible specifications, selecting that which has the highest likelihood value and examining the effect that the selected specification has on the measure of efficiency obtained. In our estimations we follow the second method using one-stage approach as in Battese and Coelli (1995). Our selection is also consistent with Reifschneider and Stevenson (1991) where the proposal is to introduce effects directly into the production function, and it is consistent with the survey results by Greene (1997) where he remarks that many models are extensions of the models that emanate from the work by Battese and Coelli (1995). In what follow we explain our results through various specifications and provide an interpretation of available

background variables justifying their effects both with economic reasoning and their statistical impact.

4. Empirical Analysis

Our main data source comes from a firm level survey conducted in May 2010 in the Emirate of Dubai, levied by the Dubai Statistics Center and the Dubai Economic Council. The original sample included 709 firms, but missing information forces us to work with a slightly shorter sample of 606 firms. The survey is deemed to be representative of the Dubai economy at the four digit ISIC sector level. Firm's dropping due to missing information does not bias the sample.[13]

Basic Specification

The first step in the empirical methodology consists in estimating the basic stochastic frontier model, where the log of costs depends on the scale variable (in our case, sales)[14] and the unitary cost of labor and capital. While the coverage of the survey is adequate for the universe of firms in Dubai during May 2010, the survey is unfortunately not as detailed as we would like it to be, in particular with regards to quantitative and financial aspects of the firms. Nevertheless, we build a measure of total direct costs which include all purchases of intermediate goods and services as well as payroll costs.

For capital costs, we do not have data in the survey. However, if firms operate using standard production functions (CES, translog, Cobb-Douglas), then the cost of capital (r) would be proportional to the capital/output ratio; for example in the case of the Cobb-Douglas function $q = AK^{\alpha}L^{1-\alpha}$, the cost of capital in equilibrium would be $r = \alpha\, K/q$. Respondents to the survey were asked to estimate separately the market value of their

[13] This firm level survey employs the same survey instruments as those of the World Bank Enterprise Level Survey, with minor modifications to fit the specific characteristics of Dubai. The stratification strategy also follows the World Bank guidelines and is based on six sectors, the two economic areas of Dubai –MD and FZ– and the size of the firm at the time of registering with the licensing authority. See http://enterprisesurveys.org/Methodology/ for further details.

[14] Using the log of value added –build as total sales less total reported costs— does not change the qualitative results, but it reduces the sample further due to missing data.

assets (land, machinery, and installations). We use the estimated market value of machinery and installations and exclude the value of land because, as described in Section 2, there is no market for land in Dubai due to legal restrictions. Estimates of the eventual market value of a plot of land tend to be very inaccurate and, in fact, 93% of the respondents could not provide any estimate of the price of their land properties.

Data on labor costs in the survey are not sufficiently disaggregated so as to compute representative unitary labor costs. However, the survey asked respondents for the median wage which we use throughout the empirical section. Note that, as mentioned, there are no income taxes in Dubai and benefits in kind –typically transportation— do not usually differ significantly among sectors at the median wage level (though they may change for high-wage workers). We therefore consider that the declared median wage is not a biased measure of the cost of labor. In any case, econometric results do not change qualitatively if average wages (computed as payroll labor costs/employment) are used instead of the median wage. Appendix A, Tables A1 to A3 provide summary statistics on the construction and nature of all variables employed in our analysis and a comparison of the characteristics between firms in MD and firms in the FAZ.

The econometric estimation of the basic stochastic frontier model (Equation 6, Section 3) is presented in Table 3. This basic specification assumes that the inefficiency disturbance distributes as half-normal (model 1), but results are virtually identical if the exponential density is used instead (see model 2). In what follows we focus on the half-normal specification (model 1). It can be seen that the likelihood-ratio test rejects at 99% the null hypothesis of absence of inefficiency components, indicating the need for the stochastic frontier model. Note also that the estimated parameter λ is significantly above 2, indicating that the standard deviation of the one-sided error term is twice as that of the double-sided error term. This is an important result: usually, models are rejected when residuals are skewed in the wrong direction, i.e., in a direction that would be seen to indicate absence of technical inefficiency so that the model reduces to one with the random residual only – although $\sigma_\mu > 0$. Using Monte Carlo simulations, Simar and Wilson (2010) found that the classical problem of "residuals wrongly skewed" disappears altogether as

