

Product Innovation and Credit Market Disruptions

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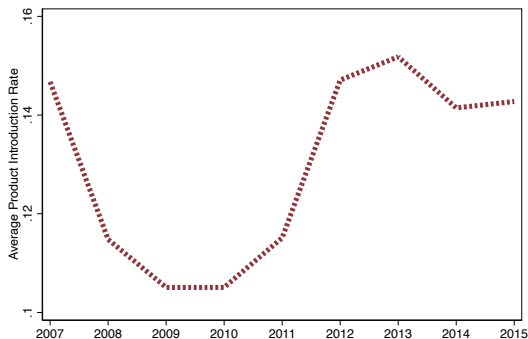
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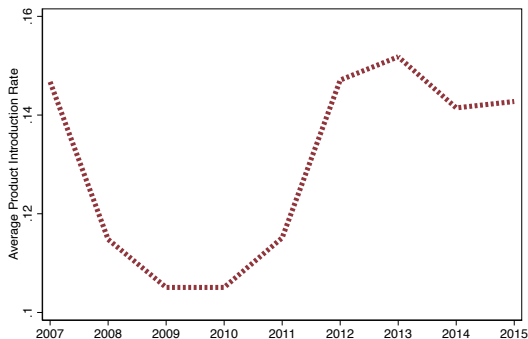
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Motivation



- The introduction of new products in the economy is highly procyclical (Broda and Weinstein, 2010; Argente, Moreira, and Lee, 2018)

Motivation



- ▶ The introduction of new products in the economy is highly procyclical (Broda and Weinstein, 2010; Argente, Moreira, and Lee, 2018)
- ▶ Why?
 - ▶ Expectations of weak product demand
 - ▶ Less Investment during times of uncertainty
 - ▶ **Financial frictions and credit market disruptions**

Why focus on product innovation?

[Introduction of new and improved products in the market]

- ▶ Interesting in itself
 - ▶ New products that satisfy previously unmet needs play important role in models of firm and economic growth (e.g. Romer, 1990; Aghion and Howitt, 1992)
- ▶ Alternatives: Patents and R&D
 - ▶ Non-patenting firms are responsible for the majority of new products in the consumer goods sector (e.g. Argente, Baslandze, Hanley, Moreira, 2020)
 - ▶ Only 6.3% of firms in the manufacturing sector hold a patent (e.g. Graham et al, 2018)
 - ▶ Patents and R&D survey data are typically skewed towards the largest firms thus missing the smaller and younger firms

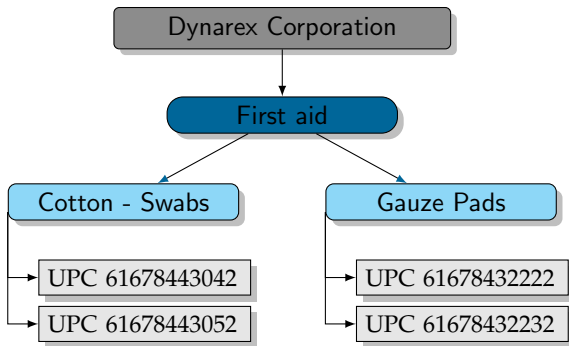
What is the impact of credit market disruptions on innovation rates and what type of product innovations are most affected?

- ▶ Use detailed information about product portfolios of firms to take deeper look at what innovations are disrupted by credit market frictions.
 - ▶ Innovations in firms' current product lines?
 - ▶ Innovations that expand the set of a firm's product lines?
 - ▶ Degree of “novelty” of new products?
- ▶ Direct link between product innovation and its subsequent product sales
 - ▶ How does initial exposure to credit market disruptions affect sales of new product lines?

