Scarring Recessions and Credit Constraints:
Evidence from Colombian Firm Dynamics

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Motivation

- Great recession brought concerns over long run effects of recessions back to town: recessions do seem to leave long-lasting scars on the economy (Ball 2014)

- Consistent with evidence for previous episodes (Cerra- Saxena '08; Reinhart –Rogoff '09; Blanchard- Summers 86, 87; Ball 97, 99; Abiad et al 09, Ball-Hofstetter '10).

Table 1 – Losses in OECD Countries

Country	Loss in Potential, 2013	Output Gap, 2013	Loss in Potential, 2015	Output Gap, 2015	Growth Rate of Potential, Pre-Crisis	Growth Rate of Potential, 2014-2015
Australia	1.40%	1.60%	1.83%	2.27%	3.33%	3.11%
Austria	6.02%	2.75%	7.14%	2.64%	2.36%	1.75%
Belgium	7.54%	1.73%	8.82%	1.19%	2.07%	1.36%
Canada	8.24%	0.75%	9.71%	-0.16%	2.90%	2.08%
Czech Republic	18.24%	3.58%	22.40%	3.52%	4.62%	1.92%
Denmark	9.73%	2.93%	11.32%	1.63%	1.76%	0.86%
Finland	15.66%	2.63%	18.99%	3.08%	3.09%	1.04%
France	7.50%	2.68%	8.58%	3.08%	2.08%	1.48%
Germany	2.87%	0.56%	3.39%	-0.87%	1.52%	1.25%
Greece	29.98%	9.33%	35.40%	7.59%	3.96%	-0.15%
Hungary	25.69%	1.93%	30.51%	0.69%	4.42%	0.98%
Ireland	27.70%	6.32%	34.15%	4.45%	5.75%	0.93%
Italy	9.88%	5.04%	12.05%	3.74%	1.34%	0.11%
Japan	8.47%	-0.15%	9.57%	-0.89%	1.40%	0.79%
Netherlands	6.83%	4.01%	8.53%	4.09%	2.14%	1.20%
New Zealand	6.50%	0.29%	7.47%	-1.22%	3.07%	2.53%
Poland	5.24%	0.66%	7.42%	0.16%	4.11%	2.91%
Portugal	11.41%	6.42%	13.74%	4.98%	1.83%	0.49%
Spain	18.21%	4.37%	22.33%	3.52%	3.47%	0.83%
Sweden	7.58%	1.75%	8.66%	0.76%	3.02%	2.41%
Switzerland	-0.42%	0.76%	-0.88%	0.39%	1.81%	2.04%
United Kingdom	10.98%	2.14%	12.37%	0.32%	2.66%	1.85%
United States	4.70%	3.35%	5.33%	1.87%	2.57%	2.23%
Weighted Average	7.18%	2.56%	8.38%	1.49%	2.39%	1.68%

Loss in Potential = (Y**-Y*)/Y**

Output Gap = (Y*-Y)/Y**

Growth Rate of Potential, Pre-Crisis: Average for 2001-2009 (December 2007 data)

Growth Rate of Potential, 2014-2015: Average for 2014-2015 (May 2014 data)

Weighted Average: Weights proportional to Y** in 2015

From Ball (2014)

Motivation

- Great recession brought concerns over long run effects of recessions back to town: recessions do seem to leave long-lasting scars on the economy (Ball 2014)

- Micro-foundations behind these scars?
  - Recessions should be times of "cleansing" (Caballero & Hammour 94)
  - But perhaps not if they hit particularly hard certain types of businesses that may not be particularly unproductive
    - Financially constrained (Barlevy, 03; Osotimehin and Pappadà, 2017)
    - Young (Ouyang , 09)

Research question

- Ultimately an empirical question. This paper:

    – Are financially constrained firms more likely forced out of business by a crisis, compared to less constrained ones?

    – Even if more productive than stayers?

    – Aggregate cost?