the number of observations exceed 500 and $\lambda > 2$, which is our case.[15] The problem of residual wrongly skewed refers to the fact that, as noted by Aigner et al. (1977), in some finite samples the composite residuals (i.e., the sum of both error terms) may be positively skewed inducing the stochastic frontier model to fail. In such cases, the maximum likelihood (ML) estimator of parameter λ will be zero, while the ML estimators of the other parameters will be equal to the corresponding ordinary least square (OLS) estimators in the case of a linear response function. Thus, identification of technical efficiency is possible in the presence of wrongly skewed composite residuals if observations exceed 500 and $\lambda > 2$. In our case, the number of observations is 606 while estimates of the parameter λ exceed 2 for models that assume a Half-Normal distribution.

The above specification assumes that firms are able to sell as much product as they would want and, consequently, that production could operate at full capacity. While this assumption is less controversial in panel-data models that can average over long periods of time, it is quite strong to assume markets and firms to be in equilibrium when using a cross-section for a single year. In particular, this could not represent the case of Dubai in 2010 which, as mentioned, was in the midst of a recessionary period when the firms were surveyed. Fortunately, the survey asked respondents about the actual level of capacity utilization in 2010. We note that not all of capacity idleness is inefficiency; a fraction could be merely a reflection of demand slack and can be easily reversed with an economic upswing while inefficiency requires internal adjustment to firm structures or management.[16] We thus extend our initial specification to include "reported capital utilization" as a control variable; Table 3, model 3, presents the econometric results. As expected, used capacity enters with a negative sign: the less capacity used, the higher the costs. Note that the estimated parameters for the other variables are not affected by the introduction of this variable, even though the sample size is reduced by 19%.

Furthermore, we expand our basic model to include the age of firms. As noted, Dubai's economy expanded significantly in the pre-global crisis period and entry by new

[15] The probability of finding a wrongly skewed sample with 500 observations and λ =2 is less than 0.1%.
[16] Fagnart et al. (1999) develop a dynamic, stochastic general equilibrium model in which capacity idleness arise in equilibrium when the possibilities of substitution between production factors are limited in the short run and there are idiosyncratic shocks: when facing an adverse shock firms find it in their advantage to leave capacity idle instead of paying the full cost of adjusting all productive factors.

firms was massive: according to the survey in 2010 around 14% of the firms were less than three years old and less than 10% were older than 25 years old. International evidence indicates that it takes some time for newly entered firms to achieve their productive potential.[17] In some sense, start-up costs should not be considered inefficiency. It seems thus logical to include the age of firms as a control variable on the grounds that newly entered firms may not be mature enough at the point of surveying (the alternative procedure of dropping firms younger that a certain cut-off date –for example, five years— would reduce the sample size significantly). The results for this extended model in Table 3 (model 4) indicates that older firms tend have lower costs on average, in line with our presumption and the previous literature, but the estimated parameter is of small economic magnitude. Note, in addition, that the estimates of the other parameters do not change in any significant way.

Finally, we consider in our estimation the fact that firms do not operate an equal number of hours a day (single vs. multiple shifts) and that fixed costs might dissipate somewhat differently among firms, even when controlling for production levels. The point estimate for this variable in model 5 of Table 3 indicates that longer hours worked reduce costs; the estimate is, nevertheless, statistically insignificant. Note, again, that the estimates of the other parameters do not change in any significant form, but the variable age of firms become insignificant.

[17] Jensen, McGuckin and Stiroh (2001) study productivity levels of different age cohorts in US manufacturing and find that new cohorts enter with productivity levels lower than that of incumbents. At the same time surviving cohorts show increases in productivity levels over time. For entering cohorts they observe a convergence of productivity levels after five to ten years.

