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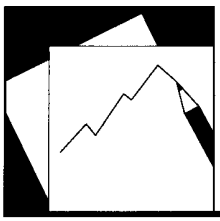

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Credit Constraints, Political Instability, and Capital Accumulation

Risto Herrala and Rima Turk Ariss

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Credit Constraints, Political Instability, and Capital Accumulation

Prepared by Risto Herrala and Rima Turk Ariss[1]

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Abstract

We investigate the complex interactions between credit constraints, political instability, and capital accumulation using a novel approach based on Kiyotaki and Moore's (1997) theoretical framework. Drawing on a unique firm-level data set from Middle-East and North Africa (MENA), empirical findings point to a large and significant effect of credit conditions on capital accumulation and suggest that continued political unrest worsens credit constraints. The results support the view that financial development measured by a relaxing of financial constraints is key to macroeconomic development.

JEL Classification Numbers:G31; E2; O16; P48

Keywords: Capital accumulation; credit constraints; political unrest; MENA countries

Authors' E-Mail Addresses: risto.herrala@bof.fi , rturk@imf.org

[1] The paper was written when Rima Turk Ariss was Associate Professor at the Lebanese American University and was later revised after joining the IMF-Middle East Center for Economics and Finance.

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I. INTRODUCTION[2]

The importance of credit constraints on capital accumulation is largely documented in the empirical literature using (i) the 'investment-cash flow sensitivity' approach (Fazzari et al. 1988) which is viewed as an indirect way of assessing financial constraints; and (ii) the 'survey-based' qualitative approach (Kaplan and Zingales 1997) which lacks quantitative rigor.[3] Weak theoretical underpinnings of these empirical methods have cast doubt on their suitability to quantitatively gauge credit constraints. A number of studies have questioned the link between the cash flow sensitivity of investment and the presence of financial constraints (Chen and Chen 2012; Laeven 2003; Kaplan and Zingales 1997) with more recent evidence pointing to a reduced cash flow elasticity of investment (Chen and Chen, 2012; Brown and Petersen, 2009; Andersen and others, 2012; and Guariglia and Poncet, 2007). Since financial frictions are believed to be significant at least in emerging markets, these recent findings further undermine the usefulness of the investment-cash flow sensitivity as a measure of credit constraints.

The paper's contribution to the literature is twofold: methodology and findings. On methodology, we assess the quantitative impact of credit constraints on capital accumulation based on the seminal work of Kiyotaki and Moore (KM, 1997). A reformulation of the latter's conceptual model is well suited to empirically demonstrate the impact of credit constraints on capital accumulation using a parametric approach, circumventing the inherent difficulty of brining the KM model to data because credit constraints are not directly observable in a quantifiable manner. Namely, recent empirical advances have yielded a solution to this problem by following a two-step estimation of the model parameters. As such, we first estimate the unobservable credit constraints denoted as credit limits using a stochastic frontier analysis (SFA) of the loan distribution for a sample of firms.[4] Next, these credit limits are incorporated in a dynamic regression framework in order to quantify their marginal effect on capital accumulation.

The second contribution of the paper rests on its findings, shedding light on the effects of continued political instability on the finance growth–nexus while drawing on a unique firm-

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[3] See Bhaumik, Das, and Kumbakhar (2012) and Abdallah and Latrapes (2012) for alternative approaches. Bhaumik, Das, and Kubakhar (2012) quantify the impact of borrowing constraints on capital accumulation by comparing the prevailing investment to capital ratios to their optimal level, which they estimate using the stochastic frontier method. Abdallah and Latrapes (2012) make use of an exogenous change in the law as a natural experiment to estimate the importance of credit constraints for households.

[4] The credit limit estimations are based on the methodology presented by Herrala (2009) and more recently employed by Fungacova and others (2013).

level dataset from Middle East and North Africa (MENA).[5] We believe to be the first to assess the effect of political instability on credit constraints and capital accumulation in a region where a number of countries are experiencing political turmoil, and to investigate the initial conditions that prevailed at the onset of the unrest.

We find that the impact of credit constraints on capital accumulation is economically and statistically significant, with the marginal effect of a change in credit limits on capital accumulation estimated at about 40 percent. The results are robust to changes in model specification and support the view that financial development in MENA countries, measured by a relaxing of financial constraints, is key to macroeconomic development in the region. Furthermore, the challenge of maintaining a well-functioning financial system in the midst of significant political instability is all too-evident and we show empirically that credit limits get tighter amid prolonged political uncertainty. However, the dynamic effects of continued political unrest on capital accumulation are insignificant, in accordance with Bloom's (2009) finding.

Compared with other countries in the region, firms operating in Arab Spring countries seemed to enjoy higher credit limits prior to the revolution, on average, but no evidence of significant differences in capital accumulation can be detected empirically.[6] It could be that revolutions are not so much fueled by lack of economic progress but may rather be triggered after some 'threshold' level of economic or financial development is reached—a finding broadly in line with the theoretical work of Acemoglu and Robertson (2012).

