The Rwandan Industrial and Mining Survey (RIMS), 2005 Survey Report and Major Findings

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i. Executive Summary

The Rwandan Industrial and Mining Survey (RIMS) was a joint exercise between the World Bank (PREM, Africa Region), and the Institute of Statistics, Ministry of Finance and Economic Planning of the Government of Rwanda (GoR). The survey was undertaken between January and March 2006, with survey data covering the period 2004. A total of 111 establishments were surveyed, of which about 26 establishments were randomly sampled from the mining sector. The rest of the survey data (non-mining) represents a census of the manufacturing sector activities in Rwanda (85 establishments). Establishments were distributed across food and beverages, construction materials, chemicals and plastics, metals, wood furniture, textiles, garments, and leather processing activities.

The 2005 RIMS shows that productivity in the sector is within the regional average. Median value added per worker is estimated at US$2,910, which is below the value for Kenya (US$3,457), but above the values for Tanzania (US$2,061) and Uganda (US$1085). Across industries in Rwanda, the median value per worker is highest in construction and mining (US$6,094 and US$6,237 respectively), compared to the chemical industry (US$5,488), food and beverages (US$3,238), and furniture making (US$1,533) Productivity per worker in Rwanda is also higher for exporters (US$9,800) than for non-exporters (US$1,700).

Firms in the manufacturing sector are relatively export-oriented – 42 percent of firms surveyed export 36 percent of their output. About 61 percent of all food and beverage firms are exporters – well above the average of 42 percent for all firms in Rwanda. This is followed by the mining and metal or furniture producers, of which about 38 percent are exporters. The average share of export value to total sales in Rwanda's food and beverage industry is about 54 percent, compared with an overall average of 36 percent across all firms in Rwanda. About 20 percent of firms in the chemical industry have engaged in export, and there is room for growth. There are also prospects for growth in the fruits and vegetables sector as well as in wood working and artisanal activities.

The overall growth potential of the manufacturing sector, however, depends on removing the constraints posed by high electricity, transport and finance costs. Cross-country comparative data reveal that infrastructure-related problems, particularly electricity and transport issues, weigh more heavily on Rwandan firms than on firms in neighboring countries. Across all surveyed firms, 81 percent said that electricity is their single biggest obstacle; for export firms, the figure was 85 percent. Losses due to unreliable power supply averaged 10 percent of the value of outputs for all firms, although some reported losses of up to 85 percent. During the fiscal year preceding the interview, which was 2003, Rwandan establishments reported an average of 23 power outages, with the outages lasting an average of 19 hours. **Firms resort to owning and sharing generators, to cope with the electricity problem**. Close to 75 percent of respondents reported owning or sharing a generator. For these firms, an average of 45

percent of their power comes from these generators. Due to costs of fuel and upkeep, however, fewer generators are owned by smaller firms, domestically owned firms, and firms that do not participate in international markets (non-exporters).

The cost of finance (interest rate, fees, etc.) was identified as a constraint by 54 percent of firms surveyed, and as a major or severe obstacle to doing business by 34 percent of firms. The percentage of firms identifying cost of finance as an obstacle was larger (i) for firms in Kigali than for those outside of Kigali; (ii) for non-exporters than for exporters; and (iii) for medium and small firms than for micro and large firms. **Smaller firms are more credit constrained than larger firms, given the need for collateral to obtain a loan**. The approximate average value of collateral required to get a loan in Rwanda is about 105 percent of the loan value. **Loan terms for small enterprises may also contribute to their credit constraints.** In 2004, the average annual interest rate on loans was a reported 17 percent, and the average term of the loan was 36 months. Longer-term financing is therefore a constraint for micro and small enterprises. Further, larger firms are charged an average of 14 percent for overdraft facilities or lines of credits, while micro and small firms are charged an average of about 17 percent.

Aside from the poor state of infrastructure, availability of skilled labor is reported to be a major constraint by 40 percent of firms. The high returns to education, by level completed (i.e.18 percent increase in income from completion of primary school), arising from employment in the manufacturing sector also indicates that educated labor is scarce in Rwanda. The increases by level are higher for women (48 percent for primary education) than men (8 percent for primary education). Overall, women have, on average, comparable years of experience in the labor market and an equivalent number of hours worked per week, across all education levels. However, their average earnings are well below the average for men. These results, including data from the 2001 household consumption survey indicate that women tend to be concentrated in low-paying occupational categories. Overall, women are disproportionately under-represented in managerial positions in manufacturing firms.

Results from the RIMS indicate that investments to ease the infrastructure constraints to growth (particularly in electricity and transport), reduce the costs of finance, and increase the supply of skilled labor will be critical to growth of the manufacturing sector. In the case of infrastructure, the priority should be in reducing the incidence of power outages and increasing access to firms. Improving the supply of skilled labor to support growth in the sector will require education and training opportunities for workers at both the firm level and the national level – particularly for women. An assessment of the skill mix of the labor force, in relation to the needs of the industrial sector, is needed to ensure that skills of graduates, the school curriculum, and education policy are aligned with growth of the sector.

I. The Economic Structure of Rwanda and the importance of the industrial sector

The manufacturing sector represents about 10 percent of the GDP and contributes about 5 percent to total exports. Manufacturing is dominated by 20 firms, which accounted for 65 percent of total manufacturing in 2002. The sector is based on agro-industrial activities, which account for 80 percent of total manufacturing output. Thus, there is an opportunity to strengthen the links to the agriculture sector, thereby helping to expand market opportunities for farmers.

However, high electricity, and transport costs have contributed to the stagnation of the sector. The sectoral share of manufacturing in GDP has gradually declined from a level of 10.6 in 1995 to 8.9 percent in 2004. The trends in the share of electricity, gas, and water, which in total account for roughly 0.3 to 0.4 percent of GDP, reflect this stagnation. By contrast, the share of the construction sector in GDP has doubled over the same period. In 2004, the manufacturing sector accounted for 11 percent of overall GDP growth, with 96 percent of this coming from the food and beverages sub-sector. Overall, the growth rate of the manufacturing sector has been on a declining trend, over the past decade.

This declining growth trend in manufacturing has posed a problem for export growth, since the manufacturing sector is relatively export oriented. For example, between 1995 and 2002, manufacturing exports experienced a negative annual growth rate of about 8 percent, on average[1]. This number is far below the 8.25 percent average growth of the manufacturing sector and the 6 percent average growth of the country's total exports during the same period. It was within the context of the extremely low levels of growth in the manufacturing sector gave that the Government of Rwanda commissioned the RIMs survey, to identify some of the factors that are constraining growth in the sector.

The remaining sections of this report summarizes the main trends in the manufacturing sector (as derived from the RIMS), and examines the level of constraints posed by the poor state of infrastructure, low availability of skills, and lack of access to finance. Section 2 provides an overview of the survey and distribution of firms across sectors. Section 3 outlines growth performance and prospects of the sector, with some regional comparisons. Section 4 summarizes the constraints to the sector as indicated by the firms surveyed. Section 5 highlights some issues in custom efficiency and trade. Section 6 analyzes the returns to education and details the differences between men and women. Section 7 concludes with an overview of the main results and policy recommendations.

[1] Yet, the average annual GDP growth rate was over 9 percent between 1995 and 2002.

II. The Rwandan Industrial and Mining Survey (RIMS), 2005

2.1. Introduction

The Rwandan Industrial and Mining Survey (RIMS) was a joint exercise between the World Bank (PREM, Africa Region), and the Institute of Statistics, Ministry of Finance and Economic Planning of the Government of Rwanda (GoR). The survey came about due to Government concerns over the extremely low rates of growth of the manufacturing sector, particularly given the energy crisis that occurred over the period 2004-2005. Low growth rates in the sector, coupled with an increasing incidence of electricity load shedding (due to the low water levels that were limiting hydro-generation), led to the urgent need to examine the constraints faced by the manufacturing sector. The RIMS therefore aimed to quantify the impact of the energy crisis (as well as other constraints faced by the manufacturing sector).

The survey was undertaken between January and March 2006, and covered a total of 111 establishments, of which about 26 establishments were randomly sampled from the mining sector. The non-mining establishments surveyed represent a census of the manufacturing sector in Rwanda (85 establishments) covering mainly food and beverages, construction materials, chemicals and plastics, metals, wood furniture, textiles, garments, and leather processing activities. The survey covered the following cities/regions in Rwanda: Kigali, Butare, Gikongoro, Gitarama, Byumba and Ruhengeri. The majority of establishments were from the capital, Kigali[2]. The survey exercise had strong support from the Government of Rwanda.

2.2. Survey data characteristics

The majority of establishments in Rwanda, according to the survey data, are concentrated in the food and beverages sub-sector (34 percent) followed by the mining sector activities (23 percent). The size distribution of the establishments in the data is as follows: close to two-third of the establishments (66 percent) are in the micro and small size category, employing less than 50 workers, and only about 14 percent of establishments in the data belong to the large size category of establishments that employ 100 or more workers. In terms of their legal status, the majority of establishments in the data (47 percent) are privately owned, limited liability companies followed by about 14 percent each from sole proprietorship and partnerships[3].

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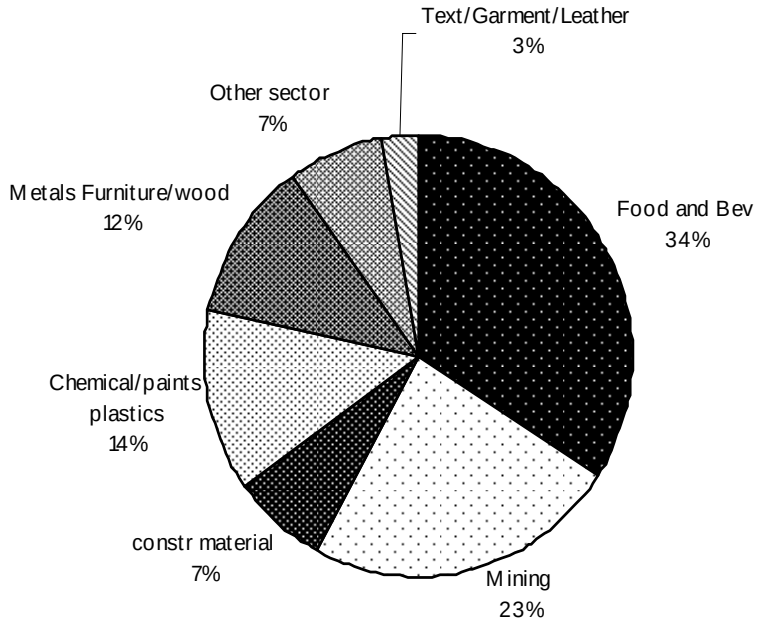
[2] Details of sampling of establishments from the mining sector; and preparation of the list of enterprises interviewed in the manufacturing census is annexed as a brief survey report prepared by a local field coordinator (see Annex 1).

[3] For additional survey characteristics and basic tabulations from the RIMS data, see Annex 2 prepared by the NISR (National Institute of Statistics of Rwanda).

Figure 2.1
Sectoral distribution of RIMS 2005 data (%)

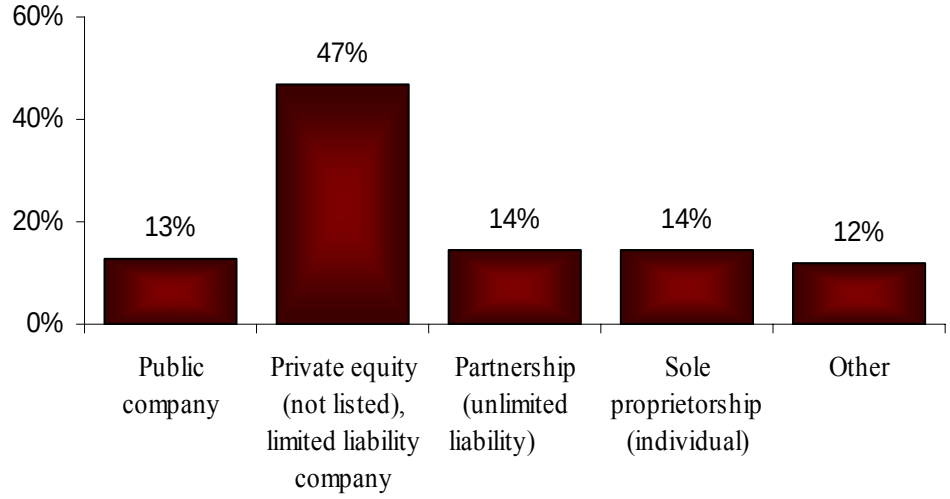


Source: RIMS, 2005.

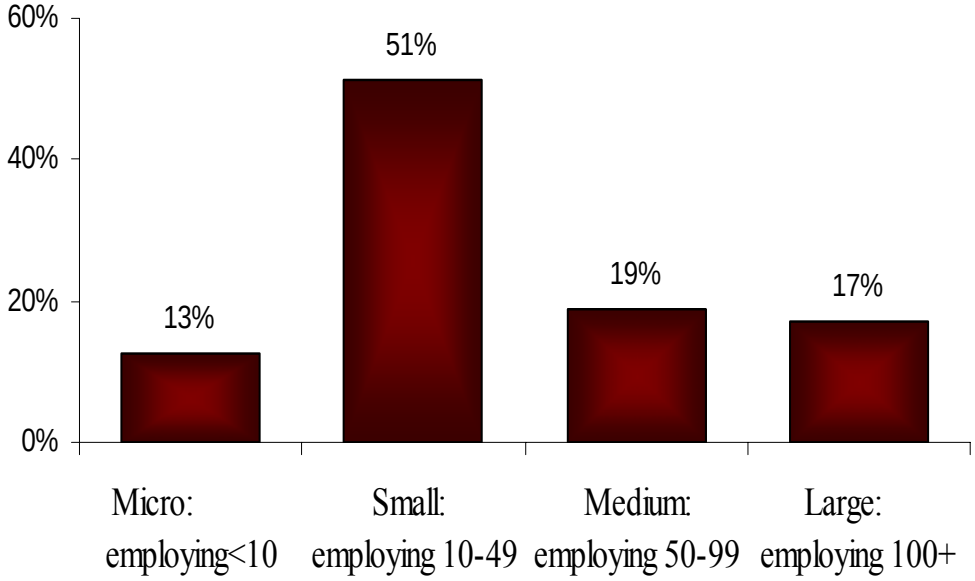
In terms of location and age of establishments, the data reveals that most of the industrial sector activities (63 percent of the establishments covered by the survey) are located in and around the capital, Kigali. The average age of establishments located in Kigali is 14 years (with a median age of 9 years); while for those located outside Kigali the average age is 13 years (with a median age of just 4 years). This implies that development of the industrial sector in Rwanda, particularly in locations outside Kigali, is basically a very recent phenomenon.

Figure 2.2
Distribution of establishments by legal status and size group

a) Distribution of Data by Legal Status (%)



b) Distribution of data by size group (%)



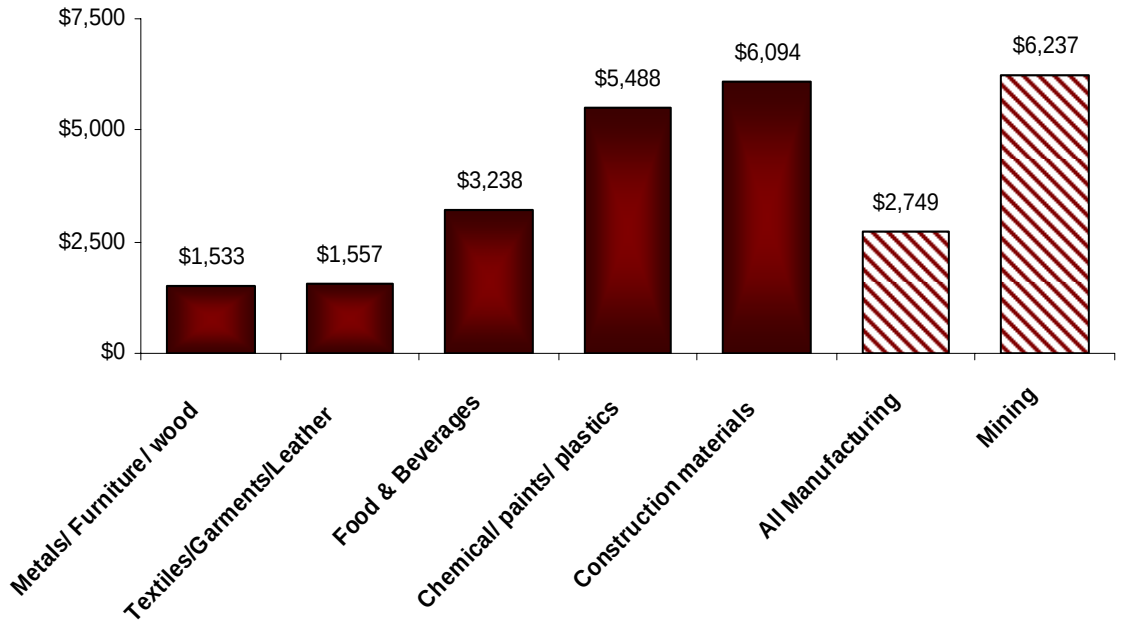
Source: RIMS, 2005.