1. MEASURES OF PRODUCT INNOVATION

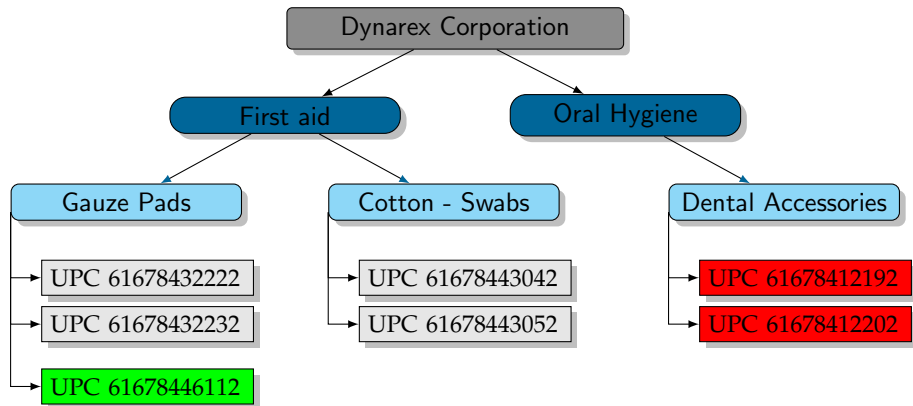
Types of Product Innovation

Example: Portfolio of a firm



Types of Product Innovation

Example: Change in the portfolio of the firm



Dynarex Drain Sponges

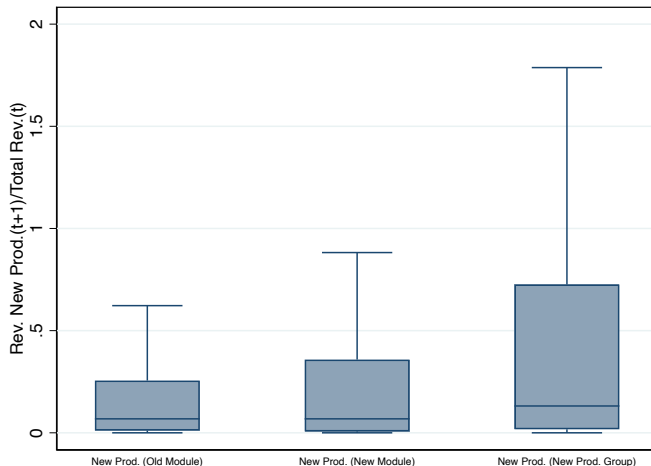


Swabsticks Flavored with Dentrifice



Types of Product Innovation

Different levels of initial investment and incremental revenue



- ▶ New products in new product lines (modules or groups) account for a greater share of their firm's total sales following their introduction

Novelty-Adjusted Product Innovation

Using product characteristics to determine degree of novelty to consumers

- ▶ New products may represent minor improvements relative to other products available to consumers

Novelty-Adjusted Product Innovation

Using product characteristics to determine degree of novelty to consumers

- ▶ New products may represent minor improvements relative to other products available to consumers

Kiinde Direct-Pump Adapters for Kiinde
Twist Pouch Breast Milk Storage Pouches



Novelty Index: 0.66

Swiffer Wetjet Hardwood Floor Mopping
Sweet Citrus



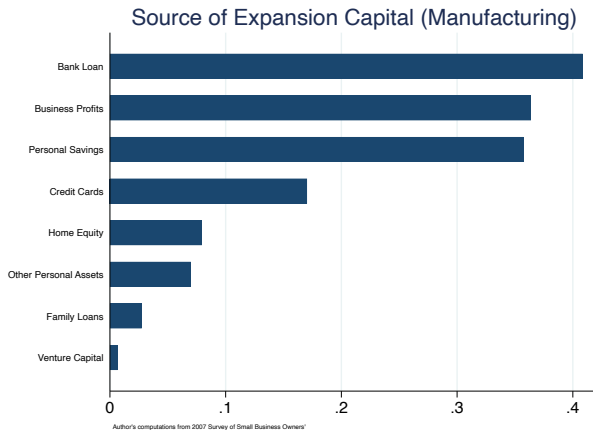
Novelty Index: 0.14

Novelty Indices Formal Definition

Novelty and Firm Performance

2. MEASURES OF CREDIT MARKET DISRUPTIONS

Why Bank Financing?

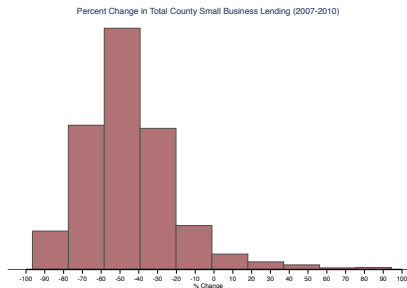
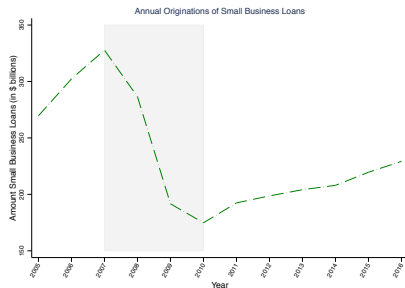


► Robb and Robinson (2014):

1. Startups rely extensively on external credit markets
2. Fraction of outside debt capital increases as firm matures

Measures of Credit Market Disruption

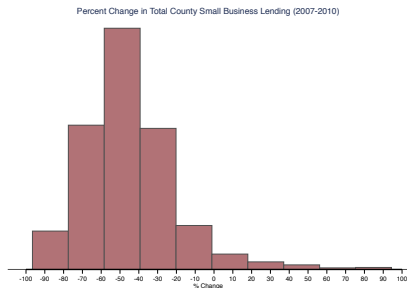
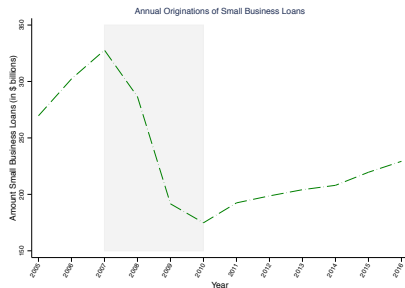
Geography-based Measure of Credit Market Disruption - (I)



- ▶ Small Business lending market (loans \leq \$ 1 million) saw significant contraction in the 2007–2010 period
- ▶ Heterogeneity across counties in the severity of the decline in the small business lending market

Measures of Credit Market Disruption

Geography-based Measure of Credit Market Disruption - (I)



- ▶ Small Business lending market (loans \leq \$ 1 million) saw significant contraction in the 2007–2010 period
- ▶ Heterogeneity across counties in the severity of the decline in the small business lending market
- ▶ BUT... total change in county lending conflates supply and demand in the market for bank lending

Measures of Credit Market Disruption

Geography-based Measure of Credit Market Disruption - (II)

- ▶ Modified-Bartik approach of Greenstone, Mas, and Nguyen (2020):

Step 1: Compute bank-specific lending shocks from OLS estimation of

$$\Delta \text{SBL}_{b,c}^{07-10} = \gamma_b + \delta_c + \epsilon_{b,c}$$

Step 2: Compute pre-determined county exposure to bank lending shocks

$$\text{SBL Shock}_c = - \sum_b s_{b,c}^{07} \times \hat{\gamma}_b$$

Step 3: Merge county lending shock with product-level data from Nielsen using firms' HQ address information from GS1 dataset

Assumption: Bank Lending is described by an additively separable decomposition between bank supply and firm demand for credit.

Measures of Credit Market Disruption

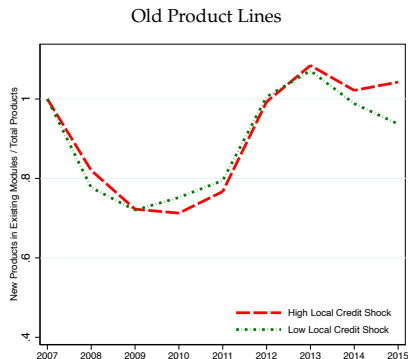
Firm-based Measure of Credit Market Disruptions

- ▶ Compute preexisting **firm-level variation** in the need to access external financing during a time of significant contraction in the syndicated lending markets
 - ▶ Hand-match the RMS product-level and firm-level dataset with LPC syndicated loan dataset.
 - ▶ Share of long-term syndicated debt coming due between July 2007 and August 2008 (e.g. Almeida et al., 2012; Benmelech, Frydman, and Papanikolaou, 2019; Costello, 2018)
- ▶ Smaller sample of larger firms but better able to capture whether such firms require access to external financing

3. CREDIT MARKET DISRUPTIONS AND PRODUCT INTRODUCTION

Descriptive Statistics

Product Introduction Rates by Innovation Type



- ▶ Credit market disruptions negatively affect firm expansion to new product lines

Main Results

Geography-based Measure of Credit Market Disruption

$$Y_{i,t} = \alpha_i + \theta_t + \beta \text{ Shock}_i \times \text{Crisis}_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Product Introduction Rate	All Product Lines		Old Product Lines		New Product Lines	
	(1)	(2)	(3)	(4)	(5)	(6)
Local Credit Shock \times I(Crisis)	-0.042 (0.027)	-0.045* (0.024)	-0.011 (0.022)	-0.013 (0.020)	-0.020*** (0.007)	-0.021*** (0.007)
Ln(Firm Revenue)		-0.176*** (0.012)		-0.114*** (0.006)		-0.044*** (0.003)
Rev. Concentration Index		-0.194*** (0.006)		-0.125*** (0.004)		-0.041*** (0.002)
Ln(Rev. per Product)		0.198*** (0.011)		0.128*** (0.006)		0.050*** (0.004)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.248	0.269	0.218	0.234	0.156	0.163
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

- ▶ No statistically significant decline in the rate of product innovation in existing product lines and statistically and economically significant decline in product expansion to new product lines ($\sim 15\%$ of decline).

Main Results

Firm-based Measure of Credit Market Disruption

$$Y_{i,t} = \alpha_i + \theta_t + \beta \text{ Shock}_i \times \text{Crisis}_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Product Introduction Rate	All Product Lines		Old Product Lines		New Product Lines	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Credit Shock \times I(Crisis)	-0.029 (0.044)	-0.026 (0.039)	0.014 (0.028)	0.014 (0.025)	-0.035*** (0.012)	-0.035*** (0.012)
Ln(Firm Revenue)		-0.148*** (0.041)		-0.056 (0.038)		-0.047** (0.020)
Rev. Concentration Index		-0.199*** (0.063)		-0.108*** (0.037)		-0.048* (0.024)
Ln(Rev. per Product)		0.176*** (0.048)		0.082** (0.037)		0.046** (0.022)
Observations	1744	1744	1744	1744	1744	1744
Adjusted R^2	0.309	0.330	0.293	0.309	0.229	0.233
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

- ▶ Similar results despite smaller sample and very different source of variation in credit market disruptions ($\sim 40\%$ of decline).

Main Results

Cross-Sectional Heterogeneity

	Prod. Intro. Rate (New Lines)					
	Age		Size		Fin. Dependence	
	Old	New	Large	Small	Low	High
Local Credit Shock \times I(Crisis)	-0.012* (0.006)	-0.095*** (0.031)	-0.007 (0.009)	-0.018* (0.010)	-0.014** (0.006)	-0.024** (0.010)
Ln(Firm Revenue)	-0.031*** (0.003)	-0.123*** (0.015)	-0.037*** (0.004)	-0.037*** (0.004)	-0.049*** (0.005)	-0.037*** (0.004)
Rev. Concentration Index	-0.032*** (0.002)	-0.060*** (0.004)	-0.053*** (0.004)	-0.033*** (0.002)	-0.042*** (0.005)	-0.033*** (0.005)
Ln(Rev. per Product)	0.035*** (0.003)	0.127*** (0.014)	0.037*** (0.004)	0.041*** (0.005)	0.054*** (0.005)	0.042*** (0.005)
Observations	135372	38075	39766	111355	90145	89358
Adjusted R^2	0.101	0.195	0.125	0.095	0.184	0.179
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Shock	1	1	1	1	1	1

- Effects concentrated in newer and smaller firms and in sectors with greater dependence from external financing sources.

Main Results

Robustness: Industry Specialization

$$Y_{i,t} = \alpha_i + \theta_t + \beta \text{ Shock}_i \times \text{Crisis}_t + \gamma X_{i,t} + \epsilon_{i,t}$$

	Prod. Intro. Rate (New Lines)					
	(1)	(2)	(3)	(4)	(5)	(6)
Local Credit Shock \times I(Crisis)	-0.018** (0.007)	-0.019*** (0.007)	-0.021*** (0.007)	-0.021*** (0.007)	-0.019** (0.008)	-0.019** (0.008)
Ln(Firm Revenue)		-0.045*** (0.003)		-0.046*** (0.004)		-0.047*** (0.003)
Rev. Concentration Index		-0.040*** (0.002)		-0.040*** (0.002)		-0.039*** (0.002)
Ln(Rev. per Product)		0.050*** (0.004)		0.051*** (0.004)		0.052*** (0.003)
Observations	173445	173445	173445	173445	172285	172285
Adjusted R^2	0.157	0.164	0.160	0.166	0.180	0.186
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Department \times Year Fixed-Effects	Yes	Yes	No	No	No	No
Prod. Group \times Year Fixed-Effects	No	No	Yes	Yes	No	No
Prod. Module \times Year Fixed-Effects	No	No	No	No	Yes	Yes
Shock	1	1	1	1	1	1

- Not consistent with credit market disruptions capturing demand shocks

Main Results

Product Novelty Index: Geography-based measure of credit market disruption

$$Y_{i,t} = \alpha_i + \theta_t + \beta \text{ Shock}_i \times \text{Crisis}_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

	Individual Charact.		Combination Charact.		Hedonic	
Novelty New Products (log)	(1)	(2)	(3)	(4)	(5)	(6)
Local Credit Shock \times I(Crisis)	-0.015*	-0.015*	-0.024**	-0.025**	-0.025*	-0.026*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.012)
Ln(Firm Revenue)		-0.009***		-0.011***		-0.015***
		(0.002)		(0.002)		(0.004)
Rev. Concentration Index		0.015***		0.017***		0.023***
		(0.004)		(0.004)		(0.006)
Ln(Rev. per Product)		0.008***		0.011***		0.014**
		(0.002)		(0.002)		(0.004)
Observations	52728	52728	52728	52728	50295	50295
Adjusted R^2	0.329	0.330	0.394	0.395	0.333	0.333
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Shock	1	1	1	1	1	1

- Credit market disruptions partly accounts for some of the decline in “never-before-seen” characteristics during the crisis

Heterogeneity and Robustness

1. Specification, sample, or weighting:

- ▶ Alternative Fixed Effects (Firm-Level Measure) ▶ Alternative FE
- ▶ Firms with Majority Sales Outside State HQ ▶ Outside State
- ▶ Eliminating each state at a time ▶ Eliminating States
- ▶ Placebo measures of Credit Market Disruption? ▶ Placebo

2. Alternative Definitions and Measures:

- ▶ Dummy New Products? ▶ Dummy New Products
- ▶ Number of New Products? ▶ Nbr. New Products
- ▶ Alternative geography-based measures? ▶ Alt. Geo. Measure
- ▶ Alternative definition of product? ▶ Brand

3. Alternative Explanations:

- ▶ Controlling for Local Economic Conditions ▶ Local Econ
- ▶ Controlling for Household Demand Shocks ▶ Household Shocks

4. Cross-Sectional Heterogeneity:

- ▶ Durable and Non-Durable Products ▶ Durable Products
- ▶ Banks' Exposure to Lehman ▶ Lehman Shock

4. CREDIT MARKET DISRUPTIONS AND EX-POST PERFORMANCE OF NEW PRODUCT LINES

Credit Market Disruptions and Ex-Post Performance of New Product Lines

- ▶ Association between initial exposure to credit market disruptions and ex-post performance of new product lines introduced during the crisis period is unclear from theoretical standpoint
 1. Initial exposure to credit market disruptions could affect overall investment in quality of the innovation, marketing, product diffusion and promotion, etc
 2. Selection margin suggests that constrained firms will only introduce their “very best” products during the crisis period

Main Results

Credit Market Disruptions and Ex-Post Performance of New Product Lines

$$Y_{i,g,c} = \alpha_i + \theta_{g,c} + \gamma \text{ Shock}_i \times \text{Crisis Cohort}_c + \epsilon_{i,g,c}$$

	Ln (Total Revenues)		Share Firm Rev.	
	(1)	(2)	(3)	(4)
Local Credit Shock \times I(Crisis Cohort)	-0.200** (0.093)	-0.219** (0.093)	-0.026*** (0.007)	-0.015*** (0.005)
Observations	13110	8464	13110	8464
Adjusted R^2	0.448	0.431	0.412	0.423
Group \times Cohort Fixed-Effects	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes
Sample	All Firms	Incumbent	All Firms	Incumbent

- ▶ New product lines introduced by firms exposed to credit market disruptions during crisis periods generate less revenue than otherwise comparable new product lines introduced by the same firm outside the crisis period.

Main Results

Credit Market Disruptions and Ex-Post Performance of New Product Lines: Channels

	$\text{Ln}(\frac{\text{Rev}}{\text{Prod.}})$	$\text{Ln}(\text{Prod})$	$\text{Ln}(\frac{\text{Rev}}{\text{DMA}})$	$\text{Ln}(\text{DMA})$	$\text{Ln}(\frac{\text{Rev}}{\text{Chain}})$	$\text{Ln}(\text{Chains})$
	(1)	(2)	(3)	(4)	(5)	(6)
Local Credit Shock \times I(Crisis Cohort)	-0.161** (0.079)	-0.039** (0.019)	-0.146** (0.061)	-0.054 (0.045)	-0.151* (0.078)	-0.049** (0.024)
Observations	13110	13110	13110	13110	13110	13110
Adjusted R^2	0.464	0.199	0.440	0.600	0.453	0.504
Group \times Cohort Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

Conclusion

What we do:

- ▶ (i) Construct measures of product innovation
 - ▶ Innovations in firms' current product lines
 - ▶ Innovations that expand the set of a firm's product lines [New to firm]
 - ▶ Degree of "novelty" using product characteristics [New to consumers]
- ▶ (ii) Construct two firm-level measures of exposure to the 2008-2010 crisis
- ▶ (iii) Analyze whether credit supply shock explains product innovation and ex-post performance.

Conclusion

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- ▶ (ii) Construct two firm-level measures of exposure to the 2008-2010 crisis
- ▶ (iii) Analyze whether credit supply shock explains product innovation and ex-post performance.

Findings:

- ▶ (1) Credit market disruptions affect the rate of introduction of new product lines. Explains between 15% to 40% decline in the rate of introduction in new product lines
- ▶ (2) Conditional on entry, new products are less novel
- ▶ (3) New product lines are less successful.

Consumer Goods Sector: Size and Representativeness

- ▶ Sector
 - ▶ Non-durable and semi-durable consumer products
 - ▶ About 14% U.S. consumption of goods
 - ▶ Product entry rates, share R&D expenses, and patenting intensity similar to other manufacturing sectors (Goolsbee and Klenow, 2018; Argente, Baslandze, Hanley, Moreira, 2020).
- ▶ Dataset: Nielsen-RMS + GS1
 - ▶ Covers about about 40% total U.S. consumer goods sales, and covers close to the universe of firms and product introduction in the sector (Argente, Moreira, and Lee, 2018)

Main Results

Robustness: Alternative Dependent Variable

$$Y_{i,t} = \alpha_i + \theta_t + \beta Shock_i \times Crisis_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Panel A: Geography-Based Measure of Credit Market Disruption

	(1) Ln(1+New Prod.) (All)	(2) Ln(1+New Prod.) (All)	(3) Ln(1+New Prod.) (Old)	(4) Ln(1+New Prod.) (Old)	(5) Ln(1+New Prod.) (New)	(6) Ln(1+New Prod.) (New)
Local Credit Shock \times I(Crisis)	-0.064 (0.050)	-0.057 (0.046)	-0.028 (0.049)	-0.020 (0.046)	-0.047*** (0.014)	-0.048*** (0.013)
Ln(Firm Revenue)		0.289*** (0.019)		0.345*** (0.017)		-0.069*** (0.010)
Rev. Concentration Index		-0.308*** (0.008)		-0.246*** (0.007)		-0.113*** (0.005)
Ln(Rev. per Product)		-0.213*** (0.017)		-0.275*** (0.014)		0.080*** (0.009)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.714	0.723	0.730	0.738	0.282	0.286
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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Main Results

Robustness: Alternative Geographic Measure of Credit Market Disruption

$$Y_{i,t} = \alpha_i + \theta_t + \beta Shock_i \times Crisis_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Panel A: Entry Rates of New Products

	(1)	(2)	(3)	(4)	(5)	(6)
	Entry Rate (All Modules)		Entry Rate (Old Modules)		Entry Rate (New Modules)	
Local Credit Shock	0.037*** (0.000)	0.032 (0.072)	0.004 (0.060)	0.000 (0.056)	0.020* (0.012)	0.019 (0.012)
Local Credit Shock \times I(Crisis)	-0.084 (0.098)	-0.086 (0.055)	-0.018 (0.053)	-0.019 (0.049)	-0.043*** (0.012)	-0.044*** (0.012)
Ln(Firm Revenue)		-0.175*** (0.020)		-0.114*** (0.014)		-0.044*** (0.003)
Rev. Concentration Index		-0.194*** (0.016)		-0.125*** (0.010)		-0.041*** (0.002)
Ln(Rev. per Product)		0.198*** (0.019)		0.128*** (0.013)		0.050*** (0.004)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.248	0.269	0.218	0.234	0.156	0.163
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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Main Results

Robustness: Alternative Definition of Product

$$Y_{i,t} = \alpha_i + \theta_t + \beta Shock_i \times Crisis_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Panel A: Entry Rates of New Products

	(1)	(2)	(3)	(4)	(5)	(6)
	Entry Rate (All Modules)	Entry Rate (All Modules)	Entry Rate (Old Modules)	Entry Rate (Old Modules)	Entry Rate (New Modules)	Entry Rate (New Modules)
Local Credit Shock \times I(Crisis)	-0.044*** (0.012)	-0.046*** (0.010)	-0.011 (0.008)	-0.012 (0.007)	-0.027*** (0.008)	-0.028*** (0.007)
Ln(Firm Revenue)		-0.132*** (0.005)		-0.054*** (0.003)		-0.074*** (0.004)
Rev. Concentration Index		-0.097*** (0.003)		-0.043*** (0.002)		-0.049*** (0.002)
Ln(Rev. per Product)		0.142*** (0.005)		0.058*** (0.003)		0.079*** (0.004)
Observations	170216	170216	170216	170216	170216	170216
Adjusted R^2	0.207	0.220	0.141	0.148	0.160	0.167
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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Robustness: Placebo Measures of Credit Market Disruptions