Table 3: Econometric Results, Stochastic Frontier Models

Dependent Variable: Log of DIRECT COSTS	(1) Half-Normal	(2) Exponential	(3) Half-Normal	(4) Half-Normal	(5) Half-Normal
Covariates					
Sales (log)	0.33** (0.03)	0.33** (0.03)	0.31** (0.04)	0.31** (0.06)	0.31** (0.04)
Median wage (log)	0.27** (0.06)	0.27** (0.06)	0.27** (0.07)	0.26** (0.08)	0.23** (0.07)
Cost of Capital (log)	0.32** (0.03)	0.32** (0.03)	0.32** (0.03)	0.32** (0.04)	0.32** (0.03)
Capital utilization (log)	-	-	-0.46** (0.18)	-0.44** (0.14)	-0.40* (0.19)
Firms age (log)	-	-	-	-0.08* (0.05)	-0.07 (0.06)
Hours worked (log)	-	-	-	-	-0.26 (0.20)
Constant	1.65** (0.44)	1.96** (0.42)	3.97** (0.95)	4.13** (0.91)	5.20** (1.30)
Diagnoses					
Observations	606	606	489	489	489
Log Likelihood	-869.1	-855.0	-696.8	-700.0	-695
Lambda	2.1 (0.13)	1.08 (0.10)	2.33 (0.15)	2.30 (0.15)	2.38 (0.15)
LR Test	41.1**	69.4**	34.2**	33.5**	35.4**
P-Value for the LM Test	0.00	0.00	0.00	0.00	0.00

Note: (*, **) significant at least at 90% and 95% confidence, respectively. Lambda is defined as $\lambda = \sigma_\mu / \sigma_\varepsilon$ and the null hypothesis of the LR test is H_0: $\sigma_\mu^2 = 0$. Bracketed numbers present asymptotic standard errors

Extended Specification

It has been documented that heteroscedasticity in the context of stochastic frontier models can potentially bias estimators, in addition to distorting standard deviations and tests of hypothesis. Caudill and Ford (1993) show that biases in ML estimation of the frontier model can be the result of heteroscedasticity in the one-sided (efficiency) component.[18] Caudill, Ford, and Gropper (1995) found that the rankings of firms by efficiency measures were significantly affected by the correction for heteroscedasticity.

Schmidt (1986) suggests that a one-sided error can be associated with factors under the control of the firm while the random component can be associated with factors outside the control of the firm. Consequently, we modify our basic model to include two additional models, one for each form of heteroscedasticity. In the case of the two-sided error component, we include dummy variables for the different economic sectors and for the different institutional arrangements in which firms operate (Main Dubai vs. free zones). In principle, firms are subject to sector-idiosyncratic random shocks to costs beyond their

[18] Using a limited Monte Carlo experiment, Caudill and Ford (1993) found that heteroscedasticity in the one-sided error term in the Cobb-Douglas stochastic frontier production function leads to overestimation of the intercept and underestimation of the slope coefficients.

control. For example, in 2010 the UN imposed trade sanctions on Iran that affected significantly the economy of Dubai which is Iran's main commercial partner. Sanctions, however, had a greater impact on the trade sector than the financial or the service sector. In addition, we include a dummy to indicate if the firm is financially repressed, i.e., the dummy is one for firms that declare to have been denied a loan (by a financial sector institution) during the calendar year 2009/2010.

With regards to heteroscedasticity in the one-sided error component, we include two variables under the control of firms that may influence the size of inefficiency shocks which are 'the length of working hours'[19] and 'the skill composition of the workforce'; the latter is measured as the ratio of (high-skilled) management personal to (low-skilled) productive workers. With these variables, we attempt to portray firms that can dissipate better idiosyncratic adverse shocks on costs as a result of their higher flexibility to accommodate production between shifts and their ability to shift operations among better educated workers.

The estimation results are presented in model (1) of Table 4.[20] The estimates of the parameters for the cost function are somewhat different from those obtained when ignoring heteroscedasticity (model 4 of Table 3). This is in line with findings in the literature that indicate that ignoring heteroscedasticity may lead to overestimation of the constant and underestimation of the slopes. Arguably, here the biases on the parameters are of small economic significance. Note however that the estimated parameter for the age of firms is now insignificant.

In the model for heteroscedasticity in the inefficiency parameter, all variables have signs that match our economic intuition. First, firms that employ a higher share of skilled workers display smaller variance in efficiency shocks than those relying heavily on the unskilled labor force. In our view this reflects largely the ability of more sophisticated firms to accommodate to shocks without incurring in higher costs; alternatively, it could reflect that firms employing higher shares of educated workforce engage in businesses that are more homogenous and have lower dispersion in technology and efficiency. Second, firms

[19] In our firm's survey around 65% of the firms are such that their employees work either 40 or 48 hours.
[20] All models in Table 4 and for all the remaining of the paper follow a Half-Normal distribution similar to models 1 and 3-5 in Table 3, Section 4.

operating more than one shift and thus having longer worked hours have on average smaller efficiency shocks that impinge on total costs.

