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Risto Herrala and Rima Turk Ariss

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Contents

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Abstract

The Arab Spring is a clear indicator of the urgency of achieving inclusive growth and ensuring job creation in the Middle East and North Africa (MENA) region, where private sector development is still hindered by limited access to credit. Following Kiyotaki and Moore's (1997) seminal model, we apply a novel methodological approach to a unique data set of MENA firms to estimate credit limits and their impacts on capital accumulation. Notably, we find higher credit limits in countries where the Arab Spring erupted than in other MENA countries and that their marginal effect on capital accumulation has been statistically and economically significant.

JEL classification: G31, L20, O16
Keywords: financing constraints, credit limits, MENA countries

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1 Introduction

Sociopolitical upheavals in the Middle East and North Africa (MENA), led by the Arab Spring of 2011, continue to spread across the region.[1] The unrest reflects general failures on the part of MENA governments to deal with widening inequality gaps and youth unemployment.[2] While private-sector development is instrumental for job creation and achieving inclusive growth, firms in the region remain mostly small family-oriented businesses with limited access to external finance.[3] Yet banks, as in other developing countries, are the main providers of credit to businesses. Domestic equity markets are inefficient and debt markets for all practical purposes are nonexistent. Access to finance for small firms in the MENA region remains limited by a weak financial infrastructure that increases agency costs of bank screening, loan contracting, and monitoring (Rocha, Arvai, and Farazi, 2011).[4] These financing constraints undermine firm investment and growth (Hubbard, 1998), jeopardizing firm survival and fueling instability.

In this paper, we estimate the effect of financing constraints on capital accumulation for firms in the MENA region to assess the potential for fostering private-sector development. We apply a novel approach in estimation of the seminal model by Kiyotaki and Moore (1997). We also construct a unique data set of MENA firms that draws on multiple data sources as private-sector information for the region is relatively scarce. By estimating the theoretical parameters of the Kiyotaki and Moore (1997) model, we add to the finance-growth literature with a case study from the MENA region. Our analysis also provides insights about economic developments in MENA countries in the run-up to the Arab Spring.

The impacts of financing constraints on capital accumulation and economic development are relatively well established in the theoretical literature (Khwaja and Mian, 2008). However, there is little agreement on how best to measure such impacts. The two most common econometric methodologies used to assess the impact of financing con-

[1] The MENA countries comprise oil-rich and resource-scarce economies, including Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, the Palestinian Territories, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen.
[2] The International Monetary Fund estimates that between 50 and 75 million new jobs are needed over the next decade in the MENA region to assure social and political stability.
[3] The World Bank Business Environment Survey (WBES) notes that financial frictions are a significant hurdle to corporate growth in the MENA region.
[4] In most MENA countries, public registries are absent and the coverage of private credit bureaus is limited, rendering credit information sharing systems inefficient. Collateral frameworks and bankruptcy codes are also underdeveloped, aggravating moral hazard and adverse selection concerns.

straints on investment are the cash flow sensitivity approach and the split sample technique.

Proposed originally by Fazzari et al (1988), the cash flow sensitivity approach uses the sensitivity of investment to cash flow as an indirect indicator of financial frictions. A positive correlation between investment and cash flow is interpreted as inadequate access to external finance that results in excessive reliance on internal funds in the financing of investment projects. The intuition of the relationship of investment to cash flow sensitivity is supported by the empirical work of Beck, Demirguc-Kunt, and Maksimovic (2005), Love (2003), and Poncet, Steingress, and Vandenbussche (2010). On the other hand, Kaplan and Zingales (1997) and Laeven (2003) argue that cash flow sensitivity is a poor indicator of credit limits, and thus likely to lead to erroneous conclusions.

Under the alternative split sample technique, firms are grouped as financially "constrained" or "unconstrained," based on direct feedback from each firm (e.g. survey responses). The effect of credit constraints on investment are then tested by comparing the investment behavior of the constrained and unconstrained firms. Kaplan and Zingales (1997) show that the cash flow sensitivity and split sample approaches sometimes reach contradictory conclusions.

For our purposes, both the cash flow and the split sample approach fall short of quantifying Kiyotaki and Moore's (1997) model. Under the cash flow approach, the link between cash flow and credit constraints remains unknown. The split sample technique fails to yield quantitative estimates of the marginal effect of credit constraints on investment.

Bhaumik, Das, and Kumbhakar (2012) assess the relationship between financial constraints and investment at the firm level using an innovative empirical approach based on stochastic frontier analysis (SFA). The authors estimate the unobserved optimal level of firm investment and compute the shortfall in investment from its desired value. This shortfall is referred to as the "financial constraint." The decomposition of firm investment into a desired level and a shortfall from credit constraints is a novel application of SFA. In standard applications, SFA is used to split firm output into a desired production frontier and an inefficiency component. By assumption, no firm in Bhaumik, Das, and Kumbhakar (2012) invests at the optimal level, so all firms are de facto financially constrained. This approach departs from the framework of Kiyotaki and Moore (1997), where some firms are credit constrained and others are not.

Financial constraints are important in the MENA region, but the corporate reality suggests that credit constraints may not be a binding hindrance to capital accumulation for all firms. Instead, low levels of investment demand are likely to be involved. Firms in the region are generally hesitant about undertaking capital projects due to either the presence of high obstacles to conducting business or political uncertainty.[5] Moreover, since the paying and receiving of interest on bank loans violates Islamic law, entrepreneurs are generally reluctant to assume interest-based debt thereby limiting their growth prospects.[6]

Based on these considerations, we extend the empirical SFA methodology to the case where some firms are credit constrained and others are not. As in Bhaumik, Das, and Kumbhakar (2012), we model financing constraints using SFA, but our estimated frontier is not the desired level of investment. Rather, it is the maximum obtainable level of debt financing, i.e. the credit limit. We show that credit limits, which we formulate along Kiyotaki and Moore's (1997) theoretical model, are estimable by SFA using borrower data and under specific assumptions regarding borrowing distribution. One such condition is that the empirical distribution of borrowings is skewed, which we can verify by standard statistical tests.