The remainder of the paper is structured as follows. Section 2 derives the quintessential estimable equations of credit limits and capital accumulation, building on the KM model. Section 3 provides an overview of the key macroeconomic and financial conditions in the MENA region as well as more recent sociopolitical challenges; it also describes the unique data set. Section 4 discusses the estimation results and section 5 conducts robustness checks. Section 6 concludes.

[5] Recent evidence by Bloom (2009) indicates that shocks related to the onset of political instability have significant but temporary negative effects on corporate investment and economic growth.

[6] Arab Spring countries include Egypt, Syria, and Tunisia. Both Egypt and Tunisia are a subset of Arab Countries in Transition that include Egypt, Jordan, Libya, Morocco, Tunisia, and Yemen.

II. METHODOLOGY

To estimate the effect of credit constraints on capital accumulation, we reformulate KM's seminal model and implement a two-stage parametric procedure, estimating the unobserved credit limits and quantifying their marginal effect on capital accumulation.

The capital accumulation equation of main interest is derived first. Consider a time invariant production function G with input K, for 'capital'. In equilibrium, unconstrained firms equate marginal product with marginal cost:

$$G'\left[K_{i,t}\right] = R + w_t, \qquad (1)$$

where G' is the first derivative, *i* denotes firms, *t* time, R real interest rate, and w opportunity cost.[7] Unless otherwise stated, all variables are in natural logarithms. Under a quadratic Taylor approximation of G around a steady state *s*, the left hand side of (1) is linear*:* $G'[K_{it}] \approx \gamma_0 + \gamma_1 K_{it}$, where $\gamma_0 = G'[s] - aG''[s],\ \gamma_1 = G''[s] < 0$. By inserting the approximation of G' into (1), taking first differences across time, and rearranging, we get a dynamic equilibrium condition for unconstrained firms:

$$K_{i,t} = K_{i,t-1} + \frac{\Delta(R+w_t)}{\gamma_1}, \qquad (2)$$

where Δ is change between two periods.

For credit constrained firms, the equilibrium condition is written as (Appendix 1 provides a detailed derivation of equation (3)):

$$K_{i,t} = \varphi_t + CL_{i,t-1}, \qquad (3)$$

where $\varphi_t \equiv ln\left(\frac{aR}{q_t\left(q_t - \frac{1}{R}q_{t+1}\right)}\right) > 0$, a is a parameter between zero and one $(0 < a < 1)$ reflecting output marketability, q is the price of the capital good, and *CL* is the (unobservable) credit limit or constraint. To interpret, for constrained firms the capital stock is proportional to the credit limit of the previous period by a 'proportionality factor' φ. The proportionality factor, which is only of secondary interest for present purposes, varies with the marketability of output and the real interest rate (these affect the loan service ability of firms), as well as capital goods prices (which affect collateral value).
Total differentiation of (3) across time and solving for K yields:

$$K_{i,t} = K_{i,t-1} + \Delta CL_{i,t-1} + \Delta\varphi[a, R, q_t, q_{t+1}], \qquad (4)$$

[7] Equation (1) corresponds with equation (11) in Kiyotaki and Moore (1997), in logarithmic form.

Aggregating the equilibrium conditions (equations (2) and (4)) over unconstrained and constrained firms and replacing unobserved variables with estimates (indicated by "hat"), yields the following capital accumulation model:

$$K_{i,t} = \alpha_K K_{i,t-1} + \alpha_{\Delta CL} \Delta \widehat{CL}_{i,t-1} + \alpha_{\Delta Z1} \Delta Z1_{i,t} + \epsilon_{i,t} \,, \qquad (5)$$

where $\widehat{CL}$ is an estimate of the unobservable credit limit, *Z1* is a vector of other variables to be specified, and the residual ϵ is a normal iid measurement error with zero mean. Based on theory, the capital's own elasticity α_K is expected to be close to unity. The main parameter of interest $\alpha_{\Delta CL}$ represents the marginal effect of credit constraints on capital—in the context of the theoretical model, it can also be interpreted as the proportion of credit constrained firms in the sample, explained by the fact that *CL* has no effect on unconstrained firms (equation (2)) and it affects constrained firms on a one-to-one basis (equation (4)).

The *Z1* vector includes the change in the real interest rate (R) and is expected to have a negative effect on capital accumulation—an extension to KM's assumption of constant interest rate. Other variables included in *Z1* are three main dummies (time, country, and sector) intended to control for changes in opportunity costs, capital goods prices, and marketability of goods across periods, countries, and economic sectors; additional dummies identify Arab Spring countries, other countries experiencing political unrest (Bahrain, Iraq, Lebanon, Sudan, and West Bank and Gaza), and Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) that exhibit similarities in their economic and socio-political (as of late) characteristics.

Moreover, an estimate of each firm's distance from the credit limit discussed extensively in the literature, defined as $DL_{i,t} \equiv CL_{i,t} - L_{i,t}$, is included in *Z1* in testing for a possible deviation from the KM's construct.[8] Under the latter, firms only react to binding credit constraints (i.e., $DL = 0$), but others (e.g., Stiglitz and Weiss 1981; Bernanke, Gertler, and Gilchrist 1999) contend that investment dynamics change in the vicinity of the credit limit *before* it becomes binding (i.e., $DL > 0$), possibly driven by rising borrowing costs when firms get closer to exhausting their credit limits (i.e., DL becomes small) and bankruptcy risk rises. We test for the existence of such a positive 'distance effect' by including $\widehat{DL}$ in *Z1*.