Table 4: Econometric Results, Extended Stochastic Frontier Models

Dependent Variable: Log of DIRECT COSTS	Model (1)	Model (2)	Model (3)
Covariates			
Sales (log)	0.39** (0.06)	0.40** (0.06)	0.37** (0.07)
Median wage (log)	0.21** (0.07)	0.24** (0.07)	0.21** (0.08)
Cost of Capital (log)	0.26** (0.04)	0.25** (0.04)	0.25** (0.04)
Capital utilization (log)	-0.33* (0.18)	-0.30* (0.18)	-0.30* (0.16)
Firms age (log)(1)	-0.04 (0.05)	-	-
Firms age in free zones (log)	-	-0.14* (0.08)	-0.12* (0.08)
International certification	-	-	0.52** (0.17)
Constant	3.633** (1.08)	3.19** (1.12)	3.88** (1.19)
	Heteroscedasticity Model for Inefficiency (one-sided error component)		
Covariates			
High-skilled workers (%)	-0.14 (0.10)	-0.14* (0.11)	-0.18* (0.11)
Hours worked per week (log)	-0.72** (0.35)	-0.71** (0.37)	-0.85** (0.37)
Constant	3.29** (1.52)	3.22** (1.55)	3.66** (1.57)
	Heteroscedasticity Model for Uncertainty (two-sided error component)		
Covariates			
Firms in Trade Sector	1.46** (0.56)	1.50** (0.55)	1.59** (0.53)
Firms in Free Zones	1.69** (0.51)	1.52** (0.45)	1.67** (0.46)
Financially repressed	-0.68 (0.61)	-0.66 (0.56)	-0.25 (0.56)
Constant	-1.61** (0.33)	-1.56** (0.33)	-1.69** (0.39)
Diagnoses			
Observations	460	460	460
Log Likelihood	-643.1	-641.5	-635.5

Note: (*, **) significant at 90% and 95% confidence, respectively. Models (1)-(3) are based on the Half-Normal distribution assumption, Equation 8, Section 3. (1) With reference to Models 2 and 3, the variable is zero for MD firms and the value 'age' for firms in FAZ. See notes in Table 3 for further details.

Heteroscedasticity models for general uncertainty in total costs reveal also interesting patterns. First, the existence of financial repression leads to higher variance in costs, most likely because repressed firms cannot smooth-out sufficiently demand or price shocks. The estimated parameter is not statistically significant, probably because of the poor quality of the proxy we are forced to use. Firms in the trading sectors face higher variance and larger cost uncertainty. Likewise, firms in free zones also face higher variance. The combined result indicates that firms face larger cost-uncertainty when they concentrate in traded goods, in particular if aimed at foreign demand, where demand and

price volatility tends to be much larger than that in markets for non-traded goods and services. As discussed in Section 2, the latter markets in Dubai are also protected and quite inflexible.

As can be seen in Table 2, the age of firms does not seem to play a significant role in affecting costs and efficiency. Nevertheless, when inspecting the data it becomes apparent that firms in the free-zones tend to be much younger than their counterparts in Main Dubai: while in free zones firms are on average 8.3 years old, in Main Dubai they are almost 12 years old. Consequently, we split the firm age variable according to FZ and MD. Model 2 in Table 4 presents the estimation results; the age of firms in MD was not significant and subsequently dropped. Again, estimated parameters do not change statistically or economically. However, the age of firms in free zones is now statistically significant, albeit at only 90%, indicating that an additional year of age in the Free Zone would reduce average costs by 1.65%, ceteris paribus.

Finally, we estimate an additional model which includes a certification dummy that takes value one when firm seeks or achieves international certification of quality (e.g., ISO 9000 or ISO 14000). Note that we include already certified firms as well as those being certified (14% of total firms).[21] Certification reflects the willingness of firms to self-imposed higher standards of quality in management and production, both of which tend to increase costs. The benefits of certification accrue in several areas, including contingent-cost savings, top management concern for reputational effects, improved employee welfare, meeting environmental regulations, meeting customer expectations, concern over trade barriers, following head office environmental practices, and gaining competitive advantages (see Quazi et al., 2001).

