RIETI Discussion Paper Series 13-E-069

Multi-Product Plants and Product Switching in Japan

Andrew B. BERNARD
Tuck School of Business at Dartmouth

OKUBO Toshihiro
Keio University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 13-E-069

August 2013

Multi-Product Plants and Product Switching in Japan*

Andrew B. BERNARD†

Tuck School of Business at Dartmouth, CEPR & NBER

OKUBO Toshihiro‡

Keio University

Abstract

This paper explores the role of multi-product plants and product switching in the Japanese manufacturing sector. While a substantial body of work has explored the importance of the extensive margins of plant entry and exit in employment and output flows, only recently has research begun to examine the adjustment across products within establishments and its importance for plant and aggregate output and employment flows. Using a novel, annual plant-product dataset covering all Japanese manufacturing plants with more than four employees from 1992 to 2006, we provide the first evidence on the role of multi-product plants in the Japanese manufacturing sector and how the product mix and the plant mix have changed over time. Unlike previous studies, we are able to track annual changes in the product mix. The period covers a major decline in manufacturing activity, and we show that the mix of products and output shifted strongly toward larger multi-product plants that are part of multi-establishment manufacturing firms.

Keywords: Product adding, Product dropping, Multi-product plants, Multi-plant firms

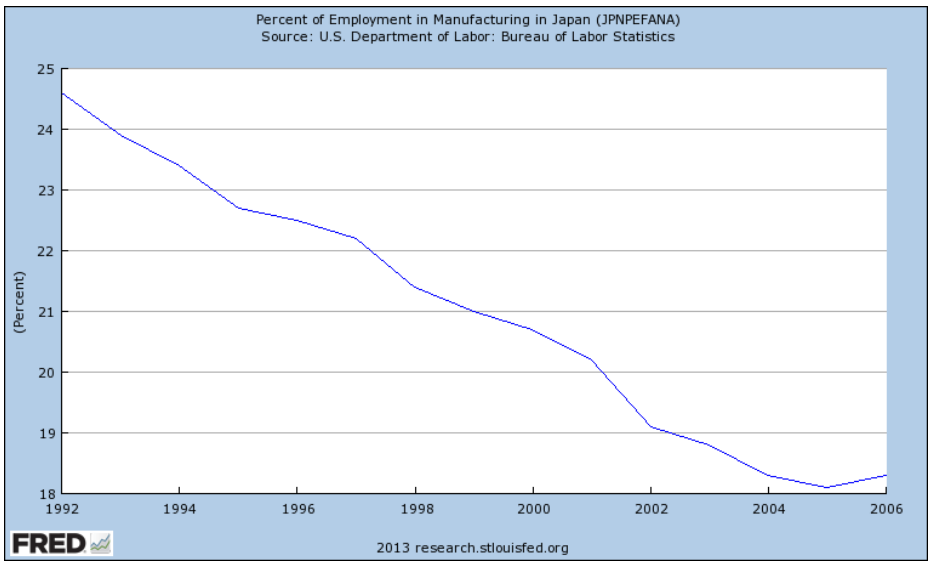
JEL codes: L11, L21, L25, L60

*This study is conducted as a part of the Project "Studies on the Structure of Japanese Economic Space and Japanese Supply Chains Sustaining Growth Under Globalization and Disaster Risks" undertaken at Research Institute of Economy, Trade and Industry (RIETI)

† 100 Tuck Hall, Hanover, NH 03755, USA, tel: +1 603 646 0302, email: andrew.b.bernard@tuck.dartmouth.edu

‡ Keio University, 2-15-45 Mita, Minato-ku, Tokyo 108-8345, +81(3)5427-1517, email: okubo@econ.keio.ac.jp

Figure 1: Manufacturing employment share, 1992-2006



1 Introduction

This paper documents the mix and evolution of plants and products in the Japanese manufacturing sector from 1992-2006. The study provides the first evidence on the product mix at Japanese manufacturing establishments and the role of product switching in the evolution of plants and sectors. The period covered by the plant-product data represents a time of radical restructuring of Japanese manufacturing with a decline in manufacturing as a share of GDP from 25 to 20 percent and an equally sharp reduction in manufacturing employment as a share of total employment, see Figure 1. We document the reallocation of activity both across plants and products.