In a second stage analysis, we investigate the implications of credit conditions on capital accumulation, again using the theoretical framework of Kiyotaki and Moore (1997). We include the credit limit estimates obtained from the SFA in a dynamic behavioral equation of capital accumulation and quantify the marginal effect of credit conditions on firm investment.

We find that the marginal effect of credit limits on capital accumulation is both statistically and economically significant, with a one percent increase in the change in credit limits from one year to the next yielding a 0.4 percentage point increase in capital accumulation. Firm capital accumulation is not found to be sensitive to interest rates in the MENA region, suggesting a weakness in the interest rate channel for the conduct of monetary policy. Intriguingly, credit limits are found to be higher in countries where the Arab Spring erupted compared to other MENA countries.

The rest of the paper is structured as follows. Section 2 derives the estimable equations of credit limits and capital accumulation following Kiyotaki and Moore's (1997)

[5] The World Bank's Doing Business indicators and the governance indices of the Heritage Foundation suggest that the MENA region fares poorly compared to other regions in the categories of ease of conducting business, political stability, and rule of law.

model. Section 3 describes the unique data set as well as the distribution of the sample across countries and industries. Section 4 discusses the estimation results and robustness checks. Section 5 concludes.

2 Methodology

We use a two-step approach to estimate capital accumulation in the presence of credit limits based on the theoretical model of Kiyotaki and Moore (1997). In the first stage, we estimate the unobservable credit limits (CL) facing firms using SFA. The analysis also yields estimates of credit availability (CA), which we define as the distance from each firm's actual use of debt financing to its credit limit. In a second stage, we employ these estimates in a dynamic capital accumulation equation using standard regression techniques.

In line with the literature, we assume that firms face an unobservable credit limit of the type:

$$L_{i,t} < \beta_t X_{i,t} + v_{i,t} \quad (1)$$

where i and t respectively indicate firms and time, L denotes total debt in natural logarithms, X is a vector of observable firm characteristics that affect its credit limit, β is a vector of parameters to be estimated that reflect the tightness of credit conditions, v is an independent normal random variable with zero mean, and $CL \equiv \beta X + v$ is the unobservable credit limit.

Following Kiyotaki and Moore (1997), we hypothesize that X includes net wealth and the real interest rate, both measured at time t. Since our sample includes mostly non-listed firms (i.e. we lack market value data), we use the book value of equity as a proxy for net wealth.[7] Higher levels of equity capital imply that the greater stake of shareholders in the business may reduce agency problems for the firm. As a result, lenders may be willing to increase the credit limits to the firm. Thus, we expect a positive sign on equity capital. In

[6] Descriptive statistics on firm leverage generally show low debt-to-equity ratios for the MENA region.
[7] This issue is unlikely to significantly affect our estimation results as the discrepancy between market value and book value is absorbed by the regression constant and the sectoral, geographical, and time dummies. In general, the estimation error in credit limits tends to weaken the relationship between the credit limit estimate and capital accumulation in the second stage regressions. This strengthens our main result of a significant effect of credit limits on capital accumulation.

contrast, higher real interest rates increase the debt service burden and create moral hazard. Here, we expect a negative sign on this variable.

Other potential determinants of the credit limits include firm age, size, profitability, and country of operation. Older firms may have higher credit limits because they have been operating for a long time and have had time to develop relationships with banks. We consider different proxies for firm size, including the number of employees and whether the firm is a small and medium enterprise (SME), since larger firms may benefit from economies of scale on the loan market. We also include indicators of current profitability, expecting a positive effect on credit limits. All models include country group dummies that identify the states belonging to the Gulf Cooperation Council (GCC), the countries that experienced Arab Spring upheavals in 2011 (Egypt, Tunisia, and Syria), and the nations that experienced other political unrest during the estimation period (Bahrain, Iraq, Lebanon, Palestinian Territories, and Sudan).

We define credit availability CA as the distance in logarithms between a firm's credit limit and its actual debt:

$$CA_{i,t} \equiv \beta_t X_{i,t} + v_{i,t} - L_{i,t} = CL_{i,t} - L_{i,t}\,. \tag{2}$$

Under (2), the firm's observed level of total debt can be written as:

$$L_{i,t} = \beta_t X_{i,t} + v_{i,t} - CA_{i,t}. \tag{3}$$

Equation (3) has the form of a stochastic frontier model with two independent residual components. The first component, v, has a standard normal distribution, and the second component, CA, known as u using SFA notation, is a random variable from an unknown distribution with a real positive domain. A small CA indicates that the firm's total debt is close to the limit, so it has poor credit availability. A large CA means that the firm's total debt is far below its credit limit, so it has abundant credit availability.

Note that we arrive at Equation (3) through a simple reformulation of the theory-based stochastic log linear limit (1) without a loss of generality. To estimate Equation (3), however, we need to make an assumption about the distribution of CA in our sample. In line with the stochastic frontier literature, we thus assume that the distribution of CA across firms is truncated normal, half normal, or exponential. Under such assumptions, the borrowing distribution is skewed, so that testing for its skewness constitutes a validation test

for our empirical model. We also test the robustness of the estimation results with respect to the alternative distributional assumptions to ensure the best possible fit for the underlying unknown borrower distribution.[8] To accommodate changes in the borrower distribution, we allow the parameters of the residual distributions to change freely across time.

In the second stage, we estimate a variant of the model of capital accumulation of Kiyotaki and Moore (1997), building on our first stage results. Following the theory, we derive a dynamic behavioral equation of capital accumulation separately for unconstrained and constrained firms, and combine them into an estimable equation.

In Kiyotaki and Moore (1997), unconstrained firms invest until the marginal product of capital equals marginal cost:

$$G'[K_{i,t}] = R_t w_t,$$

where K is the capital stock (log), G' is the marginal production function, R is the real interest rate, and w is the opportunity cost of capital. If we use a Taylor approximation of the unknown production function G, the equilibrium condition has the form $G'[K_{it}] \approx \gamma_0 + \gamma_i K_{it} + Z_{it}$, where γ_0 is the positive first order effect, γ_1 is the negative second order effect, and Z includes all higher order terms of the approximation. Taking first differences across time and rearranging, the equilibrium condition for capital accumulation among unconstrained firms can be expressed in a simple dynamic form as:

$$K_{i,t} = K_{i,t-1} + \frac{\Delta R_t w_t}{\gamma_1} - \frac{\Delta Z_{i,t-1}}{\gamma_2}, \quad (4)$$

where Δ is the difference from the previous period.