We estimate the parameters of equation (5) using a dynamic linear regression model based on a series of cross sections.[9]

To estimate the unobservable variables of equation (5), namely credit limit (*CL*) and distance from the limit (*DL*), we employ SFA assuming that firms face a credit constraint formulated as follows:[10]

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[8] By construction, *DL* is unobservable, akin to *CL*.

[9] We do not use panel estimators to avoid imposing undue restrictions on residual parameters in time.

[10] Equation (6) is the equivalent of equation (3) in KM.

$$L_{i,t} \leq \beta_{t,A} A_{t,i} + \beta_{t,R} R_t + \beta_{t,Z} Z2_t + v_{i,t}, \qquad (6)$$

where L denotes loans, A firm size, $Z2$ a vector of other variables to be specified, $\beta's$ are parameters to be estimated reflecting credit conditions, and v is a normal iid random variable with zero mean. This constraint imposes an upper bound on firm borrowing L at the unobservable credit limit which is stated as $CL_{i,t} \equiv \beta_{t,A} A_{i,t} + \beta_{t,R} R_t + \beta_{t,Z} Z2_t + v_{i,t}$. On theoretical ground, $\beta_{t,A}$ is expected to be positive since assets are generally eligible as collateral and thus likely to raise credit limits, and $\beta_{t,R}$ is expected to carry a negative sign as higher real interest rates are likely to increase the debt service burden of firms and thus reduce credit limits.

Based on the previously defined *DL*, the borrowing constraint in (6) can be rewritten without loss of generality as a stochastic frontier model:

$$L_{i,t} = \beta_{t,A} A_{i,t} + \beta_{t,R} R_t + \beta_{t,Z} Z2_t + v_{i,t} - DL_{i,t}. \qquad (7)$$

Equation (7) yields two unobserved residual components: *v* is standard normal, reflecting measurement error or random variation in credit limits across firms; and *DL* or distance from the credit limit has an unknown distribution with a real positive domain. In line with the stochastic frontier literature, we assume that the distribution of *DL* is either half normal, truncated normal, or exponential. We also assume that the two residuals are independent of each other, of the variable vector, and of sampling probabilities. Since the distributional parameters vary freely, a strength of the empirical approach is that it is also applicable in non-random firm samples provided that the sampling probabilities are independent of the two defined residuals.

We use a number of alternative indicators of firm size *A*, including total assets book value, equity capital, number of firm employees, and a qualitative indicator for small and medium-sized enterprises (SMEs). The choice among different proxies of bank size does not affect the main estimation results. We do not consider market-value indicators as our sample includes non-listed firms—arguably, this is not likely to affect the main estimation results given that *Z2* includes time, country, and industry dummies that may control for changes or differences in market prices. The latter vector includes two other firm characteristics, age and profitability believed to affect credit limits: older firms may face higher credit limits in light of their more established relationships with banks, and in terms of current profitability, pretax return on equity is likely to impact positively credit limits. Similar to *Z1*, we control for Arab Spring countries, other nations experiencing varying types of political unrest, and GCC economies.

In the robustness section, we explore the possible bias caused by estimation error in $\widehat{\Delta CL}$ and $\widehat{\Delta DL}$. This estimation error may potentially affect inference in the second stage regression, and we address it by correcting the standard errors using errors-in-variables regression techniques.[11]

[11] See Murphy and Topel (1985) for a discussion of the errors-in-variables regression techniques.

III. MENA Conditions, Data Sample, and Descriptive Statistics

A. Overview of Key MENA Macroeconomic and Financial Conditions

MENA countries comprise oil-importing (Djibouti, Egypt, Jordan, Lebanon, Morocco, Syria, Tunisia, and West Bank and Gaza) and oil-exporting (Algeria, Bahrain, Iran, Iraq, Kuwait, Lybia, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen) economies. In most oil-importing countries, recent analysis by the IMF points to widening fiscal deficits, dwindling international reserves, and increasingly subdued foreign direct investments and other portfolio flows. These economies generally need to preserve macroeconomic stability, improve competitiveness, and mobilize external financing (IMF-Middle East and Central Asia Regional Economic Outlook (MCD-REO), 2013). In parallel, oil-exporting countries are facing rising break-even oil prices in light of rising hard-to-reverse current government expenditures that may raise concerns about inter-generational equity, opening the scope for better macro-fiscal planning.

A common and rising concern across most MENA countries is the impending need to meet pressing social demands, build private sector confidence, and lay the foundations for socially-inclusive growth and jobs. However, private sector development, which is instrumental in meeting this objective, is sluggish in the region. Firms are mostly small family-oriented businesses with limited access to external finance; domestic equity markets are inefficient and debt markets are underdeveloped; and banks are the main providers of credit to businesses as in similar developing countries with little disintermediation for providing alternative sources of credit.