While single product plants are the most common type of establishment in Japanese manufacturing, multi-product plants produce twice as much output and have increased in importance over time. The rising share of multi-product plants has led to a rise in the average number of products per plant even though the number of products declined within surviving plants. Our results show that changes to the product mix of surviving plants represents a major force for reallocation in the manufacturing sector. twenty percent of plants change their product mix every year and more than a third of establishments adjust their mix over a four year interval. Product switches at continuing plants are a more substantial source of output changes than are entering and exit establishments.

Relation to the Literature

This paper is related to several new streams of research on the internal allocation of resources at firms. Bernard, Redding, and Schott (2010) document the prevalence of multi-product firms and the frequency of product switching over five-year intervals in the US manufacturing sector.

They find that a large fraction of surviving firms switch their product mix and that this product switching activity within firms is an important component of industrial evolution. A number of papers examine multiple product firms and product switching in the context of international trade and exporting, e.g. Bernard, Redding, and Schott (2011), Goldberg, Khandelwal, Pavcnik, and Topalova (2010b,a), and Iacovone and Javorcik (2010).

Our paper is most closely related to the nascent literature on product switching by surviving firms started by Bernard, Redding, and Schott (2010). Their empirical analysis focuses on multi-product firms and product switching by firms over five year intervals from 1987-1997. We are able to examine annual product switching behavior by Japanese manufacturing plants over a longer span of years.

The next section describes the data including our definition of a product, industry and sector. Section 3 documents the extent and evolution of single and multi-product plants in Japanese manufacturing. In Section4 we look at the product adding and dropping activities of plants. Section 5 quantifies the contribution of new plants and new products at continuing plants to product sales. Section 6 examines the contribution of added and dropped products to plant output. We look at the aggregate implications of product adding and dropping in Section 7 by calculating the extensive and intensive margin contributions to aggregate manufacturing growth. The final section concludes.

2 Data

Our data is taken from Japan's Annual Survey of Manufacturers (Kogyo Tokei in Japanese) prepared by METI (Ministry of Economy, Trade and Industry). The data covers all plants with four or more regular employees in each year in every manufacturing industry. Manufacturing establishments are categorized in one of three plant types: single-plant firms with co-located headquarters (C-HQ), single plants with separate headquarters (S-HQ), i.e. the headquarters has a distinct physical location, and plants that are part of a firm with more than one manufacturing establishment (ME). These establishments can be followed across years due to a common identification number but the survey does not contain information which would allow multi-establishment (ME) plants to be grouped into firms.

In addition to the standard plant-level data collected in manufacturing surveys, i.e. value of total output and inputs, there is information on the value of output for individual products on an annual basis. This disaggregated output information for each plant is available for six digit products according to the Japanese Standard Industrial Classification.[1] Table 1 gives an example of six-digit JSIC products within the General Machinery sector (23). There are 9 six-digit products within the Oil Hydraulic and Pneumatic Equipment industry (2523). As is often the case with definitions

[1] An english language description of two-digit sectors and four-digit industries is available at http://www.stat.go.jp/english/index/seido/sangyo/san07-3a.htm#e

Table 1: Sectors, Industries and Products - An Example

Product	Description
25	General Machinery
2523	Oil hydraulic and pneumatic equipment
252311	Hydraulic pumps
252312	Hydraulic motors
252313	Hydraulic cylinders
252314	Hydraulic valves
252319	Miscellaneous oil hydraulic equipment
252321	Parts, attachments and accessories of hydraulic equipment
252331	Pneumatic equipment, including pneumatic unit equipment
252332	Parts, attachments and accessories of pneumatic equipment
252391	Hydraulic and pneumatic equipment, parts, attachments and accessories (piecework)

in manufacturing surveys, these "products" are themselves aggregates of more differentiated goods. Table 2 reports the number of four digit industries and six digit products for every manufacturing sector. There are 531 industries and 2060 products in the 24 manufacturing sectors.The numbers of products per industry varies across sectors from a high of 5.9 in Production Machinery (26) to a low of 1.9 in Electronic Parts, Devices and Circuits (28)

