

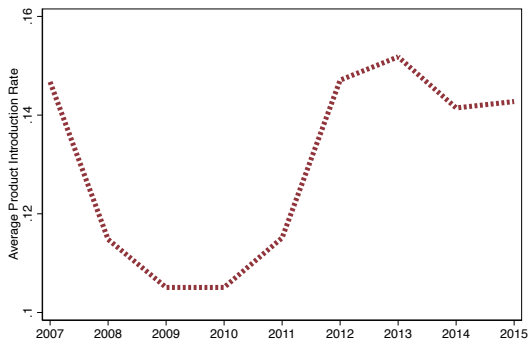
# Product Innovation and Credit Market Disruptions

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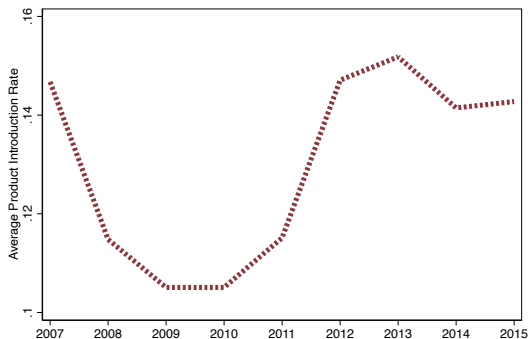
September 29-30, 2021  
4th IMF Macro-Financial Research Conference

# 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**

# Motivation

## Why focus on product innovation?

[Introduction of new 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



# This Paper

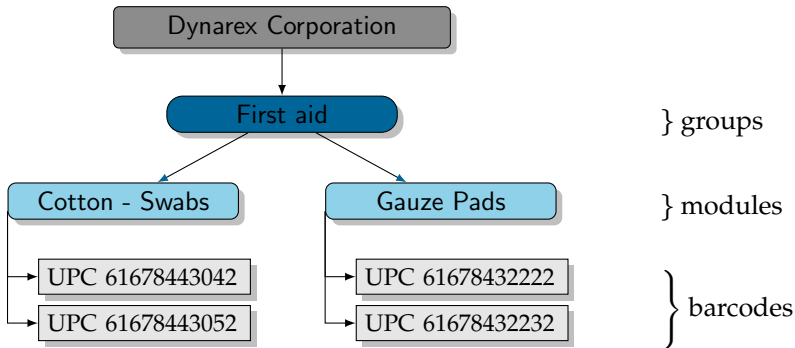
## **What is the impact of credit market disruptions on innovation rates and what type of product innovations are most affected?**

- ▶ 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 performance
  - ▶ How does initial exposure to credit market disruptions affect sales of new product lines?