According to the World Bank Business Environment Survey, financial frictions in the MENA region represent a significant hurdle to corporate growth, which has resulted in seriously impeding firm access to finance—only 10 percent of MENA firms make use of bank financing and close to 40 percent identify access to finance as a major obstacle to growth, second only to Sub-Saharan Africa (Ahmed, 2013). As such, credit constraints undermine firm investment and growth (Hubbard, 1998). They are also accentuated by prevailing weak financial infrastructures: agency costs of bank screening, loan contracting, and monitoring are quite high; public registries are rare; coverage of private credit bureaus is limited resulting in inefficient credit information sharing systems; and collateral frameworks and bankruptcy codes are underdeveloped, aggravating moral hazard and adverse selection distortions (Rocha, Arvai, and Farazi, 2011).

Furthermore, the onset of the Arab Spring movement in 2011 has sparkled sociopolitical pressures across the region. A number of countries are going through complex political, social, and economic transitions and face the challenge of maintaining macroeconomic stability amid political turmoil and social unrest (IMF-MCD REO, 2013). The political uncertainty reflects general failures on the part of governments to deal with widening inequality gaps and youth unemployment. The IMF estimates that between 50 and 75 million new jobs are needed over the next decade in MENA to secure social and political stability. Quite alarming is the increase of unemployed people (by more than one million) since the

onset of the Arab Spring, with unemployment rates varying between 9 and 15 percent and youth unemployment reaching up to 30 percent in some countries (Ahmed, 2013).

Against this background, our sample of MENA firms provides a timely opportunity to investigate the complex interactions between credit constraints, political instability, and capital accumulation.

B. Data Sample

We build a unique sample of both publicly-listed and privately-held firms in the MENA region.[12] First, we retrieve company information over the period 2007-2010 from *Orbis* database provided by Bureau Van Dijk, a widely used database covering over 85 million firms from around the world but with limited coverage of the MENA region. As such, we complement *Orbis* database with a more specialized source of information, namely *Zawya*, a leading regional online business intelligence platform that provides detailed quantitative and qualitative profiles on top companies in the MENA region.

Having streamlined the two databases for possible duplication in firm coverage, we retain a sample of 860 companies for which financial data is available, and based on the unbalanced panel in use, a total of 1,483 observations over the period 2007-2010. Despite a seemingly small number of firms, data collected is actually rich given scarce firm-level data in the region and meet the estimation needs of this paper. 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. Furthermore, limited financial reporting seriously hampers the ability of firms to secure lines of credit and other forms of financing from financial intermediaries.

C. Descriptive Statistics

Table 1 displays descriptive statistics for firms in our sample across 15 MENA countries, six of which comprise the Gulf Cooperation Council (GCC).[13]

[12] Based on data availability, the countries covered are: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, and United Arab Emirates, and West Bank and Gaza.

[13] Our baseline regressions do not include countries with a very low number of firms with available data (i.e., Lebanon, Sudan, and Syria). However, robustness checks indicate that including them does not affect our results.

Table 1. Summary statistics by country, 2007-2010

Country	Number of Firms	Number of Observations	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liabilities/ Equity	Fixed Assets
Bahrain	19	29	419,907	122,971	248,803	33.31	26.4	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	112.7	154,566
Oman	80	100	129,232	55,988	66,212	93.53	59.72	84,956
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
West Bank & Gaza	22	30	71,489	19,085	48,420	32.76	26.6	39,516
Total / Average	860	1483	897,272	368,127	483,802	66	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.

From Table 1, it is clear that Jordan dominates the sample with the largest number of firms and observations (albeit being behind other countries in terms of the size of those companies), and that Sudan has the smallest coverage. In terms of average firm size, asset values vary between $2 billion in some large GCC hydrocarbon-producing countries (i.e., Qatar, Saudi Arabia, and the UAE) and less than $10 million in Iraq. Leverage in the MENA region is moderate: average debt-to-equity ratio is 66 percent (implying an average equity capitalization of about 60 percent of assets) and current-liabilities-to-equity ratio is 58 percent.

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

Table 2. Summary statistics by sector, 2007-2010

Primary Sector	Number of Firms	Number of Observations	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liabilities/ Equity	Fixed Assets
Construction	4	15	386,572	81,007	175,878	72.83	148.00	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	124.00	109.00	102,530
Total / Average	860	1,483	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.

In grouping countries by GCC or non-GCC member (Table 3), the sample is almost evenly split across these two sub-samples but firm size differs substantially across the two groups. The statistics on debt-to-equity indicate that firms in the GCC group are more leveraged than firms elsewhere. A test of the difference in mean equity-to-assets ratios across the two groups (not reported) indicates a significant divergence. In all, lower current liabilities-to-equity ratio suggests smaller reliance on short-term debt in GCC; as GCC capital markets are relatively more developed, firms therein are more likely to rely on long-term debt.

Table 3. Summary statistics by region, 2007-2010

Region	Number of Firms	Number of Observations	Total Assets	Total Debt	Equity Capital	Debt/ Equity	Current Liabilities/E	Fixed Assets
GCC	429	708	1,369,500	614,444	700,788	73.9	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 countries. The figures indicate

that, on average, banks provide more credit in non-GCC than in GCC countries, as a percent of GDP.