We focus on the longitudinal plant and product data from recent surveys available from 1992 to 2006. Our sample ends in 2006 because of a substantial change in the definition of output starting in 2007. [2]

One issue with the data from the Annual Survey of Manufacturers involves changes in six-digit product classifications due to revisions in the JSIC. We use concordance tables available in the survey and the methodology developed by Pierce and Schott (2009) to create consistent six digit product classification changes over time.

3 Multi-Product Plants and Product Switching

In this section we begin to explore the plant-product data for Japan. As mentioned above, the Japanese data does not record a firm identifier that would allow the grouping of plants into firms, specifically we cannot aggregate plants that are part of a multiple plant firm. As a result we will focus for the rest of this paper on products at the plant level.[3]

We focus on the three plant types describing in Section 2, single-plant firms with co-located headquarters (C-HQ), single plants with separate headquarters (S-HQ), and multi-establishment plants (ME). Within each of these plant groups, we identify two product-count types: single product

[2]Starting in 2007, plant output includes outsourced production whereas prior to 2007 outsourced production was not included. Outsourcing is defined as activity where the final process is performed by other firms.

[3]Bernard, Redding, and Schott (2010) report all their results for firms, however their results and conclusions are qualitatively unchanged when conducted at the plant-level with the US data.

(SP) and multiple product (MP) establishments.

Table 3 reports the number of plants by plant group and product-count category for 1992 and 2006. At any point in time the most common plant type is the single plant firm with a co-located headquarters (C-HQ) making up more than 70 percent of establishments. Plants that are part of a multi-establishment firm (ME) are the next most common group with approximately 17 percent of total establishments. Single plant firms with a separate HQ (S-HQ) account for around 10 percent of plants in every year. Across product-count categories, single product plants are by far the most common with almost two thirds of all establishments and the large majority in every plant group.

3.1 Evolution over time

The total number of manufacturing establishments declined precipitously during the period from 412,726 to 258,543, 37.4 percent, and, in fact, fell much faster than the manufacturing shares of GDP and employment. In spite of their falling numbers, plants grew on average over the period. In 1992, it took 16,777 manufacturing establishments to produce one percent of Japanese GDP, in 2006, 11,646 plants accounted for the same share of output.

While S-HQ and SP plants are the most common in every year and in every category, there are significant trends in the types of active establishments over time. The number of single product plants dropped by more than 108,000 from 1992 to 2006, a decline of over 40 percent, while the number of multiple-product plants also fell but by less, 31.7 percent, shifting the composition of plants towards multi-product establishments. The declines were also pronounced in single plant firms with co-located headquarters, down 40 percent, while plants with separate HQs and plants that are part of larger manufacturing firms dropped by only 29 and 31 percent respectively.