Similarly, for our credit constrained firms, capital stock is determined by the firm's credit limit. In the simplified model of Kiyotaki and Moore (1997), which excludes labor and other costs, the value of the capital stock equals the credit limit. We allow for a more general equilibrium relationship between the capital stock and the limit: $K_{it} \approx \delta_0 + \delta_1 CL_{it} + \delta_2 Z_{it}$, where parameters δ_1 designate the marginal effect of the credit limit on capital (with δ_1 positive) and Z includes higher order effects as before. By simple algebra, capital accumulation among constrained firms can now be characterized as:

[8] In Kiyotaki and Moore (1997), the distribution of CA is somewhat discontinuous: for credit constrained firms, CA=0, whereas credit unconstrained firms are distributed across the positive domain CA>0, reflecting

$$K_{i,t} = K_{i,t-1} + \frac{\Delta CL_{i,t-1}}{\delta_1} - \frac{\Delta Z_{i,t-1}}{\delta_1}. \quad (5)$$

Combining (4) and (5), plugging in the credit limit estimate $\widehat{CL}$ from the first stage regression, and augmenting the investment equation by the credit availability estimate $\widehat{CA}$, we lay out the following empirical model:

$$K_{i,t} = \alpha_k K_{i,t-1} + \alpha_{\Delta CL}\Delta\widehat{CL}_{i,t-1} + \alpha_{\Delta R}\Delta R_{i,t} + \alpha_{\Delta z}\Delta Z_{i,t-1} + \alpha_{\Delta CA}\Delta\widehat{CA}_{i,t-1} + \epsilon_{i,t}, \quad (6)$$

where ϵ is an iid normal random error. The first part of the capital accumulation equation (6) $\left[K_{i,t} = \alpha_k K_{i,t-1} + \alpha_{\Delta CL}\Delta\widehat{CL}_{i,t-1} + \alpha_{\Delta R}\Delta R_{i,t} + \alpha_{\Delta z}\Delta Z_{i,t-1}\right]$ follows directly from (4) and (5). In line with theory, we expect the own elasticity of capital α_k to be close to unity. The parameter $\alpha_{\Delta CL}$ denotes the marginal effect of the change in credit limit on capital for credit constrained firms, and its sign is expected to be positive. The parameter $\alpha_{\Delta R}$ denotes the real interest rate effect, and is expected to be negative. $\alpha_{\Delta z}$ denotes the combined effect of higher order terms of credit constraints on capital accumulation. Since the magnitude and the direction of the higher order terms in (4) and (5) is unknown, the sign of the $\alpha_{\Delta z}$ parameter can be either positive or negative.

The last term in Equation (6) $\left[\alpha_{\Delta CA}\Delta\widehat{CA}_{i,t-1}\right]$ is an extension to the Kiyotaki and Moore's (1997) model. Instead of assuming that all unconstrained firms behave as if financial constraints do not exist, we follow Bernanke, Gertler, and Gilchrist (1999) in that firms may adjust their behavior even *before* the credit constraint becomes fully binding due to the fact that banks gradually tighten the terms of credit as borrowers exhaust their credit limits. The intuition is that firms avoid having to incur the higher borrowing costs that inevitably result from getting closer to their credit limits and as bankruptcy risk increases. In our dataset, we do not directly observe the firm's terms of credit such as firm-specific lending rate, but we control for the possibility that firms may preemptively respond to the presence of credit limits by considering credit availability as an additional determinant of firm investment. Since low credit availability implies tight credit conditions, and therefore low capital accumulation, we expect the sign of $\alpha_{\Delta CA}$ to be positive.

the presence of a demand for credit.

3 Data

We build a unique sample of both publicly listed and privately held firms in the MENA region.[9] First, we retrieve company information over the period 2007-2010 from the Orbis database provided by Bureau Van Dijk. While this database includes over 85 million firms around the world, its coverage is weak for the MENA region. Thus, we complement Orbis company information with data from the more specialized Zawya website. Zawya is a leading regional online business intelligence platform that provides detailed profiles on the top companies in the MENA region.

After eliminating firm duplicates from Orbis and Zawya, we obtain a sample of 860 companies for which financial data is available. This gives us a total of 1,483 observations over the period 2007-2010. While the number of firms may seem small, it is actually considerable in light of the scarcity of firm-level data in the region. More importantly, it is sufficient for our estimation needs. It should be noted that companies in MENA do not generally have the practice of disclosing financial information, thereby restricting the ability to conduct much needed research on private sector and enterprise development in the region. Of course, limited financial reporting seriously hampers the ability of firms to secure lines of credit and other forms of financing from financial intermediaries.

Table 1 displays descriptive statistics for firms in our sample across 15 MENA countries, six of which comprise the Gulf Cooperation Council (GCC) countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).[10]

[9] The countries included in the sample are Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco, Oman, Palestinian Territories, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, and United Arab Emirates (UAE).

[10] Excluding countries with a very low number of firms with available data and observations (Lebanon, Sudan, and Syria) does not affect our analysis.

Table 1 Summary statistics by country, 2007-2010

Country	No. of Firms	No. of Obs.	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liab./Equity	Fixed Assets
Bahrain	19	29	419,907	122,971	248,803	33.31	26.40	266,699
Egypt	127	192	552,778	262,925	267,549	66.84	64.04	319,514
Iraq	30	30	7,964	1,835	6,130	58.12	57.77	3,625
Jordan	162	294	90,810	25,387	57,662	52.62	47.07	44,632
Kuwait	148	288	645,869	274,829	323,539	73.44	61.32	341,681
Lebanon	4	4	715,075	104,377	527,356	54.44	54.82	81,294
Morocco	52	148	445,301	105,052	170,252	100.88	112.70	154,566
Oman	80	100	129,232	55,988	66,212	93.53	59.72	84,956
Palestinian Terr.	22	30	71,489	19,085	48,420	32.76	26.60	39,516
Qatar	27	50	2,236,634	1,093,857	1,091,055	71.93	30.57	1,505,652
Saudi Arabia	101	161	2,735,205	1,222,251	1,455,797	68.29	39.85	1,910,990
Sudan	1	1	2,656,134	996,701	1,659,433	60.06	34.66	1,736,297
Syria	5	5	79,004	26,039	52,965	58.01	55.85	23,265
Tunisia	28	71	137,279	41,628	55,259	93.85	144.65	54,377
UAE	54	80	2,536,394	1,168,974	1,226,594	71.85	55.02	1,496,267
Total / Average	860	1483	897,272	368,127	483,802	66.00	58.07	537,555