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

Country	2007	2008	2009	2010
Bahrain	56.46	67.27	84.56	75.22
Egypt	84.15	77.7	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	17.4	-3.99	0.6	-0.15
Tunisia	64.35	65.57	68.32	73.8
UAE	60.14	73.19	97.53	92.29
GCC	47.73	47.09	64.5	56.9
Non-GCC	71.54	71.39	71.07	71.67

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

These descriptive statistics are but one piece of information summarizing credit conditions in MENA. Using KM theoretical framework, we next investigate the presence of credit constraints and their implications on capital accumulation under political unrest.

IV. ESTIMATION RESULTS

A. Credit Constraints in MENA

We follow a two-step procedure to estimate KM's theoretical model. We first use the SFA of equation (7) to obtain estimates of *CL* and *DL*. The change in the predicted values of these variables $\widehat{\Delta CL}$ and $\widehat{\Delta DL}$, where hat denotes estimated values, are then used as inputs in equation (5) to quantify the effect on credit limits on capital accumulation.

The main estimation results of credit limits and distance from the limit following equation (7) are presented in Table 5.

Table 5. Credit constraints models

Variables	Model *CL1*	Model *CL2*	Model *CL3*	Model *CL4*
Equity Capital	1.039***	1.043***	1.051***	1.015***
	[0.0205]	[0.0208]	[0.0226]	[0.0219]
Real Interest Rate	0.0267***	0.0269***	0.0211**	0.0249**
	[0.0103]	[0.0103]	[0.0105]	[0.0103]
Political Unrest	-0.398**	-0.374**	-0.522***	-0.265
	[0.161]	[0.162]	[0.190]	[0.168]
Arab Spring	0.349***	0.354***	0.282***	0.331***
	[0.100]	[0.101]	[0.107]	[0.101]
GCC	0.298***	0.302***	0.305***	0.281***
	[0.0946]	[0.0960]	[0.0954]	[0.0947]
Manufacturing Industry	-0.696***	-0.724***	-0.254**	-0.671***
	[0.109]	[0.110]	[0.113]	[0.109]
Transportation	-0.781***	-0.796***	-0.352**	-0.752***
	[0.156]	[0.156]	[0.159]	[0.157]
Real Estate	-0.946***	-0.966***	-0.489***	-0.889***
	[0.114]	[0.115]	[0.117]	[0.116]
Food and Beverages	-0.521***	-0.532***	-0.0604	-0.516***
	[0.175]	[0.176]	[0.179]	[0.175]
Telecommunications	-0.956***	-0.982***	-0.531**	-0.924***
	[0.221]	[0.222]	[0.222]	[0.222]
Construction	-0.359	-0.382	0.00668	-0.343
	[0.317]	[0.316]	[0.316]	[0.316]
Oil and Gas	-0.526***	-0.548***	-0.131	-0.493***
	[0.187]	[0.187]	[0.186]	[0.187]
Firm Age		-0.000377		
		[0.00189]		
Employees			1.90e-05**	
			[8.46e-06]	
SME				-0.376***
				[0.124]
Pretax ROE				
Observations	1,533	1,501	1,422	1,533
Negative skewness test of residuals	-14.35	-14.36	-13.97	-14.31
Significance	0	0	0	0

The estimations follow equation (7). 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. *Political Unrest* and *Arab Spring* are dummy variables for countries in which there is political unrest and where Arab Spring took place, respectively. *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. *Firm Age* is the age of the firm since its establishment; *Employees* denote the number of employees; 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. The benchmark 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 Arab Spring countries, economies with other political unrest, GCC countries, and sector of economic activity.[14] In Model *CL2*, we add firm age as determining credit constraints. In Models *CL3* and *CL4*, we incorporate two indicators of firm size, the number of employees and a dummy variable for small and medium-sized enterprises (SMEs). All regressions include year dummies and a constant term (not reported).

Since we focus our attention on *CL* and the *DL* residual of equation (7), we estimate this equation as a series of cross sections rather than as a panel for the simple reason of fewer restrictions imposed on the evolution of residual parameters over time under cross-section analysis. In standard panel stochastic frontier models, the distribution of the inefficiency term u is either fixed over time or a mechanical adjustment is imposed to make it time-varying. Such assumptions are highly suspect in the present context of our estimation as the variable DL (which corresponds to the inefficiency term u under SFA) is likely to vary significantly over time depending on changes in credit conditions and the firm investment behavior. Since the distributional assumptions imposed on v and DL imply a negatively skewed residual, we test for the presence of a negative skew as a model validation criterion in each estimation. The last two rows in Table 5 show the tests results of skewness, pointing to the presence of a significant negative skew in loan distributions. The intuition is that, by imposing an upper bound on firm debt, credit limits generate a negative skew in the loan distribution.

The marginal effect of equity capital on credit limits is positive and highly significant in models *CL1-CL4* as predicted by theory. The coefficient is slightly above unity across all specifications, consistent with the hypothesis of positive scale economies presence in credit markets. One way to interpret the result is that MENA banks tend to discriminate against firms with a smaller equity base in extending credit.