Context

Colombia: GDP annual growth rate 1906 - 2013
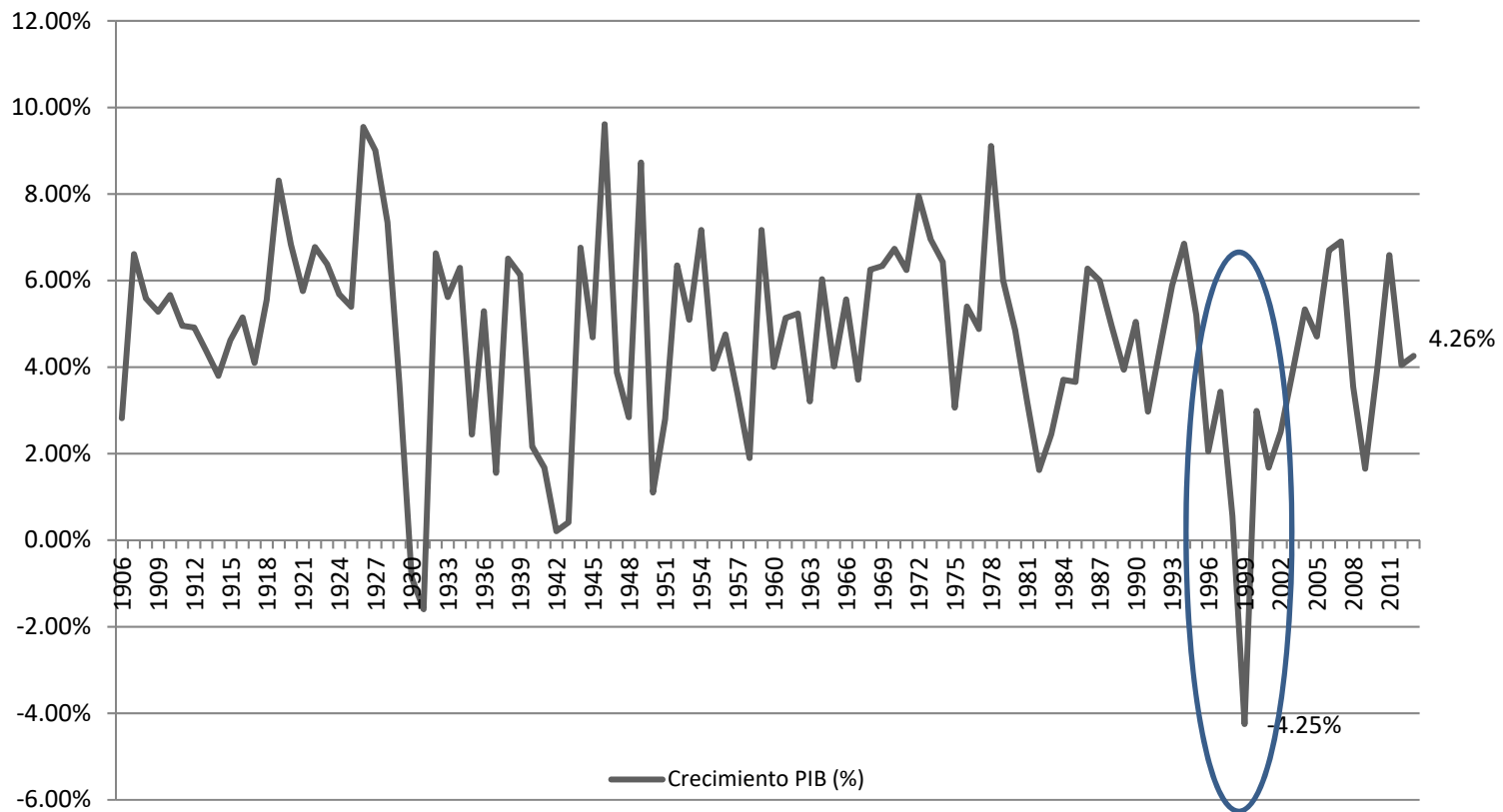
Domestic credit to private sector (% of GDP) - Colombia, OECD members, Spain, Chile, United States, United Kingdom, Germany