Panel A: Entry Rates of New Products

	(1)	(2)	(3)	(4)	(5)	(6)
	Entry Rate (New Modules)					
Local Credit Shock (2005–2008) \times I(Crisis)	-0.000 (0.012)	-0.001 (0.012)				
Local Credit Shock (2011–2014) \times I(Crisis)			-0.012 (0.009)	-0.013 (0.009)		
Local Credit Shock (2012–2015) \times I(Crisis)					-0.010 (0.010)	-0.010 (0.010)
Ln(Firm Revenue)		-0.044*** (0.003)		-0.044*** (0.003)		-0.044*** (0.003)
Rev. Concentration Index		-0.041*** (0.002)		-0.041*** (0.002)		-0.041*** (0.002)
Ln(Rev. per Product)		0.050*** (0.004)		0.050*** (0.004)		0.050*** (0.004)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.156	0.163	0.156	0.163	0.156	0.163
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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Main Results

Robustness: Alternative Fixed Effect Structures

Panel A: Geography-Based Measure of Credit Market Disruption

	(1)	(2)	(3)	(4)	(5)	(6)
	Entry Rate (New Modules)					
Local Credit Shock \times I(Crisis)	-0.018** (0.007)	-0.019*** (0.007)	-0.021*** (0.007)	-0.021*** (0.007)	-0.019** (0.008)	-0.019** (0.008)
Ln(Firm Revenue)		-0.045*** (0.003)		-0.046*** (0.004)		-0.047*** (0.003)
Rev. Concentration Index		-0.040*** (0.002)		-0.040*** (0.002)		-0.039*** (0.002)
Ln(Rev. per Product)		0.050*** (0.004)		0.051*** (0.004)		0.052*** (0.003)
Observations	173445	173445	173445	173445	172285	172285
Adjusted R^2	0.157	0.164	0.160	0.166	0.180	0.186
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Department \times Year Fixed-Effects	Yes	Yes	No	No	No	No
Prod. Category \times Year Fixed-Effects	No	No	Yes	Yes	No	No
Prod. Module \times Year Fixed-Effects	No	No	No	No	Yes	Yes

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Main Results

Geography-based Measure of Credit Market Disruption (II)

$$Y_{i,t} = \alpha_i + \theta_t + \beta Shock_i \times Crisis_t + \Gamma X_{i,t} + \epsilon_{i,t}$$

Panel B: Indicator Variables for Product Introduction

	(1)	(2)	(3)	(4)	(5)	(6)
	I(New Prod=1) (All)	I(New Prod=1) (All)	I(New Prod=1) (Old Modules)	I(New Prod=1) (Old Modules)	I(New Prod=1) (New Modules)	I(New Prod=1) (New Modules)
Local Credit Shock \times I(Crisis)	-0.049* (0.028)	-0.049* (0.026)	-0.028 (0.029)	-0.027 (0.026)	-0.032** (0.014)	-0.032** (0.013)
Ln(Firm Revenue)		0.066*** (0.006)		0.076*** (0.006)		-0.004 (0.007)
Rev. Concentration Index		-0.143*** (0.004)		-0.135*** (0.004)		-0.068*** (0.003)
Ln(Rev. per Product)		-0.035*** (0.006)		-0.048*** (0.005)		0.015** (0.006)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.453	0.460	0.464	0.470	0.210	0.213
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

- Results from regression framework indicate that credit market disruptions affect radical product innovation but not incremental product innovation

Alternative Fixed Effects (Firm-level Measure)

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Alternative Fixed Effects and Product Novelty

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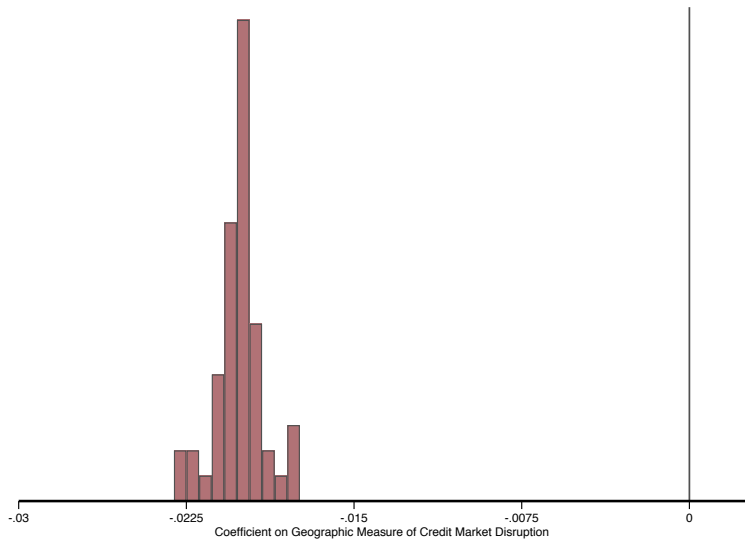
Sales Outside HQ's State and Product Novelty

	(1)	(2)	(3)	(4)	(5)	(6)
	Novelty Index			Novelty Index (Combination)		
Local Credit Shock \times I(Crisis)	-0.012* (0.006)	-0.011 (0.006)	-0.010 (0.009)	-0.019*** (0.002)	-0.017*** (0.003)	-0.018** (0.006)
Ln(Firm Revenue)	-0.008*** (0.002)	-0.008*** (0.002)	-0.007*** (0.002)	-0.011*** (0.001)	-0.011*** (0.002)	-0.009*** (0.002)
Rev. Concentration Index	0.016*** (0.005)	0.015*** (0.004)	0.018*** (0.004)	0.018*** (0.005)	0.017*** (0.004)	0.021*** (0.004)
Ln(Rev. per Product)	0.009*** (0.002)	0.008*** (0.002)	0.007** (0.002)	0.011*** (0.002)	0.011*** (0.002)	0.009*** (0.002)
Observations	35774	34049	27021	35774	34049	27021
Adjusted R^2	0.331	0.331	0.331	0.410	0.411	0.408
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	No	No	No
Subsample (% Sales Outside HQ State)	$\geq 66\%$	$\geq 75\%$	$\geq 90\%$	$\geq 66\%$	$\geq 75\%$	$\geq 90\%$

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Robustness

Eliminating one state at a time



Robustness

Alternative Dependent Variable: Dummy for Product Introduction

	(1)	(2)	(3)	(4)	(5)	(6)
	I(New Prod=1) (All)	I(New Prod=1) (All)	I(New Prod=1) (Old Modules)	I(New Prod=1) (Old Modules)	I(New Prod=1) (New Modules)	I(New Prod=1) (New Modules)
Local Credit Shock \times I(Crisis)	-0.049* (0.028)	-0.049* (0.026)	-0.028 (0.029)	-0.027 (0.026)	-0.032** (0.014)	-0.032** (0.013)
Ln(Firm Revenue)		0.066*** (0.006)		0.076*** (0.006)		-0.004 (0.007)
Rev. Concentration Index		-0.143*** (0.004)		-0.135*** (0.004)		-0.068*** (0.003)
Ln(Rev. per Product)		-0.035*** (0.006)		-0.048*** (0.005)		0.015** (0.006)
Observations	173447	173447	173447	173447	173447	173447
Adjusted R^2	0.453	0.460	0.464	0.470	0.210	0.213
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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Alternative Fixed Effects (Firm-level Measure)

	(1)	(2)	(5)	(6)	(7)	(8)
			Entry Rate (New Modules)			
Local Credit Shock \times I(Crisis)	-0.020** (0.009)	-0.020** (0.009)	-0.026*** (0.009)	-0.027*** (0.009)	-0.019** (0.008)	-0.019** (0.007)
Δ Cnty. HPI \times I(Crisis)	-0.000 (0.005)	0.001 (0.005)				
Ln(Debt to Income Ratio, 2006) \times I(Crisis)						
Ln(Housing Supply Elasticity, Saiz) \times I(Crisis)			-0.003 (0.002)	-0.002 (0.002)		
Housing Net Worth Shock, 2006–2009 \times I(Crisis)					0.007 (0.006)	0.008 (0.006)
Ln(Firm Revenue)		-0.044*** (0.003)		-0.042*** (0.003)		-0.043*** (0.004)
Rev. Concentration Index		-0.041*** (0.002)		-0.041*** (0.003)		-0.041*** (0.003)
Ln(Rev. per Product)		0.050*** (0.004)		0.047*** (0.004)		0.047*** (0.004)
Observations	171466	171466	136546	136546	132925	132925
Adjusted R^2	0.156	0.163	0.162	0.168	0.162	0.168
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

Main Results

Robustness: Firms that do not sell locally

	(1)	(2)	(3)	(4)	(5)	(6)
	Prod. Intro. Rate (New Lines)					
Local Credit Shock \times I(Crisis)	-0.033*** (0.008)	-0.033*** (0.008)	-0.038*** (0.008)	-0.039*** (0.008)	-0.037*** (0.008)	-0.037*** (0.008)
Ln(Firm Revenue)		-0.036*** (0.003)		-0.036*** (0.004)		-0.037*** (0.004)
Rev. Concentration Index		-0.035*** (0.002)		-0.034*** (0.002)		-0.032*** (0.002)
Ln(Rev. per Product)		0.041*** (0.003)		0.041*** (0.003)		0.041*** (0.004)
Observations	101817	101817	96853	96853	80471	80471
Adjusted R^2	0.113	0.119	0.113	0.119	0.110	0.116
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Subsample (% Sales Outside HQ State)	$\geq 66\%$	$\geq 66\%$	$\geq 75\%$	$\geq 75\%$	$\geq 90\%$	$\geq 90\%$

- ▶ About 50% of firms more than 90% sales outside HQ state
- ▶ Results are not driven by firms with significant exposure to local demand shocks.

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Main Results

Heterogeneity by Degree of Durability

	All Product Lines		Old Product Lines		New Product Lines	
	High	Low	High	Low.	High	Low
Local Credit Shock \times I(Crisis)	-0.073** (0.030)	-0.020 (0.028)	-0.031 (0.026)	-0.000 (0.023)	-0.026*** (0.009)	-0.015* (0.008)
Ln(Firm Revenue)	-0.173*** (0.014)	-0.195*** (0.014)	-0.112*** (0.008)	-0.131*** (0.009)	-0.043*** (0.005)	-0.046*** (0.005)
Rev. Concentration Index	-0.181*** (0.009)	-0.180*** (0.009)	-0.120*** (0.005)	-0.121*** (0.006)	-0.036*** (0.003)	-0.035*** (0.003)
Ln(Rev. per Product)	0.187*** (0.012)	0.222*** (0.014)	0.121*** (0.008)	0.149*** (0.009)	0.046*** (0.004)	0.052*** (0.005)
Observations	78802	93370	78802	93370	78802	93370
Adjusted R^2	0.279	0.287	0.243	0.241	0.176	0.191
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

- ▶ Results are more pronounced in the subset of durable products

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Robust

Cross-Sectional Heterogeneity

	Large	Small	Low Δ^- Loans	Hi Δ^- Loans	Hi. Lehman	Low Lehman
	Prod. Intro. Rate (New Lines)					
Firm Credit Shock \times I(Crisis)	0.010 (0.006)	-0.067*** (0.018)	-0.030* (0.017)	-0.047** (0.021)	-0.061*** (0.019)	-0.026 (0.017)
Ln(Firm Revenue)	-0.017 (0.014)	-0.062* (0.032)	-0.028 (0.019)	-0.062* (0.035)	-0.038 (0.044)	-0.068*** (0.025)
Rev. Concentration Index	-0.087*** (0.020)	-0.040 (0.028)	-0.080 (0.050)	-0.017 (0.035)	0.008 (0.028)	-0.091* (0.050)
Ln(Rev. per Product)	0.041* (0.018)	0.057* (0.027)	0.025 (0.027)	0.062 (0.041)	0.036 (0.053)	0.061** (0.024)
Observations	844	821	809	935	674	1070
Adjusted R^2	0.294	0.201	0.218	0.239	0.168	0.276
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

- Effects also concentrated in smaller firms and in firms whose lenders cut back lending to a greater extent or were more exposed to Lehman

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Novelty index I

- ▶ Represent product i in product module m as a vector of characteristics $V_i^m = [v_{i1}^m, v_{i2}^m, \dots, v_{iK^m}^m]$.
- ▶ K^m – the number of attributes (e.g. color, formula) we observe in product module m , v_{ik}^m is characteristic (e.g. blue, red).
- ▶ Ω_t^m – set of product characteristics for each product ever sold in module m by time t .
- ▶ Then the *newness index* of a product i in product module m , launched at time t is defined as follows:

$$\text{Newness}_{i(t)}^{(m)} = \sum_{k=1}^{K^m} \omega_k^m 1[v_{ik}^m \notin \Omega_t^m],$$

where ω_k^m represents the module-specific weight given to new characteristics within attribute k .

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Novelty index II

- ▶ Quantify importance of each attribute by estimating ω_k^m using hedonic methods.
- ▶ A linear characteristics model using the time-dummy method.
- ▶ Pooling data across products and periods, estimate non-negative LS, \forall module:

$$p_{it} = \sum_j \pi^j x_i^j + \lambda_t + \epsilon_{it},$$

where i denotes the product, j is the characteristic, and t is the time period (years).

x_i^j – dummy for a given characteristic.

- ▶ π^j – the shadow price for each characteristics.
- ▶ ω_k^m is the average contribution of the characteristic within each attribute to the price normalized so that $\sum_{k=1}^{K^m} \omega_k^m = 1$.

Newness index III. Pain Remedies - Headache

- ▶ Brand (310 distinct): Tylenol, Excedrin, Advil, Aleve
- ▶ Flavor (35 distinct): regular, orange, grape, cherry
- ▶ Container (17 distinct): pack, bottle, box, case, tube
- ▶ Style (3 distinct): children, regular, ACM
- ▶ Form (47 distinct): caplet, capsule, tablet, gelcap, powder
- ▶ Generic (2 distinct): yes or no
- ▶ Formula (25 distinct): regular, extra strength, rapid release, extended release
- ▶ Type (74 distinct): aspirin, aspirin caffeine, ibuprofen, naproxen
- ▶ Consumer (30 distinct): trauma, migraine, menstrual, arthritis
- ▶ Size (89 distinct): caplet (100, 250, 500), tablet (24, 30, 36)

Newness index: Alternatives

► Alternative measures:

1. Equal weights for each attribute.
2. Revenue-based weights for each attribute.
3. Weighting by inverse of distinct characteristics within an attribute.
4. Account for new combination of characteristics across attributes.

Newness index: External validation

- ▶ Revenue growth higher for products with higher newness.
- ▶ Lifecycle of products is longer.

Table: Newness Measure: Correlation with Firm Outcomes

	(1) Growth rate (DH)	(2) Growth rate (New)	(3) Duration 4q	(4) Duration 16q
Newness(t)	0.1476*** (0.019)	0.2773*** (0.005)	0.1172*** (0.007)	0.1118*** (0.012)
Log N(t)	0.1946*** (0.004)	0.0224*** (0.001)	0.0274*** (0.002)	0.0190*** (0.003)
Observations	93,290	112,218	97,692	54,148
R-squared	0.383	0.597	0.477	0.569
Time-Category	Y	Y	Y	Y
Firm-Category	Y	Y	Y	Y