Source: Authors' calculations based on data from Orbis and Zawya.
Financial data are in thousands of US dollars, except for the debt-to-equity and current-liabilities-to-equity ratios, which are in percent. The last row displays the total number of firms and observations, as well as the average total assets, total debt, equity capital, debt-to-equity ratio, current-liabilities-to-equity ratio, and fixed assets.

Looking at Table 1, it is clear that Jordan dominates the sample with the largest number of firms and observations, and that Sudan has the smallest coverage. GCC oil & gas producers (Qatar, Saudi Arabia, and the UAE) have an average firm size in excess of $2 billion, whereas our small firms operating in Iraq have less than $10 million in assets. Leverage in the MENA region is moderate: the average debt-to-equity ratio is 66% (implying an average equity capitalization of 60.2% of assets) and the current-liabilities-to-equity ratio is 58%.

Table 2 displays similar statistics grouped by sector of economic activity. The industrial manufacturing sector has the largest number of observations, followed by real estate. In terms of balance sheet assets, the largest firms in the MENA region belong to the telecommunications industry, followed by companies in the oil & gas and industrial manufacturing sectors.

Table 2 Summary statistics by sector, 2007-2010

Primary Sector	No. of Firms	No. of Obs.	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liab./ Equity	Fixed Assets
Construction	4	15	386,572	81,007	175,878	72.83	148	117,024
Food and Beverages	19	63	559,633	160,700	254,709	80.41	84.01	237,967
Manufacturing	617	703	885,631	419,086	462,424	69.14	53.23	633,636
Oil and Gas	17	59	888,822	353,116	365,236	70.39	63.19	492,906
Real Estate	100	329	779,814	235,591	393,340	50.77	51.59	107,900
Telecommunications	10	36	3,179,679	870,210	1,400,588	54.26	88.77	1,140,480
Transport	24	81	208,880	60,780	103,500	46.48	55.34	78,374
Other Sectors	69	197	226,978	108,316	74,958	124	109	102,530
Total / Average	860	1483	889,501	286,101	403,829	70.97	81.62	363,852

Source: Authors' calculations based on data from Orbis and Zawya.
Financial data are in thousands of US dollars, except for the number of firms and the number of observations, as well as the ratios of debt to equity and current liabilities to equity, which are in percent.
The last row displays the total number of firms and observations, as well as the average total assets, total debt, equity capital, debt-to-equity ratio, current-liabilities-to-equity ratio, and fixed assets.
* Other sectors are those sectors that include few observations: Agriculture; Chemicals, Rubber, Plastics, and Non-metallic products; Consumer Goods, Education, Health Care, Information Technology, Leisure and Tourism, Machinery, Equipment, Furniture, Recycling; Media; Metals & Metal Products; Mining and Metals, Power and Utilities, Retail; Services; Wholesale & Retail Trade; and Wood, Cork, and Paper.

When grouping countries by GCC membership (Table 3), we note that the sample is almost evenly split across these two sub-samples and that firm size differs substantially across the two groups of countries. The statistics on debt to equity indicate firms in the GCC region are more leveraged than other firms in the region. A test of difference in the mean equity to assets across GCC and non-GCC countries (not reported) indicates that there are significant differences in this ratio across sub-regions. The lower ratio of current liabilities to equity suggests smaller reliance on short term debt in the GCC; capital markets in the GCC region are more developed than in other regional countries and firms in those countries are more likely to rely on long-term debt.

Table 3 Summary statistics by region, 2007-2010

Region	No. of Firms	No. of Obs.	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liab./ Equity	Fixed Assets
GCC	429	708	1,369,500	614,444	700,788	73.90	51.69	879,794
Non-GCC	431	775	277,579	107,081	136,898	64.78	66.17	140,428
Total /Average	860	1483	823,540	360,762	418,843	69.34	58.93	510,111

Source: Authors' calculations based on data from Orbis and Zawya.
The GCC countries include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
The last row displays the total number of firms and observations, as well as the average total assets, total debt, equity capital, debt-to-equity ratio, current-liabilities-to-equity ratio, and fixed assets.

As background information on credit availability in the MENA region, Table 4 shows the ratio of domestic credit provided by the banking sector across MENA countries. The figures show that, on average, banks provide more credit as a percentage of GDP in non-GCC countries than in GCC countries.

Table 4 Domestic credit provided by banking sector (% of GDP), by country

Country	2007	2008	2009	2010
Bahrain	56.46	67.27	84.56	75.22
Egypt	84.15	77.70	75.11	69.42
Iraq*	3.86	4.08	6.57	9.21
Jordan	114.32	110.97	104.61	99.92
Kuwait	68.84	65.33	86.81	66.01
Morocco	91.03	98.64	100.75	105.97
Oman	32.73	29.09	41.27	37.68
Qatar	50.83	51.67	76.23	70.38
Saudi Arabia	17.40	-3.99	0.60	-0.15
Tunisia	64.35	65.57	68.32	73.80
United Arab Emirates	60.14	73.19	97.53	92.29
GCC	47.73	47.09	64.50	56.90
Non-GCC	71.54	71.39	71.07	71.67

Source: International Financial Statistics
* Domestic credit to private sector (% of GDP)

These descriptive statistics overall give only a murky picture of financing conditions in MENA. We continue our investigation of credit conditions in the region with multivariate frameworks based on the work of Kiyotaki and Moore (1997).

4 Estimation results

4.1 Credit frontier model

The main estimation results for Equation (3) are provided in Table 5.