International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.
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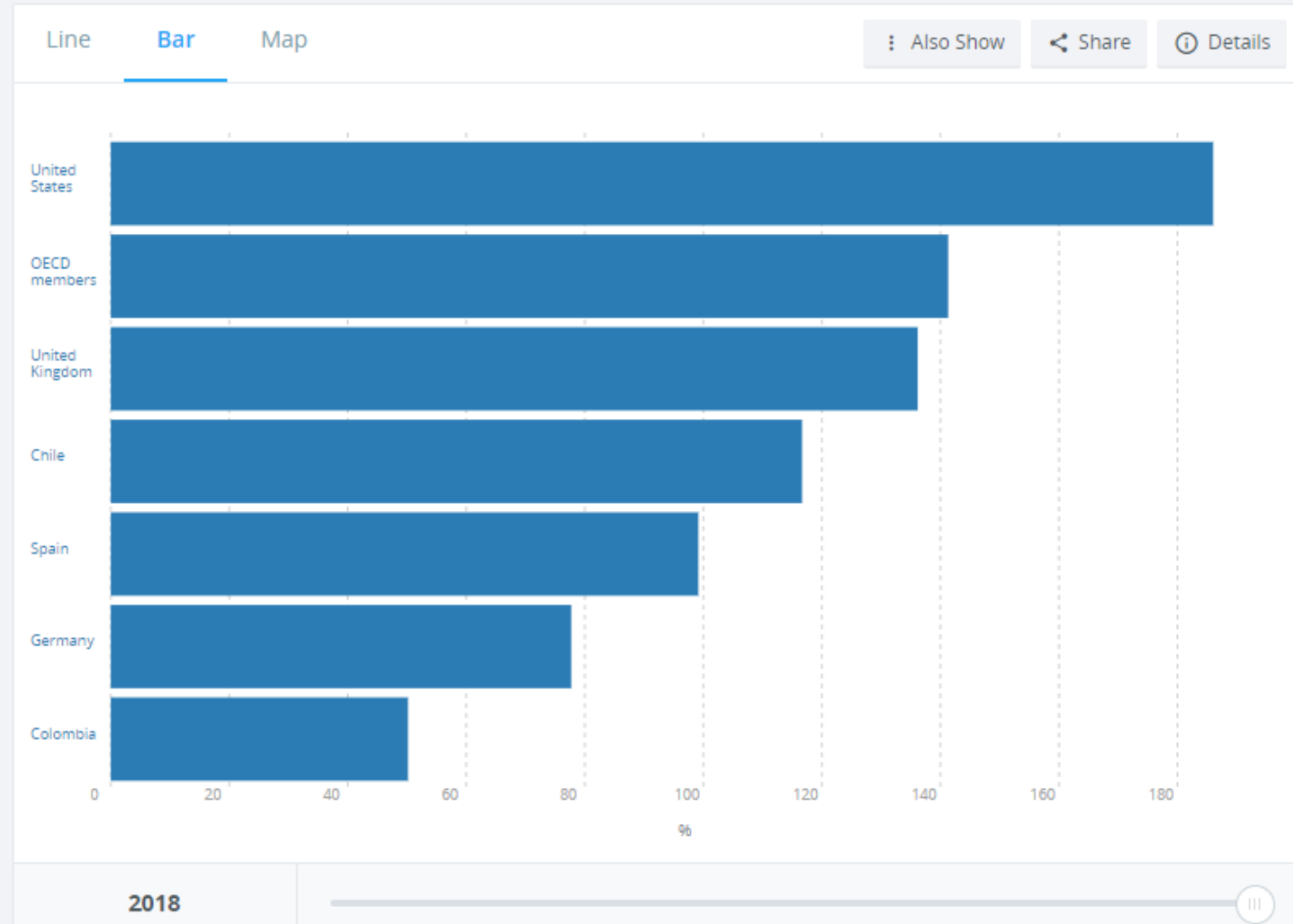
Findings

- More credit constrained firms in high liquidity needs sectors more likely to exit than others, especially in recessions
  - Additional probability of being forced off the market by recession for high constraints firms vs. others is 1.7% for average productivity firms, 8.5% for P3 productivity firms.
- TFP distribution of firms forced of the market by recession is significantly shifted to the right if proportion of constrained firms higher.
- Implication is aggregate TFP loss from financial constraints during recessions
  - But moderate in magnitude because mechanism hits low productivity firms the hardest, and exit probability is low.

Outline of the talk

1. Related literature

2. Conceptual framework

3. Empirical model and data
   – Measuring financial constraints

4. Results

5. Conclusion

Related literature

- Long run effects of recessions: Ball '14; Reifschneider et al ´13; Cerra- Saxena '08; Reinhart –Rogoff '09; Blanchard- Summers 86, 87; Ball 97, 99; Abiad et al 09, Ball-Hofstetter '10.