III. Performance and growth prospects of industries in Rwanda.

3.1. Productivity of Rwandan firms is high for micro enterprises and for those who are exporters

One measure of productivity that we used here to compare establishment level performance in Rwanda is value added per worker. Accordingly, we get from the data that the median value added per worker in Rwanda's manufacturing sector in general (for the year 2004) was approximately $2,749. The mining sector establishments registered a much higher median value added per worker of $6,237. Within Rwanda's manufacturing sector, the data shows that the construction materials producing establishments have registered the highest median value added per worker of $6,094), which is equivalent to more than twice the average for the whole manufacturing sector survey data (see Figure 3.1).

Figure 3.1
Median Value added per worker in Rwanda by industry (in US dollars)



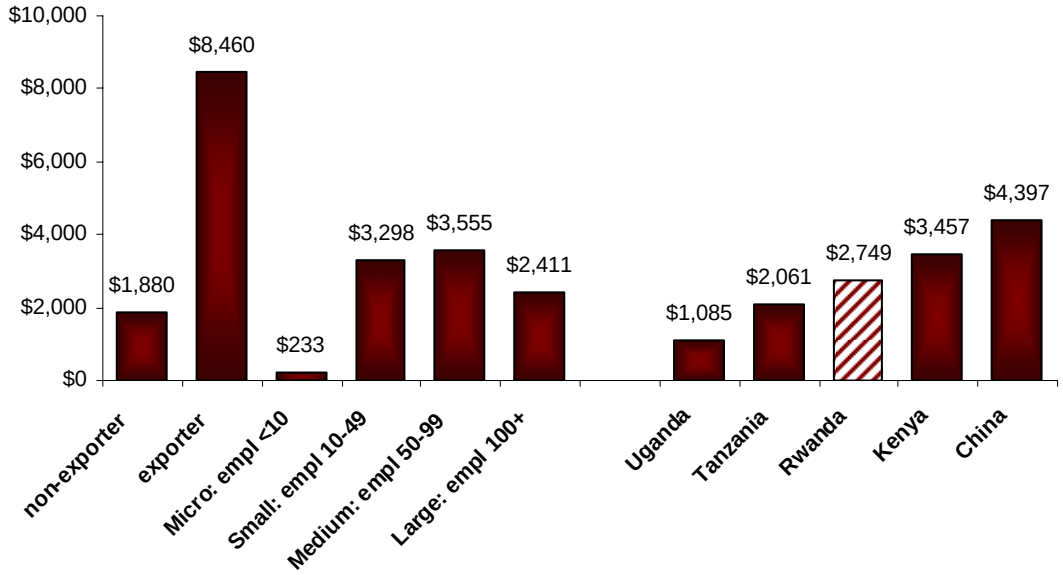
Source: RIMS, 2005

Looking at the performance of establishments in the various size groups within the manufacturing sector, we get that the highest (median) value added per worker was registered by the Small and Medium Enterprises (SMEs) defined as those establishments with employment levels of between 10 and 100 workers, compared with the large and micro enterprises. Median value added per worker for small enterprises (those employing between 10 and 49 workers) is about $3,298; while the median value added per worker

for medium sized enterprises (those employing between 50 and 99 workers) is $3,555; and it is about $2,411 for large enterprises (those with employment levels of 100 or more workers). Productivity, as measured by median value added per worker, is also higher for exporters than for non-exporters in both manufacturing and mining enterprises. The value added differential between exporters and non-exporters is in fact very high by any standard in Rwanda. A comparison of estimated median value added per worker from RIMS, 2005 data shows that productivity in the exporters group of the manufacturing sector (at a median value added per worker of about $8,460) is more than four times that of the non-exporters (which is about $1,880); similarly, the median value added per worker of exporting establishments in the mining sector (at $6,420) is about three times that of non-exporters (which is estimated at $2,144).

Cross country comparison of the figures for the median value added per worker in manufacturing based on similar survey data sets shows that labor productivity in Rwanda is, in fact, relatively higher than that of two of its neighbors -- Uganda and Tanzania, but is much less than the other neighboring country, Kenya (see Fig. 3.2).

Figure 3.2
Median Value added per worker in Manufacturing (in US dollars)

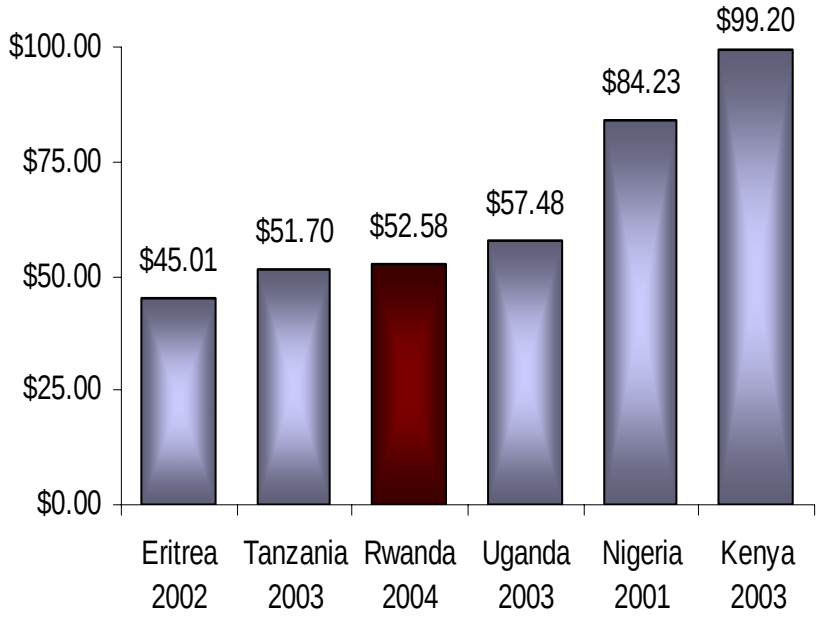


Source: RIMS, 2005; and Investment Climate Surveys.

Comparable industrial survey data sets in Africa that are similar to RIMS, 2005 show that wages in Rwanda are generally in line with that of its neighboring and other African countries. For example, the monthly average wage for an unskilled production worker in Rwanda is about $52.6, which is a bit lower than Uganda's $57.5 (2003), but much lower than Kenya's $99.2 (2003) and Nigeria's $84.2, and a bit higher than

Tanzania's $51.7 (2003)[4]. Rwanda is competitive with its neighbors in terms of wages and labor productivity. Improving Rwanda's strategic competitiveness does not therefore much depend on the wage rates.

Figure 3.3
Average wage rates of unskilled production worker in selected African countries



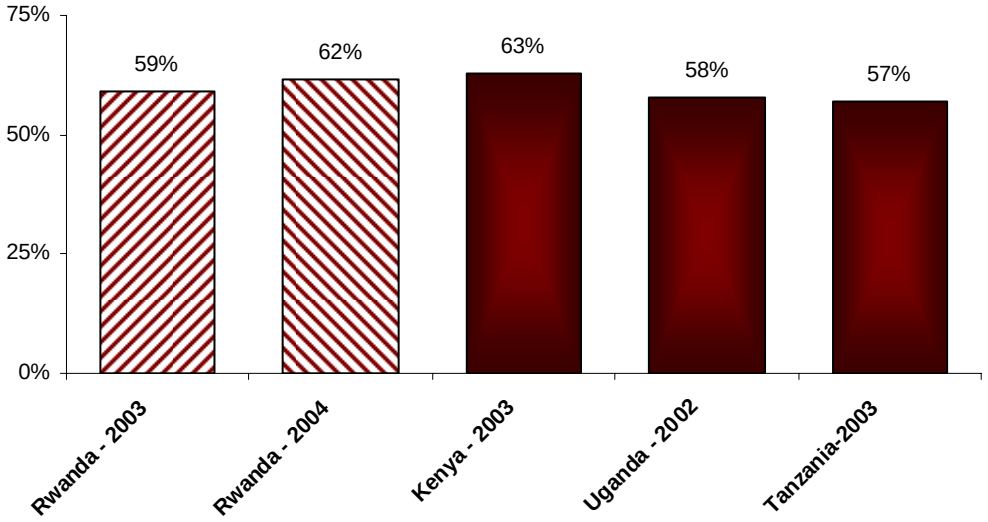
Source: RIMS, 2005; ICA surveys various years.

3.2. Establishments in Rwanda generally perform well below their full capacity.

The RIMS shows that Rwandan establishments are performing at less than their full capacity. Accordingly, RIMS data shows that during the fiscal year prior to the interview (i.e. 2004), the average capacity utilization in Rwanda was about 62 percent; and the average for the fiscal year 2003 was about 59 percent. These figures are comparable with figures in the neighboring African countries (see Figure 3.4) showing that capacity under utilization is a common problem in Africa's industrial sector. There are reasons why African countries generally perform well below their capacity for a variety of reasons including shortage of materials, shortage of capital, lack of sufficiently trained manpower including managerial know how, low domestic demand and a high degree of cumbersome and bureaucratic regulations

[4] Figures in parentheses indicated the years to which the survey data refers.

Figure 3.4
Average capacity utilization: Rwanda and comparators (%)



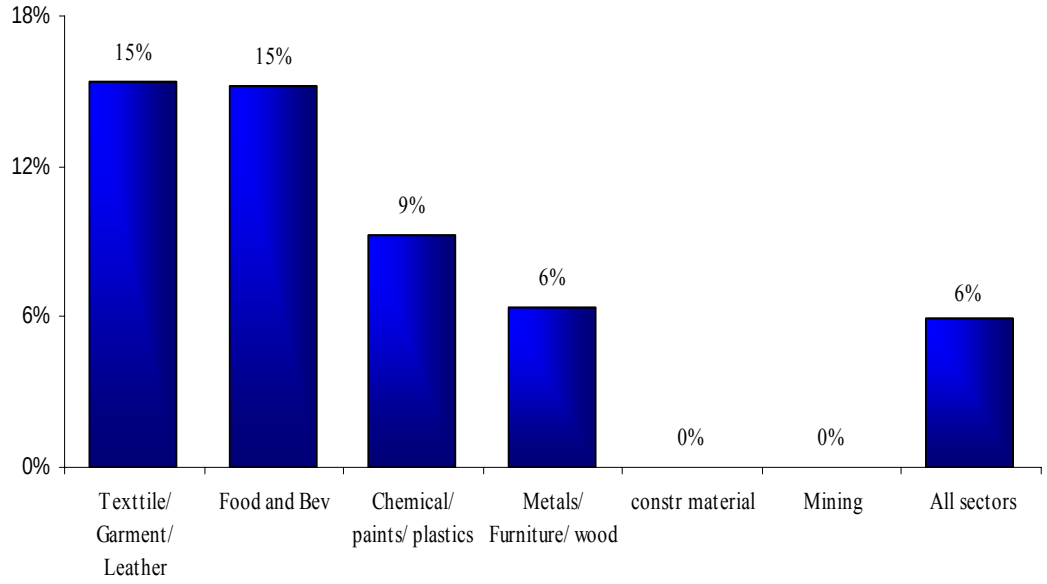
Source: RIMS, 2005; and Investment Climate Surveys

Identifying and addressing the major causes of low capacity utilitzation in Rwanda would play a very important role in raising the contributions of the formal industrial sector to growth. The prevalence of such a huge excess capacity, for example, can be used to spur the export performance of the economy in the short run through appropriate policy instruments that encourage exports, or those that address, as necessary, constraints such as shortage of raw materials, improved availability and efficiency of infrastructure such as power, roads, customs facilities. These issues are examined in sections 4 and 5 of this report.

3.3. Textile/Garments and Food/Beverages industries, as well as small and large firms are the main employers

The industrial sector in Rwanda generally employs about 8 percent of the total labor force. However, the level of industrial sector employment has been picking up in recent years. According to the RIMS, the median growth rate of employment between 2003 and 2004 for the whole industrial sector in Rwanda was about 6 percent. Textile/garment/leather and Food/beverages sectors each registered about 15 percent median growth rates of employment for the same period followed by chemicals/paints sector that registered a median growth rate of 9 percent. The median growth rates for the construction materials and mining sectors, on the other hand, was just close to 0 percent.

Figure 3.5
Median growth rates of employment by industry in 2003-2004 (%)



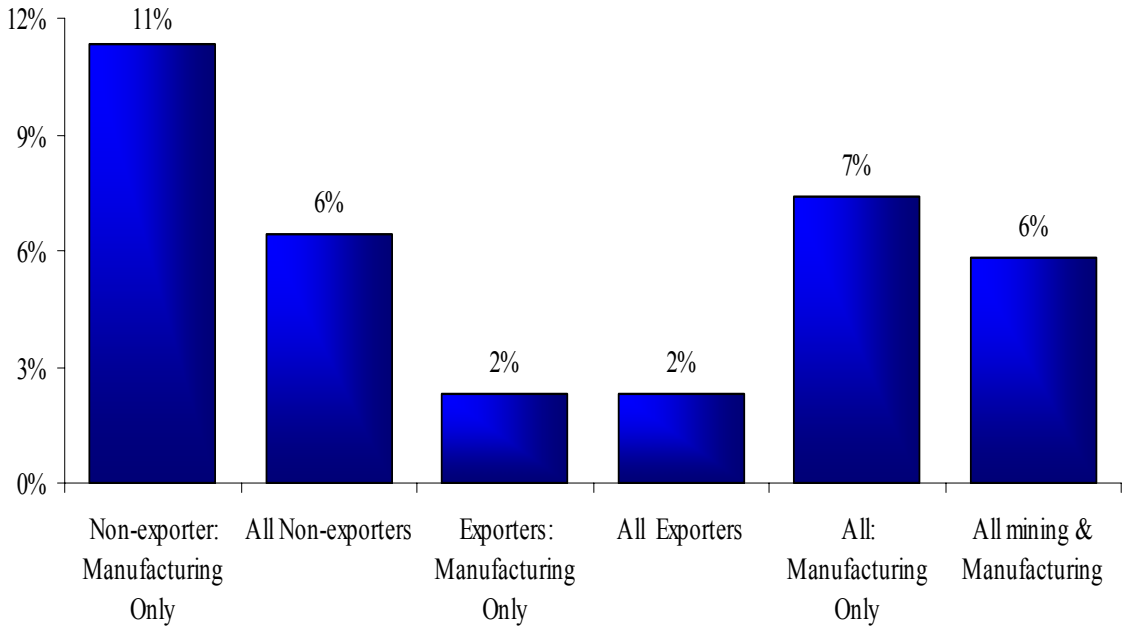
Source: RIMS, 2005

Looking at employment growth rates by size groups, RIMS data shows that small sized enterprises (those with employment levels of 10-49 workers) and large size enterprises (those employing 100 or more employees) have registered median employment growth rates respectively of about 6 percent and 5 percent respectively between 2003 and 2004; while for the micro (employing less than workers) and medium sized establishments (those employing 50–99 workers), median employment growth rate was zero.

A comparison of the employment growth performance by export status reveals that, despite the very high median level of value added per worker created by the exporting establishments compared with the non-exporters (as discussed in section 3.1), a relatively larger share of employment growth in Rwanda's manufacturing and mining sectors was generated by the non-exporting establishments[5]. Accordingly, the median growth rate of employment for the non-exporters using the whole RIMS data (combining both the manufacturing and mining sectors) was about 6 percent compared with 2.3 percent for the exporters. For establishments in the manufacturing sector establishments alone, the median employment growth rate for exporters was about 2.3 percent compared with about 11 percent for non-exporters. On the other hand, the median employment growth rate for non-exporting mining establishments was about 2.6 percent compared with 0 percent for the exporters.

[5] Exporters here are defined as establishments that reported to have produced at lease 20% of their sales for exports (either for direct or indirect exports).