The estimated econometric model including certification is presented in model 3 of Table 4. Once more, the point estimates of all other parameters remain unchanged from a statistical point of view, while the estimated parameter for certification has the expected

[21] Using SF analysis in a sample of foreign-financed manufacturing firms in southern China, Yeung and Mok (2008) found that implementation of ISO 9000 was able to improve firms' productivity in the form of a wholly disembodied shift of the production frontier. The results further show that there was a mildly positive embodied shift of the production frontier due to the effects of ISO on the marginal product of labor but not on the marginal product of capital.

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positive sign and is significant at 95% confidence. This estimated coefficient indicates that the expected cost would rise by 6.7% on average due to certification.

Measuring Technical Efficiency

We use Model 3 in Table 3 to compute technical inefficiency at the plant level. As indicated in Section 3, when computing technical inefficiency the distance between the cost frontier and the cost of each firm is a biased estimate of efficiency. We thus use equation 8 in Section 3 to compute unbiased estimates of technical inefficiency: note that the word 'unbiased' is used in this context to imply that the estimate of technical inefficiency μ is conditional on the distribution of ε_i and, therefore, we need to correct for the bias that results given a half-normal distribution truncated from the left at the zero point (see Horrace and Schmidt, 1996, for further details).

The estimation of technical inefficiency is presented in Table 5 according for each economic sector and separating between MD and FZ. With regards to the latter, we have also separated the Dubai International Financial Center (DIFC) from the other financial institutions in FZ because DIFC has a particular institutional set up that induces some differences with regards to business environment. In particular, the DIFC has been given its own independent regulations and independent common law framework regulated by an independent court (the DIFC Courts) and own Financial Service Authority (DIFSA). This gives all firms that operate in the DIFC a different legal environment with respect to MD and the other FZ.

The results in Table 5 show that inefficiency levels for Dubai as a whole amount to 6.6% of the total costs. We first observe that there is substantial heterogeneity in the mean values of technical inefficiency among sectors in both Main Dubai and the free zones: in general, manufacturing displays the highest inefficiency levels. Furthermore, firms in Main Dubai are on average less efficient in manufacturing and financial activities, while in the other sectors the differences are insignificant.

Table 5: Estimated levels of Technical Inefficiency (percent)

	Financial Sector	Manufacturing Sector	Non-Financial Services	Trading of Goods
MAIN DUBAI				
Mean Technical Inefficiency (%)	**5.69**	**12.43**	**3.46**	**3.05**
Dispersion (Standard Error/Mean)	3.49	6.37	0.91	0.65
Change, Sales per worker (2010 - 2007)	53.1	6.4	-2.8	-11.5
Change, Size of workforce (2010 - 2007)	-78	+1	-3	+3
FREE ZONES (excluding DIFC)				
Mean Technical Inefficiency (%)	**2.52**	**7.19**	**3.46**	**3.38**
Dispersion (Standard Error/Mean)	0.75	0.66	0.63	0.92
Change, Sales per worker (2010 - 2007)	-8.3	36.1	3.5	25.4
Change, Size of workforce (2010 - 2007)	+42	+9	+14	+6
DIFC				
Mean Technical Inefficiency (%)	**5.24**	N/A	N/A	N/A
Dispersion (Standard Error/Mean)	1.26			
Change, Sales per worker (2010 - 2007)	27.0			
Change, Size of workforce (2010 - 2007)	+64			
All the Economy				
Mean Technical Inefficiency (%)		**6.57**		
Dispersion (Standard Error/Mean)		6.09		
Change, Sales per worker (2010 - 2007)		-0.1		
Change, Size of workforce (2010 - 2007)		-11		

Note: Dispersion is measured using the coefficient of variation: $CV=\sigma/\bar{\mu}$. For the International Financial Center we use the median of the increase in sales per worker to avoid the distorting effects of three outliers.

In addition to heterogeneity among sectors, there is heterogeneity within sectors. Naturally, the estimates of dispersion between firms in given sub-groups are smaller than that for the aggregate: table 5 shows a dispersion estimate for 'all the economy' of 6.09, which is largely driven by the manufacturing sector. In MD manufacturing firms show substantial degrees of technical inefficiency (12.4% of total costs) there is a great deal of variation between firms in MD's manufacturing sector. Otherwise, estimates of dispersion suggest that the percentage of technical inefficiency is similar between firms in a given sector and given economic zones, i.e., the magnitude of inefficiency is significant for most sub-groups of firms – sector/economic area – in the economy.