Table 5 Credit frontier models

Variables	Model CL1	Model CL2	Model CL3	Model CL4	Model CL5
Equity Capital	1.039***	1.043***	1.051***	1.015***	1.030***
	[0.0205]	[0.0208]	[0.0226]	[0.0219]	[0.0211]
Real Interest Rate	0.0267***	0.0269***	0.0211**	0.0249**	0.0277***
	[0.0103]	[0.0103]	[0.0105]	[0.0103]	[0.0104]
GCC	0.298***	0.302***	0.305***	0.281***	0.385***
	[0.0946]	[0.0960]	[0.0954]	[0.0947]	[0.0959]
Arab Spring	0.349***	0.354***	0.282***	0.331***	0.404***
	[0.100]	[0.101]	[0.107]	[0.101]	[0.101]
Political Unrest	-0.398**	-0.374**	-0.522***	-0.265	-0.411**
	[0.161]	[0.162]	[0.190]	[0.168]	[0.163]
Manufacturing Industry	-0.696***	-0.724***	-0.254**	-0.671***	-0.604***
	[0.109]	[0.110]	[0.113]	[0.109]	[0.108]
Transportation	-0.781***	-0.796***	-0.352**	-0.752***	-0.753***
	[0.156]	[0.156]	[0.159]	[0.157]	[0.153]
Real Estate	-0.946***	-0.966***	-0.489***	-0.889***	-0.996***
	[0.114]	[0.115]	[0.117]	[0.116]	[0.123]
Food and Beverages	-0.521***	-0.532***	-0.0604	-0.516***	-0.415**
	[0.175]	[0.176]	[0.179]	[0.175]	[0.170]
Telecommunications	-0.956***	-0.982***	-0.531**	-0.924***	-0.587***
	[0.221]	[0.222]	[0.222]	[0.222]	[0.224]
Construction	-0.359	-0.382	0.00668	-0.343	-0.491
	[0.317]	[0.316]	[0.316]	[0.316]	[0.303]
Oil and Gas	-0.526***	-0.548***	-0.131	-0.493***	-0.491***
	[0.187]	[0.187]	[0.186]	[0.187]	[0.182]
Firm Age		-0.000377			
		[0.00189]			
Employees			1.90e-05**		
			[8.46e-06]		
SME				-0.376***	
				[0.124]	
pretax_roe					0.000311
					[0.00162]
Observations	1,533	1,501	1,422	1,533	1,322
Negative skewness test of residuals	-14.35	-14.36	-13.97	-14.31	-14.11
Significance	0.00	0.00	0.00	0.00	0.00

The dependent variable is firm debt measured in natural logarithm. *Equity Capital* is firm equity also in logarithm. *Real Interest Rate* is the difference between the lending rate and the inflation rate. *GCC* is a dummy variable equal to 1 if the country belongs to the GCC. *Arab Spring* and *Political Unrest* are dummy variables for countries in which there occurred an Arab Spring or other political unrest, respectively. Omitted sectors include Agriculture; Chemicals, Rubber, Plastics, and Non-metallic products; Consumer Goods, Education, Health Care, Information Technology, Leisure and Tourism, Machinery, Equipment, Furniture, Recycling; Media; Metals & Metal Products; Mining and Metals, Power and Utilities, Retail; Services; Wholesale &

Retail Trade; and Wood, Cork, and Paper. *Firm Age* is the age of the firm since its establishment; *Firm Size* is proxied by total assets, and *SME* is a dummy variable for firms with less than $5 million in sales. All models assume a truncated normal distribution for the residuals. Year effects and a constant term are included in all regressions but not reported. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

In all models, the regressed variable is total debt in natural logarithms. Our benchmark model (Model CL1) includes firm equity capital, the real rate of interest (defined as the difference between the average lending rate and the inflation rate), dummy variables for GCC countries, Arab Spring countries, economies with other political unrest, and sector of economic activity. In Model CL2, we add firm age as a determinant of the credit limit. In Models CL3 and CL4, we incorporate two indicators of firm size: number of employees and a dummy variable for small and medium-sized enterprises (SMEs).[11] Model CL5 includes profitability measured in terms of operating return on assets. All regressions include year dummies and a constant term (not reported).

We estimate a series of cross sections rather than a panel; cross-section analysis imposes fewer restrictions on the development of the residual parameters over time. In standard panel frontier models, the distribution of CA is either fixed over time or then a mechanical adjustment is imposed. Such assumptions are highly suspect in the present context as CA is likely to vary significantly over time depending on changes in credit conditions and the investment behavior of firms. For these reasons, we do not show the results of panel frontier estimates.[12]

The last two rows in Table 5 display the results of statistical tests of skewness in the distribution of firm loans. The skewness tests are highly significant across all models, indicating negative skew. This validates the estimation of Equation (3), which uses stochastic frontier analysis rather than simple standard linear regression techniques. The presence of a negative skew is an important model validation criterion, since the distributional assumptions we impose on v and CA imply a negatively skewed residual for Equation (3). The intuition is that, by imposing an upper bound on the firm's borrowing capacity, credit limits create a negative skew in debt distribution.

[11] A common official definition of SMEs in developed countries is firms with fewer than 250 employees. For the MENA region, however, there is no such common definition for SMEs and certain MENA countries characterize SMEs differently. Here, we define a firm as an SME if it has less than $5 million a year in sales.
[12] Results available on request.

In the benchmark model (Model CL1 in Table 5), the marginal effect of equity capital on credit limits is highly significant and slightly above unity in magnitude. This positive sign is in line with the theoretical prediction that the credit limit of a firm will increase with net wealth. The marginal effect of equity capital is fairly similar across all models in Table 5, even after controlling for firm size using alternative measures. Since the coefficient is above unity in all models, the results are consistent with the hypothesis of positive scale economies at the credit market − MENA region banks tend to discriminate against smaller firms when extending credit.

Against our expectations, the effect of the real interest rate on the credit limit is positive and significant. One explanation is that, despite moral hazard incentives, higher real interest rates increase loan returns for banks and thus provide an incentive to boost credit limits. This finding may also reflect data problems in the absence of a fully harmonized interest-rate series for all countries considered. Indeed, when we exclude from the sample countries with poor statistics for loan interest rates, the effect of interest rates turns negative and significant without modifying other reported results.