Figure 3.6
Median growth rates of employment in Rwanda by export status (%)



Source: RIMS, 2005

3.4. Significant share of Rwandan establishments export, and Export orientation is relatively higher for food and beverage industries

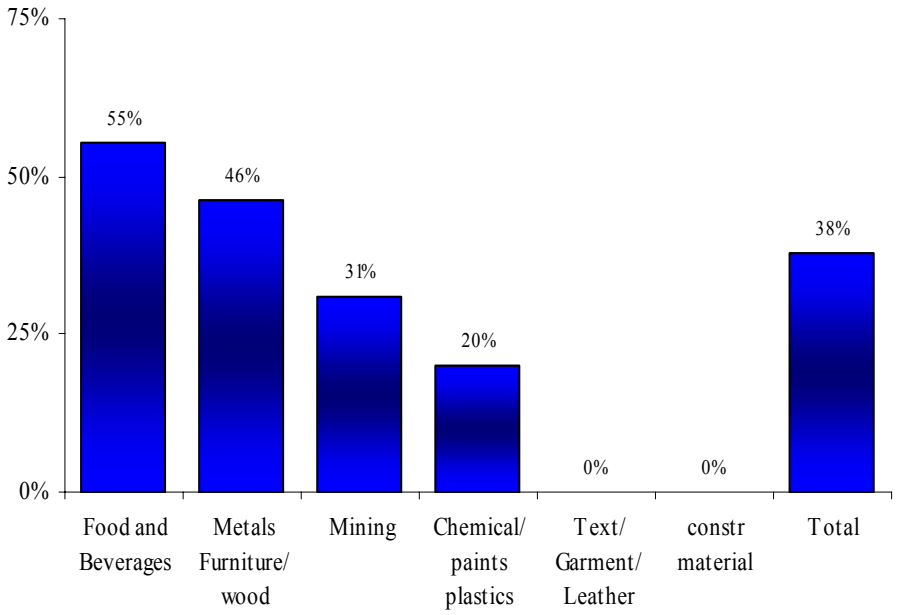
A closer look at the sectoral breakdowns of exporters in Rwanda's manufacturing sector reveals that the food/beverages establishments are more likely to be exporters than those in the other sectors, and they also on average export a larger share of their output than the other sectors do (see Figure 3.7 a and b). According to RIMS data, about 55 percent of establishments in the food and beverage industries are exporters – well above the average of 36 percent for the whole data. This is followed by the metal/furniture producers where about 46 percent are exporters. For the mining sector alone, the percentage of exporting establishments was about 31 percent in 2004.

The average share of exports as a percentage of total sales in the food and beverages industry was about 53 percent compared with an overall average of 34 percent for the whole of Rwanda. No significant share of exports has been reported from the construction materials producers and establishments in the textile/garments sectors. Only one establishment (out of three) in the textile/garments sector reported to have exported (and the share of its exports was just 12 percent of its sales in 2004); and only three establishments (out of 15) in the chemicals sector reported to have exported either

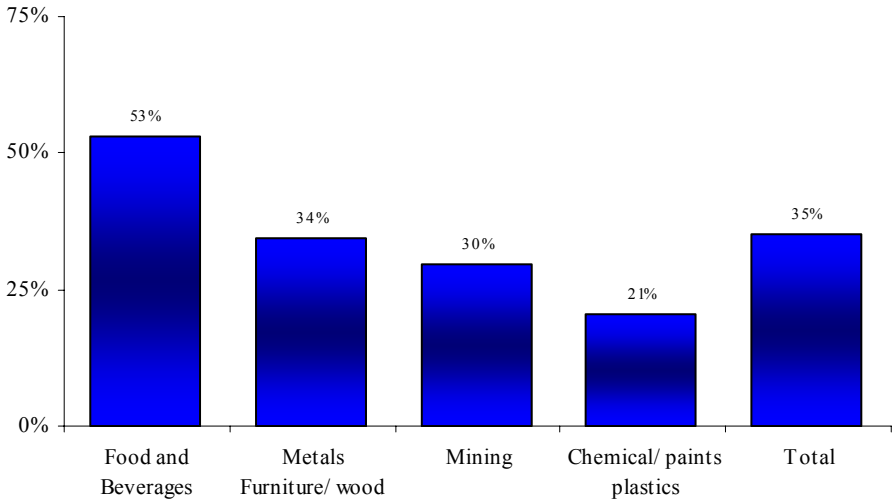
directory or indirectly, and the average share of their total exports was about 20 percent of their total sales.

Figure 3.7
Percent of exporters (direct+indirect) and average exports by sector (%)

a) Percent of exporting establishments (%)



b) Average share of exports as a percentage of sales (%)

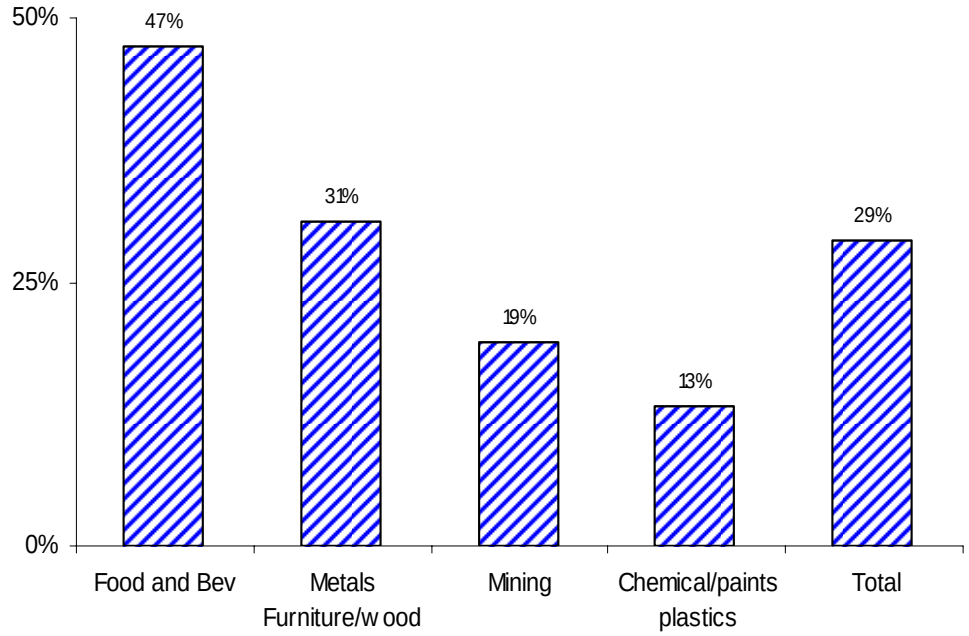


Source: RIMS, 2005

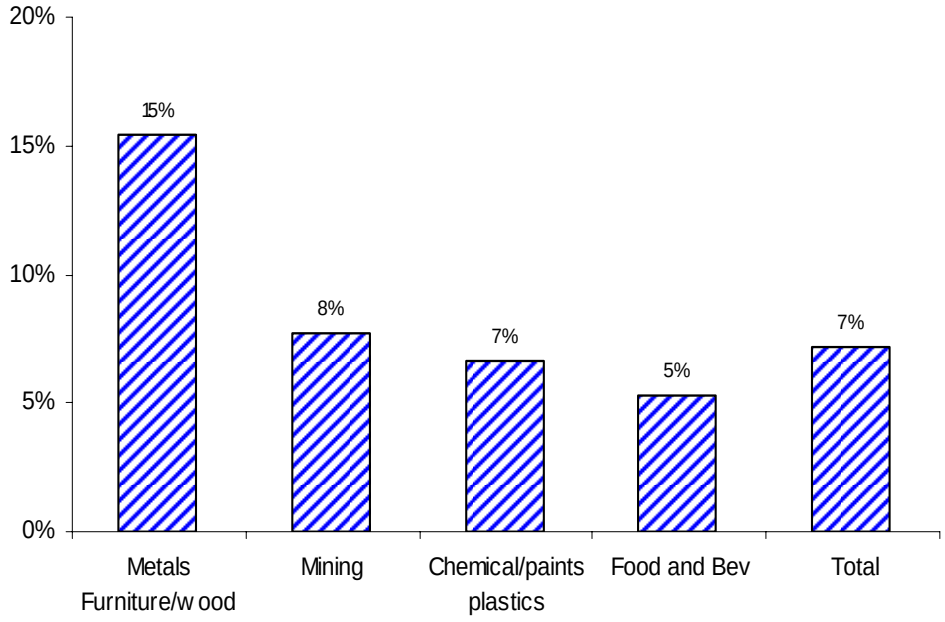
It should be pointed out here that the number and share of exporting establishments shown above is on the high side because of a significant presence of indirect export activities in Rwanda. If exporters are defined solely based on the share of sales that they export direct y, that is excluding products they indirectly export through another establishment or through a distributor, then the share of exporting establishments in Rwanda would just be about 29 percent. On the other hand, RIMS data shows that about 7 percent of the Rwandan establishments surveyed reported to have indirectly exported more than 20 percent of their sales through another establishment (or a distributor). Overall, the relative majority of establishments in the food/beverages (47 percent) and metals/furniture (34 percent) sectors reported to have exported directly; while a relatively higher share of indirect-exporters are found in the metals/furniture producing (15 percent) and Mining (8 percent) sectors.

Figure 3.8
Percent of direct exporters and indirect exporters in Rwanda by sector (%)

a) Percent of establishments that are direct exporters



b) Percent of establishments that are indirect exporters



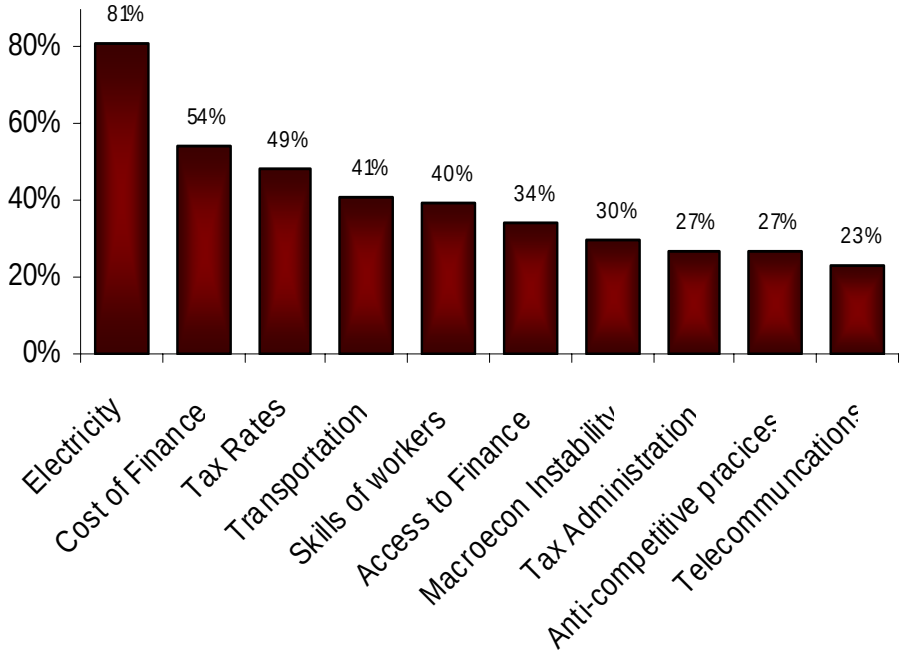
Source: RIMS, 2005

IV. Overview of constraints to growth and performance of industrial firms in Rwanda.

4.1. Electricity, finance, transportation and shortage of skilled labor are among the major business obstacles in Rwanda

The survey instrument used for the RIMS asked respondents whether a given type of potential business impediment is an obstacle to the growth and performance of their establishment, and if so, how they rate the level of severity about each of these obstacles. Accordingly, for Rwandan establishments, the five (5) most important impediments to their growth and performance, based on the share of respondents who identified them as major to severe obstacles, are: Power (identified by 81 percent of firms), cost of financing (54 percent), tax rates (49 percent), Transportation (41 percent) and shortage of skilled workers (40 percent). The following chart shows the ten most important business obstacles in Rwanda identified by the relative majority of respondents, along with the percentage of respondents who rated them as major to severe.

Figure 4.1
Ten major business obstacles in Rwanda (% of firms complained)



Source: RIMS, 2005.

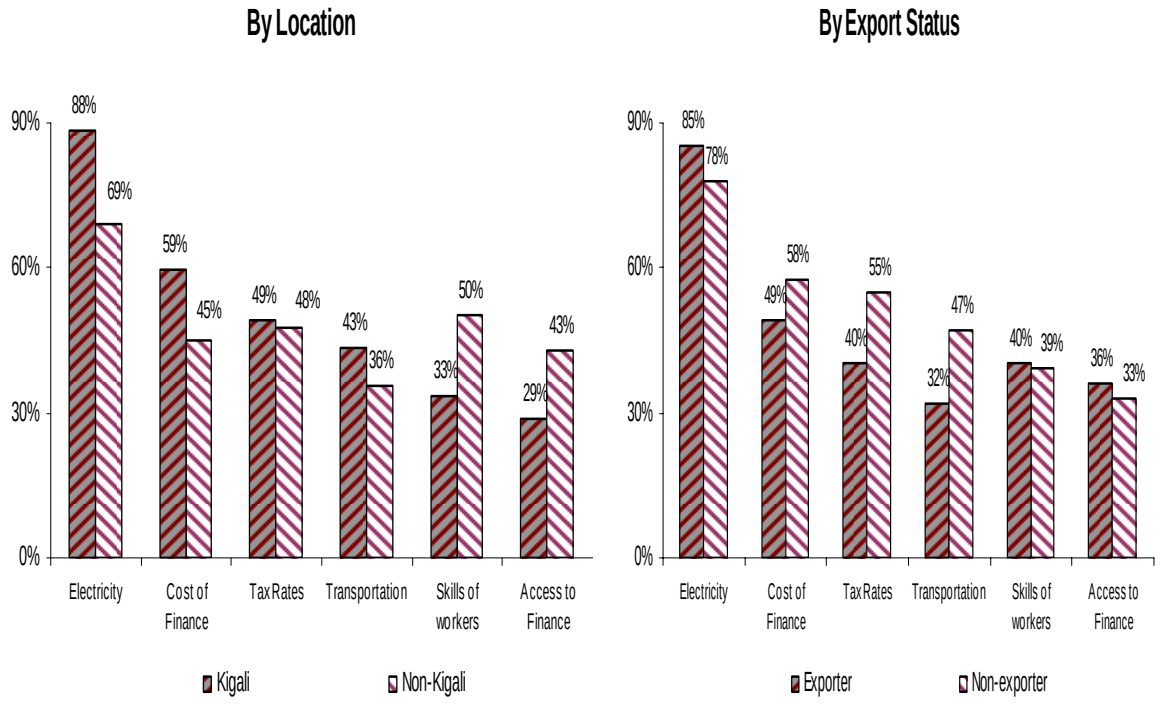
4.2. There are variations in ratings of business obstacles by different establishment characteristics

The perceptions about the ratings and the rankings of business constraints in Rwanda significantly vary by the various characteristics of the establishments surveyed. The following figure shows such differences by region (between Kigali and outside Kigali), and by export status (between establishments who export at leas 5 percent of their sales and those with no exports) as well as by the size of establishments.

Figure 4.2 below shows that there is a regional variation in the perceived investment climate constraints between establishments in Kigali and those located outside Kigali in that availability of skilled workers, access to finance, and telecom are more concerns to the latter. On the other hand, most of the major business constraints identified by both exporters and non-exporters seem to be similar: Both groups identified power (electricity), cost of financing and tax rates as major to severe business obstacles. There are some differences in terms of the share of respondents who identified each of these obstacles, however. Electricity, skills of workers, access to finance, macroeconomic stability, and business licensing were identified as impediments by a relative majority of exporters that non-exporters: a larger percentage of respondents from the exporting

establishments (85 percent), for example, identified power as a serious obstacle compared with 77 percent from the non-exporting group. On the other hand, tax administration and anti-competitive practices have been identified by a relatively larger share of respondents in the non-exporting group of establishments than those in the exporting group.

Figure 4.2
Major obstacles (and % who identified them as major to severe) by location and export status



Source: RIMS, 2005.

4.3. Variation of subjective business obstacles by size

Business obstacles seem also to be different for the different size groups. For example, we see that electricity, which is the obstacle identified as major to severe by the largest majority of establishments in the data is more of a concern to Small and Medium Enterprises (SMEs) in Rwanda than to larger establishments. The same is true about access to finance and issues of macroeconomic instability; while issues such as anti-competitive practices, taxation, and cost of finance are relatively more of a concern for larger sized establishments.