Contrary to expectation, the effect of the real interest rate on credit limit is positive and significant. A possible explanation for this finding is that an increased rate of return on loans extended by banks may induce banks to supply more credit (granted availability of projects to finance and a demand for credit) or at least increase firms' credit limits. This result can be due to the absence of harmonized interest-rate data series for the MENA countries under study or because most economies in the region maintain a form of a peg with the U.S. dollar, thereby arguably lessening the effect of the domestic interest rate as a tool of monetary policy.

[14] We distinguish between Arab Spring countries and countries that experience political unrest for two reasons. First, Arab Spring countries did not experience political unrest during our sample period and the uprising came about in 2011. Second, political unrest in the other countries has been on-going for an extended period of time.

Further, the results in Table 5 point to lower credit limits in countries that experience severe political unrest. Interestingly, the Arab Spring dummy is positive and highly significant implying that, ceteris paribus, Arab Spring countries enjoyed on average higher credit limits than other firms in the region prior to the start of Arab Spring. The result may be surprising, but seems consistent with Acemoglu and Robinson's (2012) "virtuous circle" hypothesis of revolutions. According to the authors, the most likely candidates for revolutions are not the poorest countries. Rather, a shift from an oppressive regime towards democracy is more likely to occur following globalization and the opening up of markets (likely followed by improved overall economic conditions) as motivation by the elite to maintain a repressive regime diminishes. Our results show that countries that experienced revolutions in the Arab world may have undergone greater financial development in terms of facing easier financing conditions relative to other MENA countries, thereby moving to economic societies that are less "extractive".

The estimations also indicate that firms in the GCC region enjoy better credit conditions than companies elsewhere. 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 over the study period despite the global financial turmoil.

We also observe sectoral effects in Table 5, indicating significant differences in credit constraints across sectors. The negative sign on the coefficients of the various key industries indicate low borrowing constraints relative to the 'benchmark' category, consisting of industries for which sector dummies are not included. This benchmark category spans diverse 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. Comparing the magnitude of the estimated coefficients, we note that, among the reported sectors, credit limits are lowest for companies in telecommunication, while firms in the construction sector enjoy significantly higher credit limits relative to other sectors, corroborating the optimism and boom that the real estate sector witnessed recently, especially in Kuwait and the UAE.

Models *CL2*-*CL4* include additional firm-level controls. From Model *CL2*, age differences are insignificant across firms, probably because the latter already comprise a select group of creditworthy borrowers. Models *CL3* and *CL4* provide further evidence of scale economies in borrowing. Firms with a larger number of employees are likely to enjoy higher credit limits compared to firms which employ a smaller number. Also, in line with survey-based evidence provided by Rocha, Arvai, and Farazi (2011), SMEs in the MENA region appear to be more financially constrained compared to larger companies. We also estimated the models with current profitability, but the coefficient is insignificant and is therefore not shown; it could be that profits are already accounted for in firm equity capital as retained earnings.

Finally, we compute the credit limits estimates using the stochastic frontier *CL1* regression results of Table 5. We report descriptive statistics on the ratio of total-debt-to-credit limit estimates by country (Panel A), and by sector (Panel B) in Table 6.

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	21.8	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	69.7	17.69
Morocco	55.93	50.35	21.06	99.85	22.87
Oman	58.56	55.29	24.64	99.42	20.82
Qatar	62.12	67.29	29.38	91.54	19.17
Saudi Arabia	63.42	63.69	24.05	99.9	20.44
Syrian Arab Republic	62.76	60.69	39.65	88.74	18.34
Tunisia	59.4	52.65	25.36	99.68	21.17
United Arab Emirates	59.53	57.36	26.98	95.13	19.62
West Bank & Gaza	69.97	74.61	51.48	79.2	12.63
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	60.1	21.06	99.78	21.11
Industrial Manufacturin	61.36	59.67	21.8	99.85	20.26
Oil and Gas	61.87	62.85	26.87	99.42	21.2
Real Estate	63.39	63.38	21.77	99.8	22.81
Telecommunications	61.08	59	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*	*27.5*	*94.63*	*19.13*

Table 6 illustrates the scale and distribution of credit limits in MENA, indicating that firm debt amounts on average to about 60 percent of credit limits. This ratio varies between 55 (Lebanon) to 70 percent (West Bank and Gaza) but exhibits lower variability across industries. The same remark can be made when using median values, suggesting a limited role for possible outliers. There is, however, larger variation between the minimum and maximum debt to credit limits ratio across firms, suggesting heterogeneity in the use of financing.

B. Capital Accumulation

Using the standard method by Jondrow et al. (1982), we compute the estimates $\widehat{CL}_{i,t-1}$ and $\widehat{DL}_{i,t-1}$ for each stochastic frontier specification *CL1-CL4* from Table 5. We insert these derived values into equation (5), estimate respective models *K1-K4* by dynamic pooled OLS regression models, and present the estimation results for the capital accumulation equation (5) in Table 7.

Table 7. Capital accumulation models

Variables	Model *K1*	Model *K2*	Model *K3*	Model *K4*
Fixed Assets, Lagged	0.994***	0.995***	0.995***	0.994***
	[0.0351]	[0.0351]	[0.0356]	[0.0353]
Real Interest Rate, Change	0.00824	0.00822	0.00672	0.00806
	[0.00565]	[0.00564]	[0.00568]	[0.00564]
Credit Limit, Lagged Change	0.392**	0.400**	0.395**	0.402**
	[0.185]	[0.184]	[0.190]	[0.177]
Distance from Limit, Lagged Change	-0.0235	-0.028	-0.0225	-0.0268
	[0.0306]	[0.0305]	[0.0314]	[0.0312]
Political Unrest	0.469	0.458	0.461	0.462
	[0.366]	[0.367]	[0.366]	[0.364]
Arab Spring	0.107	0.108	0.122	0.093
	[0.0797]	[0.0799]	[0.0871]	[0.0799]
GCC	-0.312***	-0.302**	-0.315***	-0.315***
	[0.118]	[0.118]	[0.119]	[0.118]
Manufacturing Industry	0.135*	0.122	0.119	0.138*
	[0.0782]	[0.0775]	[0.0803]	[0.0784]
Transportation	0.0917	0.0789	0.0913	0.0866
	[0.0747]	[0.0737]	[0.0766]	[0.0756]
Real Estate	-0.338**	-0.351**	-0.348**	-0.334**
	[0.152]	[0.151]	[0.158]	[0.151]
Food and Beverages	-0.0395	-0.0505	-0.0554	-0.0394
	[0.0647]	[0.0640]	[0.0655]	[0.0648]
Telecommunications	0.12	0.106	0.104	0.12
	[0.133]	[0.133]	[0.132]	[0.133]
Construction	0.580**	0.563**	0.574**	0.577**
	[0.240]	[0.239]	[0.241]	[0.240]
Oil and Gas	0.228**	0.211**	0.220**	0.226**
	[0.103]	[0.103]	[0.101]	[0.103]
Observations	382	381	370	382
Adjusted R2	0.89	0.89	0.89	0.89
F-Statistic	214.98	214.88	205.8	213.51
Log Likelihood	-541.81	-540.51	-530.23	-541.5

The estimations follow equation (5). 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 *Distance from Limit* are estimated from equation (7). *Political Unrest* and *Arab Spring* are dummy variables for countries in which there

is political unrest and where Arab Spring took place, respectively. *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. A constant term is 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 Table 7, the regressed variable is the firm's fixed assets, used as proxy for capital. All four models *K1* to *K4* include as explanatory variables lagged fixed assets, the change in the real rate of interest, the lagged change in credit limits (CL) and the distance from the credit limit (DL). We also incorporate dummy variables for Arab spring countries, other countries with political unrest, the GCC region, and sector of economic activity.

In line with theoretical prediction, the marginal effect of lagged capital is very close to unity in magnitude across all models. Of main interest is the positive and highly significant marginal effect of the lagged change in credit limits—its magnitude is also economically large, ranging between 0.4 and 0.48. We interpret these coefficients in two ways: one, the results imply that between 40 to 48 percent of firms in MENA are credit constrained;[15] and two, a change in credit limits by one unit is likely to contribute between 40 and 48 percent increase in capital accumulation in the following year. The estimations therefore support the view that improvements in credit conditions may significantly contribute to firm growth and more broadly to economic development in the region.

Table 7 results also show that $\alpha_{\Delta DL}$ is insignificant across all models. In efficient and well-functioning credit markets, the interest rate charged on the debt would rise as *DL* falls (since higher leverage depicted by getting closer to the credit limit pushes firms closer to bankruptcy), thereby exerting a pressure on firms to curtail future investments (see Bernanke, Gertler, and Gilchrist, 1999). The insignificance of the $\alpha_{\Delta DL}$ parameter, however, is in line with the predictions of KM that investment conditions are not affected by credit constraints unless the latter are binding. Any unused portion of the credit limit (designated by *DL* in our model) does not represent a binding financial constraint and effectively has no effect on capital accumulation. It could be that interest rates on loans are insensitive to the bankruptcy risk of firms in the MENA region due to poor credit risk assessment mechanisms that would otherwise determine risk premiums for firms of different credit quality. In support of the above the MENA region lags behind in terms of judicial enforcement, wide coverage of credit bureaus and public registries, and availability of historical financial data on companies (Rocha, Arvai, and Farazi, 2011).

The parameter estimates for political unrest and Arab Spring countries are both insignificant in the capital accumulation models, which implies that the dynamics of capital accumulation have not been directly affected by the political situation in MENA. However, since Political

[15] This interpretation is not at variance with Table 6, since the estimates of *DL* for individual firms are expected values.

Unrest and Arab Spring are found to be significant in the credit limit regressions of Table 5, they are interpreted as having indirect effects via their influence on financial conditions.

Further, the GCC dummy in Table 7 is negative and significant across all models, indicating that the dynamics of capital accumulation differ among GCC and other regional countries. Whereas investment in the oil and gas sector requires substantial real capital, the less-diversified GCC economic base may account for the negative sign on the GCC dummy variable. We also find that investment is higher in the oil and gas and construction sectors relative to other sectors, followed by a marginally more pronounced investment in the industrial manufacturing sector. Investment in real estate is less than other sectors, probably due to the real estate bubble that some MENA countries experienced in 2008.