An intriguing result is that the Arab Spring dummy is highly significant and positive, implying that, ceteris paribus, firms operating in countries which experienced the Arab Spring in the subsequent year enjoyed higher credit limits than firms elsewhere in the MENA region.[13] The indicator of positive financial development before the onset of Arab Spring may be surprising, but it is consistent with Acemoglu and Robinson's (2012) "virtuous circle" proposed in their hypothesis of revolutions. The authors argue that a shift from an oppressive regime towards democracy is more likely to occur following globalization and the opening up of markets as the motivations to the elite for maintaining a repressive regime diminish. As markets liberalize, the ruling political and economic elite can more easily transfer their funds outside the country where it is harder to tax them. With their assets safe, they feel more secure about democratic politics and less inclined to oppose the transition to democracy. Many MENA countries have joined the World Trade Organization in recent years, opening up capital accounts, increasing their trade volumes, and paving the way for regime change. Just as the political and ruling elite as more likely to

[13] The Arab Spring began in Tunisia on 17 December 2010 after a 26-year-old street vendor, Mohamed Bouazizi, set himself on fire. Bouazizi, who supported eight people in his household on less than $150 a month, had seen his fruit-and-vegetable cart confiscated by the police, probably as retribution for failing to pay a bribe. In the following months, the Arab Spring spread to Egypt, Yemen, and Syria, as Arabs realized they had the power to overthrow their governments.

support regime change following financial liberalization, the private benefits enjoyed by favored firms are reduced through generally lower agency costs in lending and higher credit limits.

Our results indicate that firms in the GCC region enjoy better credit conditions than companies in other countries, and, as expected, that political unrest adversely affects credit limits in big way. We find only small variation in credit limits over time (year dummies are not reported), suggesting that credit conditions in the MENA region remained relatively stable despite the global financial turmoil.

We also observe significant sectoral effects in Table 5, indicating the presence of differences in agency costs and expectations about firm development across sectors. The omitted sectors span industries for which there are few observations such as agriculture; chemicals, rubber, plastics, and non-metallic products; consumer goods; education; health care; information technology; leisure and tourism; machinery, equipment, furniture, and recycling; media; metals and metal products; mining and metals; power and utilities; retail; services; wholesale and retail trade; and wood, cork, and paper. The negative sign on the coefficients of the various key industries listed in Table 5 suggests that credit limits are lower for these sectors relative to the omitted category. Comparing the magnitude of the estimated coefficients, we note that, among the reported sectors, credit limits are lowest for companies in the telecommunications industry. In contrast, firms in the construction sector enjoy significantly higher credit limits relative to other reported sectors, corroborating the optimism and boom this sector witnessed in recent years, especially in the UAE and Kuwait.

Models CL2-CL5 includes additional firm-level controls. The results confirm our prior findings and providing several new insights. In Model CL2, the coefficient on firm age is insignificant. In Model CL3, the marginal effect of firm size, measured in terms of number of employees, is positive and significant. The SME dummy in Model CL4 is negative and significant. These results indicate that larger businesses enjoy higher credit limits than SMEs. Moreover, larger firms in the MENA region are likely to wield greater economic and political influence, allowing them to benefit from higher credit limits. These results strengthen the survey-based findings by Rocha, Arvai, and Farazi (2011) that SMEs are financially constrained in the region. Finally, the sign on profitability is positive, but insignificant. This may be because profits are already included in firm equity capital as retained earnings.

To provide additional insights into financing conditions in the MENA region, we compute the ratio of total debt to the estimated credit limits and report their descriptive statistics in Table 6 by country (Panel A) and by sector (Panel B).

Table 6 Descriptive statistics, ratio of total debt to credit limits (in %)

Panel A: By country

Country	Mean	Median	Minimum	Maximum	Standard Deviation
Bahrain	66.69	64.54	37.41	92.57	18.71
Egypt	61.65	58.57	24.96	99.66	19.73
Iraq	56.65	52.19	21.80	99.31	21.73
Jordan	67.63	68.83	21.77	99.62	20.33
Kuwait	61.95	58.95	21.85	99.42	21.94
Lebanon	55.04	60.09	30.28	69.70	17.69
Morocco	55.93	50.35	21.06	99.85	22.87
Oman	58.56	55.29	24.64	99.42	20.82
Palestinian Territories	69.97	74.61	51.48	79.20	12.63
Qatar	62.12	67.29	29.38	91.54	19.17
Saudi Arabia	63.42	63.69	24.05	99.90	20.44
Syrian Arab Republic	62.76	60.69	39.65	88.74	18.34
Tunisia	59.40	52.65	25.36	99.68	21.17
United Arab Emirates	59.53	57.36	26.98	95.13	19.62
Average	*61.52*	*60.36*	*28.62*	*93.84*	*19.66*

Panel B: By Sector

Primary Sector	Mean	Median	Minimum	Maximum	Standard Deviation
Construction	56.93	55.43	37.93	84.63	14.44
Food and Beverages	62.21	60.10	21.06	99.78	21.11
Industrial Manufacturing	61.36	59.67	21.80	99.85	20.26
Oil and Gas	61.87	62.85	26.87	99.42	21.20
Real Estate	63.39	63.38	21.77	99.80	22.81
Telecommunications	61.08	59.00	27.83	99.54	20.53
Transportation	60.77	57.28	25.36	99.68	19.95
Other Sectors	56.78	56.26	37.36	74.37	12.72
Average	60.55	59.25	27.50	94.63	19.13

We observe that the average firm borrowing amounts to about 60% of credit limits across the sampled countries and industries. It seems that firms in the MENA region tend to assume debt levels below their credit limits or that they borrow sparingly. Further, in both Panels A and B, mean and median values are close to each other, suggesting that credit conditions do not differ significantly across firms in different countries or sectors. The

standard deviation is lower than average values, pointing to low volatility in credit conditions across firms in the MENA region. In the next section, we examine the effect of credit limits on corporate investment.

4.2 Capital accumulation models

The main estimation results for capital accumulation equation (6) are presented in Table 7.