Table 4.1
Business obstacles in Rwanda by size group of firms

percent of firms evaluating constraint as "major" or "very severe"					
	All Rwanda	Micro (empl <10)	Small (empl 10-49)	Medium (empl 50-99)	Large (empl 100+)
Electricity	81%	86%	82%	81%	74%
Cost of Finance	54%	43%	53%	71%	47%
Tax Rates	49%	43%	44%	62%	53%
Transportation	41%	36%	40%	57%	26%
Skills of workers	40%	36%	42%	48%	26%
Access to Finance	34%	36%	37%	33%	26%
Macroeconomic Instability	30%	36%	32%	33%	16%
Tax Administration	27%	7%	30%	43%	16%
Anti-competitive practices	27%	7%	21%	52%	32%
Telecommunications	23%	21%	28%	10%	26%
Access to Land	23%	21%	28%	14%	21%
Trade/Customs Regulations	23%	14%	25%	38%	11%

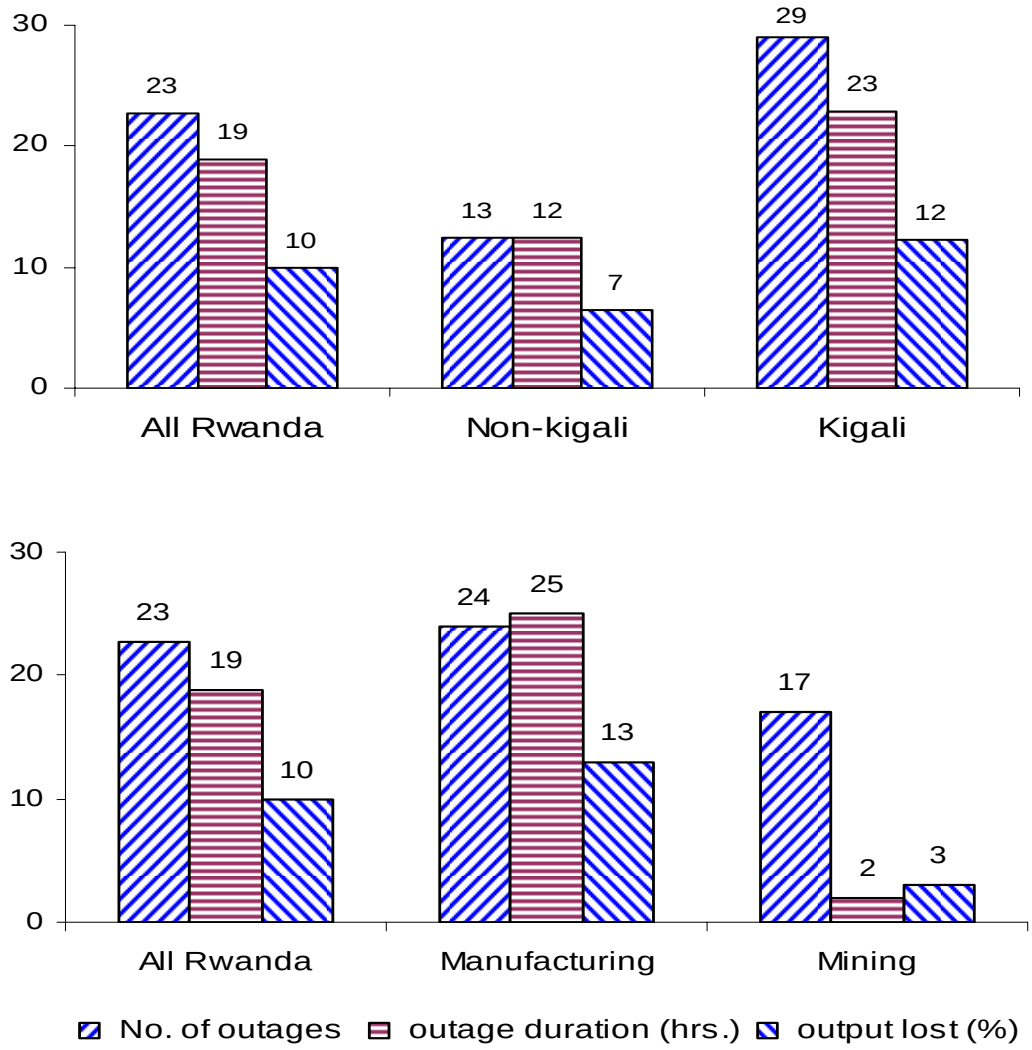
Source: RIMS, 2005.

4.4. Infrastructure related impediments are generally high in Rwanda

Overall, above discussion identifies the high cost and availability of electricity, transportation and telecommunication services, as big constraint to the development and competitiveness of industrial sector in Rwanda. Out of the 65 establishments that responded to the question to identify the single biggest constraints they face, 48 percent pointed out that electricity is their single biggest obstacle. Out of the non-exporting establishments who responded to this question, about 50 percent identified this same problem (electricity) as their biggest single obstacle; while 45 percent of the respondents in the exporters group did so. Thus, even though the energy problem is common to all establishments in Rwanda, poor access to power may be the main factor explaining capacity under-utilization for exporters. Reducing the cost of power generation and improving its availability would be one way to encourage export growth.

Objective indicators from the data also confirm the severity of power problems in Rwanda. During the fiscal year preceding the interview (i.e. 2003), responding establishments reported to have faced power outages for an average of 23 times, and on average when the outages occurred, they reported to have stayed with out power for an average of 19 hours before power was restored. The resulting loss of output due to such power interruptions was also quite high. Establishments estimated that, during the same year, their loss due to unreliable power supply was equal to an average of 10 percent of their outputs (and some report that up to 85 percent of value is lost due to these outages). The problem generally seems to be more severe in Kigali than in other locations. The RIMS data also shows that power related constraints are much higher in the manufacturing sector than in the mining sector.

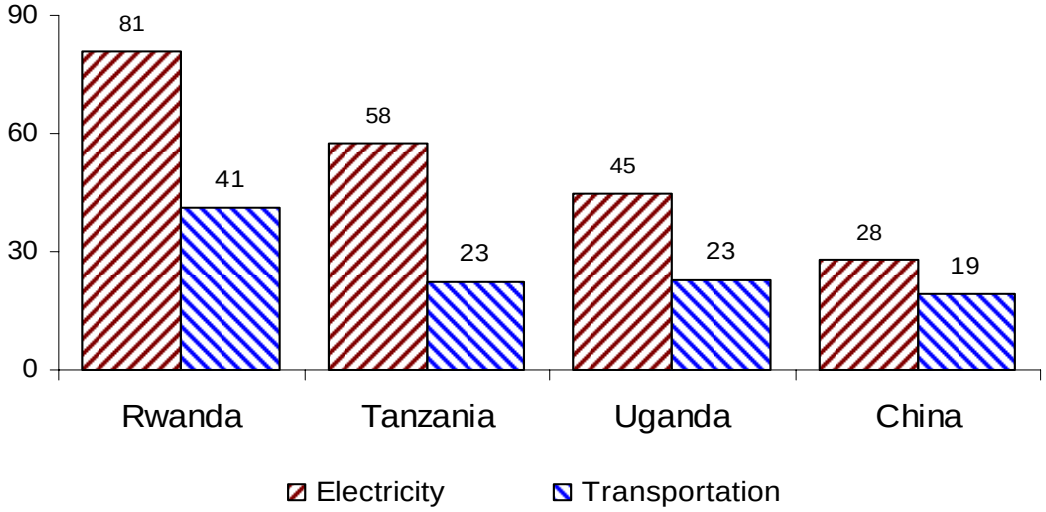
Figure 4.3
Infrastructure indicators: Electricity



Source: RIMS, 2005.

Cross country comparative data between Rwanda and other countries also reveal that infrastructure related problems, particularly those of electricity, telecommunications and transport issues are more of a concern to businesses in Rwanda.

Figure 4.4
Infrastructure: Electricity and Transport as major concerns
(% o firms complained)

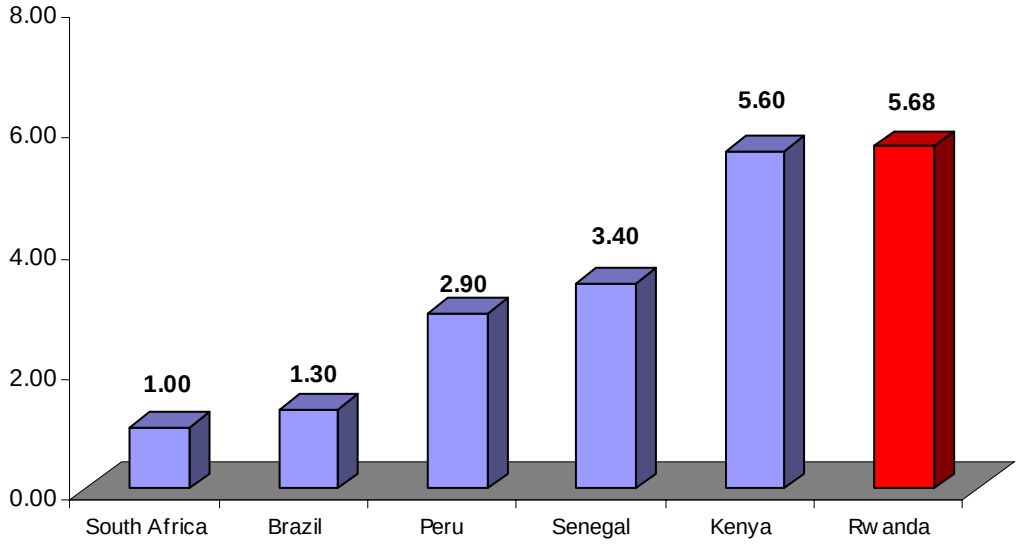


Source: RIMS, 2005; and Investment Climate Surveys

The above figure shows that more than 40 percent of Rwandan establishments rated transportation as a major to severe constraint to the operation and growth of their business compared with 23 percent in both Tanzania and Uganda and less than 20 percent in China. The same is true for electricity: more than 80 percent of Rwandan establishments rate electricity as a major to severe constraint to the operation and growth of their business compared with 58 percent in Tanzania, 45 percent in Uganda and less than 30 percent in China.

Objective indicators from comparative datasets also show that the relative cost of energy borne by manufacturers in Rwanda is much higher than those in other countries both inside and outside Africa, thus reducing the international competitiveness of the Rwandan industrial sector. The following chart shows that the share of energy cost to sales is significantly higher in Rwanda than in the other comparator countries: close to six (6) times than that of South Africa, and close to double that of Peru.

Figure 4.5
Comparing Share of Energy Cost as percent of sales (%)

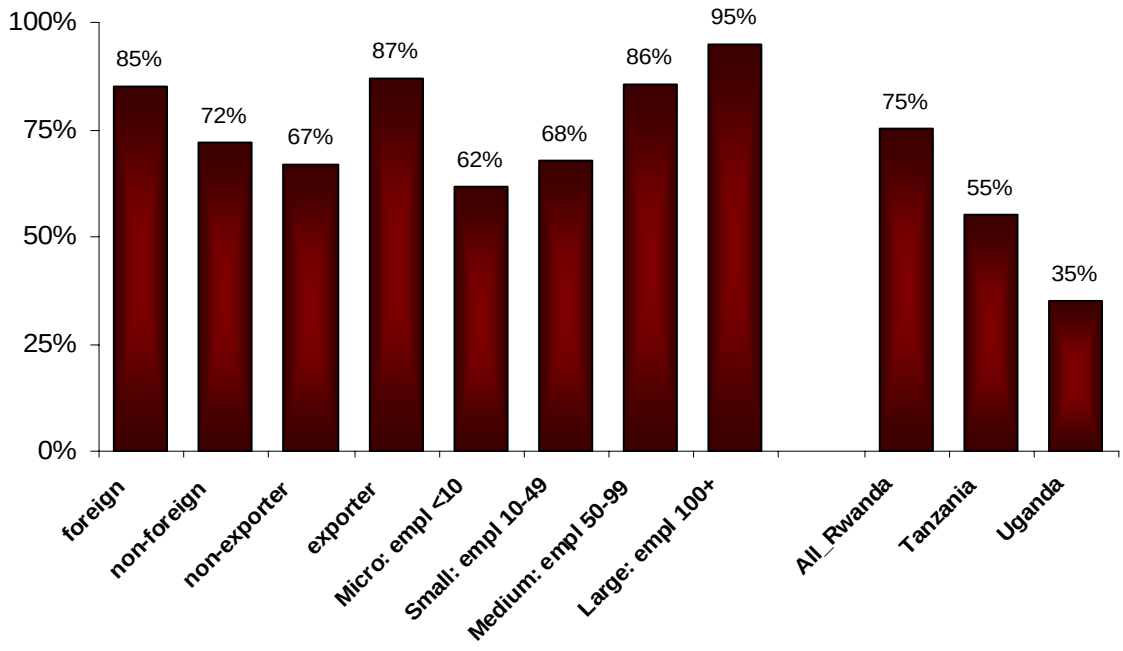


Source: RIMS, 2005; and Investment Climate Surveys

4.5. High rate of generator ownership: One coping mechanism for unreliable power supply?

It seems that the majority of Rwandan businesses attempt to cope with the power problems by having or sharing a generator. Generator ownership in Rwanda is surprisingly very high compared with that in other countries. According to the data, close to 75 percent of respondents reported to have or shared a generator to cope with unreliable power supply from the public grid. Generally, an average of 45 percent of power used by Rwandan establishments that use/share generators comes from these generators -- a very high proportion by any standard and thus adds up to the high cost of production in Rwanda. However, for the obvious potential reasons of cost and relative need, smaller establishments, fully domestic owned establishments (i.e. those with out a foreign ownership) and establishments who do not participate in international markets (non-exporters) are less likely to own or share a generator.

Figure 4.6
Generator ownership by various establishment characteristics in Rwanda (%)

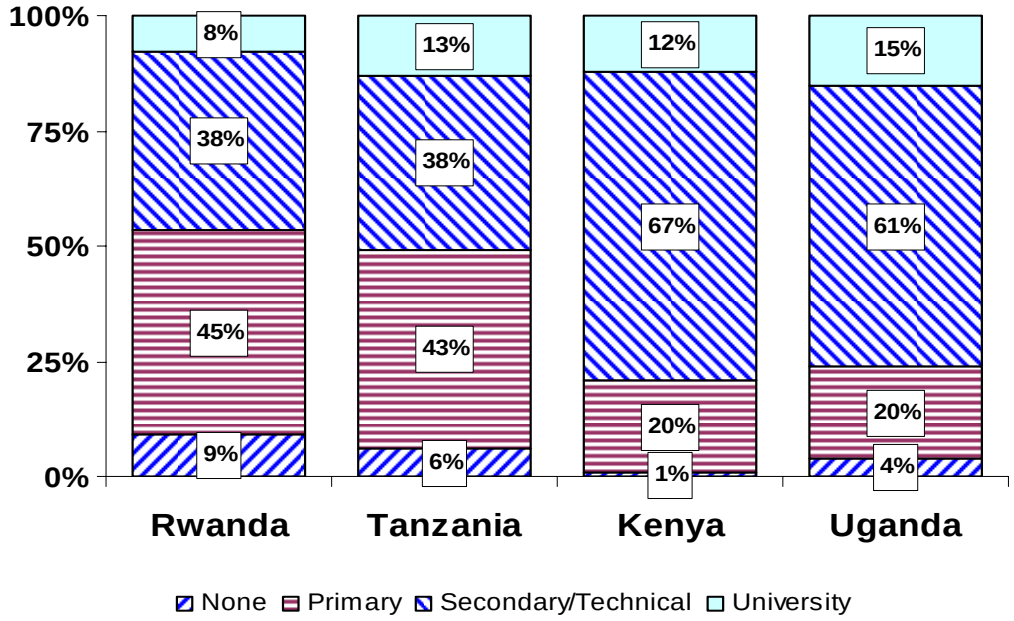


Source: RIMS, 2005; and Investment Climate Surveys.

4.6. Shortage of skilled manpower more serious in Rwanda than in comparable neighboring countries.

As mentioned earlier, one of the major impediments that a good majority of Rwandan establishments (about 40 percent of them) identified as major to severe problem is lack of sufficiently skilled labor force. A close look at the composition of the Rwandan industrial workers from the survey data confirms this. Indeed, the majority of industrial workers in Rwanda (45 percent) did have only primary level education. This is very high compared, for example, with 20 percent each in Kenya and Uganda, and 43 percent in Tanzania. Similarly, the share of workers with out any education is also relatively very high in Rwanda at close to 10 percent compared with just 1 percent in Kenya, 4 percent in Uganda and 6 percent in Tanzania. On the other hand, the same comparative datasets show that the share of workers who have completed university level education is the lowest in Rwanda compared with that of its neighboring countries: As shown in the figure below, just about 8 percent of workers in Rwanda have completed university level education compared with about 15 percent in Uganda, 13 percent in Tanzania and 12 percent in Kenya. Similarly, we see that the share of workers who have completed secondary or vocational schooling is also relatively low in Rwanda at only 38 percent compared with 67 percent in Kenya and 61 percent in Uganda.