# 1. MEASURES OF PRODUCT INNOVATION

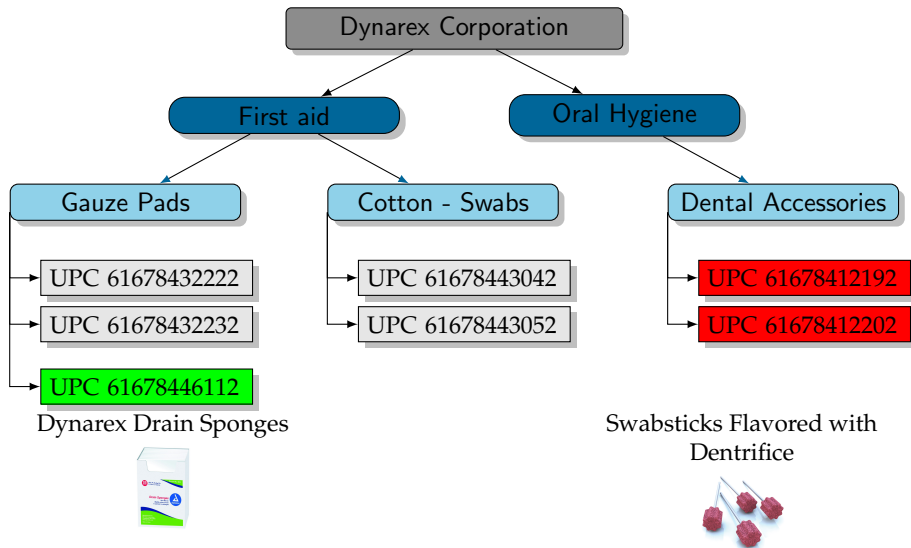
# Types of Product Innovation

Example: Portfolio of a firm



# Types of Product Innovation

Example: Change in the portfolio of the firm



# Types of Product Innovation

Different levels of initial investment and incremental revenue

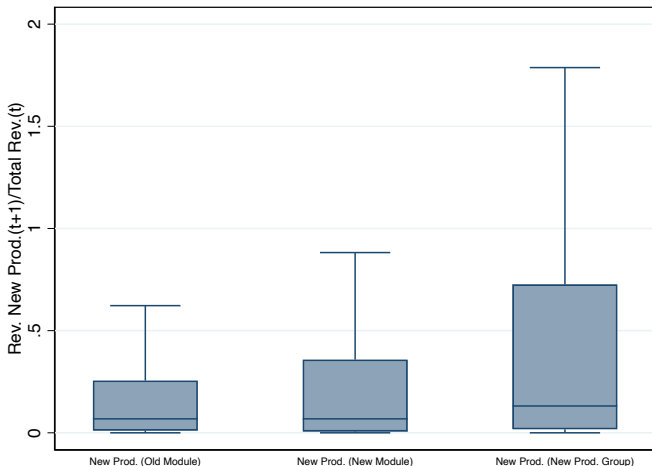
$$Y_{it} = \sum_{j=-2}^{j=+2} \beta_j^0 \text{Entry Rate (Old Lines)}_{it+j} + \sum_{j=-2}^{j=+2} \beta_j^1 \text{Entry Rate (New Lines)}_{it+j} + \Gamma X_{it} + \gamma_t + \delta_i + \epsilon_{it}$$

	Ln(Nbr. Establishments)		I(New Establishment=1)	
Entry Rate (Old Lines) <sub>t-2</sub>	-0.001 (0.004)	-0.002 (0.005)	0.006 (0.006)	0.006 (0.006)
Entry Rate (Old Lines) <sub>t-1</sub>	0.003 (0.006)	0.002 (0.006)	0.024*** (0.006)	0.024*** (0.006)
Entry Rate (Old Lines) <sub>t</sub>	0.009 (0.008)	0.010 (0.009)	0.015* (0.008)	0.026*** (0.007)
Entry Rate (Old Lines) <sub>t+1</sub>	0.004 (0.006)	0.006 (0.006)	0.005 (0.007)	-0.001 (0.007)
Entry Rate (Old Lines) <sub>t+2</sub>	-0.003 (0.006)	-0.001 (0.006)	0.010 (0.008)	0.003 (0.008)
Entry Rate (New Lines) <sub>t-2</sub>	0.001 (0.009)	0.001 (0.009)	0.015 (0.012)	0.019 (0.012)
Entry Rate (New Lines) <sub>t-1</sub>	0.022** (0.010)	0.023** (0.009)	0.032** (0.012)	0.035*** (0.012)
Entry Rate (New Lines) <sub>t</sub>	0.028** (0.012)	0.030** (0.012)	0.056*** (0.014)	0.072*** (0.014)
Entry Rate (New Lines) <sub>t+1</sub>	0.028* (0.014)	0.030** (0.015)	0.042** (0.017)	0.040** (0.017)
Entry Rate (New Lines) <sub>t+2</sub>	0.025* (0.014)	0.027* (0.014)	0.032* (0.017)	0.032* (0.017)
Observations	49140	49140	50846	50846
Adjusted R <sup>2</sup>	0.967	0.967	0.028	0.036

- ▶ New products in new product lines more likely to be preceded new plant capacity

# 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

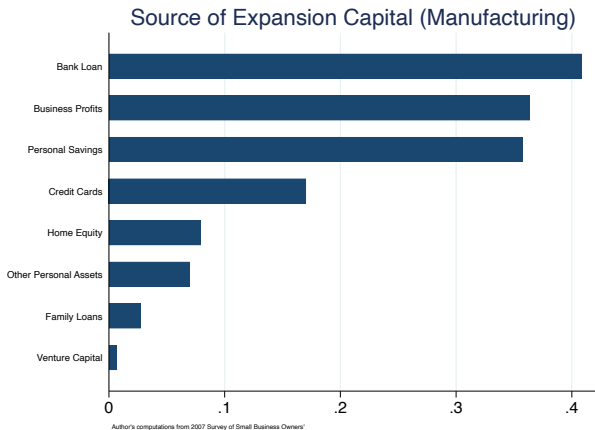
Novelty Indices Formal Definition

Novelty and Firm Performance



## 2. MEASURES OF CREDIT MARKET DISRUPTIONS

# Why Bank Financing?

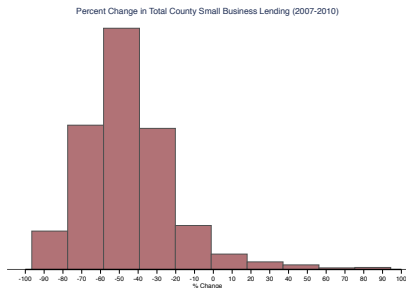
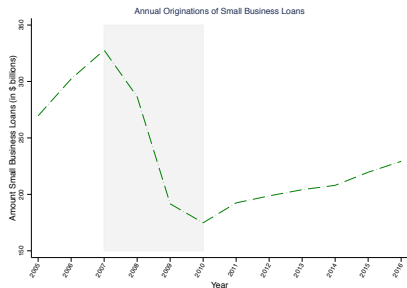


► Robb and Robinson (2014):

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
- ▶ 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

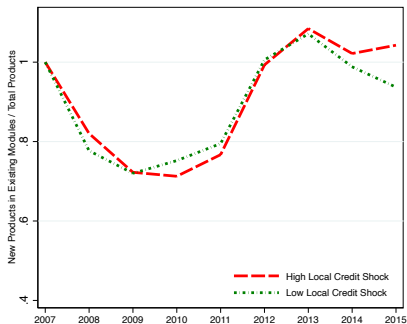
- ▶ Compute preexisting **firm-level variation** in the need to access external financing during a time of significant contraction in the syndicated lending markets
  - ▶ Hand-match the RMS product-level and firm-level dataset with LPC syndicated loan dataset.
  - ▶ Share of long-term syndicated debt 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

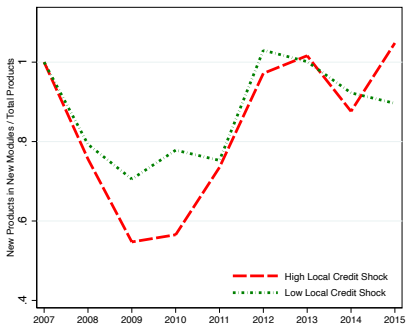
# Descriptive Statistics

## Product Introduction Rates by Innovation Type

Old Product Lines



New Product Lines



- 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

- Credit-market disruptions account for approximately 30% of the total decline in new product in new product lines during the Global Financial Crisis.



# 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.

# Main Results

## Cross-Sectional Heterogeneity

	Entry Rate (New lines)			
Local Credit Shock $\times$ I(Crisis)	-0.090*** (0.033)	-0.088*** (0.033)	-0.005 (0.010)	-0.007 (0.010)
Local Credit Shock $\times$ I(Crisis) $\times$ Old Firm	0.079** (0.034)	0.076** (0.033)		
Local Credit Shock $\times$ I(Crisis) $\times$ Hi. Debt Dep.			-0.028** (0.012)	-0.025* (0.013)
Observations	173447	173447	154705	154705
Adjusted $R^2$	0.156	0.163	0.162	0.170
Other Controls	No	Yes	No	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes

- Cross-sectional heterogeneity in the impact of local credit shocks consistent with a credit frictions channel

# 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:

- ▶ Product Line-Year Fixed Effects (Geographic Measure) ▶ Product Line FE
- ▶ Product Line-Year Fixed Effects (Firm Measure) ▶ Product Line 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
- ▶ Patent-Based Measure of Innovation? ▶ Patents

## 3. Alternative Explanations:

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

## 4. Cross-Sectional Heterogeneity:

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

## 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

	Ln( $\frac{\text{Rev}}{\text{Prod.}}$ ) (1)	Ln(Prod) (2)	Ln( $\frac{\text{Rev}}{\text{DMA}}$ ) (3)	Ln(DMA) (4)	Ln( $\frac{\text{Rev}}{\text{Chain}}$ ) (5)	Ln(Chains) (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

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- ▶ (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
- ▶ (2) Conditional on entry, new products are less novel
- ▶ (3) New product lines are less successful

# Literature on the impact of financial constraints

Many papers! Can be compared on the following categories:

- ▶ **What variable is affected?** R&D, physical investment, intangible investment, productivity, employment [most using variation from publicly traded firms or sample of firms]
  - ▶ This paper: product innovation
- ▶ **How it affects?** short/long term investment
  - ▶ This paper: nature of product innovation: improvements/ radical
- ▶ **what firms are affected?** small/large, young/young, entrants/incumbents
  - ▶ This paper: nearly universe of firms in consumer goods sector
- ▶ **Does it matter for the aggregate? Needs theory!**
  - ▶ This paper: Evidence supporting persistent effects

# 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)	(2)	(3)	(4)	(5)	(6)
	Ln(1+New Prod.) (All)	Ln(1+New Prod.) (All)	Ln(1+New Prod.) (Old)	Ln(1+New Prod.) (Old)	Ln(1+New Prod.) (New)	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

► Go Back

# 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 (All Modules)	Entry Rate (Old Modules)	Entry Rate (Old Modules)	Entry Rate (New 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

▶ Go Back

# 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

▶ Go Back



# Main Results

## 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*	-0.049*	-0.028	-0.027	-0.032**	-0.032**
	(0.028)	(0.026)	(0.029)	(0.026)	(0.014)	(0.013)
Ln(Firm Revenue)		0.066***		0.076***		-0.004
		(0.006)		(0.006)		(0.007)
Rev. Concentration Index		-0.143***		-0.135***		-0.068***
		(0.004)		(0.004)		(0.003)
Ln(Rev. per Product)		-0.035***		-0.048***		0.015**
		(0.006)		(0.005)		(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

# Robustness

## Alternative Fixed Effects (Firm-level Measure)

	(1)	(2)	(3)	(4)	(5)	(6)
	Entry Rate (New Modules)					
Firm Credit Shock $\times$ I(Crisis)	-0.036*** (0.011)	-0.037*** (0.006)	-0.065*** (0.017)	-0.059*** (0.017)	-0.065* (0.031)	-0.070* (0.035)
Ln(Firm Revenue)		-0.059** (0.018)		-0.076*** (0.020)		-0.067 (0.040)
Rev. Concentration Index		-0.048** (0.019)		-0.089** (0.035)		0.018 (0.045)
Ln(Rev. per Product)		0.056*** (0.014)		0.070*** (0.015)		0.043 (0.050)
Observations	1740	1740	1445	1445	825	825
Adjusted $R^2$	0.236	0.240	0.290	0.300	0.210	0.208
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

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# Robustness

## Alternative Fixed Effects and Product Novelty

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Novelty Index)			Ln(Novelty Index (Combination))		
Local Credit Shock $\times$ I(Crisis)	-0.012 (0.007)	-0.017* (0.007)	-0.016* (0.008)	-0.022** (0.007)	-0.028*** (0.008)	-0.028** (0.010)
Ln(Firm Revenue)	-0.008*** (0.002)	-0.008*** (0.002)	-0.008*** (0.002)	-0.011*** (0.002)	-0.011*** (0.002)	-0.011*** (0.001)
Rev. Concentration Index	0.016*** (0.004)	0.015*** (0.004)	0.012** (0.005)	0.017*** (0.004)	0.017*** (0.004)	0.014** (0.005)
Ln(Rev. per Product)	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.011*** (0.002)	0.011*** (0.002)	0.011*** (0.001)
Observations	52726	52706	50969	52726	52706	50969
Adjusted $R^2$	0.331	0.334	0.348	0.397	0.399	0.409
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Department $\times$ Year Fixed-Effects	Yes	No	No	Yes	No	No
Prod. Group $\times$ Year Fixed-Effects	No	Yes	No	No	Yes	No
Prod. Module $\times$ Year Fixed-Effects	No	No	Yes	No	No	Yes