Comparing between sectors we observe that both the manufacturing sector is that with greater degree of technical inefficiency in Dubai, be it in MD or FZ. It is important to

notice that the manufacturing sector was one of the first to develop in Dubai in its drive for diversification. However, the sector remains relatively labor intensive compared to other economies where manufacturing is significant. For example, according to Lee and Mather (2008), in the USA only 9% of the workforce is in the manufacturing sector whereas in the UAE we estimate that 15% of workers are engaged in manufacturing (UAE Employment Hours and Wage Survey, 2008). It is also important to notice that inefficiency in MD, where the *Kafala* applies, is almost twice the size – in relative costs – than in the free zones.

The most striking evidence in Table 5 is that firms in MD are consistently less or as inefficient as firms in free zones for anyone of the four sectors. Thus, inefficiency in MD firms is higher for both the financial sector and the manufacturing sector but have similar levels of inefficiency in the non-financial sector and the trades sector. When we talk about non-financial services these typically include the health sector, educational and IT services. Due to the fact that such sectors serve the public directly we can think that MD has a 'client-reputation' advantage over free zone areas which have yet to develop – e.g., the trustworthiness of new health services in newly developed free zones that are exclusively developed to healthcare.

Finally, we notice that the financial sector in MD and DIFC are more inefficient than firms offering financial services in the free zones (excluding DIFC). This would seem to contradict the expectations and motivation that drives the DIFC: in practice, the DIFC functions with a set of rules and regulations that are close in nature to those exercised in the City of London offering firms that settle in there far greater freedom to operate in the region relative to firms in Main Dubai – that are subject to the regulations from the UAE Central Bank. The DIFC regulating authorities do not allow for the creation of new financial entities – e.g., new banks or insurance firms – but new partnerships can be created to provide legal and financial services on a consultancy basis. Overall, the DIFC has contributes about 6% of GDP in Dubai and provides work to about 12,000 graduates in financial service sector. However, at the end of 2006 about 100 firms had been authorized in the DIFC and only about 2/3 had commenced any significant level of activity, reporting only $1 Billion USA dollars in assets and $ 550 million USA dollars in deposits. Perhaps the fact that it started to take off during the start-up period of the Global Financial Crisis might

show the fact that it has yet not evolved away from their partners operating in MD, which is why the operations of firms in MD and DIFC are similar in terms of inefficiency.

Table 3 further indicates the percentage change in real sales per worker and the change in level of workers – on average – between 2007 (the year before the onset of the crises) and 2010. Results are striking. First, note that the contraction in real sales affected mainly firms in trading and services in Main Dubai, there counterpart in free zones fared much better. Manufacturing seems to have adjusted well in Main Dubai but firms in free zones improved substantially more. Finally, the asymmetric response of the financial sector is notable: while sales per worker in firms located in free zones contracted, banks and financial institutions in Main Dubai and in the DFIC expanded markedly. However, only in the DIFC we see employment expanding whereas in MD or free zones employment declined by around 25% to 30% in the three years after the crises; consequently, the performance of the financial sector in MD and the DIFC would be the result of a smaller decline in sales.

5 Conclusions and Policy Observations

The defining feature of economic development in the UAE –as in all GCC countries— is the sponsorship system or *Kafala*. The *Kafala* regulates both labor immigration and the operations of foreign entrepreneurs operating in Main Dubai. It requires native UAE citizens to act as sponsors of each immigrant worker and participate with at least 51% in the property of each incoming investment. The sponsor, thus, enjoys significant command over the worker and/or foreign investment and is able to reap significant economic rents. In contrast, firms in free zones are not requested to comply with the *Kafala* and, thus, provide an adequate benchmark to measure the potential inefficiencies arising from the sponsorship system.

This paper takes advantage of the differences in business environment between firms under the *Kafala* and those exempt in free zones to study technical inefficiency at the plant level. Inefficiency under the *Kafala* arises from three sources: (a) because rent-extraction is only compatible with non-competitive labor markets that allocate resources on the basis of their capacity to generate rents and not on their productive ability and more efficient use, (b) because innovation is hampered if it induces lower levels of employment

(labor saving) and (c) because of rent-seeking behavior on the part of entrepreneurs that find it more profitable to search for sponsorship rents than to increase productivity and offer efficiency wages.