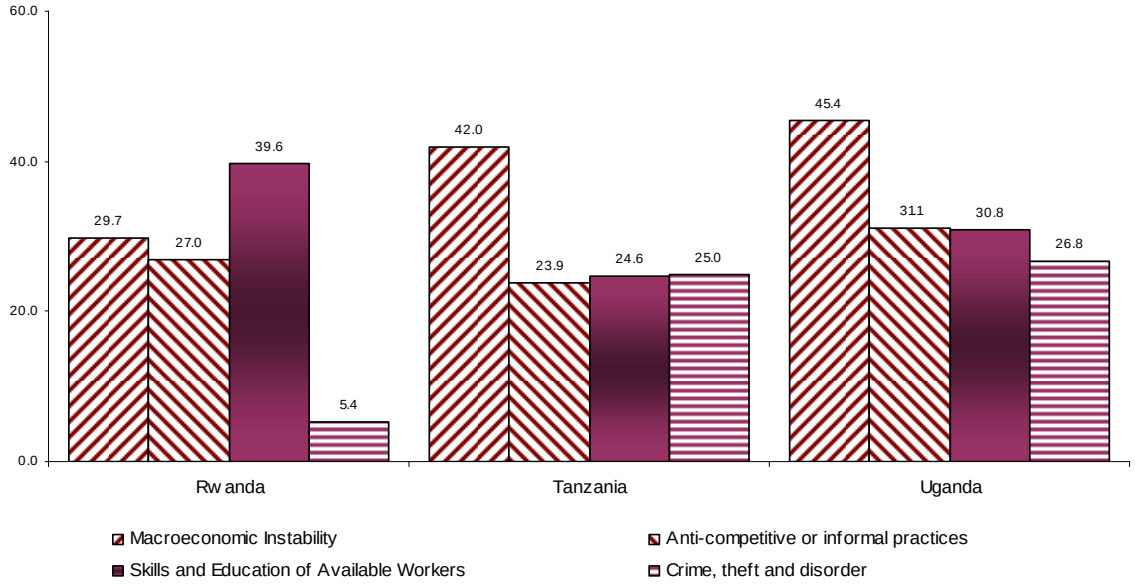
Figure 4.7
Workers education: Share of workers by level of education completed (%)



Source: RIMS, 2005; Investment climate surveys.

The business constraint related to availability of skill is clearly recognized by Rwandan entrepreneurs. A significant share of the labor force in Rwanda (9 percent) does not have primary level of education; in addition, a large share of firms report a shortage of skills as a business concern, more so than in the comparator countries in Africa. More entrepreneurs identify this as more of a concern compared to other general business concerns (see Figure 4.8 below).

Figure 4.8
Shortage of skills and other selected non-infrastructure business obstacles
(% of firms who identified each as major to severe constraint)



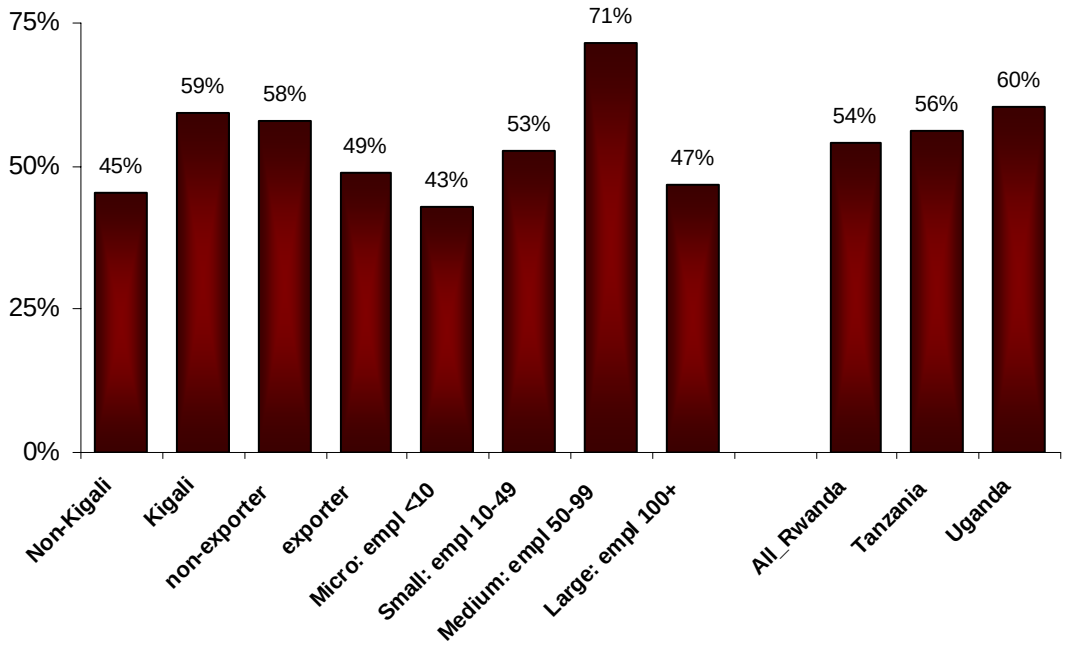
Source: RIMS, 2005; Investment climate surveys.

As shown in the figure above, the low skill level of currently available workers in the Rwandan labor market is identified by more respondents (40 percent) as major to severe business obstacles than macroeconomic instability (29 percent), anti-competitive practices (27 percent) and crime (5 percent) within Rwanda. This is also very high when compared with 24 percent of respondents in Tanzania and 30 percent of respondents in Uganda who identified skill shortages as a major or severe business obstacle. Clearly, issues related to crime, theft and disorder are not significant business concerns compared with other problems within Rwanda, and also compared with that of the other neighboring countries.

4.7. Access to and cost of Finance generally matter too, but are relatively more concerns for firms in Kigali and for SMEs

Finance, particularly cost of finance is another major obstacle to the performance and growth of businesses in Rwanda. In fact, cost of finance (interest rate, fees, etc) has been identified by the second largest majority (by 54 percent) just next to electricity. Access to finance (availability) is also identified by 34 percent of respondents as major to severe business obstacle. The percentage of establishments who identified cost of finance as a business obstacle is larger in Kigali (compared with establishment outside Kigali), for non-exporters than for exporters, and for medium and small enterprises than for micro and large ones.

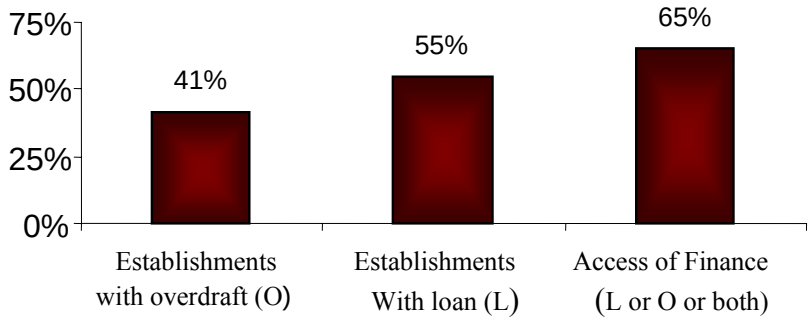
Figure 4.9
Cost of finance: percentage of respondents who identified it as major/severe business obstacle (%)



Source: RIMS, 2005; Investment climate surveys.

Generally, however, the figures from the data sets also show that access to bank loans and overdraft facilities does not seem to be much different from what one can find in other African countries. Accordingly, we see that the shares of firms who have access to overdraft facilities or bank loans in Rwanda respectively are 41 percent and 55 percent; and close to 65 percent of establishments in Rwanda have access to at least one them (either of overdraft facilities or bank loan or both).

Figure 4.10
Access to Finance in Rwanda:
Establishments with overdraft facility or bank loans (%)

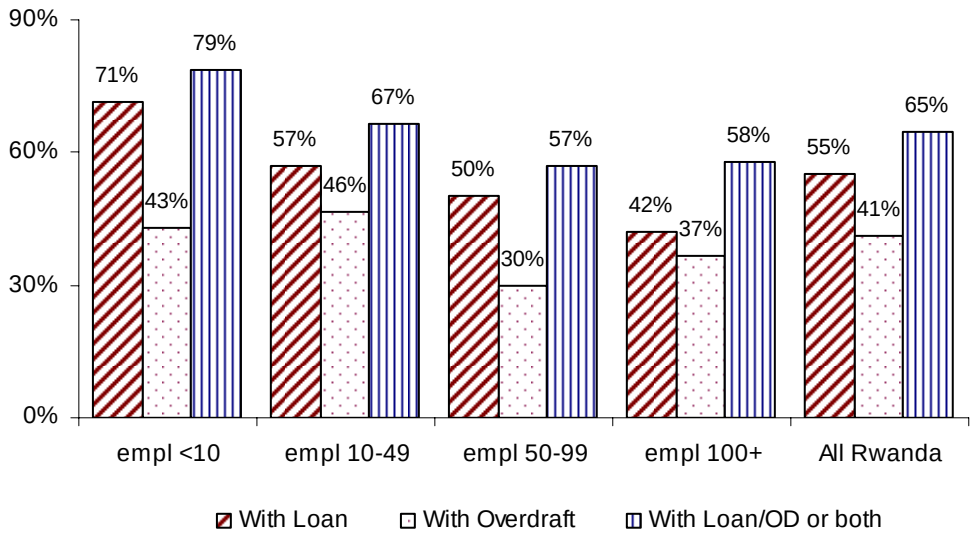


Source: RIMS, 2005

The RIMS data also show that the majority of loans secured by establishments (about 85 percent of them) in Rwanda required some type of collateral. This means there is a very good likelihood that micro and small enterprises, that are generally less likely to own various types of assets for collateral purposes, will be deprived of getting the finance they need to expand their operations. Data also shows that it is mostly land, buildings and immovable plant and machinery that are used as collateral in most cases in Rwanda, and thus establishments that do not have such types of assets will have a hard time to get the finance they want even though they may have other types of assets. According to RIMS, 2005 data, the majority of loans to Rwandan establishments were provided against one or a combination of the following types of assets: land and buildings (with 86 percent reporting of the firms reporting having used this as collateral), immovable plant and machinery (58 percent), movable machinery and equipments, including vehicles (32 percet), other tangible assets such as accounts receivable and inventory (29 percent), personal assets of the owner/manager such as his/her house (37 percent) and other types of assets not specified above (19 percent).

As expected, the problem of access to finance varies by establishment size. Majority of establishments in what can be termed as 'Micro' size group reported having had access to some form of finance from banks (either a loan, an overdraft facility or both). This contrasts with establishments in the other size groups.

Figure 4.11
Establishments with either or both overdraft facility and bank loans (%)



Source: RIMS, 2005

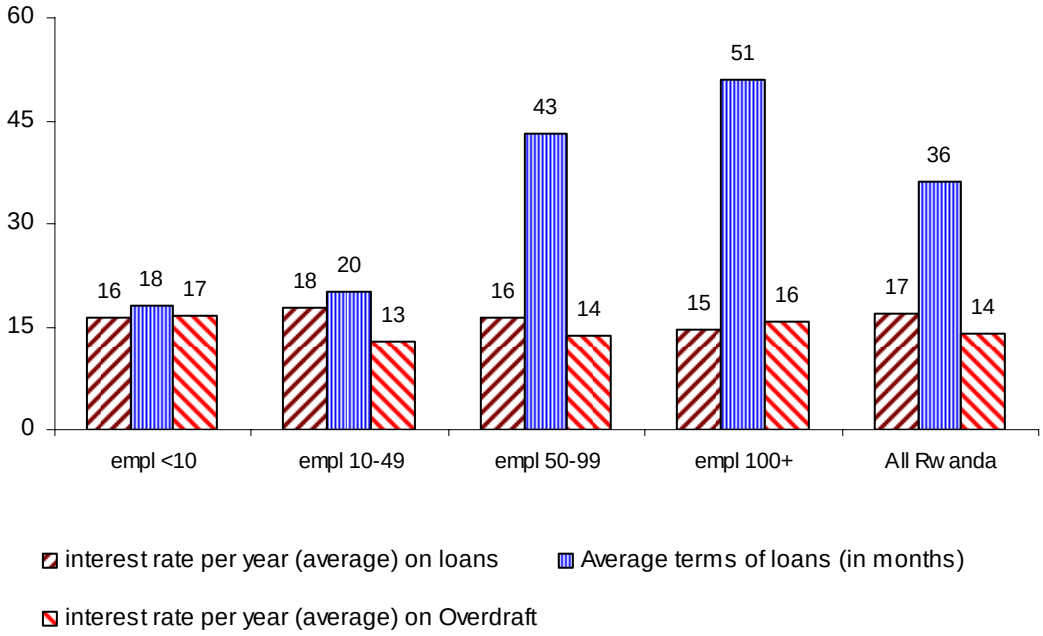
The figure shows that there are more micro establishments in our data (about 71 percent of them) with bank loans than with overdraft facilities (43 percent). On the other hand, out of a total of about 58 percent of large enterprises (defined as establishments that employ 100 or more workers) with loans, with overdraft facilities, or with both (i.e. those that have access to some type of bank finance), 42 percent reported to have loans and 37 percent reported to have overdraft facilities. We also see that in all other size groups too the share of enterprises with loans is higher than that of those with overdraft facilities; but there is a relative tendency of larger enterprises to have relatively more access to overdraft facilities:

Having loan or overdraft facility does not, however, show the whole picture regarding access to finance, particularly from the point of view of SMEs financing. For example, it is equally important and worthwhile to look at the various types of terms and conditions (including interest charges) that are imposed on establishments and see if they are different between the various establishment characteristics, for example, between small and large firms.

According to the RIMS data, the approximate average value of collateral required to get a loan in Rwanda is about 105 percent of the loan value; and over the year of 2004, the average annual interest rate on loans was reported to have been around 17 percent; while the total duration (term) of the loan (from the moment the establishments received the money until the moment the loans must be fully repaid) was on average about 36 months. However, the corresponding average interest rates of loans charged to micro and

small establishments were respectively 16.3 percent and 18 percent per year, which is comparable with the average for the whole data. On the other hand, the average terms of loans for micro and small establishments respectively were 18 months and 43 months compared with 51 months for large establishments. Longer term financing from banks is therefore more likely to be a major problem for micro and small enterprises. Similarly, RIMS data reveals that while the average annual interest rate charged for overdraft facilities or lines of credits was about 14 percent per year, the average interest rate charged to micro enterprises was about 17 percent per year – which shows that smaller firms not only are given shorter terms to pay off their loans, but they are also charged a relatively very high interest rates.

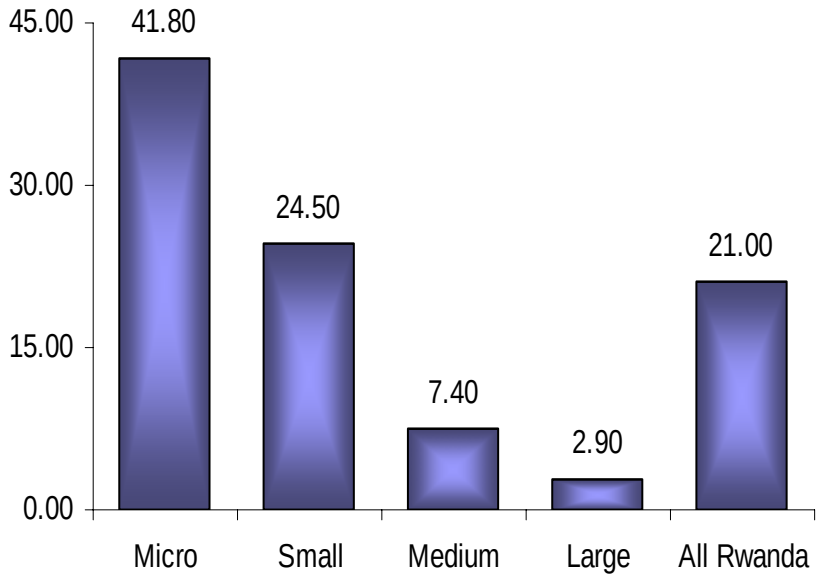
Figure 4.12
Interest rates paid (%) and terms of loans (months) by size



Source: RIMS, 2005

Moreover, as mentioned earlier, the percentage of establishments with overdraft facility or line of credit is a little more than 40 percent. However, a close look at the level of unused share of overdrafts or credit lines shows that, on average, a larger proportion of these facilities owned by micro and small establishments remain unused compared with those owned by larger firms (see Figure 3.13 below). Therefore, for smaller establishments, getting the access to overdraft facilities does not seem to be much of a problem. Rather, the major problems seem to be associated with the costs and terms of these financing arrangements, as well as relatively large unused production capacity that bars them from effectively using the financing options available to them.

Figure 4.13
Average unused share of overdrafts or lines of credits by size of establishments (%)



Source: RIMS, 2005

The above figure shows that overall, the average value of overdraft and credit lines facilities that were not used by Rwandan establishments during the year right before the interview period (2004) was about 21 percent. However, the corresponding figures for the micro and small size establishments (respectively at 42 percent and 25 percent) were well above the averages for medium and large establishments (respectively at 7 percent and 3 percent). This may mean that for a variety of unknown reasons micro and small establishments could not make use of the facilities they are already entitled to. Another point to note here is that the majority of establishments that did not have bank loans. About 80 percent of establishments reported that the reason for not having a bank loan was because they did not apply for one; this contrasts with only 3 percent of establishments who claimed that they did not have bank loans because their loan applications were rejected. The higher incidence of having loans for smaller establishments in Rwanda therefore may indicate that these establishments are more likely to apply for loans; while larger firms are likely to use other non-loan sources of financing as well.

