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ABSTRACT/RÉSUMÉ

Legal reform, contract enforcement and firm size in Mexico

Legal systems provide the basic institutions for firms and markets to operate. Their quality can have important consequences on the size distribution of firms, who rely on them for contract enforcement. This paper uses the variation in legal system quality across states in Mexico to examine the relationship between judicial quality and firm size. Although the country has a single legal system, its implementation and procedures vary widely, while development outcomes there are more imbalanced and unequal than in any other country of the OECD. The effect of the legal system on inter-state firm efficiency is therefore examined. Building on Laeven and Woodruff (2007), this study uses economic census microdata and contract enforcement ratings to examine the impact of state-level legal institutions on firm and industry-level outcomes. A robust effect of judicial quality is observed on the firm size distribution and efficiency, instrumenting for underlying historical determinants of institutions. Indicative evidence is found that the effect is strongest in more capital-intensive industries. Market size and distance-to-market are also found to matter for firm size outcomes, consistent with the new trade literature.

JEL classification codes: F12, K4, L11, O12.
Keywords: Legal institutions, judicial efficiency, firm scale, international trade.

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La réforme juridique, la mise en application des contrats et la taille des entreprises au Mexique

Les systèmes juridiques fournissent les institutions de base pour que les entreprises et les marchés fonctionnent. La qualité du système juridique peut avoir des conséquences importantes sur la distribution de la taille des entreprises. Ces mêmes entreprises comptent sur le système juridique pour la mise en application des contrats. Cet article utilise la variation de la qualité du système juridique dans tous les États du Mexique pour examiner la relation entre la qualité judiciaire et la taille des entreprises. Bien que le pays dispose d'un système juridique unique, sa mise en œuvre et les procédures varient considérablement, tandis que les résultats de développement y sont plus déséquilibré et inégal que dans n'importe quel autre pays de l'OCDE. L'effet du système juridique sur l'efficacité des entreprises interétatique est donc examiné. S'appuyant sur les travaux de Laeven et Woodruff (2007), cette étude utilise les microdonnées du recensement économique et les notes sur la mise en application des contrats pour examiner l'impact des institutions juridiques étatiques sur l'entreprise et les résultats au niveau de l'industrie. Un effet significatif de la qualité judiciaire est observé sur la distribution de la taille des entreprises et leur efficacité, en instrumentation pour les déterminants sous-jacents historiques des institutions. Nous trouvons également que l'effet est plus important dans les industries à forte intensité de capital. La taille du marché et la distance aux marchés sont également influents sur les résultats de la taille de l'entreprise, conforme à la nouvelle littérature sur le commerce.

Codes JEL : F1, K2, L2, L5, O1.
Mots clés : Les institutions juridiques, efficacité judiciaire, taille des entreprises, commerce international.

Legal reform, contract enforcement and firm size

Sean M. Dougherty*

1 Introduction

Contract enforcement is essential to the efficient functioning of decentralised markets that are essential for development, and legal systems provide necessary institutions to support such enforcement. The quality of the judicary is based not only on *de jure* laws and regulations, but also on their *de facto* implementation, which can often differ considerably from statutes in countries that are still developing and have relatively weak state capacity. In theory, without a high-quality judiciary, transaction costs may be prohibitive, deterring market transactions and firm entry, inhibiting competition and trade. The literature on growth and development has long argued for a fundamental role of "deep" institutions such as the judiciary in determining long-run economic convergence outcomes (Acemoglu et al., 2005), yet identification of the mechanisms at play is often difficult (see OECD, 2012).

Increasing firm scale or size is the main channel through which the most efficient firms can expand their production, by taking on capital and labour as they grow. This up-scaling may be motivated by competition with less efficient firms, who give up market share, particularly when they exit the market. Such dynamics are thought to be a main driver of aggregate productivity growth in open economies (Melitz, 2003; Melitz and Ottaviano, 2008), though there is also evidence of substantial within-firm productivity gains induced by foreign and domestic competition (Harrison et al., 2011; Ben Yahmed and Dougherty, 2012).

This paper examines the link between legal systems and firm size in a developing economy – Mexico – where legal system quality and enforcement varies across states and is also in the

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process of being substantially reformed. We proceed by extending the study of Laeven and Woodruff (2007), that focused on Mexico in the year 1998, to look at a more recent time period – the five years to 2009 – using new insights from the trade literature to interpret the mechanisms at work. Our study also relates to Kumar et al. (2002), who carried out an analysis of the effect of court efficiency on average firm size across 15 European jurisdictions, as well as studies of Italy and Spain, where firms in provinces with more efficient courts are found to be larger (Fabbri, 2010; Bürker and Minerva, 2012; García-Posada and Mora-Sanguinetti, 2012; Giacomelli and Menon, 2012).

We find that firms in states with higher judicial quality tend to be substantially larger than those in remaining states, and this result is robust to a variety of alternative measures of firm size, as well as to instrumentation for the potential endogeneity of judicial quality. Additionally, we find that firms in more capital intensive industries are more likely to benefit from higher quality judicial systems, consistent with insights from the incomplete contracting literature, suggesting that hold-up problems may be limiting the scaling up of firms, and helping to explain the concentration of capital beyond geography.

The paper proceeds by considering the theoretical linkage between firm size and judicial quality in the next section. In the third section, we discuss the data used in the analysis. In the fourth section, the estimation strategy and results are discussed. The fifth section concludes.

2 Firm size and legal systems

The industrial organisation and new institutional economics literatures both give support for the idea that average firm size should be positively related to legal system characteritics (see Kumar et al., 2002). We focus on a model that takes inspiration from both of these literatures, based on Laeven and Woodruff's (2007) adaptation of Lucas's (1978) model of firm size, which views the legal system as reducing the investment risk faced by entrepreneurs who invest an increasing share of their wealth in an enterprise. The model predicts that improvements in the legal system will cause an increase in the demand for capital and labour from all entrepreneurs. This in turn puts upward pressure on wage and rental rates, inducing entrepreneurs with low ability to leave self-employment for wage work in incorporated firms. As a result, average firm size increases.