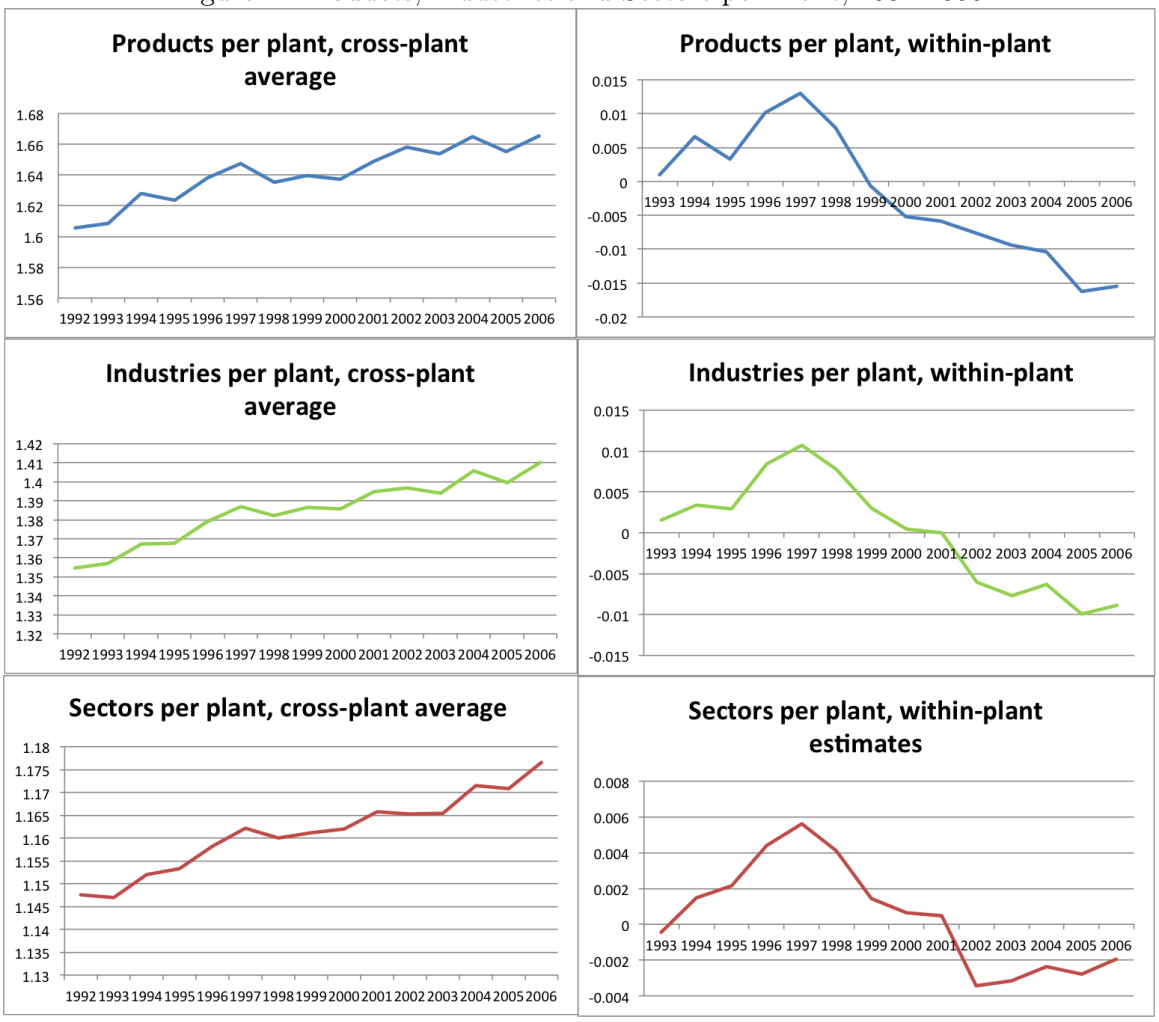
3.2 Products per plant

Table 4 reports the frequency of multi-product, multi-industry and multi-sector plants for all manufacturing plants and for the three categories. Plants producing a single product are by far the most common variety, but they are smaller than average and account for only 37.0 percent of output. Multi-product plants produce 2.7 products on average. Among multi-product plants, multi-sector establishments are almost three times larger than single industry, multi-product plants; every 1 percent of plants that are multi-sector accounts for 2.41 percent of output. Comparable ratios for single-industry and multi-industry (single-sector) plants are 0.83 and 1.61 respectively.[4]

The share of single-product, multi-product, multi-industry and multi-sector plants varies systematically across plant categories. Single, co-located HQ plants have the highest shares of single-product plants and the highest shares of output in those establishments. This category has the

[4]Comparing to the firm-level results for the US in Bernard, Redding, and Schott (2010), we observe similar patterns: multi-product firms are relatively rare, 39 percent of US manufacturing firms, but disproportionately important in total output (87 percent).