Table 7 Capital accumulation models

Variables	Model K1	Model K2	Model K3	Model K4	Model K5
Fixed assets, lagged	0.997***	0.998***	0.998***	0.996***	1.008***
	[0.0348]	[0.0348]	[0.0352]	[0.0350]	[0.0370]
Real interest rate, change	0.00745	0.00744	0.00598	0.00731	0.00345
	[0.00560]	[0.00559]	[0.00562]	[0.00558]	[0.00602]
Credit limit, lagged change	0.399**	0.407**	0.407**	0.412**	0.0479
	[0.187]	[0.186]	[0.192]	[0.179]	[0.124]
Credit availability, lagged change	-0.0250	-0.0296	-0.0238	-0.0285	-0.0175
	[0.0307]	[0.0306]	[0.0314]	[0.0314]	[0.0281]
Industrial manufacturing	0.134*	0.122*	0.123*	0.136*	0.126
	[0.0726]	[0.0718]	[0.0734]	[0.0729]	[0.0779]
Transportation	0.0872	0.0746	0.0891	0.0806	0.0743
	[0.0711]	[0.0700]	[0.0731]	[0.0722]	[0.0762]
Real estate	-0.323**	-0.336**	-0.329**	-0.322**	-0.318*
	[0.151]	[0.150]	[0.156]	[0.150]	[0.163]
Food and beverages	-0.0402	-0.0510	-0.0508	-0.0415	-0.0576
	[0.0614]	[0.0606]	[0.0615]	[0.0618]	[0.0651]
Telecommunications	0.112	0.0987	0.101	0.111	0.106
	[0.132]	[0.132]	[0.131]	[0.132]	[0.139]
Construction	0.564**	0.547**	0.563**	0.561**	0.600**
	[0.235]	[0.235]	[0.236]	[0.235]	[0.239]
Oil and gas	0.206**	0.189*	0.201**	0.204**	0.221**
	[0.0970]	[0.0967]	[0.0947]	[0.0966]	[0.101]
GCC	-0.329***	-0.319***	-0.335***	-0.327***	-0.378***
	[0.111]	[0.111]	[0.112]	[0.112]	[0.118]
Observations	382	381	370	382	305
Adjusted R2	0.89	0.89	0.89	0.89	0.93
F-statistic	249.96	249.79	237.94	248.57	406.72
log likelihood	-542.68	-541.36	-531.10	-542.29	-324.90

The dependent variable is *Fixed assets* in natural logarithms. *Real interest rate* is the difference between the lending rate and the inflation rate. *Credit limit* and *Credit availability* are estimated from Equation (3). *GCC* is a dummy variable equal to 1 if the country belongs to the GCC. Omitted sectors include Agriculture; Chemicals, Rubber, Plastics, and Non-metallic products; Consumer Goods, Education, Health Care, Information Technology, Leisure and Tourism, Machinery, Equipment, Furniture, Recycling; Media; Metals & Metal Products; Mining and Metals, Power and Utilities, Retail; Services; Wholesale & Retail Trade; and Wood, Cork, and Paper. Year effects and a constant term are included in all regressions but not reported. Robust standard errors are reported in brackets. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

The regressed variable is the firm's fixed assets, which we use as an empirical proxy for the theoretical concept of "fixed capital." The benchmark model (Model K1) includes as explanatory variables lagged fixed assets, the change in the real rate of interest (defined as the difference between the lending rate and the inflation rate), the lagged change in credit limits (CL) and credit availability (CA), as well as dummy variables for the GCC region and sector of economic activity. In Models K1-K5, the CL and CA estimates are derived from the corresponding credit frontier Models CL1-CL5 of Table 5.

As expected the marginal effect of lagged capital is very close to unity in magnitude in the benchmark Model K1 as well as all other models. Across all models of Table 7, with the exception of Model K5, the coefficient on the lagged change in credit limits is positive and highly significant.[14] The magnitude of the effect is economically large, ranging between 0.4 and 0.48, implying that, if the change in credit limits is higher by one percent relative to the change in the previous year, capital accumulation in the following year will rise by at least 0.4%. The estimation results generally support the hypothesis that credit limits hinder the development of firms and the economy overall in the MENA region.

The findings also indicate that $\alpha_{\Delta CA}$ is insignificant across all models. The result implies that a change in credit availability does not significantly affect capital accumulation the following year. Recall that a small value for CA implies that the firm is close to its credit limit, i.e. it is highly leveraged and faces a heightened risk of bankruptcy. Under well-functioning credit markets, the interest such a firm would have to pay on its debt would rise, thereby curtailing its future investments (see Bernanke, Gertler, and Gilchrist, 1999). Our results, however, support the view of Kiyotaki and Moore (1997), where un-

[14] In the case of Model K5, the credit limit estimates are derived from the specification of equation (3) that includes the effect of profitability, which was found to be statistically insignificant in Table 5. Including profitability in equation (3) results in a drop in the number of observations that could affect the estimation results of Table 7.

constrained firms, i.e. firms with a positive CA term, do not preemptively adjust their behavior even when they approach their credit ceiling. It could be that interest rates on loans are insensitive to the bankruptcy risk of firms in the MENA region. The absence of a wide coverage of credit bureaus and public registries, combined with the lack of available historical financial data on companies, hinders the application of standard risk-assessment mechanisms in the MENA region that creditors use for setting risk premiums on loans for firms of different credit quality.

The GCC dummy is negative and significant across all specifications, indicating that the dynamics of capital accumulation differ for the GCC and other regional countries. Whereas investment in the oil and gas sector requires substantial real capital, the less diversified economic base of the GCC countries may account for the negative sign on the GCC dummy variable. We also find that investment in the oil & gas and construction industries is higher relative to other sectors, and that investment in the industrial manufacturing sector is marginally higher than in other industries. Investment in real estate is less than other sectors, probably due to the real estate bubble that certain MENA countries experienced in 2008.

4.3 Credit constraints and cash flow sensitivity

We now test the validity of the cash flow sensitivity approach in assessing the impact of credit conditions on capital accumulation. As we are also interested in comparing the results of our novel econometric approach with those of the cash flow sensitivity approach, we first include cash flow indicators in the investment equation to test for their significance, and second to consider the effect of both cash flow measures and credit limits. If traditional indicators of cash flow and our novel estimates of credit limits are substitutes, then we should observe a decrease in the significance of one of these variables when they are both included in the capital accumulation equation. The results should provide evidence for the debate over the channel through which financing constraints affect investment.