A related adaptation of the Lucas (1978) model by Quintin (2008) sees the contractual framework as imperfect, with a variable degree of enforcement across jurisdictions, and describes the quality of the legal system as an exogenous probability that agents will default. They calibrate their model to the firm size distribution in the United States, Mexico and Argentina, and show that differences in enforcement in the model explain a key moments of the observed differences in economy-wide firm size distributions.

Delving more into the mechanisms that determine the link between the legal system and firm size, the role of capital intensity is central. The Grossman-Hart-Moore property rights theory of the firm emphasizes the importance of hold-up costs in contracting, which can make capital-intensive and input-dependent investments especially risky. However, the evidence for this idea in the context of legal systems is mixed.[1] Laeven and Woodruff (2007) find no significant effect of increasing capital intensity or decreasing vertical integration, but do find a role for risk diversification through incorporation in affecting the incentives of entrepreneurs, increasing average firm size. Kumar et al. (2002) even find some evidence in the opposite direction: that firms in more capital intensive industries are less affected by judicial quality, which they speculate to be attributable to physical capital needing less protection than do intangible assets. In contrast, our study re-examines these questions, finding new evidence supporting the idea that hold-up costs may be more substantial in capital intensive manufacturing industries, making the quality of the legal system even more important for these sectors to support higher average firm size.

Limited guidance is available on the shape of the firm size distribution. The model of Guner et al. (2008) suggests that the firm size distribution should be more dispersed when there are fewer restrictions on capital use. However, Bürker and Minerva (2012) find that in Italian provinces with shorter civil trials – one narrow measure of judicial quality – the firm size distribution is more compact. We, however, find evidence that the shape of the distribution tends to be more dispersed when firms are located in Mexican states with better judicial quality, using our fairly broad measure. Next we turn to the data at hand.

3 Data

The key data used in this study are economic census microdata for measuring firm size and characteristics, and survey-based data, that measure judicial quality for contract enforcement,

[1]Evidence from Nunn (2007) and Ma et al. (2010) also supports the idea that hold-up costs from a weak judiciary may distort the comparative advantage of some industries through an influence on their input structure, though outcomes are measured in terms of exporting rather than increasing firm size. Such findings suggest that improving legal instititions allows firms to better specialize, by reducing transactions costs (Williamson, 2005).

along with state-level demographic, distance and gravity-type data that are included as control variables.

3.1 Bin-level economic census data

Disaggregated data from the Mexican economic census were sourced from the *Instituto Nacional de Estadística y Geografía* (INEGI) in Aguacalientes, for the census years 2003 and 2008. The economic census enumerates all fixed establishments in Mexico every five years, and we sourced the information it collects from firms on output, employment, fixed assets, and intermediate inputs. While we gained access to the unit-level microdata, due to the complexity of confidentiality proceedures, we chose to use the data at the firm-size bin level. This data is available for all 31 Mexican states and the *Distrito Federal* (Mexico City) from the level of "sub-sector", or three-digit industry. Within manufacturing, where we focus most of our analysis, there are up to 21 such industries in each state. These industries are then stratified by firm size, in the following size "bins": 0 to 2; 3 to 5; 6 to 10; 11 to 15; 16 to 20; 21 to 30; 31 to 50; 51 to 100; 101 to 250; 251 to 500; 501 to 1000; and over 1000. The bin-level data allow for computation of a weighted-average firm size at the industry level by state.

An employee-weighted firm size, following the approach of Kumar et al. (2002) and Laeven and Woodruff (2007), is specified as follows, for state s, industry i and time t:

$$EWFS_{s,i,t} = \sum_{b=1}^{n} \left(\frac{N_{b,s,i,t}^{emp}}{N_{s,i,t}^{emp}} \right) \left(\frac{N_{b,s,i,t}^{emp}}{N_{b,s,i,t}^{firm}} \right) \tag{1}$$

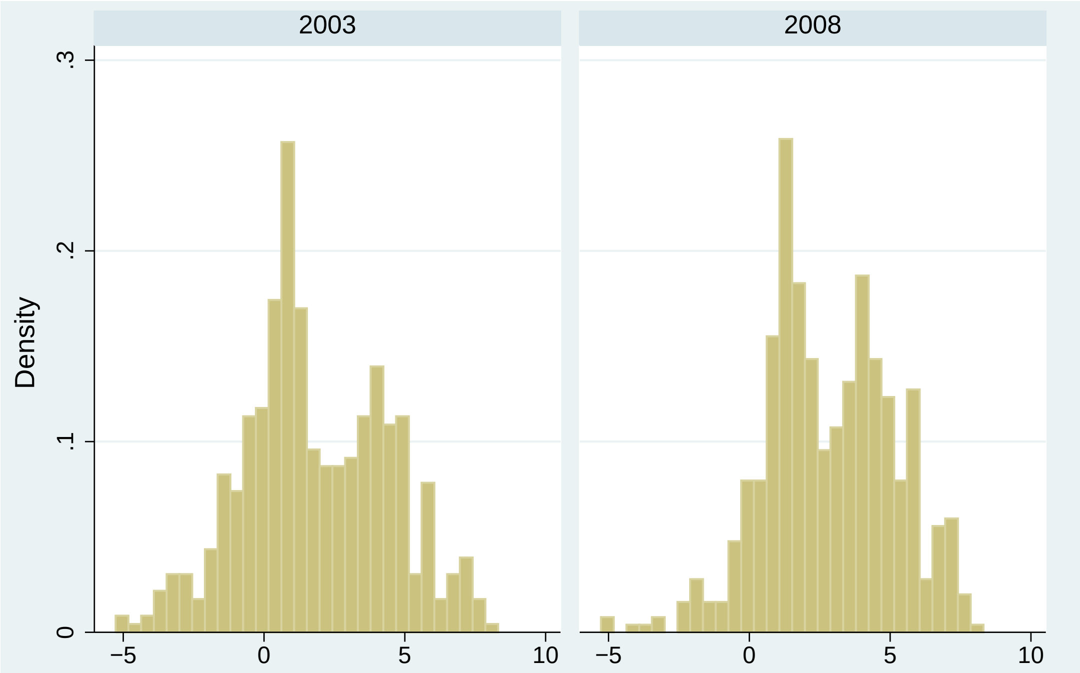
where b is a firm-size bin, and $N_{b,s,i,t}^{emp}$ captures the employment in a single bin, for all bins with more than 3 firms,[2] and up to 12 bins. The formula weights average firm size by the share of employment in each firm size bin. We use the natural log of EWFS, and the distribution of this variable in manufacturing is shown for 2003 and 2008 in Figure 1. The distribution is normal according to standard tests, although qualitatively there appears to be some indication that it could be bi-modal.[3]

Equation 1 gives greater weight than a simple average to those bins that contain larger firms. Alternative measures, including a simple average of firm size across bins and the average size of firms in the bin with the median worker, are also computed.

[2]When three or fewer units are available in a firm bin (true for 15% of establishments), the firm count data are suppressed, which we exclude these bins from our firm size analysis.

[3]As a result, when we use $\log(EWFS)$ as a dependent variable below, we also carry out quantile regressions, though there does not appear to be any significant difference across quartiles in the main coefficients of interest.

Figure 1: Distribution of log employee-weighted firm size



Source: Calculations from INEGI bin-level economic census data.

3.2 Measures of judicial quality

The Intituto Technológico Autónomo de México (ITAM) and the law firm Gaxiola, Moraila and Associates (GMA) have cooperated since 2001 with Moody's Investors Service to measure the efficiency of state institutions involved in the administration of justice every 2-3 years, for 2001, 2003, 2006, 2008 and 2011 (see Appendix). These studies focus on the adequacy of legal administration, as it relates to the enforceability of commercial contracts and mortgages disputed in state courts in Mexico. The sources of information for the measures comprise expert opinion surveys completed by litigation attorneys in each of the federal entities, information supplied by each state tribunal, data collected by the researchers and on-site visits by ITAM in each state.

The four key factors considered in the measures are:

1. *Institutional quality – 50%*: factors within and outside the control of the judicial branch in a state that affect its ability to carry out its functions. These include the perceived quality of tribunals' judges and magistrates, their expertise in commercial cases, the criteria required for the promotion of judges and the nomination of magistrates and the impartiality of persons in both of these positions.

2. *Duration of cases – 40%*: the average time and backlog involved in processing a typical

case related to contract enforcement.

3. *Quantity and efficiency in the use of resources – 10%*: human and physical resources devoted to the judicial branch, including an assessment of their qualilty by legal practitioners.

4. *Enforcement of resolutions – adjustment to the criteria*: an evaluation of the support provided by the executive branch in obtaining final enforcement of verdicts.

These factors are combined into a five-level score by Moody's (2011), from which we code judicial quality from worst to best as follows:

- *Lowest quality (EC5)*: scored 1
- *Below-average quality (EC4)*: scored 2
- *Average quality (EC3)*: scored 3
- *Above-average quality (EC2)*: scored 4
- *Highest quality (EC1)*: scored 5

The scores we use are based on an inversion of the digit associated with the Moody's *EC* rating, and we disregard the "+" that some states receive for being at the top end of a given rating category. Using our scoring of the Moody's measure of contract enforcement, a higher score for judicial quality JQ represents "better" state-level institutions.

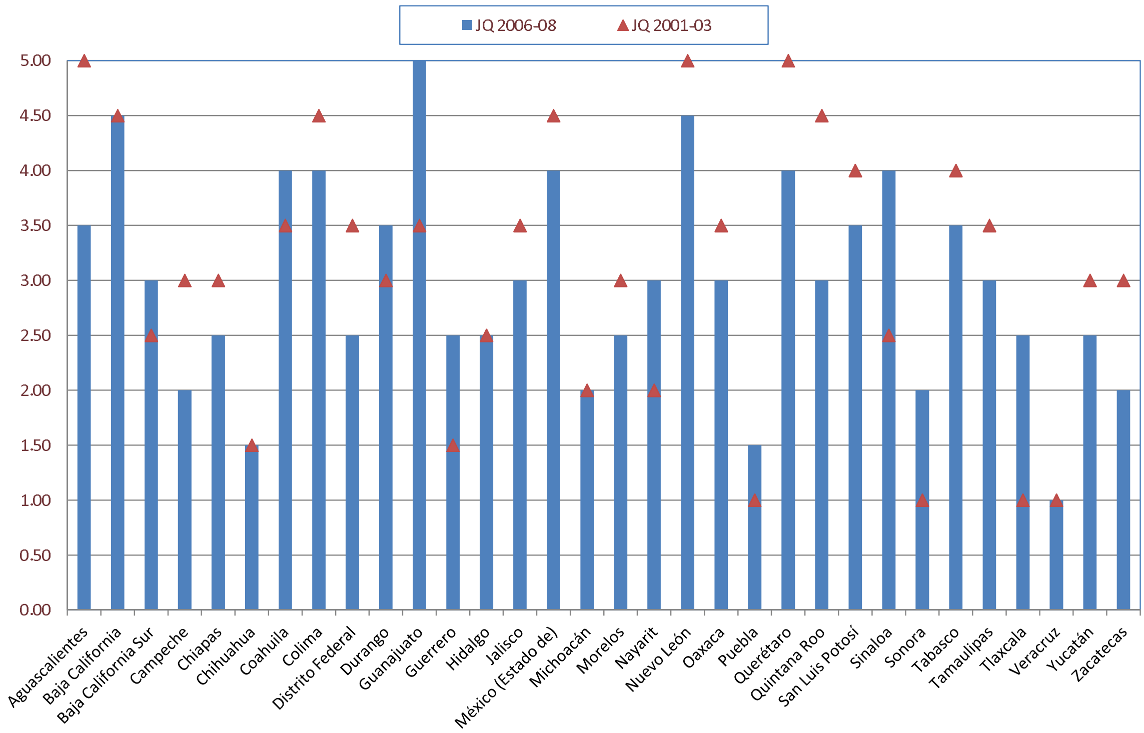
Comparison across states of the scores for judicial quality in each of the state-level entities, in Figure 2, shows considerable heterogeneity for the period immediately preceding 2003 and 2008. The measures for 2006 and 2008 are averaged by state and shown in the columns, and the measures for 2001 and 2003 are averaged and shown with diamonds. There is some evidence of a deterioration in the state-level scores, with two-thirds of states having a worse score in the period preceding 2008 than in 2003. The reasons for this evolution varies, and may also partly reflect slight differences in the survey instruments and potential measurement errors.

A map of the most recent vintage of the judicial quality scores for 2011, shown in Figure 3, reveals few obvious patterns in the spatial distribution of judicial quality, although there is some indication that states closer to the border with the United States tend to score more highly.

As an alternative measure of legal system quality, we use a standard measure of financial market development – the ratio of private credit to GDP, from the Banco de México. This measure is based on more concrete data than our survey-based measure of judicial quality, and gives a useful additional robustness check to our estimates.

Figure 2: Evolution of judicial quality measure by state

Rated on a scale of lowest (1) to highest (5) quality



Source: Moody's based on ITAM and Gaxiola, Moraila and Associates survey.

3.3 Instruments

Judicial quality cannot be considered to be exogenous to economic outcomes such as investment and firm size, so we employ an instrumentation strategy taking inspiration from Acemoglu et al. (2005), and also used by Laeven and Woodruff (2007) in their earlier study. The key instruments are indigenous state-level population in 1900, and the number of crops with large economies of scale in 1939. The justification for their use is based, first, on the use of *encomienda* system imported from Europe, that treated indigenous labour as a resource to be used by the ruling elite. Hence, the presence of a larger share of indigenous people could be expected to be associated with a worse institutional environment. The second instrument is based on the presence of substantial production of crops that had sufficiently large economies of scale that they led to substantial distortions in the distribution of land and income. Thus, where there was more cultivation of sugar, coffee, rice and cotton as revealed in the 1940 census, we expect that political institutions and thus legal system should be worse. The correlation between both instruments is low, and together they explain a appreciable share of the state-level variation in judicial quality.

Figure 3: Map of judicial quality measure by state, 2011

Rated on a scale of lowest (1) to highest (5) quality

Source: OECD based on Moody's (2011).

3.4 Geographic controls

Mexico's firm size distribution can be viewed as distorted, and skewed towards small firms, especially when compared with the United States (see Hsieh and Klenow, 2012). However, this is in part due to its considerably smaller market size, as measured by either GDP or population. Theoretical work in the trade literature has demonstrated that in a monopolistically competitive model with firm heterogeneity, average firm size is larger and dispersion is higher in larger markets (Melitz and Ottaviano, 2008). Thus, we control for market size using the log of state population, or alternatively the log of total state GDP, though the later is more likely to be endogenous.

The firm geography literature also makes predictions about export market success and consequently firm size (see Redding and Venables, 2004), and we thus use several different variables to proxy distance to market and foreign market potential. These controls include the following: (*i*) distance to the nearest major point of entry into the United States, from Rios and Romo (2008); (*ii*) the average distance to the closest of one of the 10 largest cities in Mexico, weighted by the inverse of the distance, from the same source; and (*iii*) foreign market potential, as estimated by Escobar (2010) using the Head and Mayer (2004) method. We also use GDP per capita and murders per capita to proxy level of development and the crime rate, from the INEGI and OECD Regional Database, respectively. Next we turn to the estimations.

4 Estimation strategy and results

The empirical analysis starts with a basic estimation of the firm size equation and its distribution, then a series of additional variables are introduced to examine the robustness of the relationship, and alternative measures are explored, as well as interactions. Finally, a production function is estimated that looks at the efficiency implications.

Table 1: Summary statistics for pooled 2003 and 2008 data

VARIABLE	Obs.	Mean	Std. Dev.	Min.	Max.
Industry/state-level /a					
Employment-weighted firm size	1,062	119.0	328.1	0.005	4,076
Log employment-weighted firm size	1,062	2.4	2.49	-5.27	8.31
Simple average firm size	1,062	56.3	115.4	1.1	1,952
Typical firm size (median bin)	1,062	19.6	72.5	1.1	1,952
Number of employees	1,062	8,172	13,833	14.0	161,347
Number of firms (establishments)	1,062	108.6	1,517	3.0	19,451
Log capital intensity (K/L) /b	538	1.72	1.65	-4.81	5.39
Log vertical integration (GO/VA) /b	550	1.03	.369	.156	3.79
Log value added /b	550	12.9	2.31	4.76	18.0
Log gross output /b	555	13.9	2.36	5.77	18.9
State-level					
Judicial quality (JQ)	64	3.1	1.11	1	5
Log JQ score	64	1.0	0.44	0	1.61
Market size (log population)	64	14.8	0.76	13.1	16.5
Foreign market potential	32	.097	.246	.014	1.35
Log international distance to market	32	6.2	1.90	0	7.74
Log domestic distance to market	32	7.1	1.4	4.1	9.6
Log private credit as a share of GDP	64	-1.9	0.9	-4.6	0.10
Log real GDP in millions of pesos	64	19.0	0.84	17.5	21.1
Log GDP per capita	64	8.8	0.48	8.1	10.8
Log indigenous share in 1900	32	0.1	0.19	0	0.69
Number of large-scale crops in 1939	32	1.7	1.2	0	4

/a For industry and state pairs where firm size data is available. **/b** 2008 only.

Summary statistics for the variables used in the main analysis are shown in Table 1. They show that across industries, the average employment-weighted firm size is 119, while the simple average is 56. Yet the typical size of a firm (in the median size bin) is only 20. The average industry has slightly over 100 firms in total.

4.1 Basic estimates

Following Laeven and Woodruff (2007), the default estimation equation is:

$$firm\_size_{s,i,t} = \alpha_i + \beta B_{s,t} + \gamma \Gamma_{s,i,t} + \epsilon_{s,i,t} \tag{2}$$

where α_i is an industry fixed effect, $B_{s,t}$ is a vector of state-level variables, $\Gamma_{s,i,t}$ is a vector of variables that vary by state and industry, when applicable; $\epsilon_{s,i,t}$ is the error term.

In the first set of regressions, shown in Table 2 (columns 1 to 3), we set $firm\_size$ as $\log(EWFS)$, and regress it on judicial quality and market size, using the pooled 2003 and 2008 data, with industry fixed effects. Estimates of the equation are shown using both ordinary least squares (OLS) and instrumental variables (IV) methods. All estimates show a significant positive coefficient on judicial quality (JQ), supporting our hypothesis that states with better legal institutions should have larger firms on average. Market size using state population is also found to be significant, with systematically high t-statistics.

The OLS estimates of JQ appear to be highly biased downwards, as the IV estimates show much higher coefficients on JQ, which is well-identified using the standard Hansen overidentification test once both instruments are included. The first stage equation shows the expected signs on both instruments, though the indigenous population share is only significant when the number of large-scale crops is also included.

The second set of regressions in Table 2 (columns 4 and 5) include our preferred gravity variable, the log of the distance to the nearest point of entry to the United States, which we call distance to international markets, since the US border is the departure point for most of Mexico's exports. This variable is also highly significant (and negative), along with state market size (positive).

Our preferred specification is the final IV estimate (column 5), which shows a coefficient of 2.9 on judicial quality, which represents a median increase of 24% in terms of weighted average firm size for each one-step increase in judicial quality, or a near-doubling of average firm size if the legal system in the typical state were to improve from the worst to best practice in judicial quality. An illustration of the impact of such a dramatic reform on the predicted firm size distribution is shown in Figure 4, plotted on a log scale. This plot shows that the shape of the distribution also shifts with the increase in judicial quality, becoming more dispersed, as

Table 2: Baseline estimates of the effect of judicial quality

	Dependent variable: weighted average firm size				
	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS-1	IV-1a	IV-1b	OLS-2	IV-2
Judicial quality (JQ)	0.698**	4.223*	3.641***	0.740***	2.907***
	(0.306)	(2.098)	(0.623)	(0.227)	(0.507)
Market size	1.321***	1.533***	1.496***	1.273***	1.378***
	(0.124)	(0.185)	(0.080)	(0.144)	(0.107)
Distance to int'l markets				-0.209***	-0.244***
				(0.074)	(0.045)
Constant	-16.651***	-23.402***	-22.257***	-14.658***	-18.220***
	(1.771)	(4.471)	(1.788)	(2.246)	(1.628)
Observations	1,062	1,062	1,062	1,062	1,062
R-squared	0.315	0.320	0.359	0.340	0.367
First Stage: JQ (2008 estimates shown)					
Indigenous		-0.445	-0.509*		-0.637**
		(0.307)	(0.285)		(0.305)
Crops			-0.121**		-0.129**
			(0.054)		(0.054)
Market size		-0.067	-0.011		0.006
		(0.100)	(0.080)		(0.077)
Distance to int'l markets					0.041
					(0.044)
Constant		2.077	1.473		0.999
		(1.458)	(1.187)		(1.223)
Observations (States)		32	32		32
Hansen overidentification test (p-value)			0.711		0.188
Partial R-squared		0.050	0.159		0.185
Instrumented	No	Yes	Yes	No	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1

hypothesized.[4]

4.2 Robustness tests

Several sets of robustness checks are carried out: (*i*) to account for the possiblity of additional geographic and gravity-type effects; (*ii*) with alternative measures of firm size and institutions; (*iii*) using various specification with respect to time.

The first set of these regressions are shown in Table 3, Panel A, compared with the preferred IV specification above. Using an additional distance variable, for distance to domestic markets (column 2), does reduce the size of the estimated (IV) coefficient, and strangely judicial quality

[4] A quantile regression was also run using the preferred equation specification, and no significant difference was found in the estimated JQ coefficient for firms at the first and third quartiles, as compared with the median firm. However, the estimated coefficients were slightly larger for firms in the lower half of the distribution, which is consistent the the idea that they face greater effective barriers to up-scaling.

Table 3: Robustness checks of preferred specification

Panel A

VARIABLES	(1) Preferred specif- ication	(2) with domestic distance	(3) without market size	(4) with market potential	(5) using GDP for market size
Judicial quality	2.907***	1.729***	-0.131	3.563***	1.386**
	(0.507)	(0.629)	(0.518)	(0.626)	(0.539)
Market size	1.378***	0.897***		1.495***	
	(0.107)	(0.229)		(0.105)	
Distance to int'l markets	-0.244***	-0.210***	-0.168***		-0.178***
	(0.045)	(0.032)	(0.039)		(0.058)
Distance to domestic markets		-0.349**	-0.797***		
		(0.149)	(0.085)		
Foreign market potential				0.259	
				(0.293)	
GDP size					1.218***
					(0.152)
Constant	-18.220***	-7.612	10.492***	-22.184***	-19.864***
	(1.628)	(4.834)	(0.914)	(1.666)	(3.095)
Observations	1,062	1,062	1,062	1,062	1,062
R-squared	0.367	0.383	0.363	0.365	0.369
Instrumented	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes

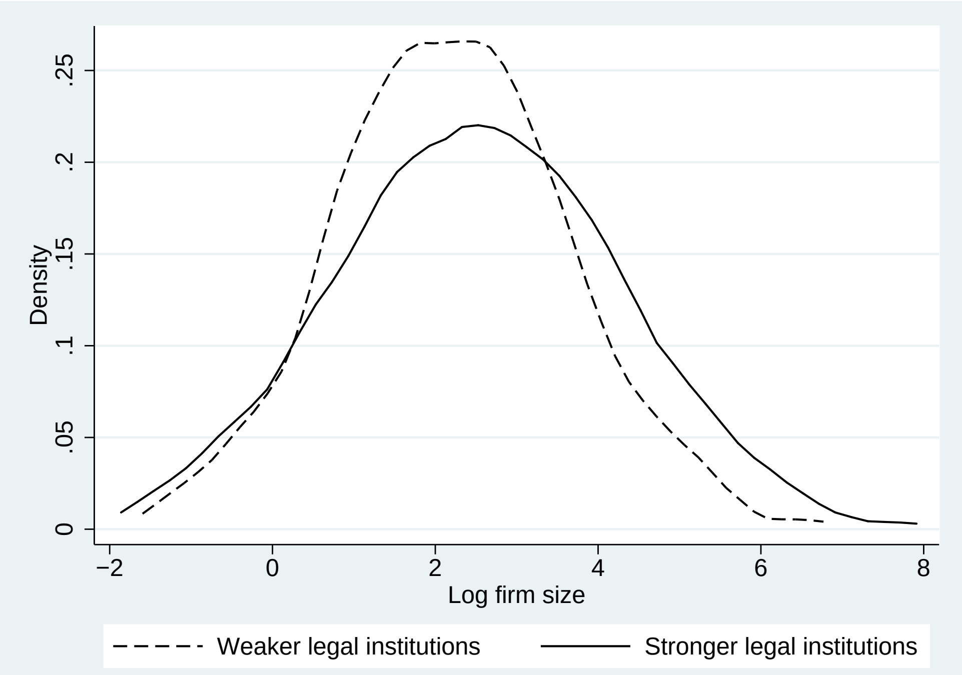
Panel B

VARIABLES	(6) Average firm size	(7) Typical firm size	(8) Private credit	(9) with GDP per capita	(10) with crime rate
Judicial quality	2.021***	1.222***		2.152***	2.658***
	(0.372)	(0.235)		(0.600)	(0.457)
Private credit			0.694***		
			(0.190)		
Market size	0.918***	0.557***	0.973***	1.421***	1.287***
	(0.074)	(0.052)	(0.189)	(0.135)	(0.116)
Distance to int'l markets	-0.202***	-0.142***	-0.188***	-0.202***	-0.257***
	(0.029)	(0.020)	(0.053)	(0.052)	(0.051)
GDP per capita				0.706**	
				(0.309)	
Murders per capita					-0.638***
					(0.224)
Constant	-10.485***	-5.772***	-8.249***	-24.584***	-15.200***
	(1.162)	(0.792)	(2.965)	(3.426)	(1.928)
Observations	1,062	1,062	1,062	1,062	1,062
R-squared	0.498	0.490	0.373	0.381	0.370
Instrumented	Yes	Yes	No	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1

Figure 4: Predicted employee-weighted firm size distribution

Density function of firm size conditional on presence in best or worst-performing state



Source: Calculations using the "preferred" estimated equation from Table 2, column 5.

is no longer significant once market size is removed from the equation (column 3). This would appear to be a result of multicolinearity, as these two variables are highly correlated (Rios and Romo, 2008), and partly for this reason, foreign market potential is often preferred (Bénassy-Quéré et al., 2005). Thus, we also estimate the equation using Escobar's (2010) estimate of foreign market potential (FMP) in 2002 for each Mexican state (column 4), and while FMP is not significant, judicial quality remains strongly significant. The effect of JQ remains significant, though the size of the coefficient is diminished, when total GDP (in the year of observation) is used in place of total population (column 5).

Estimates using alternative measures of firm size and institutional quality are shown in Table 3, Panel B. The estimates using a simple average firm size (column 6) and typical firm size (column 7) still support significantly positive effects of judicial quality, and the R-squared for these regressions is even higher than for our preferred employment-weighted firm size.

Alternative estimates of the quality of judicial-related institutions show that the effects we are observing are unlikely to be spurious. Private credit as a share of GDP can also be thought of as a proxy measure of the effectiveness of contract enforcement (see Laeven and Woodruff, 2007). When we replace JQ with this variable (column 8), its effect is significant and positive on weighted firm size.

Controlling for the overall level of development using GDP per capita (column 9) only reduces the size of the estimated coefficient on JQ, but it remains large and significant. Similarly, adding the crime rate (column 10) – measured as the annual number of murders per capita – does not substantially diminish the impact of JQ on firm size.

So far the estimates have been based on pooled estimates over 2003 and 2008; while this is an improvement over the earlier results by Laeven and Woodruff (2007) who examined only a single year (1998), in order to more fully take advantage of the time dimension of the data, state-year dummies are introduced, and panel data models are estimated. The results, in Table 4 (columns 1–3), show that using either random (column 1) or fixed effects (column 2), there is a strong positive relationship between judicial quality and firm size, though the size of the effect is lower when using fixed effects, or when the relationship is estimated in differences (column 3).

Table 4: Specifications taking into account time and sample selection

VARIABLES	(1) Levels using random effects	(2) Levels using fixed effects	(3) estimated using first differences	(4) Levels, with all industries /b	(5) Domestic single-plant firms /b
Judicial quality	1.623***	0.667**		1.761*	1.523*
	(0.265)	(0.283)		(0.899)	(0.788)
Change in judicial quality			0.256*		
			(0.141)		
Market size	1.363***	15.447***	-0.449***	0.783***	0.671***
	(0.105)	(1.329)	(0.127)	(0.189)	(0.180)
Distance to int'l markets	-0.223***			-0.114*	-0.039
	(0.042)			(0.068)	(0.068)
Constant	-18.084***		6.051***	-10.744***	0.000
	(1.683)		(2.014)	(3.392)	(0.000)
Observations	1,062	1,062	407	1,822	1,771
Number of groups	563	499			
R-squared (overall)	0.322	0.216	0.135	0.431	0.369
Instrumented	Yes	Yes /c	No	Yes	No
State-year dummies	Yes	No	No	No	No
Industry controls	Yes	Yes	Yes	Yes	Yes

/a Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1
/b 2008 only **/c** Sargan overidentification statistic: 97.4 (p<0.001)

In all of the estimates so far, only manufacturing industries have been included. This has been to ensure that the firms included were roughly comparable, since they are primarily goods-producing sectors. If we include all services, the sample size is about four time larger; however, these firms are not as comparable given the extreme heterogeneity of their activities with respect to "optimal" firm size (since this includes many sole-proprietorship dominated service sectors).

Nevertheless, if we carry out an estimate using all industries (Table 4, column 4), the coefficient on JQ remains significant and positive. However, distance to international markets is no longer significant, presumably indicating the fact some of these sectors do not engage extensively in international trade.

A final robustness check examines whether there may be selection biases through the channel of multi-plant and foreign-invested firms, who could potentially select the states with better-quality judicial systems as the home of their investments. Moreover, foreign companies may not necessarily be subject to weaknesses of state courts, since some of them rely on arbitration to handle certain types of contractual disputes. At the same time, we also limit the sample to single-plant firms, since there is then less possibility for a firm with plants in multiple states to arbitrage across different state courts. Reassuringly, the results of these estimates (Table 4, column 5) re-confirm the findings we found using the full sample.[5]

4.3 Interactions

Next we explore the mechanisms that may explain the effects that we have been observing, using the ratio of fixed assets to employment to measure capital intensity, and the ratio of gross output to value added to measure the degree of intermediate input use, or decreasing vertical integration. Extending the estimation equation to include interactions terms with judicial quality gives us:

$$firm\_size_{s,i} = \alpha_i + \beta B_s + \gamma \Gamma_{s,i} + \xi X_{s,i} \Omega_s + \epsilon_{s,i} \tag{3}$$

where the variables are as in equation (2), except an extra term $X_{s,i}\Omega_s$ is included, where $X_{s,i}$ is the log of the ratio of fixed assets to employment for each state s and industry i, or alternatively, the ratio of gross output to value added, and Ω_s is judicial quality in state s, that may also be included in the vector B_s. We estimate this equation using only 2008 data, due to data availability.

The estimates including capital intensity imply that the capital intensity of a firms' activities may be a dominant mechanism determining the effect of judicial quality on firm size. For comparisons in Table 5, the preferred OLS equation is estimated using only 2008 data (col-

[5]Estimates of all the key equations presented in the paper were made using this more limited dataset, and with it, all coefficients on JQ still remained significant, and of comparable magnitudes. Nevertheless, we choose to present the results with the broader dataset since while only 5% of firms are lost from the sample, these firms cover (just) over 50% of employment.

Table 5: Interactions with capital intensity and vertical integration

2008 data only

VARIABLES	(1) Preferred 2008 eqn.	(2) Capital intensity	(3) only interaction	(4) interaction (IV)	(5) Vertical integration
Judicial quality (JQ)	0.951***	0.282			0.853**
	(0.287)	(0.290)			(0.380)
JQ X Capital intensity		0.285***	0.317***	0.725***	
		(0.049)	(0.051)	(0.159)	
JQ X Vertical integration					0.085
					(0.271)
Market size	1.118***	1.039***	1.017***	0.859***	1.089***
	(0.146)	(0.136)	(0.140)	(0.146)	(0.146)
Distance to int'l markets	-0.249***	-0.253***	-0.250***	-0.245***	-0.276***
	(0.084)	(0.078)	(0.073)	(0.053)	(0.074)
Constant	-10.219***	-14.155***	-13.614***	-6.930***	-13.935***
	(2.591)	(2.392)	(2.456)	(2.116)	(2.567)
Observations	555	538	538	555	550
R-squared	0.390	0.426	0.424	0.417	0.394
Instrumented	No	No	No	Yes	No
Industry controls	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by state. *** p<0.01, ** p<0.05, * p<0.1

umn 1). It is probably a lower-bound estimate, due to OLS bias. In the estimate when JQ and its interaction with capital intensity are both included (column 2), only the interaction term is significant. Moreover, dropping JQ from the equation only increases the estimated effect of the interaction (column 3), that is considerably larger when using IV estimates (column 4).

Effects of decreasing vertical integration (or heightened input use) in affecting firm size thorugh judicial quality are not observed in our estimates (column 5), when the direct effect of JQ is included. However, there is some weak indication that vertical integration may have an indirect effect on firm size through judical quality.[6] We plan to examine the integration channel further in future work.

4.4 Efficiency effects

At the outset, we argued that removing barriers to firm growth was a "good" in that it facilitates the expansion of more efficient firms, promoting entrepreneurship and productivity. While this link is well-known, we have adequate data in 2008 to perform a straightforward test, using production function estimates at the industry level. Thus, a translog gross output (Y)

[6] The coefficient on the interaction is only significant when included without JQ. We are not able to identify this channel in the current dataset due to high co-linearity of vertical integration with judicial quality. If decreasing vertical integration (or heightened input use) was indeed an important mechanism for explaining the effect of judicial quality on firm size, this would be consistent with both the hold-up explanation highlighted above, as well as the transaction cost theory of the firm.

production function of the following form is estimated on manufacturing firms only:

$$\begin{aligned}\log(Y) &= (\alpha + \gamma\Omega) + \beta_K \log(K) + \beta_L \log(L) + \beta_M \log(M) + \\ &\quad \beta_{KL} \log(K)\log(L) + \beta_{KM} \log(K)\log(M) + \beta_{LM} \log(L)\log(M) + \\ &\quad \beta_{KK} \log(K)^2 + \beta_{LL} \log(L)^2 + \beta_{MM} \log(M)^2 + \epsilon \end{aligned} \tag{4}$$

where the β coefficients are the elasticities on the production factors: capital K, measured as fixed assets; [7] labour L, measured as employment; and intermediate materials M, approximated by the difference between gross output and value added. The constant α is the average level of TFP and γ is the effect of state-level judicial quality Ω on TFP, which we instrument with indigenous population in 1900 and large scale crops in 1939, as above. The error term ϵ captures the residual TFP. We similarly estimate a translog value added production function, replacing Y with value added, with intermediate materials M in the equation set to unity, so that only capital and labour inputs remain.

The results, shown in Table 6, reveal a strongly positive effect on TFP of differences in state-level judicial quality. The estimated size of the effects of judicial quality in value added (column 1) and gross output (column 2) specifications – of about 2% of GDP per step of the judicial quality score – are roughly equivalent since the ratio between the coefficients is similar to the average ratio (in the dataset) of gross output to value added of three (3.12). The gross output specification is usually preferred in industry-level data, and it seems to be more robust here (column 2), both in terms of its R-squared as well as its significant capital coefficients, that are of a similar magnitude to what is commonly found in emerging country microdata.

5 Conclusion

This paper has found a robust relationship between the increasing quality of the legal system and higher average firm size in Mexico, strongly supporting variations of the Lucas (1978) model of firm size that incorporate contractual uncertainty in investment decisions. These effects are estimated using bin-level census data and state-level measures of judicial quality observed over a period of five years. The findings are strengthened with the inclusion of geographic controls, historical instruments and the use of alternative measures of firm size and judicial quality.

[7] Gross fixed capital formation is presently being used to proxy fixed assets.

Table 6: Production function estimates with judicial quality

2008 data only

VARIABLES	(1) Value added production function	(2) Gross output production function
Judicial quality	0.727***	0.226**
	(0.200)	(0.107)
log(K)	0.062	0.218***
	(0.078)	(0.083)
log(L)	1.383***	0.415***
	(0.118)	(0.094)
log(K)×log(L)	-0.019	0.004
	(0.020)	(0.013)
log(M)		0.523***
		(0.113)
log(K)×log(M)		-0.045***
		(0.014)
log(L)×log(M)		-0.027
		(0.020)
log$(K)^2$	0.030***	0.021***
	(0.007)	(0.006)
log$(L)^2$	-0.039**	0.006
	(0.017)	(0.013)
log$(M)^2$		0.035***
		(0.010)
Constant	1.633***	0.941**
	(0.421)	(0.385)
Observations	594	605
R-squared	0.896	0.975

/a Instrumental variable estimates.
/b Robust standard errors shown in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Moreover, evidence is found that firms in capital-intensive industries are affected the most by lower judicial quality. This is consistent with hold-up problems in contract enforcement limiting investment in states and regions that lack an adequate quality legal system.

The size of the estimated effects on firm size and efficiency are substantial. Moving from worst to best-practice judicial quality is estimated to be able to nearly double average weighted firm size, widen the dispersion of its distribution, and increase GDP by as much as 8% through higher TFP, substantially reducing imbalances in development levels. A more feasible improvment in the weakest states' performance to the average is estimated to still increase aggregate GDP by a few percentage points of GDP.

In future work, we would also like to be able to decompose judicial quality further, and identify in more detail the effects of specific channels and ongoing reforms. In particular, it would be useful to understand how recent constitutional amendments that have promted some of the changes in state judicial quality measured in our indicators, even if there are long lags.

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A Appendix

Table A.1: Indicators of judicial quality for contract enforcement

	Ejecutabilidad Contractual ("EC")				
FEDERAL ENTITY	2001	2003	2006	2008	2011
Aguascalientes	EC1	EC1	EC2+	EC3	EC2
Baja California	EC2+	EC1	EC2+	EC1	EC1
Baja California Sur	EC3	EC4+	EC4	EC2+	EC3
Campeche	EC4+	EC2	EC3	EC5	EC2
Chiapas	EC3	EC3	EC3+	EC4+	EC4
Chihuahua	EC5	EC4+	EC4	EC5	EC4
Coahuila	EC2	EC3+	EC2+	EC2	EC2
Colima	EC2+	EC1	EC2+	EC2	EC2
Distrito Federal	EC3+	EC2+	EC3+	EC4+	EC2
Durango	EC4+	EC2+	EC2+	EC3+	EC2
Guanajuato	EC3+	EC2	EC1	EC1	EC2
Guerrero	EC5	EC4+	EC3	EC4+	EC3
Hidalgo	EC4+	EC3	EC4	EC3+	EC3
Jalisco	EC2	EC3	EC3	EC3+	EC3
México (Estado de)	EC2	EC1	EC1	EC3+	EC2
Michoacán	EC5	EC3+	EC4+	EC4+	EC3
Morelos	EC4+	EC2	EC4	EC3+	EC3
Nayarit	EC4+	EC4	EC2	EC4	EC1
Nuevo León	EC1	EC1	EC1	EC2+	EC3
Oaxaca	EC3	EC2	EC3	EC3+	EC4
Puebla	EC5	EC5	EC4	EC5	EC3
Querétaro	EC1	EC1	EC1	EC3	EC4
Quintana Roo	EC1	EC2	EC4+	EC2	EC5
San Luis Potosí	EC2	EC2	EC3	EC2+	EC3
Sinaloa	EC3	EC4+	EC3+	EC1	EC2
Sonora	EC5	EC5	EC4+	EC4+	EC3
Tabasco	EC2	EC2	EC3+	EC2	EC3
Tamaulipas	EC2+	EC3	EC2+	EC4	EC2
Tlaxcala	EC5	EC5	EC4	EC3	EC5
Veracruz	EC5	EC5	EC5	EC5	EC4
Yucatán	EC4+	EC2	EC3	EC4	EC5
Zacatecas	EC4	EC2+	EC4	EC4	EC5

Source: Moody's (2011) and its surveys with ITAM and GMA.

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