We use a stochastic-frontiers approach applied to a firm-level survey collected in 2010 and find, as expected, that production costs depend positively on the scale of operations, wages and the costs of capital. We control for capacity utilization since the survey was levied in the aftermath of the 2008/2009 global crisis and find a sizable effect indicating that not all of capacity idleness is inefficiency; a fraction could be merely a reflection of demand slack and can be easily reversed with an economic upswing while inefficiency requires internal adjustment to firm structures or management. We also find that entry by new firms has been massive in Dubai. Because it takes time for newly entered firms to achieve their productive potential, we control for the age of firms and find that older firms tend have lower costs on average, but the effect is of small economic magnitude. Finally, we include international certification of quality, as certification reflects the willingness of firms to self-imposed higher standards of quality in management and production, both of which tend to increase costs.

We extend our basic model to take into account the sensitivity of estimated cost functions and inefficiency measures to heteroscedasticity and find that our results are quite robust. We found that there are significant sectorial effects inducing cost-heterogeneity among firms: firms in free zones and firms in trade sectors tend to be significantly more heterogeneous than their counterparts in Main Dubai or operating in non-traded sectors. In addition to cost-heterogeneity, there is evidence of heterogeneity in inefficiency levels: firms that employ a better educated workforce tend to be more homogeneous independently of the sector in which they operate. In our view this reflects largely the ability of more sophisticated firms to accommodate to business shocks without incurring in higher costs.

Finally, we find that firms operating under the *Kafala* display substantially and statistically higher technical inefficiency than those in free zones. Considering all sectors, we estimate that the inefficiency levels of firms in Dubai amount to 6.6% of total costs (11% of profits) on average. At the sectorial level, however, firms in manufacturing and the financial sector in Main Dubai operate, on average, with twice as much inefficiency levels

relative to firms inside free zones. We do not detect significant differences between Main Dubai and free zones for firms in the non-financial services and the trading sector. The latter may reflect that in such sectors there are higher degrees of competition. It is noteworthy, on the other hand, that the Dubai International Financial Centre (DIFC) –a free zone intended to be a financial hub in the Arab Region—operates with technical inefficiency levels that are very similar to the estimated technical inefficiency of firms in in Main Dubai's financial sector (and significantly above that of the financial sector in non-DIFC free zones).

Overall, our results suggest that the regulations embedded in the sponsorship system have a significant negative effect on the performance of firms in Main Dubai: non-competitive labor markets and investment biases in favor of the local population induce inefficiency and allow significant rent-extraction. On the contrary, in free zones businessmen operate under more competitive conditions and inefficiency levels are consequently smaller.

Clearly, the *Kafala* served the economy of Dubai in the past. It provided a method of regulating the massive import of low-cost, unskilled labor that built the country's infrastructure and delivered significant rents to the local population. Nowadays, as Dubai strives to diversify away from oil and ventures into new industries, the *Kafala* system has become a liability. Shifting to higher value-added industries would require moving away from low-cost, labor-intensive industries in favor of production methods based on the ability of high-skilled workers to operate in dynamic, capital-intensive industries. In attracting such workers and investors, the economy has to move away from the *Kafala* towards business environments that resemble those found in free zones in Dubai. This paper shows empirically that such a move would bring about significant gains in the form of reduced inefficiencies in production.

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Appendix A: Data Construction

Total direct costs were computed as the sum of purchases of all intermediate goods and services (including utilities). Value added per firm was thus computed as total sales less total direct costs. Profits were computed as value added less payroll labor costs. The age of firms was directly asked in the survey. Employment corresponds to total permanent employment at the end of 2010 as asked in the survey plus an adjustment for the use of temporary workers.

Skill categories are based on the classification of occupations using the ISO88 4-digit code. *Unskilled*: elementary occupations and plant machine operation that do not require formal education; *Low Skills*: clerks, service workers and craft workers; *Semi and technical skills*: semi-professional workers that require technical skills and at least vocational formation; *High skills and managerial*: occupations in senior categories including skilled professional occupations, managerial positions and directors.