Table (8) shows the estimation results based on the cash flow variables. Since the dataset does not include direct indicators of cash flow for firms in the MENA region, we use “current assets” and “ sales” as indirect indicators of cash flow. All models are variants of the benchmark model (K1) of capital accumulation in the presence of credit limits.

Table 8 Alternative estimations

	Model A1	Model A2	Model A3
Fixed assets, lagged	1.023***	0.998***	1.023***
	[0.0322]	[0.0354]	[0.0322]
Real interest rate, change	0.00527	0.00259	0.00498
	[0.00495]	[0.00620]	[0.00560]
Sales, lagged change	3.92e-07***		3.74e-07***
	[9.21e-08]		[8.48e-08]
Current assets, lagged change		0.323**	0.0809
		[0.126]	[0.127]
Credit limit, lagged change			0.0345
			[0.181]
Industrial manufacturing	0.116	0.143*	0.115
	[0.0771]	[0.0764]	[0.0769]
Transportation	0.0507	0.0909	0.0470
	[0.0651]	[0.0741]	[0.0663]
Real estate	-0.120	-0.286**	-0.121
	[0.121]	[0.141]	[0.123]
Food and beverages	-0.0925	-0.0450	-0.0937
	[0.0598]	[0.0595]	[0.0586]
Telecommunications	0.0657	0.108	0.0580
	[0.126]	[0.131]	[0.127]
Construction	0.469*	0.571**	0.478**
	[0.243]	[0.241]	[0.242]
Oil and gas	0.131*	0.248**	0.136*
	[0.0751]	[0.103]	[0.0776]
GCC	-0.288***	-0.348***	-0.284***
	[0.104]	[0.116]	[0.104]
Observations	308	379	308
Adjusted R2	0.93	0.89	0.93
F-statistic	283.73	277.50	296.28
Log likelihood	-324.24	-537.53	-323.84

The dependent variable is *Fixed assets* in natural logarithms. *Real interest rate* is the difference between the lending rate and the inflation rate. *Credit limit* is estimated from Equation (3). *GCC* is a dummy variable equal to 1 if the country belongs to the GCC. Omitted sectors include Agriculture; Chemicals, Rubber, Plastics, and Non-metallic products; Consumer Goods, Education, Health Care, Information Technology, Leisure and Tourism, Machinery, Equipment, Furniture, Recycling; Media; Metals & Metal Products; Mining and Metals, Power and Utilities, Retail; Services; Wholesale & Retail Trade; and Wood, Cork, and Paper. Year effects and a constant term are included in all regressions but not reported. Robust standard errors are reported in brackets. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

In Model A1 of Table 8, the lagged change in credit limits is replaced with the lagged change in current assets. In Model A2, the lagged change in sales substitutes for the lagged change in credit limits. We simultaneously include all three indicators (lagged changes in credit limits, current assets, and sales) in Model A3.

We observe from Models A1 and A2 that both proxies of cash flow are highly significant and positive as predicted by the cash flow sensitivity approach. These results confirm the previous findings on the importance of credit limits that we derived from the novel econometric approach of stochastic frontier analysis. Under both approaches, we find evidence of a significant and positive effect of credit limits on capital accumulation in the MENA region.

Model A3, which considers credit limit estimates and cash flow indicators, contributes to the ongoing debate about the relevance of the cash flow sensitivity approach. Recall from our mention in introductory section of the debate on whether the cash flow sensitivity of investment constitutes evidence on the influence of credit limits on capital accumulation. If cash flow sensitivity reflects the effect of credit limits on investment, then including cash flow indicators in investment equation (6) should weaken the relationship between credit limits and investment. If, on the other hand, cash flow sensitivity mirrors the importance of factors other than financing conditions, then the coefficient of credit limits should be unaffected by the inclusion of cash flow variables.

We observe from Model A3 in Table 8 that adding cash flow indicators into the model reduces the estimated marginal effect of credit limits on capital accumulation. The coefficient of credit limits is still positive, but its magnitude is much reduced and it loses significance. Therefore, the findings suggest that cash flow sensitivity may be a good approximation of the effect of credit limits on investment in the MENA region.

4.4 Sensitivity checks

We investigate the robustness of our results with respect to the distribution of CA (truncated normal, exponential, or half normal), inclusion of higher order terms in Equation (3), as well as variable effects of equity capital across sectors and countries. We use short-term debt as an alternative endogenous variable, consider alternative indicators of firm size (total assets) and interest rates, replace the GCC dummy with individual country dummies, and use other indicators of profitability. Finally, we filter the data by removing countries

and sectors with few firms and observations. Our main estimation results are robust to all these changes.

With respect to the capital accumulation estimations, we investigate the robustness of the results to including additional lags of real capital, higher order terms, individual country effects, as well as additional explanatory variables such as the change in consumer prices. We also incorporate the Arab Spring and Political Unrest dummies into these models. Overall, we find that our results are robust to alternative specifications.[15]

5 Conclusions

We estimate the seminal dynamic model of capital accumulation proposed by Kiyotaki and Moore (1997) by means of a novel two-step empirical approach. Using a unique data set on firms in the MENA region, we employed SFA to estimate credit limits and then investigated their effect on capital accumulation. Our results indicate significant differences in credit conditions across countries and sectors of this volatile region of the world. Interestingly, we find that credit markets in Arab Spring countries show higher financing limits than for the rest of the MENA region. Further, credit conditions have a significant and very large effect on capital accumulation, with a one percentage increase in credit limits yielding an increase of almost half a percentage point in capital accumulation within one year.

Our work complements previous studies by scholars and international organizations about the link between credit conditions and capital accumulation. It provides new evidence on credit conditions and their importance in a region that is witnessing major economic and political changes. The implementation of a novel empirical approach to quantify Kiyotaki and Moore's model also paves the way for a wide research agenda for similar studies on other regions and time periods.

[15] The tabulations of the robustness checks are available upon request from the authors.

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