4.8. Internal funds are the main sources of financing for Rwandan Establishments

Another issue related to finance in Rwandan manufacturing sector is that of financing sources for working capital and new investments. Our data shows that retained earnings are the major financing sources followed by local commercial Banks. For

working capital, 53 percent was contributed in 2004 by retained earnings compared with 80 percent in Uganda and 46 percent in Kenya. On the other hand, for new investments undertaken by Rwandan establishments, 51 percent was contributed by retained earnings compared with 71 percent in Uganda and 45 percent in Kenya. Generally, retained earnings are by far the most important sources of financing both working capital and new investments in Rwanda; and the next most important source of financing is domestic commercial banks. Other sources such as trade credits, equity sales, and informal sources play smaller roles in the financing of establishments needs in working capital and new investments in Rwanda.

Table 4.2
Sources of financing for working capital and new investments

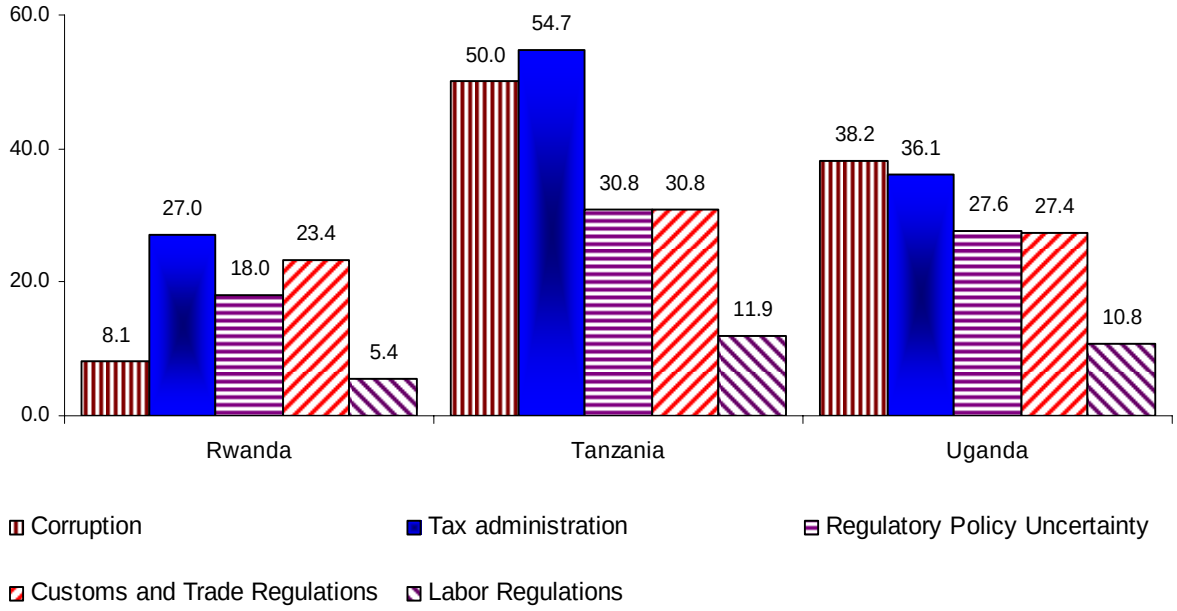
Sources of financing	Working Capital			New Investments		
	Uganda	*Kenya*	*Rwanda*	*Uganda*	*Kenya*	*Rwanda*
Retained Earnings	80.0	45.8	53.0	71.1	44.6	51.3
Domestic Commercial Banks	5.65	23.5	19.0	11.64	25.36	21.3
Foreign Commercial Banks	1.30	1.70	0.20	1.80	2.0	1.2
Leasing Arrangements	0.09	0.44	2.20	2.36	0.16	1.3
Trade Credit	5.31	15.34	3.80	0.48	3.07	1.0
Credit Cards	0.00	1.4	0.30	0.0	0.70	0.0
Equity, Sale of stocks	1.81	1.1	8.50	1.95	0.31	7.6
Family/Friends	1.40	1.2	3.0	2.0	0.80	4.6
Informal Sources	0.36	0.00	1.5	1.46	0.0	1.2
Other Sources	4.20	4.20	8.2	6.7	6.90	8.7

Source: RIMS, 2005; Investment Climate Surveys.

4.9. The regulatory environment appears to be less of concern to Rwandan establishments compared to neighboring countries.

It is worth noting here that compared with neighboring countries, regulation issues are not identified as serious impediments in Rwanda. It does not necessarily mean that policy regulation issues are not a problem at all, Rather what it may mean is that Rwandan entrepreneurs would like to see improvements in the provision of infrastructure, an education system that provides them with the required level and quality of skilled labor force, and better access to financing arrangements with better terms (see the following chart)

Figure 4.14
Regulatory Environment as major concerns (% o firms complained)



Source: RIMS, 2005

V. Customs efficiency and participation of Rwandan firms in international trade

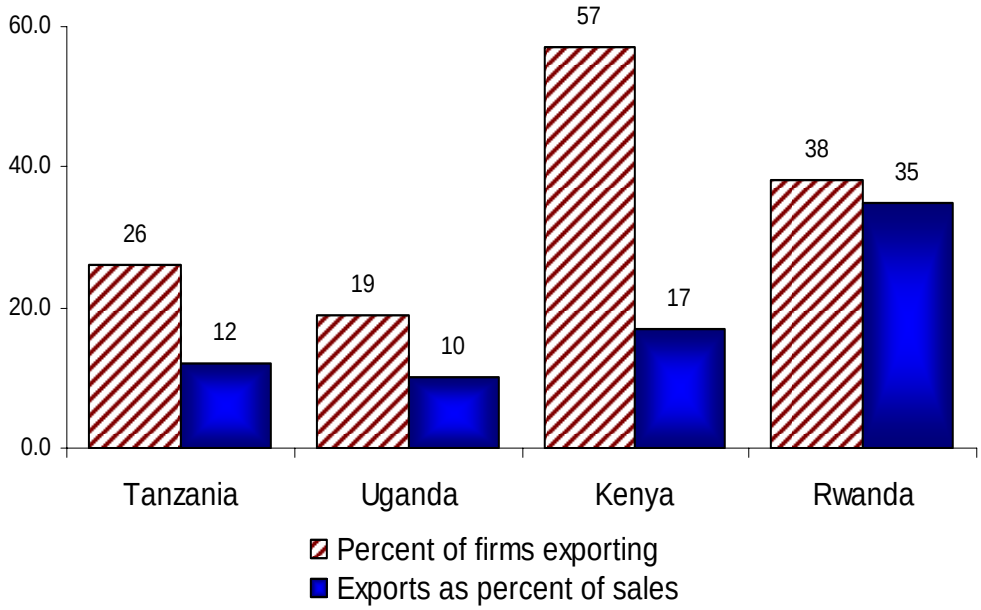
5.1 Participation of Rwandan firms in international trade is comparable with other African countries.

As pointed out earlier, a good number of Rwandan establishments (38 percent of the sample) export at least 20 percent of their sales value. The average share of exports, as a percent of their total sales in Rwanda, is about 35 percent. These figures, compared with 19 percent exporters in Uganda (with an average of 10 percent of their sales exported) are relatively high; particularly given the fact that Rwandan establishments face serious infrastructure related obstacles, and also face a disadvantage of being located in a land locked country which all would make exporting a challenging venture.

The only country within the comparators with Rwanda where the share of exporters is high is Kenya (at 57 percent), but still the average share of exports as a percent of total sales, at 17 percent is just half of the average export share of Rwandan

establishments. The following chart shows the relative positions of Rwanda in terms of the share of exporting establishments and their average exports as a percent of sales.

Figure 5.1
Participation in international trade: Share of exporters and average exports (%)



Source: RIMS, 2005; Investment climate surveys.

5.2 Direction of Trade: Major destinations of Exports and major origins of Imports for Rwanda.

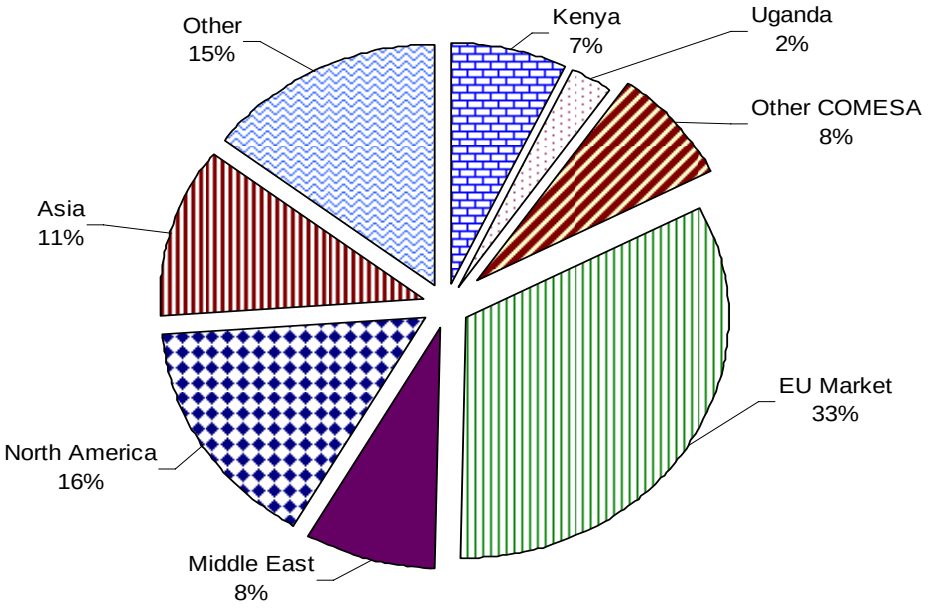
It is interesting to note here that despite the relatively challenging export environment in Rwanda compared with its neighboring countries, as shown above,, a good number of Rwandan establishments export at least some part of their sales. Trading of Rwandan establishments with neighboring countries is also generally significant, particularly in terms of imported inputs into Rwanda. A look at the direction of exports from Rwandan industrial establishments generally shows that their major destinations are the European Union, North America, and Asia. According to RIMS data, these three regions have been destinations respectively for about 33 percent, 15 percent and 11 percent of Rwandan industrial exports.

Rwandan industrial exports to neighboring African countries, on the other hand were reported to have been relatively small: Only an average of about 7 percent of

exports were destined to Kenya, while another 2 percent was destined to Uganda, 3 percent to DRC and 5 percent to other COMESA countries (for a total of 17 percent to COMESA) in 2004. No industrial exports to Tanzania were reported during this period. On the other hand, Rwandan establishments reported to have imported an average of 13 percent of their imported inputs each from Kenya and Uganda, and an average of about 5 percent from other COMESA countries.

Figure 5.2

Direction of Exports from Rwanda: Average share by destination, 2004 (%)

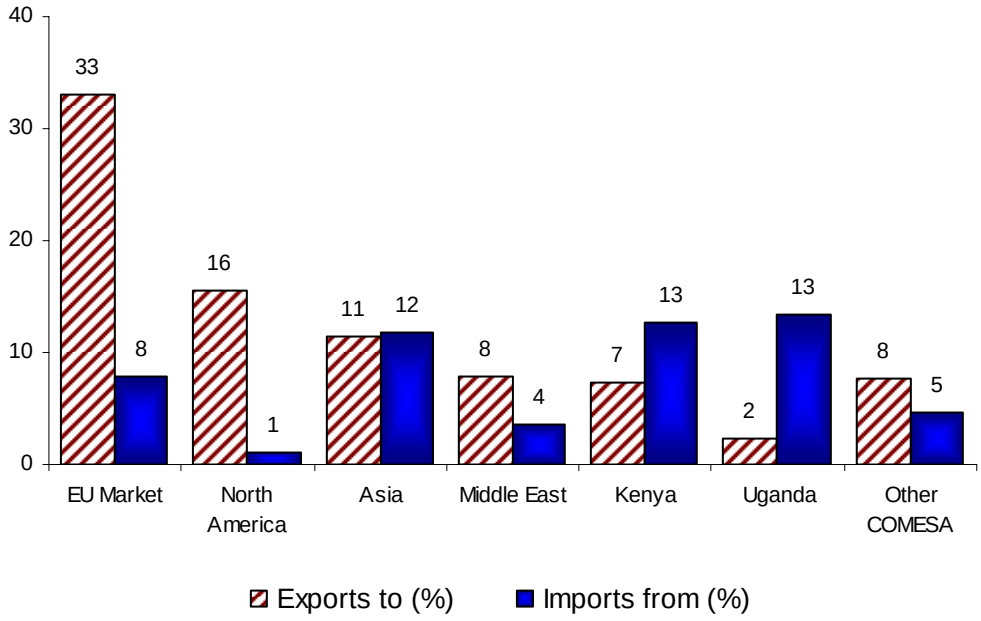


Source: RIMS, 2005

A look at the geographical distribution of the origins of imports provides a different picture, in that unlike the export destinations most of the imported inputs for the Rwandan establishments originate from the neighboring and other COMESA countries. The two manor sources (origins) for industrial inputs to Rwanda were Uganda and Kenya (13 percent each), followed by Asia that accounted for 12 percent. A very small percentage of imports originated from other neighboring African countries. Only around 1 percent of imports of industrial inputs originated from Tanzania, and only about 2 percent originated from the Democratic Republic of the Congo (DRC); while only a further 2 percent originated from other COMESA member countries. Outside COMESA, the major share of imported industrial inputs to Rwanda thus originated from Asia (at 12 percent in 2004) followed by the European Union (at 8 percent) and the Middle East (just at 3 percent). This implies that COMESA dominates as origin of industrial inputs to

Rwanda, but close to three-fourth of the total imports for industrial use (72 percent) that comes from COMESA originated from the two neighboring countries: Uganda and Kenya. The following figure shows the comparison of average share of exports to selected regions/countries from Rwanda with the corresponding average share of imports from the same regions/countries into Rwanda for the year 2004.

Figure 5.3
Direction of Trade: Share of exports (by destination) and imports (by origin) - (%)



Source: RIMS, 2005

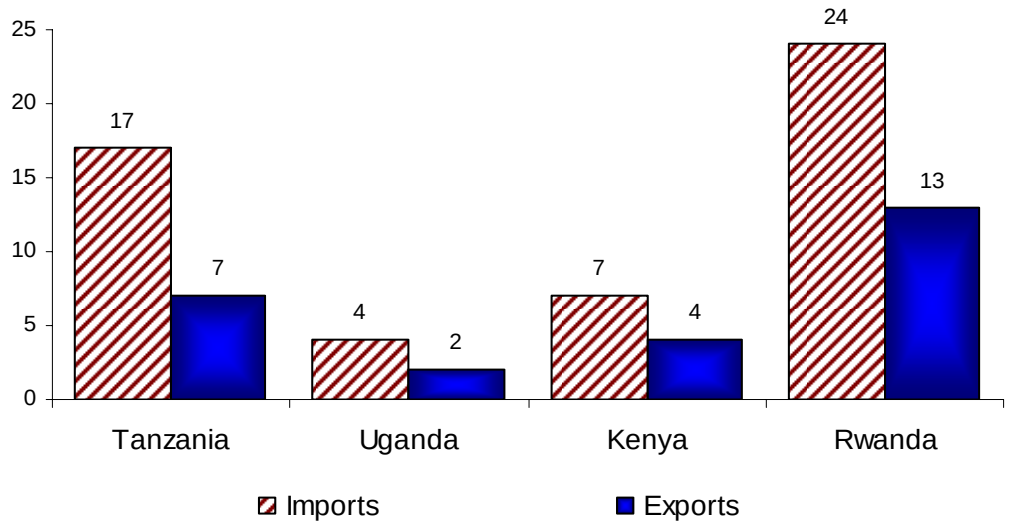
5.3 Improvement in customs efficiency in Rwanda is needed

Rwandan establishments have shown relative success in terms of being able to export, and in terms of the share of their sales that is exported. However, they were able to do this against all odds, and there is a reason to think that they could do even better if customs inefficiency issues are addressed.

It has been shown earlier that close to a quarter of establishments in Rwanda (23 percent) identified trade and customs regulations as major or severe business obstacles. This may not seem as serious as electricity, cost of finance, and the like that have been identified as major or very severe obstacles by greater majority of respondents; but it is serious enough to deserve sufficient attention in order to improve the international competitiveness of Rwandan establishments and to improve the foreign exchange earnings to finance the country's import requirements and achieve its development

objectives. RIMS data shows that customs efficiency is one area where Rwanda lags behind its neighboring comparators and needs to work on improving.