Figure 2: Products, Industries and Sectors per Plant, 1992-2006



Note: The right-hand set of figures reports the cross-plant averages of products, industries and sectors. The left-hand figures report within-plant changes in products, industries, and sectors per plant; 1992 is the base.

lowest concentration of output in multi-industry and multi-sector plants and have the lowest dispersion of output shares across the product groups.

In contrast plants that are part of a multiple establishment firm have the greatest share of multi-sector establishments and the greatest concentration of output in this product type. Within the group more than 40 percent of plants are multi-product and they account for more than two thirds of the output in the multiple-plant category.

3.3 Products per plant over time

Over time, the share of multi-product establishments is increasing within every plant group. In addition there is a simultaneous shift towards plants that are part of a larger manufacturing firm,

so-called ME plants, which have greater numbers of products per plant. These two trends result in an increase in the average number of products per plant, rising from 1.61 in 1992 to 1.67 2006. Similar trends occur in the number of industries and sectors per plant. In Figure 2 the graphs in the left-hand column show the average number of products, industries and sectors per plant. All three increase relatively steadily across the years.

Within surviving plants, however, the story is quite different. The right-hand column of Figure 2 report the coefficients on year dummies in plant-level regressions of the form,

$$lnN^i_{pt} = \alpha_p + \delta_t + \varepsilon_{pt}$$

where lnN^i_{pt} is the (log) number of products, industries or sectors (i) at plant p in year t, α_p is a plant fixed-effect and δ_t are year dummies. In contrast to the rising average across plants, within surviving plants, the numbers of products, industries and sectors initially increases and then steadily falls after 1997. On average surviving plants have fewer products, industries and sectors in 2006 than they did in 1992.

We do not have direct evidence on the source of these changes in the composition of plants and the within-plant changes in the product range, but this period coincides with a substantial increase in offshore investment by Japanese manufacturing firms and increasing competition from imported products. The rise in competition would be expected lead to an extensive margin adjustment in the number of plants, especially those of lower productivity and output. Similarly the reduction of the number of products would be consistent with increasing specialization in core activities at home accompanied by rising production overseas.

3.4 Characteristics

We next consider the differences across plants in terms of employment, output, exports, productivity (value-added per employee and TFP). For 2006, we run a regression of the (log of the) characteristic on separate dummies for plants with multiple products, multiple industries and multiple sectors,

$$lnX_{pt} = \alpha + \delta_{mp} + \delta_{mi} + \delta_{ms} + \delta_i + \varepsilon_{pt}$$

where lnX_{pt} is the log of the characteristic for plant p in year t, δ_{mp}, δ_{mi}, and δ_{ms} are dummies that equal one if the plant produces multiple products, multiple industries or multiple sectors respectively and δ_i is a set of industry dummies. Table 5 contains the results. As expected, multiple product plants are significant larger in terms of output and employment than single-product plants. They also have higher productivity in terms of TFP and especially labor productivity and are more likely to export. The large labor productivity difference signals that capital intensity is much greater as these plants as well. The second and third columns report the additional difference for plants that are also multi-industry and multi-sector. Again the results are as expected with the largest plants

being those that produce in multiple sectors. Productivity is somewhat lower as the complexity of the product mix rises, a result which mirror that found for multi-industry and multi-sector firms in the US by Bernard, Redding, and Schott (2010).

4 Product Adding and Dropping

In this section we explore the extent and consequences of product switching at continuing plants over time. Unlike Bernard, Redding, and Schott (2010) who have product-level information at 5-year intervals, we are able to look at annual product adding and dropping activity at plants. Table 6 reports on four types of mutually exclusive activity within plants over time. Plants can either do no switching (None), i.e. leave their product mix unchanged from one year to the next, drop one or more products without adding a product (Drop only), add one or more products without dropping a product (Add only), or both add and drop at least one product (Both). [5]

The large majority of plants (80 percent) do not change their product mix in any given year. When plants do adjust their product mix they are most likely to both add and drop products at the same time (11 percent). Drop only and Add only are much less common activities, 5 and 4 percent respectively. Multi-product establishments do more product switching than do single-product plants, in large part due to their ability to Drop only. However MP plants are also twice as likely to churn their product mix by both adding and dropping products from one year to the next. These results suggest a dynamic and active margin of adjustment within the establishment. One fifth of plants change their product mix each year, and the share of product switchers rises to one third among multi-product establishments.