V. ROBUSTNESS CHECKS

We check for the sensitivity of our results to a number of alternative specifications.[16] We first investigate the robustness of the results by including additional lags in real capital, higher order terms, individual country effects, as well as additional explanatory variables such as the change in consumer prices. Our results are robust to these alternative specifications.

We also confirm the robustness of our results to alternative credit limit estimates by assuming different distributions for DL (truncated normal, exponential, or half normal), including higher-order terms for our main variables of interest, and considering 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 short-term interest rates, replace the GCC dummy with individual country dummies, and control for firm profitability.

Further, we explore the impact of estimation error in *CL* and *DL* in the second stage regression results using standard errors-in-variables techniques. The qualitative results are not affected by the change in estimation method. In errors-in-variables regressions, the quantitative impact of credit constraints on capital accumulation is even larger than in the baseline regression.

Finally, the results are robust to including countries and sectors with few firms and observations. Our main estimation findings are maintained and are robust to alternative specifications.

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

VI. CONCLUSIONS

This paper investigates the complex interactions between credit constraints, political unrest, and capital accumulation. We estimate the seminal dynamic model of capital accumulation of Kiyotaki and Moore (1997) by means of a novel two-step empirical approach and using a unique data set on firms from the MENA, a region with a number of countries experiencing political instability. We first employ the SFA methodology to estimate credit limits and then quantify the effect of these limits on capital accumulation. Three main findings stand out: First, credit conditions exhibit a significant and economically large impact on capital accumulation. Our estimate of the marginal effect of a change in credit limits on capital accumulation is about 40 percent, suggesting that improved financing conditions are likely to be key for macroeconomic development in the region. Second, political upheaval has a significant negative effect on credit constraints, but its direct effect on the dynamics of capital accumulation is subdued. Finally, the analysis of our firm-level sample that ends right before the onset of the Arab Spring suggests that political unrest may more likely to erupt after some level of financial development has been reached.

This paper contributes to existing work exploring the relationship among credit conditions, political unrest, and capital accumulation. It provides new quantitative evidence on credit constraints in a region that is witnessing major political and socio-economic changes. More importantly, it highlights the importance of targeting financial inclusion by relaxing financing constraints on firms as a means to foster private sector development and bring about inclusive growth. The novel empirical approach that quantifies KM model also paves the way for a wider research agenda for similar studies on other regions.

Appendix

Capital accumulation for credit constrained firms in Kiyotaki and Moore (1997)
This appendix derives a dynamic capital accumulation equation for credit constrained firms, using equilibrium conditions for 'farmers' as in Kiyotaki and Moore (1997). For ease of comparison, we use KM's notation and then map equations to our own notation at the end. The variables are: k=capital; q=capital price; b=borrowing; R=real interest rate; a=traded output. Equilibrium values are denoted by *.
The borrowing constraint is characterized (page 218 eq 3) by:

$$b_t < \frac{q_{t+1}}{R} k_t \qquad \text{(A1)}$$

The equilibrium is characterized (page 220, around eq 7) by:

$$\begin{aligned} b_t * &= \frac{q_{t+1} k_t}{R} \\ k_t * &= \frac{1}{q_t - \frac{1}{R} q_{t+1}} [(a + q_t) k_{t-1} - R b_{t-1}] \end{aligned} \qquad \text{(A2)}$$

where the denominator $q_t - \frac{1}{R} q_{t+1}$ is taken to be positive. Define credit limit $cl_t \equiv \frac{q_{t+1}}{R} k_t$, which is binding under (A2) as appropriate under Kiyotaki and Moore (1997). The equilibrium relationship between capital and the credit limit can be derived by manipulating the lower part of (A2). First insert b* into k* and simplify:

$$\begin{aligned} k_t * &= \frac{1}{q_t - \frac{1}{R} q_{t+1}} [(a + q_t) k_{t-1} - R b_{t-1}] \\ &= \frac{1}{q_t - \frac{1}{R} q_{t+1}} \left[(a + q_t) k_{t-1} - R \frac{q_t}{R} k_{t-1} \right] \\ &= \frac{a}{q_t - \frac{1}{R} q_{t+1}} k_{t-1} \end{aligned}$$

Then divide and multiply the rightmost expression by $\frac{R}{q_t}$, and insert cl:

$$\begin{aligned} k_t * &= \frac{a}{q_t - \frac{1}{R} q_{t+1}} \frac{R}{q_t} \frac{q_t k_{t-1}}{R} \\ &= \frac{aR}{q_t \left(q_t - \frac{1}{R} q_{t+1} \right)} cl_{t-1} \end{aligned} \qquad \text{(A3)}$$

In the body of the text, we use capital K=ln(k) and the credit limit CL=ln(cl) in logarithmic form. Equation (A3) then becomes:

$$K_t * = \varphi_t + CL_{t-1} \qquad \text{(A4)}$$

where $\varphi_t \equiv ln\left(\frac{aR}{q_t \left(q_t - \frac{1}{R} q_{t+1} \right)} \right)$. Interpreting this result, the proportionality factor φ between the capital stock and the credit limit varies in time with capital goods prices.

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