Figure 5.4
Customs administration: Average time it takes to clear customs (number of days)



Source: RIMS, 2005; Investment climate surveys.

The average number of days it takes customs to clear for export in Rwanda is 13 days, compared with 7 days in Tanzania, 4 days in Kenya, and just 2 days in Uganda. This shows that it takes close to double the time for an export shipment in Rwanda to clear customs than the slowest comparator in the region (Tanzania). The same is true for imports: It takes 24 days on average for an import to clear customs in Rwanda compared with 14 days in Tanzania, 7 days in Kenya, and 4 days in Rwanda.

Similarly, as shown in the following table, Doing Business data (World Bank, 2006) confirm the findings from our survey data and reveals that Rwanda has a lot to do in terms of improving its establishments' participation in international trade further.

Table 5.1
Doing Business in Rwanda: Trading across borders

Country	No. of documents required for exports	Total number of signatures	Time it takes to export (days)
Burundi	11	29	67
Congo (Dem.)	8	45	50
Ethiopia	8	33	46
Kenya	8	15	45
Rwanda	14	27	63
Tanzania	7	10	30
Uganda	13	18	58
SSA average	8.5	19	49

Source: Doing business database, 2006.

From the above comparative data, we see that export potential of Rwandan establishments seem to have been constrained by the current trade policy and practices compared with those in its neighboring countries. In fact, issues related to trading across borders are where Rwanda relatively underperforms compared with the average in Sub-Saharan Africa. The number of documents required for exports from Rwanda stands at 14, requiring about 27 signatures. These numbers are high compared with the averages of Sub-Saharan Africa at 8.5 documents and 19 signatures. Also, the time it takes for exports according to the Doing Business database, is 63 days in Rwanda, compared with 30 in Tanzania, 45 in Kenya, 58 in Uganda and an average of 49 days for the whole of Sub-Saharan Africa.

Shipping and transport costs are also the other challenges for Rwandan exporters. The RIMS, 2005 survey instrument asked respondents to identify the three most important impediments to export. Accordingly, two-thirds of respondents (67 percent) claimed that shipping and transport costs are one of the top three important factors that constitute an obstacle to export or one that completely inhibits them from exporting. We also find from the data that transport costs for exporters are very high in Rwanda, where it averaged about 11 percent of export values in 2004.

Finally it is important to note that our survey data collected information only in those establishments that are already operational and focuses on the impediments to their operation and growth. However, it is also equally important to take a look at what encourages or prohibits entrepreneurs from starting a business. For example, in this regard, information from the doing business data base also indicates that, as has been shown in this report, that in some areas Rwanda needs to do a lot to improve its business environment and make its industrial sector competitive with those in other countries of similar economic development and location. The following table summarizes some selected and basic comparative doing business indicators from Rwanda and other selected African countries.

Table 5.2
Doing Business in Rwanda and other African countries: Starting a business

Country	No. of procedures	Time it takes (in days)	Cost (as % of P/C income)	Minimum capital required (% of P/C income)
Burundi	11	43	201	0
Congo (Dem.)	13	155	503	216
Ethiopia	7	32	65	1532
Kenya	13	54	48	0
Rwanda	**9**	**21**	**280**	**0**
Tanzania	13	35	161	6
Uganda	17	36	118	0
SSA average	11	64	215	297

Source: Doing business database, 2006.

As shown in the above table, in terms of the number of procedures involved in starting a business and the time it takes to do so, Rwanda is with in the range and in some cases even better than most of the comparator countries in Africa. There is no minimum capital requirement to start a business in Rwanda, whereas the average minimum capital requirement in Sub-Saharan Africa is 297 percent of per capita income. In terms of the number of procedures and the time it takes to start a business, Rwanda in deed rates favorably among most of the African countries, while in terms of the relative cost of doing so, it does not look as attractive. Starting a business costs an average of 280 percent of per capita income in Rwanda compared with, for example, 48 percent in Kenya, 65 percent in Ethiopia and an average of 215 percent for the whole of Sub-Saharan Africa. Thus, identifying priority areas of reform in this regard and easing the procedures and costs of entry into business in Rwanda is also important.

VI. Gender and Returns to Human Capital Characteristics

The RIMS instrument was also designed to collect individual level information from a random sample of workers in each establishment drawn from different occupational categories. Accordingly, a total of about 700 workers were interviewed using a structured module of workers' questionnaire. Out of these, about 204 (29 percent) were women.

6.1. There are some differences in human capital characteristics between men and women, but the average wages for men are relatively very large

The worker level information collected in RIMS, 2005 show that the average human capital measures such as education and experience that are generally important determinants of earnings are not much different between men and women workers, as are their average earnings. In fact, women have on average ten years of education compared with nine years for men. They also have comparative years of experience and an equivalent number of hours worked per week, but the average earnings that they receive are well below the average for men.

The worker level data from RIMS, 2005 also shows that women tend to concentrate more on low-paying occupational categories, and very few of them are found in high paying managerial positions. Analysis based on the 2001 household survey (see Ezemenari and Wu (2005) and Pierre (2003) also show that women in Rwanda are engaged more in low paying occupational categories. The following table depicts the occupational distribution of sampled workers from each gender group interviewed as part of the RIMS, 2005.

Table 6.1
Occupational distribution of workers in the Rwandan Industrial sector

Occupational category	Management	Professional	Technical	Services	Production	Other*	**Total**
Column Sum							
Men	83%	58%	66%	65%	84%	62%	**71%**
Women	17%	42%	34%	35%	16%	38%	**29%**
Col. Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Row Sum							
Men	5%	7%	13%	12%	40%	27%	**100%**
Women	2%	13%	16%	16%	19%	34%	**100%**
All Obs.	**4%**	**9%**	**14%**	**14%**	**34%**	**25%**	**100%**

Source: RIMS, 2005.
* Includes all other occupational categories other than listed, and those not reported.

Despite their relatively higher average years of education (10.3 years compared with 9.2 for men), very few women have made it to the managerial occupational category: women's share in the sample is about 30 percent, but they occupy only 17 percent of management positions. On the other hand, there are relatively more women in the professional, services and other occupational categories such as health and other non-production workers category. Within the female sub-sample of workers, the majority of women (19 percent) are concentrated in the production occupational category followed by the technical and services categories (16 percent each). Only 2 percent of women are in the management occupational category compared with 5 percent for men. Women have less average years of labor market experience in Rwanda (about 16 years compared with 20 years for men) and an equivalent number of hours worked per week, but the average earnings that they receive are well below the average for men.

Table 6.2
Average education, experience, and weekly earnings in Rwanda

	Average education (years)	Average work Experience (years)	Union membership (%)	Average Hours worked weekly (number)	Average weekly earnings (Rwfr)
Men	9.2	20.0	23.0%	42.1	42,956
Women	10.3	16.0	24.1%	41.3	22,239
Total	**9.6**	**21.8**	**23.3%**	**41.9**	**37,665**

Source: RIMS, 2005

Women in the Rwandan industrial sector on average get a little more than half (52 percent) of the average weekly earnings of their male counterparts. This means that for

every single dollar of earnings men receive, women get just about 52 cents. Of course, this difference in earnings may be partly due to the fact that women tend to have less experience and their relative concentration in low paying occupational categories. The gender gap in average wages is found to be different for different occupational categories and completed education levels. For example, women in the management positions on average receive 89 percent of what men in the same occupational category (management) receive; compared with 54 percent in the professional and less than 30 percent in production occupational categories (within the latter, women were concentrated in unskilled production categories). Similarly, women who have completed university level of education get about 83 percent of earnings received by men counterparts who have completed the same level of education (university); compared with 73 percent in primary and less than 30 percent in secondary levels. However, differences in human capital characteristics and occupational categories do not fully explain all differences in earnings between workers. It is, therefore, useful and policy relevant to see whether such differences in human capital characteristics and occupation account for a large part of the differences in the earnings differences between workers in general, and between men and women in particular; and also to identify other factors that determine workers' earnings. It would also be important to see whether the returns to human capital characteristics for men and women are equivalent in the Rwandan urban labor market. One commonly used procedure of answering such questions is by estimating the earnings function, which is what this section of the report attempts to accomplish.

6.2. The returns to human capital characteristics are different by gender and are generally high for women.

In order to estimate the average returns to human capital characteristics such as education, and to answer the question of whether there are significant gender based differentials in these returns, we applied the commonly used Mincerian Earnings Function. The common functional form of the basic Mincerian earnings function (Mincer, 1974) can be specified as:

$$\ln(w_i) = \alpha + \beta S_i + \gamma_1 EXPR_i + \gamma_2 EXPR_i^2 + \varepsilon_i \quad (1)$$

where *ln(wi)* is the natural logarithm of hourly wages, *Si* is number of years of schooling, and *EXPRi* is total labor market experience. The coefficients β and γ1 represent the returns respectively to 'schooling' and total labor market 'experience'. Since our data set has a unique characteristic in that worker level information was linked to workplace (firm) characteristics, we will be able to control for such characteristics in our regression. The augmented form of the earnings function model we use in this exercise thus takes the following form:

$$\ln(w_i) = \alpha + \beta S_i + \gamma_1 EXPR_i + \gamma_2 EXPR_i^2 + \varphi_i z_i + \varepsilon_i \quad (2)$$

where Z_i is a vector of firm level characteristics that we control for; whereas φ_i is a vector of the corresponding coefficients to be estimated for each of the firm level

characteristics, and ε_i, is a normally behaving error term, and it captures other unobserved factors that contribute to worker's earnings. Experience is computed as age in years minus 13. As is clear, $EXPR_i^2$ is a quadratic term for experience. Note that the function is concave in experience because of diminishing marginal returns to accumulated on-the-job training. As a result, the coefficient γ_2, which is the coefficient of the squared value of lab market experience, is negative. Note also that the effect of experience on earnings peaks when total experience reaches $-\gamma_1/_2\gamma_2$.[6] Variables included in vector *Z'* include sector, size, location and domestic/foreign ownership categories.

We run various specifications of the earnings function model using the Linked Employer-Employee (LEE) data from RIMS, 2005. The following table shows the results from these various specifications.

Table 6.3
Gender and returns to human capital in Rwandan Industry

variable	All workers (1)	(2)	Men (3)	Women (4)
Female	-0.2343			
	(2.653)***			
Educyrs	0.0684	0.0675	0.0646	0.0851
	(6.460)***	(6.322)***	(5.343)***	(4.086)***
Expr	0.0264	0.0297	0.0343	0.0395
	(2.408)**	(2.651)***	(2.559)**	(1.666)*
Exprsq	-0.0003	-0.0004	-0.0004	-0.001
	(1.812)*	(1.963)*	(1.862)*	(1.985)**
Mgr	0.9238	0.9518	0.8549	1.4721
	(3.991)***	(4.185)***	(3.227)***	(4.897)***
Prof	0.4907	0.4772	0.644	-0.1258
	(3.162)***	(3.010)***	(3.557)***	(0.516)
Tech	0.0941	0.0853	0.08	0.0543
	(0.951)	(0.871)	(0.722)	(0.248)
Observations	552	552	411	141
R-squared	0.349	0.341	0.363	0.451

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Dependent variable is ln of hourly wages (lnhrwag)

Note: for variable descriptions, see Appendix I
Note 2. Foreign ownership, Firm size, Region, and Industry/sector have been controlled for

.Source: Calculated by the authors using LEE data from RIMS, 2005.

[6] see Willis (1986) , pp.529-532 for the derivation.

Overall, we see that after controlling for a number of individual level and firm level characteristics, the returns to one full year of education for all the observations is about 6.8 percent and about 2.6 percent for each additional year of labor market experience. Generally, we observe that the returns to human capital in Rwandan urban labor market are different by gender. Based on the above estimates using the full model, the marginal return to one additional year of education for men is about 6 percent and close to 9 percent for women.[7] These estimates are generally lower than most of the estimates for other developing countries, but the finding that the returns are higher for women than for men is consistent with most other empirical findings (see, Psacharopoulos (1993); Moock, Patrinos and Venkataraman (1998), World Bank (1996). The return to an additional year of labor market experience is about 3 percent; while for women it is close to 4 percent. Occupational categories are also important. Working in managerial and professional positions pays respectively up to 152 percent and 63 percent respectively for the whole sample compared to the excluded occupational categories (production, sales, and other non-production occupational groups). Looking at each gender group separately, we see that the returns to being in a managerial occupational category are much higher for women than they are for men, after controlling for other individual and firm level characteristics. The implications are clear: Investment on raising the educational standards of women and ensuring their continual stay in the labor market (to enable them gain labor market experience), and provision of better opportunity for women with better opportunities, in as far as they are qualified, to get into managerial positions would all have very high returns and thus would be welfare enhancing at the individual and household levels.

Results also confirm that establishment characteristics too are important in earnings determination for both men and women. Establishments with foreign ownership pay up to 25 percent more compared with those that are 100 percent domestically owned; and workers in Kigali receive up to 44 percent more than workers located outside Kigali. Food and beverages industries also pay more for men sub-sample – up to 40 percent higher than the other industries[8]; while for women sub-sample they pay less – by up to 36 percent than other industries.

[7] A joint F-test was done in order to investigate whether men and women face different labor market structure. The joint F test considers the null hypothesis that the earnings regressions that were run independently for each gender group are identical. If, say, βi and $\propto i$ are the two coefficients respectively from the regressions for men and women workers, we test the null hypothesis that , $\beta i = \propto i$ jointly which is equivalent to testing whether the labor market structures faced by both men and women are the same. The relevant joint F test is therefore expressed as:

$$F_{K,\ N+M-2k} = \frac{(EES_R - EES_{UR})/K}{EES_{UR}/(N+M-2k}$$

Where K is the degrees of freedom, N and M are the number of male and female workers respectively, EES_R is the error sum of squares in the restricted model (where the regression for the whole sample is run with out the gender dummy – i.e. the coefficient for the gender dummy set to zero); and EES_{UR} stands for the error sum of squares in the unrestricted model. The null hypothesis was rejected with 99 percent probability

[8] When a certain characteristics of a worker is represented by a dummy variable (with a value of '1' and estimated coefficient of λ_i), then that worker has earnings of $e^{\lambda i}$ times the earnings of a worker with out that characteristics (dummy variable equals zero. Thus, in order to calculate a precise percentage change ($\delta 1$) on the dependent variable due to a dummy variable, it is necessary first to calculate the anti-log of the regression coefficient ($\beta 1$) and then subtract one from the result. See Havorsen and Palmquist (1980) for interpretation of dummy variables in Semilogarithmic equations.

One interesting result that needs further study is the fact that Micro and Small enterprises pay well above the medium and large sized enterprises, other things being equal. Accordingly, workers in micro and small enterprises on average get respectively up to 18 percent and 56 percent more than those working in large enterprises. This is contrary to what one expects to be the case in Africa and other developing countries (Mazumdar, 1994; Temesgen, 2001; Temesgen and Zeufack, 2002). However, given the fact that these two size groups (Micro and Small) generate the highest value added per worker (see World Bank, Rwanda CEM, 2006; Temesgen and Ezemenari, 2006a), the results suggest there may be some kind of profit sharing in these enterprises.

Finally, the regression results also show that gender indeed matters in earnings determination in Rwandan urban labor market. After controlling for a number of worker and establishment level characteristics, the results show that women on average get compensated at a rate 24 percent lower than men workers with comparable or equivalent qualifications.

It is also interesting to note here that despite the higher returns to professional occupation (where there is a relatively higher concentration of women) for the whole sample (at about 60 percent over production and sales occupational categories), the returns to being in this occupational category for women is not significant. On the other hand, being in the managerial occupational category has a very high return for women, much larger than that of men.