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# Robustness

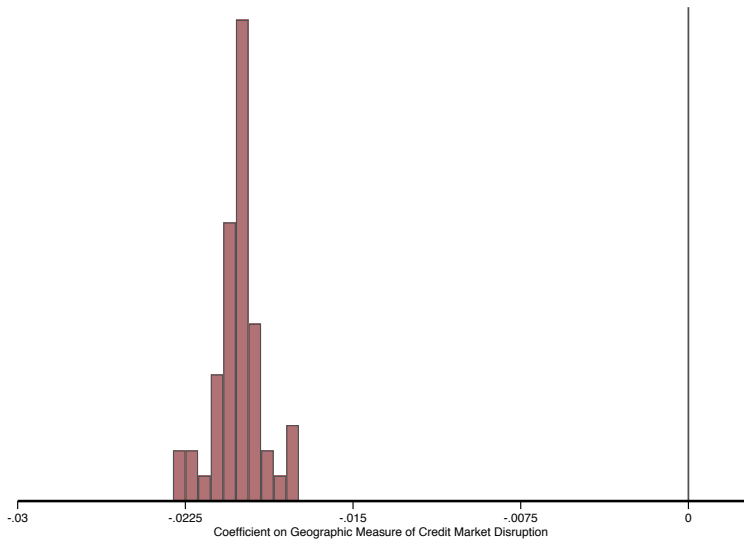
## Sales Outside HQ's State and Product Novelty

	(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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# Robustness

## Controlling for Local Indicators of Economic Conditions

	(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)	-0.046*	-0.050**	-0.018	-0.020	-0.019***	-0.020***
	(0.026)	(0.024)	(0.021)	(0.019)	(0.007)	(0.006)
Ln(Unemployment Rate) $\times$ I(Crisis)	0.014*	0.014*	0.014**	0.013**	0.001	0.001
	(0.008)	(0.008)	(0.006)	(0.006)	(0.003)	(0.002)
Ln(Cnty Inc. pc) $\times$ I(Crisis)	0.026***	0.022***	0.018***	0.016***	0.004**	0.003**
	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
Ln(Unemployment Rate)	-0.032***	-0.031***	-0.009	-0.009	-0.016***	-0.015***
	(0.011)	(0.010)	(0.009)	(0.009)	(0.004)	(0.004)
Ln(Cnty Inc. pc)	-0.007	-0.013	0.010	0.006	-0.015	-0.017
	(0.029)	(0.028)	(0.018)	(0.017)	(0.014)	(0.014)
Ln(Firm Revenue)		-0.175***		-0.113***		-0.044***
		(0.012)		(0.006)		(0.003)
Rev. Concentration Index		-0.195***		-0.126***		-0.041***
		(0.006)		(0.004)		(0.002)
Ln(Rev. per Product)		0.198***		0.128***		0.050***
		(0.011)		(0.006)		(0.004)
Observations	172189	172189	172189	172189	172189	172189
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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# Robustness

## 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)
$\Delta$ 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

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# 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 $\Delta^-$ Loans	Hi $\Delta^-$ 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 II

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

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

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

$a_i^j$  – dummy for a given characteristic.

- ▶  $\pi^j$  – the shadow price for each characteristics.
- ▶  $\omega_k^m$  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.

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# 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)	(2)	(3)	(4)
	Growth rate (DH)	Growth rate (New)	Duration 4q	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

# 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

## Robustness: Patents

	(1)	(2)	(3)	(4)	(5)	(6)
	$\frac{\text{Nbr. Patents}_t}{\text{Nbr. Products}_{t-1}}$	$\frac{\text{Nbr. Patents}_t}{\text{Nbr. Products}_{t-1}}$	$\frac{\text{Nbr. Product Patents}_t}{\text{Nbr. Products}_{t-1}}$	$\frac{\text{Nbr. Product Patents}_t}{\text{Nbr. Products}_{t-1}}$	$\frac{\text{Nbr. CPG-Product Patents}_t}{\text{Nbr. Products}_{t-1}}$	$\frac{\text{Nbr. CPG-Product Patents}_t}{\text{Nbr. Products}_{t-1}}$
Local Credit Shock $\times$ I(Crisis)	-0.636 (0.921)	-0.689 (0.946)	-0.379 (0.296)	-0.388 (0.290)	-0.357** (0.172)	-0.358** (0.170)
Ln(Firm Revenue)		-0.384 (0.476)		-0.134 (0.162)		-0.077 (0.090)
Rev. Concentration Index		0.012 (1.111)		-0.501 (0.534)		-0.409 (0.339)
Ln(Rev. per Product)		0.789 (0.493)		0.305* (0.167)		0.177* (0.093)
Observations	161359	161359	161066	161066	158462	158462
Adjusted $R^2$	0.708	0.708	0.808	0.808	0.815	0.815
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

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