- Cleansing vs. scarring recessions: Caballero and Hammour 94, Barlevy 03, Ouyang 09, Hallward-Driemeier and Rijkers ('13), Nishimura et al. 05.

- Calibrated models of endogenous credit constraints and firm dynamics/misallocation Caggesse-Cuñat 11; Midrigan and Xu ('13); Gopinath et al '17.

- Empirical effects of exogenous credit constraints on businesses:

  – Cross country: e.g. Rajan and Zingales, '98; Sector: Manova '13; Firm on investment: Fazzari et al '98, Hoshi et al ´91, Devereuz and Schiantarelli, '90; Whited, '92...

- Recessions and endogenous financial frictions: Osotimehin and Pappadà, 2017; Midrigan and Xu '13.

Conceptual framework

- Melitz' model with financial frictions: imperfect contractability a-la Manova, 2013

  – Firms need (at least partial) financing for fixed costs of production. Failing to get funds forces firm out of market.

  – Heterogeneity in sector's need for external financing, and in collateral that firm can post

- Because bank cannot appropriate full profits, firm must be more than profitable to obtain financing.

  – Cutoff larger the larger need for external financing and the lower firm's colateral

- Thus, for given productivity level, higher external dependence-lower collateral firm more likely to exit.

- Recession: lower collateral, lower demand, hence greater need for financing

Empirical model

$$\Pr(x_{it} = 1)$$

$$= N(\beta_0 + \beta_1 L_{it-1} + \beta_1 TFP_{it} + \beta_C C_i + \beta_B B_t + \beta_c C_i B_t + \varepsilon_{it})$$

$$x_{it} = 1 \; if \; i \; exits \; in \; t$$

$$B_t = 1 \; if \; t \; \epsilon \; 1998 - 2001$$
$$C_i = 1 \; if \, ED_s * IR_i \; in \; top \; quintile$$
$$ED_s = external \; dependence$$
$$IR_i \; proxies \; for \; firm \; inability \; to \; access \; ext. funds$$

Plus interactions with TFP

Data

Colombian Annual Manufacturing Survey

- Yearly data, 1995 – 2004

- Unbalanced panel, all manufacturing establishments with 10+ employees, each linked to a firm

- Output, input use. We obtain measure of TFPR

Superintendencia de Sociedades dataset

- Balance Sheet information, firms

- Only not-so-small firms (all medium and large, some small)

- Firm Ids: can be merged

Measurement: credit constraints

- Two different strands of literature:

    1. Sector-level external dependence = capital expenditures /cash flow in the US (Rajan-Zingales, 1998)

    2. Firm level investment to cash flow sensitivity (Fazzari et al, 1998)

        Potentially biased by simultaneity: higher productivity affects investment and cash flow

- We use 1 to measure ED and 2 to measure IR.

- For IR we calculate investment to cash flow sensitivity using only components orthogonal to TFP innovations

Descriptive statistics

Table 1: Descriptive statistics

	N	Mean	St.Dev.	P10	P90
Exit Dummy	18986	0.030	0.172	0.000	0.000
TFP	18986	1.026	0.645	0.314	1.776
Labor	18986	169	253	22	388
Firm's Reliance on Internal Funds	18986	0.639	0.268	0.254	0.977
RZ Sector's External Dependence	18986	0.470	0.190	0.302	0.767
Firm credit constraints (External Dependence* Int. Reliance)	18986	0.302	0.187	0.101	0.526

Notes: Firm's reliance on internal funds corresponds to the coefficient of correlation between capital expenditures and the cash flow, at the level of the firm. Sector's External Dependece is Rajan and Zingales' measure of the sector's dependence on external financing, as measured by the relative gap between capital expenditures and the cash flow in the U.S., taken as the benchmark economy with greatest financial development.
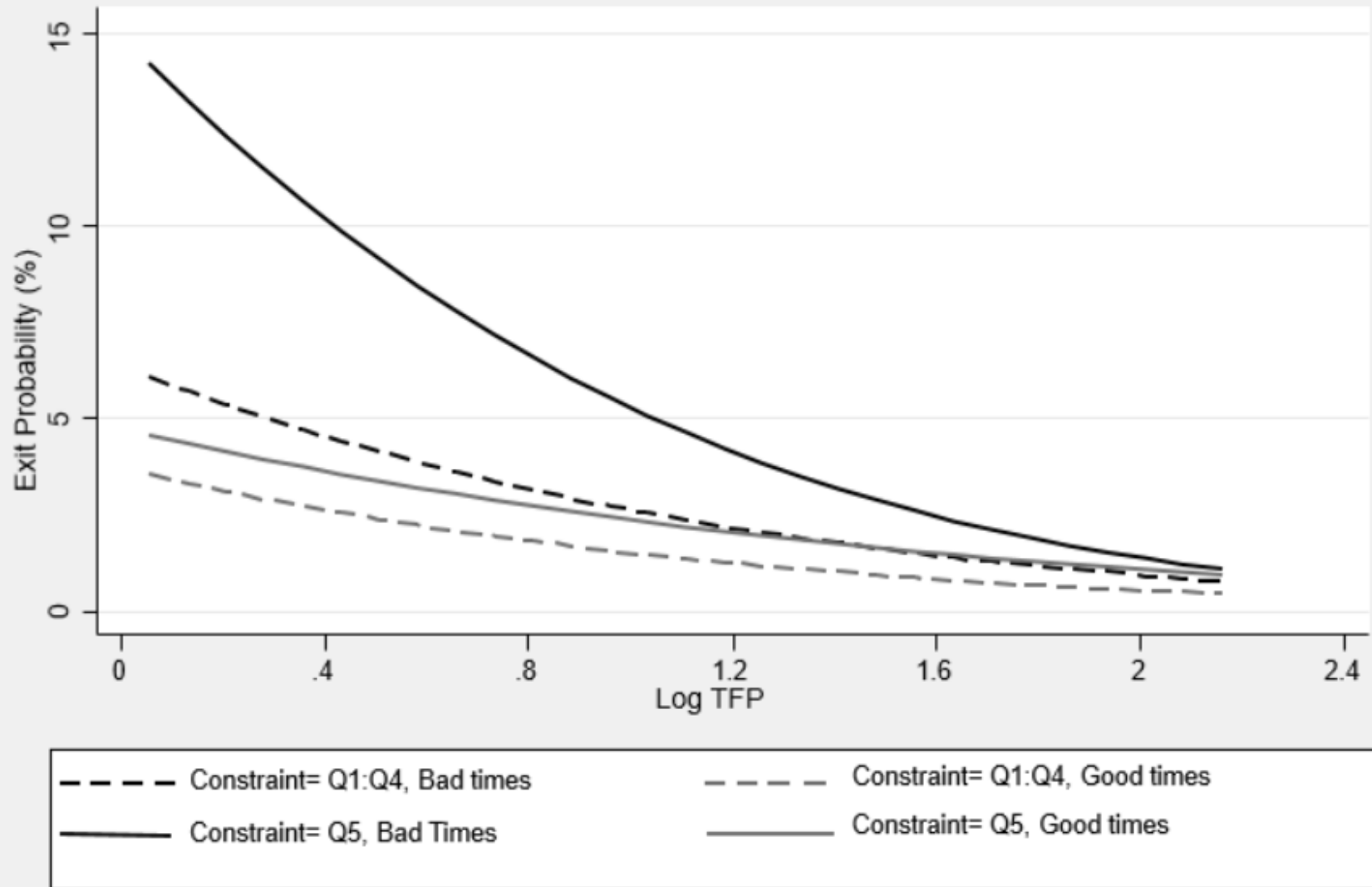
Results: exit probability

Table 2: Probability of exit in good and bad times vs. financial constraints, nonlinear discrete model
"Constrained"= Firm in Top Quintile of External Dependence * Internal

	No TFP interactions	Adding TFP interactions
Lagged Labor	-0.1446***	-0.1445***
	(0.023)	(0.023)
TFPR	-0.4144***	-0.3824***
	(0.034)	(0.058)
Bad times	0.2312***	0.2611***
	(0.044)	(0.080)
Constrained	0.1708**	0.1162
	(0.085)	(0.130)
Bad times * Constrained	0.1958**	0.3717**
	(0.091)	(0.154)
TFPR * Constrained		0.0692
		(0.105)
TFPR * Bad times		-0.0319
		(0.075)
TFPR * Bad times * Constrained		-0.2345
		(0.147)
Observations	18,956	18,956
Sector FE	Yes	Yes

Figure 2. Exit probability vs. TFP: financial constraint above/below P80, good/bad times.
Financial Constraint = External Dependence* Int. Reliance

Notes: This Figure presents the probability of exiting as a function of the firm's TFP, as predicted by the model estimates presented in Table 2, column 4 (probit model including interactions with TFP)
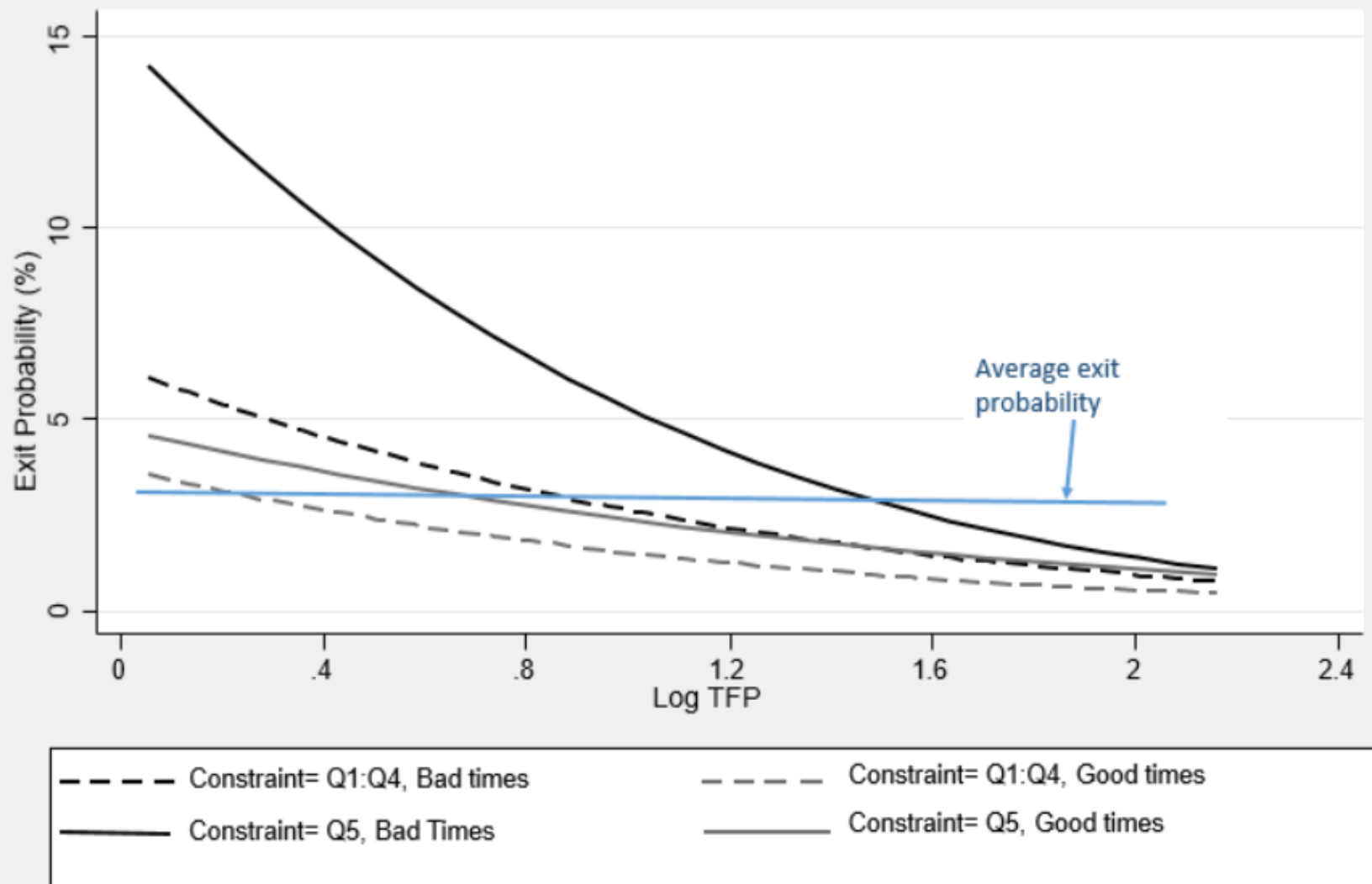
Table 3. Differentials in Predicted Exit Probabilities: Bad vs. Good Times for More and Less Constrained Firm "Constraint"= External Dependence * Internal Reliance

	No TFP interactions	Adding TFP interactions
TFP 3rd percentile		
A. Bad- Good Times (External Dependence * Internal Reliance=Avg. Top Quintile)	7.1%***	11.4%***
B. Bad- Good Times(External Dependece*Internal Reliance =Avg. Quintiles 1 to 4)	2.6%***	2.9%***
A-B: Constrained penalty in bad times	**4.5%***	**8.5%***
Average TFP		
A. Bad- Good Times (External Dependence * Internal Reliance=Avg. Top Quintile)	3.4%***	2.8%***
B. Bad- Good Times(External Dependece*Internal Reliance =Avg. Quintiles 1 to 4)	1.1%***	1.1%***
A-B: Constrained penalty in bad times	**2.3%***	**1.7%**

Results: productivity

Figure 2. Exit probability vs. TFP: financial constraint above/below P80, good/bad times.
Financial Constraint = External Dependence* Int. Reliance

Legend:
- Constraint= Q1:Q4, Bad times
- Constraint= Q1:Q4, Good times
- Constraint= Q5, Bad Times
- Constraint= Q5, Good times

Notes: This Figure presents the probability of exiting as a function of the firm's TFP, as predicted by the model estimates presented in Table 2, column 4 (probit model including interactions with TFP)

Table 4: Counterfactual effects of financial constraints

Panel A: Exit probability of Constrained=0 firm with TFPR in lowest 10% of distribution is equal to exit probability of Constrained=1 firm in lowest…

Good Times	Bad Times
31%	55%

Figure 3. TFP of Firms that Survive in good but not in bad times

Mean=0.481

Mean=0.573

Unconstrained scenario

Constrained scenario

Table 4: Counterfactual effects of financial constraints

Panel A: Exit probability of Constrained=0 firm with TFPR in lowest 10% of distribution is equal to exit probability of Constrained=1 firm in lowest…
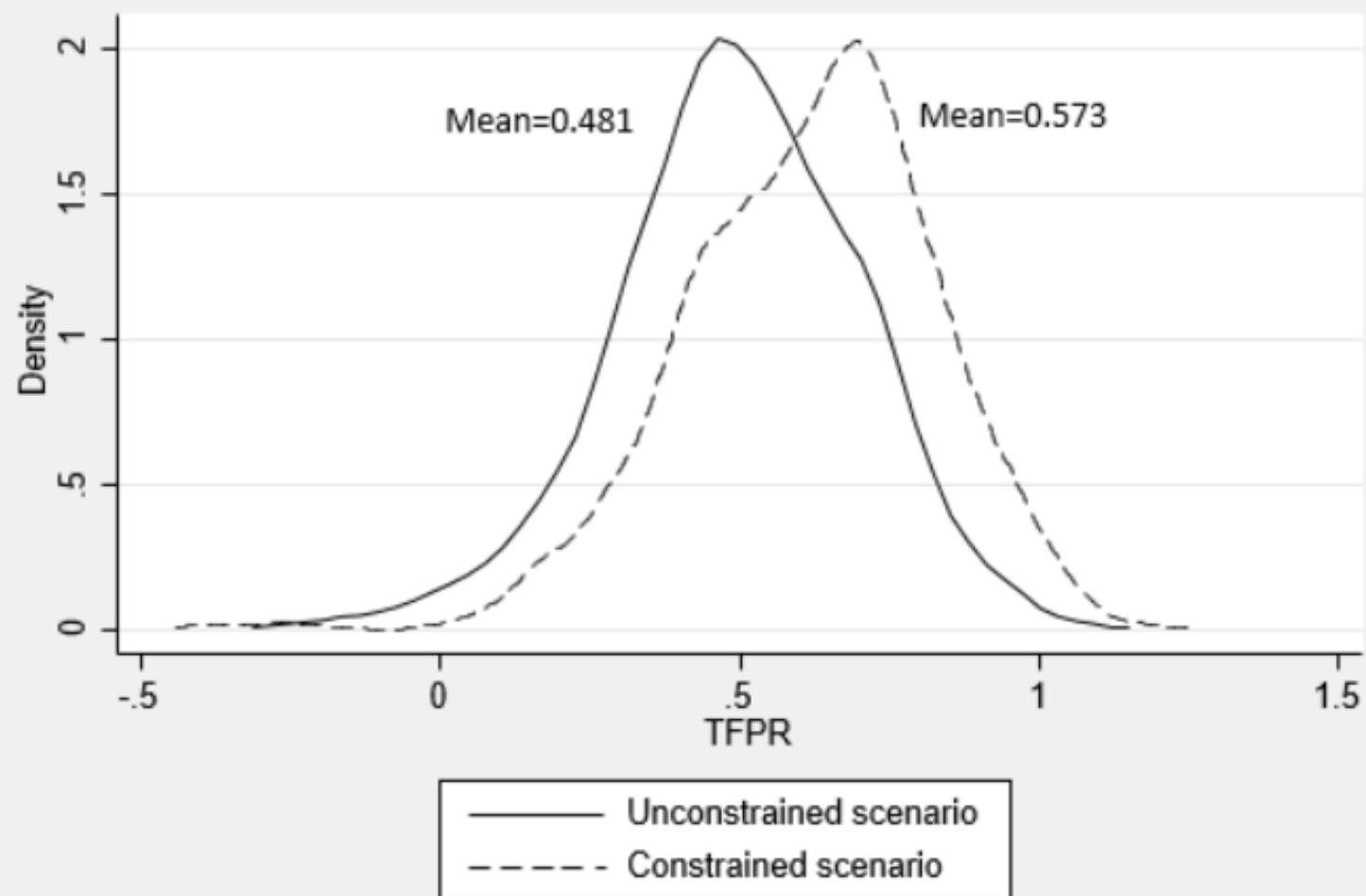
Good Times	Bad Times
31%	55%

Panel B: the average TFP of survivors by 2002 is…

	Constrained scenario	No constraints	Difference
Bad times	1.110	1.115	-0.44%
Good times	1.095	1.095	0.00%

Notes: This table present results of counterfactual exercises based on Table 2, column 4, estimates (probit model including TFP interactions). The Constrained Scenario in Panel B is one where 50% of firms have been placed in the top quintile of Firm Credit Constraints, while the remaining 50% are in the bottom four quintiles. In the Unconstrained Scenario, all firms have been placed in the bottom quintile of Firm Credit Constraints.

Results: simulated effect on aggregate TFP

- Simulated sample predicted by model:
  - Start with 1997 "population"
  - Predict exit probability, project exit
    - Actual exit rate of good vs. bad times
  - Take new 1998 projected population, add entrants
    - Project for each TFP with AR1 model
  - Repeat for years up to 2001
  - Obtain distribution of TFP
- Two scenarios: no constraints (all firms in lowest quintile), 50% constrained 50% "normal"

Results: taking stock

- Credit constrained firms in high liquidity needs sectors more likely to exit than others, especially in recessions
  - The additional probability of being forced off the market by recession for high constraints firms vs. others is 1.7% for average productivity firms, 8.5% for P3 productivity firms.
- TFP distribution of firms forced of the market by recession is significantly shifted to the right if proportion of constrained firms higher.
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Policy implications

- Room for policy intervention:

  - Working capital intervention!

  - Especially for high productivity businesses

  - But not necessarily by making SMEs the target

Measurement: recession

Years of Recession (Bad times)

Negative annual per capita GDP growth	1998, 1999, 2001
Negative annual ~~per capita~~ GDP growth	1999
Trough to peak strategy	1998, 1999, 2000, 2001, 2002
Two or more quarters with negative GDP growth	1998, 1999
Sudden Stop	1998, 1999, 2000
Banking Crisis	1999, 2000, 2001
Years with cyclical component below 1 std devation	1999, 2000, 2001, 2002, 2003, 2004
Years that satisfy at least four criteria	1998, 1999, 2000, 2001