6.3. There are also returns to completing the various levels of education in Rwanda, not just the years of education

The basic literature on the returns to education assumes that it is the number of years of education that matters – whether the worker has completed a given level of education or not. But the number of years of education as a measure does not necessarily capture possible lags due to grade repetition, or drop out right before completing a level in which case the estimated returns to education may be understated. To account for this, augmented versions of the basic Mincerian Earnings model in the literature are used as an alternative specification. These versions are known as the Sheepskin effects or as the Credential Effects models referring to the increases in labor market earnings associated with the completion of a diploma or degree. As pointed out above, most labor market studies commonly assume that the only relevant education variable is the total number of years of education acquired by an individual. However, the sheepskin or credentials effects theory alternatively considers that having degrees or diplomas have an independent effect on the returns to education. Testing for such effects is done by including dummy variables for the various completed levels of education while controlling for the years of education. Thus, building upon the extended version of the Mincerian function that controls for firm level characteristics the sheepskin effects specification in our case would take the following form:

$$\ln(w_i) = \alpha + \beta S_i + \gamma_1 EXPR_i + \gamma_2 EXPR_i^2 + \varphi_i z_i + \ell LCED_i + \varepsilon_i \qquad (3)$$

Where $LCED_i$ is the level of completed education, and the other variables remain as defined before. The above specification of the expanded Mincerian function is applied to evaluate the extent of effects of holding credentials over and above the years of education. The idea here is that with only the total number of years of education as a measure of human capital, estimation of the returns to education may tend to be biased because of the omission of diplomas, certificate or degree effects (see also Card (1999); Kane, Rouse and Staiger (1999) and Ashenfelter and Krueger (1994)). The following summarizes the basic results of this specification:

Table 6.4
Sheepskin or credential effects in Rwandan Industrial labor market

	Sheepskin effect:	
Variable	**(1)**	**(2)**
female	-0.2199	
	(2.505)**	
educyrs	0.041	0.0399
	(2.910)***	(2.829)***
comp_secondary	0.177	0.1654
	(1.564)	(1.441)
comp_techvoc	0.3022	0.310
	(2.024)**	(2.076)**
comp_univ	0.6707	0.6881
	(2.828)***	(2.931)***
expr	0.0246	0.0274
	(2.257)**	(2.480)**
exprsq	-0.0003	-0.0003
	(1.667)*	(1.797)*
Observations	552	552
R-squared	0.361	0.354

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Calculated by the authors using LEE data from RIMS, 2005.
Note: Occupation, Foreign ownership, Firm size, Region, and Industry/sector have been controlled for

The table summarizes the main findings regarding the magnitude of possible sheepskin effects for the Rwandan industrial and mining sector workers. The estimates on the last two columns report the impact on earnings of having a degree, diploma or certificate (for completing a given level of education) after controlling for years of schooling and the influences of other factors. Results of the above specification show us that after controlling for the years of education, there are strong 'sheepskin or credential effects' remaining for all levels of completed education. The magnitudes of these credential effects are 19 percent, 35 percent, and 95 percent respectively for secondary, technical/vocational and university levels over and above the average returns to years of education. There are no such effects for completed primary (after controlling for years of education). We also thought that it would be interesting and policy relevant to see

whether the various levels of completed education do have different levels of effects on the returns to education. We run various specifications of the Mincerian earnings model using dummy variables for various levels of completed education. We find that completing secondary, technical/vocational and university level studies in Rwanda increase earnings by 64 percent, 102 percent, and 227 percent respectively compared with those with no-completed education; and again that the returns to each of these completed levels are much larger for women than for men (see appendix).

Finally, the regression results both with and without dummies for completed levels of education also show that gender indeed matters in earnings determination in the Rwandan formal labor market. After controlling for a number of worker and establishment level characteristics, the results show that women on average get compensated at a rate 24 percent lower than men workers with comparable or equivalent qualifications.

VII. Summary and policy recommendations

Despite its relative young age compared with its neighboring countries, productivity of Rwanda firms, as measured by median value added per worker, is in line with what one finds neighboring countries. In addition, a significant number of Rwandan establishments reported to have exported at least some part of their outputs directly or indirectly (through another establishment).

However, there is a sufficient reason to strongly believe that Rwandan firms could do even better, if the current obstacles to their performance and growth are addressed. For example, infrastructure problems, particularly power and transportation, as well as lack of skilled manpower are among the major obstacles cited by the majority of entrepreneurs. Thus, improvements in the capacity and efficiency of the power and transport sectors in Rwanda is clearly an investment and policy priority to spur the development of the industrial sector in Rwanda and to improve the private sector's participation in the country's development agenda. In particular, the analysis here suggests that investments to address the constraints posed by the low availability of power could help address the issue of underutilized capacity in the Rwandan manufacturing and industrial sector. In particular, addressing the immediate constraints to full capacity utilization (including shortage of raw materials, improved availability and efficiency of infrastructure such as power, roads, and customs facilities) could help to quickly raise exports.

It is also equally important to think ahead to develop an education policy that provides for a sufficient number of well qualified professionals, in line with demand from the industrial sector. This would facilitate improvements in productivity for Rwandan establishments and thus improve their competitiveness.

The report also provides evidence that human capital characteristics, specifically, education and work experience are important determinants of hourly wages in the

Rwandan urban labor market. The results show that the returns to both education and experience are higher for women than for men. Thus, providing educational and training opportunities for workers, particularly for women, both at the establishment level and at the national level, to raise the overall skills level is important for growth in the industrial sector. In particular, an examination of the skill mix outcomes of the current school curriculum and education policy in Rwanda, together with the demands and requirements of the industrial sector is an important priority

Appendix I
Definitions of variables used

Variable	Description
Lnhrwag	log of hourly earnings
Female	dummy equals '1' if worker is female
comp_primary	dummy equals '1' if worker has completed primary level of education
comp_secondary	dummy equals '1' if worker has completed secondary level of education
comp_techvoc	dummy equals '1' if worker has completed technical/vocationsl level of education
comp_univ	dummy equals '1' if worker has completed university level of education
Educyrs	Total years of education
Expr	Years of total labor market experience
Exprsq	Experience squared
Mgr	dummy equals '1' if worker is manager
Prof	dummy equals '1' if worker professional
Prod	dummy equals '1' if worker is in the production occupational category
Tech	dummy equals '1' if worker is technician
Foreign	dummy equals '1' if establishment has foreign ownership
Exporter	dummy equals '1' if establishment exports part of its sales (at least 5%)
Micro	dummy equals '1' if establishment is micro (with lesss than 10 full time employees)
Small	dummy equals '1' if establishment is small (with 10 to 50 full time employees)
Medium	dummy equals '1' if establishment is medium (with 50 to 99 full time employees)
Foodbev	dummy equals '1' if establishment is in the Food and Beverages industry
Kigali	dummy equals '1' if establishment is located in Kigali

Source: Calculated by the authors using LEE data from RIMS, 2005

Appendix II
Average values of variables used

Variable Name	All Observation (1)	Men (2)	Women (3)
Lnhrwag	5.95	6.00	5.82
Female	0.29	..	..
comp_primary	0.32	0.33	0.30
comp_secondary	0.30	0.26	0.41
comp_techvoc	0.14	0.14	0.13
comp_univ	0.09	0.10	0.06
Educyrs	9.55	9.24	10.32
Expr	19.35	20.52	16.50
Exprsq	493.04	544.88	366.76
Mgr	0.04	0.05	0.02
Prof	0.09	0.07	0.13
Tech	0.13	0.13	0.16
Foregn	0.23	0.25	0.18
exporter	0.38	0.37	0.39
Micro	0.13	0.12	0.16
Small	0.48	0.48	0.47
Medium	0.20	0.20	0.19
Foodbev	0.38	0.32	0.51
Kigali	0.63	0.61	0.68

Source: Calculated by the authors using LEE data from RIMS, 2005

Appendix III
Estimates of returns to human capital characteristics by gender: years of education

Variable	All Observation (1)	(2)	Men (3)	Women (4)
Female	-0.2343			
	(2.653)***			
Educyrs	0.0684	0.0675	0.0646	0.0851
	(6.460)***	(6.322)***	(5.343)***	(4.086)***
Expr	0.0264	0.0297	0.0343	0.0395
	(2.408)**	(2.651)***	(2.559)**	(1.666)*
Exprsq	-0.0003	-0.0004	-0.0004	-0.001
	(1.812)*	(1.963)*	(1.862)*	(1.985)**
Mgr	0.9238	0.9518	0.8549	1.4721
	(3.991)***	(4.185)***	(3.227)***	(4.897)***
Prof	0.4907	0.4772	0.644	-0.1258
	(3.162)***	(3.010)***	(3.557)***	(0.516)
Tech	0.0941	0.0853	0.08	0.0543
	(0.951)	(0.871)	(0.722)	(0.248)
Foregn	0.2229	0.2446	0.1797	0.515
	(2.488)**	(2.766)***	(1.825)*	(2.124)**
exporter	0.6574	0.6686	0.5751	0.8336
	(7.531)***	(7.665)***	(5.317)***	(5.125)***
Micro	0.1668	0.1486	0.0759	0.4992
	(1.383)	(1.252)	(0.537)	(2.152)**
Small	0.4476	0.4525	0.4387	0.3311
	(4.106)***	(4.117)***	(3.690)***	-1.388
Medium	0.1652	0.1751	0.1409	0.3184
	(1.365)	(1.437)	(1.058)	(1.243)
Foodbev	0.1451	0.1106	0.3404	-0.3137
	(1.535)	(1.163)	(2.679)***	(2.325)**
Kigali	0.3636	0.3433	0.2855	0.5542
	(4.270)***	(4.059)***	(2.961)***	(3.191)***
Constant	4.0784	3.9958	4.0337	3.7071
	(20.487)***	(20.011)***	(17.134)***	(8.753)***
Observations	552	552	411	141
R-squared	0.349	0.341	0.363	0.451

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Calculated by the authors using LEE data from RIMS, 2005

Appendix IV
Estimates of sheepskin (credentials) effects and returns to completed education levels

Variable	All Observation (1)	All Observation (2)	Men (3)	Women (4)	Sheepskin effect: All observations (5)	Sheepskin effect: All observations (6)
Female	-0.2211				-0.2199	
	(2.479)**				(2.505)**	
Educyrs					0.041	0.0399
					(2.910)***	(2.829)***
comp_primary	0.1766	0.1563	0.0802	0.4772		
	(1.402)	(1.236)	(0.589)	(1.687)*		
comp_secondary	0.5295	0.4969	0.5434	0.5828	0.177	0.1654
	(3.922)***	(3.623)***	(3.619)***	(2.008)**	(1.564)	(1.441)
comp_techvoc	0.7198	0.7047	0.6122	1.0582	0.3022	0.310
	(4.631)***	(4.478)***	(3.614)***	(2.838)***	(2.024)**	(2.076)**
comp_univ	1.1943	1.1862	1.0975	1.5945	0.6707	0.6881
	(5.365)***	(5.338)***	(4.371)***	(3.429)***	(2.828)***	(2.931)***
expr	0.0197	0.0228	0.0283	0.0172	0.0246	0.0274
	(1.831)*	(2.085)**	(2.153)**	(0.764)	(2.257)**	(2.480)**
exprsq	-0.0002	-0.0003	-0.0004	-0.0005	-0.0003	-0.0003
	(1.356)	(1.515)	(1.605)	(0.988)	(1.667)*	(1.797)*
mgr	0.8651	0.8859	0.785	1.2995	0.8068	0.8293
	(3.834)***	(4.009)***	(3.049)***	(2.818)***	(3.585)***	(3.773)***
prof	0.46	0.4428	0.5923	-0.0511	0.3982	0.3828
	(3.083)***	(2.924)***	(3.486)***	(0.206)	(2.610)***	(2.471)**
tech	0.1532	0.1462	0.1336	0.1754	0.1013	0.0949
	(1.546)	(1.478)	(1.167)	(0.841)	(1.023)	(0.965)
foregn	0.193	0.2122	0.1673	0.3827	0.1933	0.2124
	(2.167)**	(2.405)**	(1.684)*	(1.818)*	(2.178)**	(2.416)**
exporter	0.5986	0.6078	0.5168	0.7498	0.6239	0.6332
	(7.025)***	(7.110)***	(4.864)***	(4.695)***	(7.257)***	(7.337)***
micro	0.1565	0.1375	0.1118	0.3397	0.1653	0.145
	(1.253)	(1.112)	(0.758)	(1.536)	(1.367)	(1.217)
small	0.4163	0.419	0.4093	0.2381	0.4322	0.4354
	(3.812)***	(3.813)***	(3.379)***	(1.111)	(3.967)***	(3.973)***
medium	0.1565	0.1622	0.135	0.2243	0.1373	0.1428
	(1.297)	(1.344)	(1.027)	(0.861)	(1.147)	(1.190)
foodbev	0.2006	0.1704	0.4075	-0.2936	0.1693	0.1388
	(2.116)**	(1.800)*	(3.204)***	(2.175)**	(1.779)*	(1.462)
Kigali	0.3841	0.3664	0.2732	0.6649	0.3796	0.3626
	(4.479)***	(4.291)***	(2.813)***	(4.050)***	(4.461)***	(4.275)***
Constant	4.3971	4.3324	4.3813	4.1389	4.2293	4.1576
	(22.528)***	(21.895)***	(18.961)***	(10.285)***	(20.501)***	(20.112)***
Observations	552	552	411	141	552	552
R-squared	0.354	0.347	0.372	0.465	0.361	0.354

Robust t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Annex -1

REPORT ON THE MANUFACTURING SECTOR AND MINING SECTOR CENSUS.

The Manufacturing and Mining sectors' census exercise began in August 2005 with the World Bank team drawing up a questionnaire to be used and the guidelines for the exercise.

Objectives:

The aim of the census project is to draw support to other outputs that together will assist the Government of Rwanda and the private sector to develop and actualize a long-term vision for improving productivity and competitiveness of the industrial sector. The study will examine the constraints and opportunities to improved competitiveness for Rwanda in international markets, with particular attention to impacts of the energy crisis, regional integration, and productivity and export issues. The objective of the project is also intended to strengthen the capacity of the Government of Rwanda to develop policies for private sector growth through the analysis of data systematically collected from firms. The specific objectives of the census project can be summarized as follows:

- Collecting and analyzing an industrial survey data using a face-to-face interview of business owners and managers to identify business impediments that constrain the startup and growth of the private sector in Rwanda; to assess and compare the current performance of Rwandan firms among themselves by different characteristics (such as by region, sector and size) and vis a vis those in other comparator countries, particularly those in neighboring countries and other parts of Africa, in an international context; and to identify mechanisms for the creation of an enabling environment to improve the competitiveness of the industrial sector so that its contribution to the growth of the Rwandan economy and to the government's effort in poverty reduction can be enhanced.

- Assisting the Government of Rwanda (GOR) to formulate an appropriate industrial policy and create a forum of dialogue with the private sector to develop and actualize a long-term vision for improving productivity and competitiveness in the sector.

- Assist the GOR, its development partners and policy makers identify ways of removing obstacles to participate in international markets, increasing the production capacity of the Rwandan manufacturing sector, and improving the level of capacity utilization of the industrial sector.

- Assess the current skill mix of the industrial labor force in Rwanda, identify gaps and help in the identification of labor market and education policies to upgrading the human resource capacity in Rwanda.

• Assess, as much as possible, the current and potential contributions of the mining sector as sources of pro-poor growth and development in Rwanda through employment creation and generation of foreign currency.

METHODOLOGY:

(a) Sampling.

Being a census, the exercise began by identifying members of both sectors. Lists were gathered from MINCOM, RFPS, RRA, MINITERE, and the association of mineral exporters. The overall list formed the sample of respondents over the period.

Unfortunately some of the members on the list of manufacturing sector turned out to be in the Construction industry while others had closed business at various times between 1993 and 2003 . Fortunately however, all active members have been successfully covered.

In the mining sector, the rural based mining Cooperatives were visited. These are still grossly disorganized, have no records and are made of rural illiterate miners. These could not offer useful information. They were dropped and the concentration remained on mineral exporters and processors who buy the bulk of their minerals from those rural based associations of miners. Again nearly 95 percent of these were covered. The other 5 percent are temporarily out of business and were not available for the interviews.

(b) The Questionnaire.

A Questionnaire was drawn up by the World Bank team (Washington) in august 2005. This was shared with MINECOFIN (Statistics Department, MACRO Department), MINICOM (Department of industry) and Rwanda Private Sector Federation (RPSF). In addition, number of Video Conference were conducted at the World Bank Offices and attended by the Director of Industry (MINCOM), Mr. Oscar Masabo of MINECOFIN, Myself and Director of Macro department (MINECOFIN) on the Rwanda side. The Washington team included M/S Kene Ezemenari, Tilahun Temesgen, Kalamogo Coulibaly, and Mary Kamari. The conferences focused on improving the study methodology and ironing out any logistical constraints.

(c) Enumerators and Supervisors:

The Consultant with support of his supervisor got number o f candidates from the department of Statistics and also advertised at MINECOFIN for interested candidates. An initial list of 28 enumerators was compiled and these were graduates, mainly in Business administration and B.com from National University of Rwanda, KIST, KIE and UNLAC. Eventually the list was reduced to 23 o f which 4 became supervisors.

Training of these enumerators was conducted for a period of 4 days. The training was conducted by Mr. Tilahun of the World Bank Washington. The team conducted MOCK interviews under his supervision and had also to pass a written test. The training focused on the questionnaire and enumerators manual. It is this group that conducted the interviews.

(d) Data entry.

The National institute of Statistics developed a data entry program. Mr. Oscar Masabo has been following this up. Once the program was ready two data entry personnel were recruited to carry out the data entry exercise.

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Signature: