

Multi-Product Firms and the Dynamics of Product Mix

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Questions

How prevalent are multi-product (MP) firms and product switching?

- Large literatures focus on firm growth, entry/exit
- What about firms' product-market entry/exit?

How do firms' add and drop products?

- Within existing facilities?
- New plants?
- Via mergers and acquisitions (M&A)?

Why do firms switch products? What are the implications?

Data

- U.S. Census of Manufactures
 - Covers all U.S. manufacturing firms
 - Conducted every fifth year, 1972 to 1997
 - Collected at the establishment (plant) level
 - We aggregate to firms, ~140,000 per year
- In each Census year, we observe
 - Firm inputs of capital, labor, skill
 - Firm's mix of products

We Define "Product" as a 5-digit SIC Code

	SIC	Description
Sector →	33	Primary Metal Industries
Industry →	3357	Nonferrous Wiredrawing and Insulating
Products {	33571	Aluminum Wire
	33572	Copper Wire
	33573	Other Nonferrous Metal Wire
	33575	Nonferrous Wire Cloth
	33576	Apparatus Wire and Cord Sets
	33577	Magnet Wire
	33578	Power Wire
	3357A	Electronic Wire
	3357B	Telephone Wire
	3357C	Control Wire
	3357D	Building Wire
3357E	Other Wire NES	
	33579	Fiber Optic Cable

In U.S. manufacturing there are 20 sectors, 450 industries, 1848 products

The typical sector has 24 industries and 76 products

Source: U.S. Census Bureau (1996).

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Characteristics of MP Firms

Breakdown of Firm Types

(Averages across census years, 1972 to 1997)

Type of Firm	Percent of Firms	Percent of Output	Mean Products, Industries or Sectors per Firm
Single-Product	59	9	1
Multiple-Product	41	91	4.0

Multi-product (MP) firms are a minority but they dominate U.S. production

Breakdown of Firm Types

(Averages across census years, 1972 to 1997)

Type of Firm	Percent of Firms	Percent of Output	Mean Products, Industries or Sectors per Firm
Single-Product	59	9	1
Multiple-Product	41	91	4.0
Multiple-Industry	29	87	3.1
Multiple-Sector	13	76	2.5

Multi-industry and multi-sector firms are even rarer but also disproportionately large

Characteristics of MP Firms

(Percent differences, 1997)

	Multiple Product v Single Product
Output	0.77
Employment	0.66
Wages	0.08
Production Worker Wages	0.08
Non-Production Worker Wages	0.05
Probability of Export	0.13
Labor Productivity	0.10
TFP	0.01

Multi-product (MP) firms are larger, more productive, pay higher wages and are more likely to export than SP firms;
Differences are similar in other years

Characteristics of MP Firms

(Percent differences, 1997)

	Multiple Product v Single Product	Multiple Industry v Single Industry	Multiple Sector v Single Sector
Output	0.77	0.77	0.92
Employment	0.66	0.68	0.83
Wages	0.08	0.06	0.05
Production Worker Wages	0.08	0.06	0.05
Non-Production Worker Wages	0.05	0.03	0.03
Probability of Export	0.13	0.13	0.15
Labor Productivity	0.10	0.08	0.09
TFP	0.01	0.04	0.00

Similar trends for multi-industry and multi-sector firms vs single-industry and single-sector firms

Distribution of Shipments within Firms

(Averages across census years)

		Number of Products Produced by the Firm									
		1	2	3	4	5	6	7	8	9	10
Average Share of Product in Firm's Output (High to Low)	1	100	81	71	64	59	55	52	50	48	45
	2		19	22	23	22	22	21	21	21	20
	3			7	10	11	11	12	12	12	12
	4				4	6	6	7	7	8	8
	5					2	4	4	5	5	5
	6						2	2	3	3	4
	7							1	2	2	2
	8								1	1	2
	9									1	1
	10										1

MP firms generally have a dominant product;
Relative dominance declines with number of products

Product Co-Production within Firms

(Average number firms by 2-digit sector across 1972 to 1997)

Sector	20	22	23	31	24	25	26	27	30	28	29	32	33	34	35	37	36	38	39
20 Food	2,479	25	210	19	30	22	51	46	75	178	23	41	32	75	79	27	36	35	37
22 Textile	5	512	249	25	32	38	62	38	132	85	19	41	42	80	77	35	46	49	59
23 Apparel	210	249	1,839	125	206	192	179	188	344	263	66	187	223	825	1,057	220	263	210	335
31 Leather	19	25	125	147	16	19	19	20	58	24	.	14	13	34	29	12	19	23	46
24 Lumber	30	32	206	16	2,846	429	87	47	157	75	20	91	59	213	118	68	68	48	86
25 Furniture	22	38	192	19	429	1,203	52	44	154	45	10	98	60	237	188	65	101	75	104
26 Paper	51	62	179	19	87	52	538	408	239	116	31	61	56	154	142	38	64	70	92
27 Printing & Publishing	46	38	188	20	47	44	408	6,510	134	92	35	48	52	187	152	57	90	69	253
30 Rubber & Plastic	75	132	344	58	157	154	239	134	1,187	319	59	209	215	572	910	187	271	221	243
28 Chemicals	178	85	263	24	75	45	116	92	319	1,297	160	159	139	235	288	88	146	165	150
29 Petroleum	23	19	66	.	20	10	31	35	59	160	128	146	39	57	63	27	36	27	21
32 Stone & Concrete	41	41	187	14	91	98	61	48	209	159	146	1,097	122	267	236	83	131	96	70
33 Primary Metal	32	42	223	13	59	60	56	52	215	139	39	22	847	615	789	162	225	127	78
34 Fabricated Metal	75	80	825	34	213	237	154	187	572	235	57	267	615	4,203	2,311	456	522	336	242
35 Industrial Machinery	79	77	1,057	29	118	188	142	152	910	288	63	236	789	2,311	4,887	571	688	464	226
37 Transportation	27	35	220	12	68	65	38	57	187	88	27	83	162	456	571	860	246	159	71
36 Electronic	36	46	263	19	68	101	64	90	271	146	36	131	225	522	688	246	1,254	511	135
38 Instruments	35	49	210	23	48	75	70	69	221	165	27	96	127	336	464	159	511	680	112
39 Miscellaneous	37	59	335	46	86	104	92	253	243	150	21	70	78	242	226	71	135	112	1,137

Dark shading: co-production more likely than random
 Light shading: co-production less likely than random
 No shading: co-production indistinguishable from random

Prevalence of Product Switching

Prevalence of Product Switching

(Percent of surviving firms; averages across census years)

Firm Activity	Percent of Firms
None	32
Drop Product(s) Only	12
Add Product(s) Only	11
Both Add and Drop Products	45

Firms can be classified according to four mutually exclusive behaviors

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On average, 68 percent of surviving manufacturing firms add and/or drop a product over a five-year period

A majority (45/68) of them does both

How Do Firms Switch Products?

(Averages across census years)

Firm Adds Product(s) via:	Percent of Firms	
	All Product Additions	Product Adds That Result in Adding a Sector
Existing Plant(s) Only	94.3	88.7
Acquired Plant(s) Only	0.4	1.9
New Plant(s) Only	1.6	6.0
Combination	3.6	3.5

Firm Drops Product(s) via:	Percent of Firms	
	All Product Drops	Product Drops That Result in Dropping a Sector
Existing Plant(s) Only	94.1	89.1
Divested Plant(s) Only	0.2	1.4
Closing Plant(s) Only	2.0	5.8
Combination	3.7	3.6

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M&A accounts for very little adding and dropping of products;
A bit more important for sectors

Product Switching at M&A vs No M&A Firms

(Averages across Census Years)

Firm Activity	Product Switching	
	No M&A	With M&A
None	32	5
Drop Only	12	5
Add Only	11	17
Both Add and Drop	44	73

Though M&A accounts for relatively little product switching, product switching is more prevalent at firms engaging in M&A

Aggregate and Micro Importance of Product Switching

Aggregate Importance of Product Switching

Overall growth in U.S. manufacturing can be decomposed according to the contributions of

– Entering/exiting firms

– Continuing firms

- Added/dropped products

- Growth/decline of continuing products

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“Extensive” Margin

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“Intensive” Margin

Change in Overall U.S. Real Manufacturing Growth, 1972-97

(Net contributions)

Period	Aggregate Growth	Source of Growth								
		Entry and Exit			Extensive Margin			Intensive Margins		
		Net	Firm Births	Firm Deaths	Net	Added Products	Dropped Products	Net	Growing Products	Shrinking Products
1972-77	9	0	8	-9	-1	24	-24	10	22	-12
1977-82	-4	-3	10	-12	2	30	-28	-3	15	-19
1982-87	13	-2	16	-18	5	45	-40	10	24	-13
1987-92	10	0	15	-15	5	36	-31	5	18	-14
1992-97	27	2	16	-14	4	33	-29	21	32	-11
Total Change	65	-3	73	-76	19	189	-170	50	127	-77
% Total Change	100	-5	112	-118	29	291	-262	77	195	-119

Total change for 1972-97 is 65%

Net firm entry/exit: -3%

Net adding/dropping: 19%

Net growth/declining: 50%

Change in Overall U.S. Real Manufacturing Growth, 1972-97

(Gross contributions)

Period	Aggregate Growth	Source of Growth								
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Total Change	65	-3	73	-76	19	189	-170	50	127	-77
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The gross contribution of product adding/dropping is larger than the gross contribution of entry/exit

Product Switching Often Extends Firms' Scope

(Percent of surviving firms; averages across census years)

Firm Activity	Percent of Firms		
	Product Activity	Industry Activity	Sector Activity
None	32	53	79
Drop Only	12	13	8
Add Only	11	13	7
Both Add and Drop	45	21	7

Product switching often pushes firms into new industries and sectors

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Firm Outcomes and Product Switching

(Percent change in firm characteristics vs firms that do nothing; all years)

	Drop Only	Add Only	Both Add and Drop	Obs	R ²
Δ Output	-0.0140 *** 0.0007	0.0203 *** 0.0007	0.0055 *** 0.0005	447,399	0.05
Δ Employment	-0.0159 *** 0.0006	0.0184 *** 0.0006	0.0057 *** 0.0005	447,399	0.02
Δ Wages	0.0009 *** 0.0004	0.0017 *** 0.0004	0.0011 *** 0.0003	447,399	0.03
Δ Shipments/Worker	0.0014 ** 0.0006	0.0013 ** 0.0006	0.0006 0.0004	273,927	0.03

Notes: OLS regressions of log changes in firm characteristics (first column) on set of dummy variables describing firm product switching activity vs doing nothing. Regressions include all years of sample and industry as well as year fixed effects.

Dropping associated with declining size;
Adding/both associated with growth

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All activities associated with growing wages, productivity

Why Do Firms Switch Products?

(Results of regression analysis)

- Dropping
 - “Low-productivity” firms tend to drop products, i.e., firms that are relatively young, relatively small
 - Firms tend to drop “low-productivity” products, i.e., those that are relatively young or small
- Adding
 - “High-productivity” firms are more likely to add products

Implications of Product Switching

- In a closed economy
 - Self-selection of most productive firms into product markets
 - Reallocation of economic activity within firms towards more productive uses
- Extension to international trade
 - Trade liberalization induces firms to focus on “core competencies”
 - Firms drop lowest-productivity products, expand and export highest-productivity products
 - This effect is strongest in comparative advantage industries

Conclusions

MP firms dominate U.S. manufacturing

- 2/3 of firms alter product mix every five years
- Product switching is primarily in-house
- More-productive firms add; less-productive drop

Product switching is important

- 1/3 of overall growth is due to net adding/dropping
- Firms that switch products have “better” outcomes

Firms self-select into product markets

- Product switching, firm entry/exit induce productivity growth both within and across firms

Thank You

Table 2: Products per Sector and Industry

Two-Digit SIC Sector	Industries	Products	Products/ Industry
20 Food	49	157	3.2
22 Textile	23	79	3.4
23 Apparel	31	75	2.4
24 Lumber	17	59	3.5
25 Furniture	13	36	2.8
26 Paper	17	55	3.2
27 Printing & Publishing	14	72	5.1
28 Chemicals	29	102	3.5
29 Petroleum	5	15	3.0
30 Rubber & Plastics	15	63	4.2
31 Leather	11	12	1.1
32 Stone & Concrete	26	47	1.8
33 Primary Metal	26	89	3.4
34 Fabricated Metal	38	135	3.6
35 Industrial Machinery	51	187	3.7
36 Electronic	37	111	3.0
37 Transportation	18	65	3.6
38 Instruments	17	44	2.6
39 Miscellaneous	18	53	2.9

Why Do Firms Switch Products?

- Product explanations
 - E.g., firms add hot products, drop cold products
 - Problem: add, drop rates are correlated
- Firm explanations
 - E.g., positive shock induces firms to add products
 - Problem: firms simultaneously add, drop
- Firm-product explanations
 - Decision based on firm, product and firm-product characteristics
 - Firms drop low-productivity products
 - Firms add high-productivity products

Table 13: Which Products do Firms Drop?
 (Linear probability model; drops between 1992 and 1997)

	Drop Product	Drop Product	Drop Product
Relative Product Size	-0.0419 *** 0.0003	-0.0684 *** 0.0004	-0.0370 *** 0.0012
Relative Product Tenure	-0.1200 *** 0.0015	-0.0625 *** 0.0023	-0.1388 *** 0.0034
Relative Firm Size	0.0690 *** 0.0019	0.0408 *** 0.0047	0.0568 *** 0.0037
Relative Firm Age	0.0361 *** 0.0011	0.0182 *** 0.0028	0.0336 *** 0.0017
Number of Products	0.0011 *** 0.0000	0.0015 *** 0.0004	0.0011 *** 0.0001
Fixed Effects	No	Firm	Product
R-Squared	0.05	0.33	0.14
Observations	782,486	782,487	782,488

Firms tend to drop relatively small/young products

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Relative Product Tenure	-0.1200 *** 0.0015	-0.0625 *** 0.0023	-0.1388 *** 0.0034
Relative Firm Size	0.0690 *** 0.0019	0.0408 *** 0.0047	0.0568 *** 0.0037
Relative Firm Age	0.0361 *** 0.0011	0.0182 *** 0.0028	0.0336 *** 0.0017
Number of Products	0.0011 *** 0.0000	0.0015 *** 0.0004	0.0011 *** 0.0001
Fixed Effects	No	Firm	Product
R-Squared	0.05	0.33	0.14
Observations	782,486	782,487	782,488

Firms are more likely to drop if they are smaller/younger
 or if they already produce lots of products

Table 14: Which SP Firms are More Likely to Add?
 (Linear probability model; SP firm adds 1972 to 1997)

	Add	Add	Add	Add
TFP	0.0541 *** 0.0065	0.0592 *** 0.0065		
ln(Output/Worker)			0.0294 *** 0.0025	0.0369 *** 0.0027
ln(Employment)		0.0512 *** 0.0023		0.0710 *** 0.0025
ln(Age)		0.0028 *** 0.0004		0.0025 *** 0.0003
Year Fixed Effects	Yes	Yes	Yes	Yes
Product Fixed Effects	Yes	Yes	Yes	Yes
R-Squared	0.06	0.08	0.16	0.16
Observations	331,431	331,431	503,348	503,348

Adding by SP firms increases with their productivity, size and age

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