We examine product switching across the plant groups and plant-product types in Table 7. Single plant firms are more likely to adjust their product mix by adding and dropping at least one product at the same time. Multiple-establishment plants do the least amount of product switching. In every category MP plants do much more switching than SP plants typically by churning their product mix.

Table 8 summarizes the differences in multi-product plants and product switching across sectors. Column 1 gives the share of multi-product plants by sectors. While 38 percent of plants are multi-product, there are substantial differences across sectors. Plants in the Petroleum and Coal (17) sector are the least likely to be multi-product while more than 60 percent of plants in the Transportation Equipment (31) sector produce multiple products. interestingly there is no correlation between the number of products in a sector and the share of multi-product plants. The share of plants that change their product mix is given in column 2. While there is a substantial range in product switching activity across sectors, we find that product switching is found in each sector. Product switching is more common in sectors with large shares of multi-product plants, more than a

[5] Of course SP plants cannot Drop only as this would leave them with no products.

quarter of plants in Information and Communication Equipment (30), Production Machinery(26), General Machinery (25), and Business Machinery (27) add and/or drop products each year.

The last column of Table 8 reports the average add rate across products in the sector, the share of plants producing the product that added the product in the last year.[6] Sectors with low product adding rates include capital intensive sectors such Chemicals, Petroleum and Iron and Steel, while the Printing (15) and Plastics (18) sectors have a large share of new entrants each year.[7]

4.1 Industry and Sector Switching

We observe similar switching behavior with respect to even more aggregate four-digit JSIC industries and two-digit JSIC sectors. Table 9 documents the extent to which plants switch across industries or sectors when they change their product mix using the same definitions as in Table6. The top panel reports on annual changes at all plants and multi-product plants for 1992-2006. Half of the 20 percent of plants that change their product mix each year are also changing their industry mix, primarily through the simultaneous adding and dropping of industries. Of those plants, half (5 percent) are also switching their mix of sectors. The addition of activity in new industries and sectors typically involves substantial differences in production techniques and potentially represents a major change in the activity of the plant.

The right side of the panel shows that multi-product plants are relatively more active in switching industry and sectors. Among these larger and more complex plants, one third adjust their product mix each year, 21 percent do the same for their industry mix and 12 percent shuffle their sectoral composition.

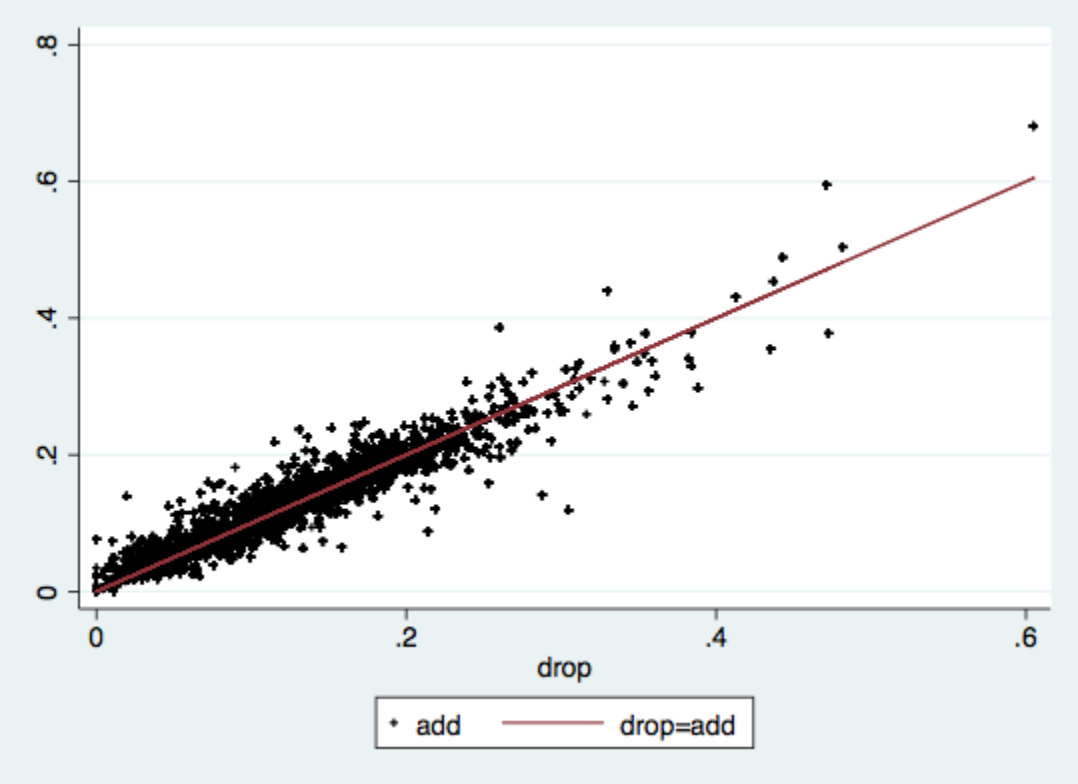
The bottom panel reports the same set of numbers for four-year intervals from 1993 to 2005. Not surprisingly, product switching (38 percent) is more common over longer intervals and is more frequent than industry switching (17 percent) or sector switching (9 percent). Even so, product adding causes an average of 15 percent of plants to enter at least one new industry and 8 percent of plants to enter at least one new sector every four years.[8] At MP plants the rates of product, industry and sector switching are much higher. Fully 58 percent of MP plants change their product mix over a 4 year interval with 38 percent adding a new product, 28 percent adding anew industries and 17 percent adding a new sector.

[6]The add rate for a product is calculated as the number of plants producing the product in year t that did not produce the product in year $t-1$ divided by the average number of plants that produced the product in years t and $t-1$.

[7]Product drop rates are highly correlated with product add rates across sectors.

[8]These rates are lower than those reported for the US both because of the shorter interval, 4 years instead of 5, and because these numbers are for plants rather than firms.

Figure 3: Add and Drop Rates Across Products



Note: Each point represents the average annual add rate for a product plotted against the average annual drop rate. The 45 degree line indicates where the add rate equals the drop rate. Only products produced at more than 5 plants are included.

5 Products

We now shift our perspective to examine how changes in product mix by plants are reflected in the distribution of output of a product over time and across establishments.

5.1 Adding and Dropping Rates

One possible explanation for product adding and dropping within surviving manufacturing plants is the secular shift of production away from some products and industries and the growth of others. Figure 3 plots the product-level add rates against drop rates for every product. Products above the 45 degree line are on net being added by Japanese manufacturing plants while products plotted below the 45 degree line are being dropped. Across products add and drop rates strongly covary, products that are being added by many plants the same products that are being dropped by many other plants. There are some products that are, on net, being added and others that are being dropped. However, the rates are tightly clustered along the 45 degree line which suggests that the add and drop rates are being driven by the same underlying factors. The main determinants of the

covariation of add and drop rates across products are usually thought to be related to variation in product-level sunk costs.

5.2 Decomposition across Types of Plants

Still considering product-level activity, we now focus on how a product's activity is distributed across types of plants. In particular, we report the share of plants adding and dropping a product as well as the share of product output at adding and dropping plants in Table 10. The top panel reports unweighted annual averages across all products while the bottom panel report unweighted averages across all products for 4-year intervals. The left-hand columns give information about plants that produce a product today and what those plants were doing in the previous year. Of plants that produce a product in year t, 83 percent also produced the product in the previous year. 12 percent of today's producers existed in the previous period and added the product to their mix while a much smaller number, 5 percent, of today's producers are altogether new plants, i.e. plants that did not produce anything in the previous year. The forward looking shares are similar. On average 80 percent of today's producers will continue to make the typical product in year t+1, while 12 percent will continue to operate but drop the product from their portfolio and 7 percent will cease operations.

As expected the preponderance of product output is at plants that continue to make the product. However, surviving establishments that switch into or out of the product are relatively more important that new or exiting plants. This margin of adjustment inside the firm plays a key role in the evolution of product output.

The bottom panel does the same decomposition for output. Plants that made the product last year and continue to make it account for 90 of the average product's output across the period. Plants that added the product and new plants producing the product are smaller than continuing plants and account for 6 and 3 percent of output in year t. The forward looking decomposition is similar with plants that will no longer make the product and plants that will cease operations smaller than continuing producers.

Looking over longer intervals increases the importance of the extensive margin as more plants enter the product market by adding it to their portfolios and more new plants enter and produce. Of plants that produce a product in year t, 64 percent also produced 4 years previously. 23 percent of today's producers existed 4 years ago but added the product in the meantime and 12 percent of plants did not produce 4 years prior. The forward looking shares are similar. On average 58 percent of today's producers will continue to make the typical product in year t+4, while 121 percent will continue to operate but drop the product from their portfolio and 20 percent will cease operations.

The bottom panel does the same decomposition for output. Plants that made the product 4 years ago and continue to make it account for 76 of the average product's output across the period.

Plants that added the product and new plants producing the product are smaller than continuing plants and account for 14 and 9 percent of output in year t. The forward looking decomposition is similar with plants that will no longer make the product and plants that will cease operations smaller than continuing producers.

6 Plant Activity

6.1 Decomposition Across Types of Products

In this section, we switch our perspective to analyze the contributions of different types of products to the total output of continuing plants.[9] We again perform backward and forward looking decompositions. The backward decomposition divides current period output into the share from products produced by the plant in a previous period and the share from new products. The forward decomposition divides the plant's output in the current year into the share in products that will continue to be produced in the next period and the share in products that will be dropped from the product mix in the next period.

Table11 shows the results of these decompositions for all continuing plants as well as separately by plant group. The top panel reports unweighted annual averages across all plants in the category while the bottom panel report unweighted averages across all products for 4-year intervals. The left-hand columns give information about the backward decomposition while the right-hand panels perform the forward looking decomposition. Of today's output mix, 93 percent is in products that were produced last year (or products that will continue to be produced next year) while 7 percent of plant output is in products that are new to the plant (or will be dropped form the output mix). Over longer intervals, as expected, the share of output in new or soon-to-be dropped products is larger, 17 and 18 percent respectively.

The differences across plants types are relatively small. In spite of the fact that plants that belong to multi-establishment firms are larger and have more products they have the same output shares in new and old products.

7 Contributions to Aggregate Output

We now turn our attention to the contribution of within-plant product adding and dropping to overall output growth in the manufacturing sector. Table 12 decomposes average annual manufacturing output growth from 1992-2006 into extensive and intensive margins.[10] The two extensive

[9] Here we limit our attention to plants that survive from a previous period to the current period or from the current period to the next.

[10] The output growth decomposition is performed on nominal output as product-level price indices are not available. given the near zero change in aggregate prices during the period there is little need for deflation of output over time. A concern remains that there is a systematical relationship between growing products, or products at growing plants, and relative prices changes.

margins are the net entry of new plants and the net addition of new products at continuing firms. The intensive margin is the net growth of output at continuing products at continuing plants.

The first column decomposes total output into the gross and net contributions of the three margins. Average annual output growth over the period was 2.43 percent. As is typically the case the net intensive margin contributes most of the total, 2.92 percent, while net plant entry (or in this case exit) was a negative contributor to output changes.[11] The within-firm new product margin was slightly positive. Of perhaps greater interest is the relative size of the gross contributions of the two extensive margins. The new product entry margin is larger than the new plant entry margin and the product exit at continuing plants is also larger than the plant exit margins. The reallocation inside firms is as large or larger than the reallocation across establishments that is the typical focus of the literature.

8 Conclusion

This paper has documented the extent and importance of multi-product plants in the Japanese manufacturing sector. Multi-product plants are larger and more productive than simple product establishments and their importance increased during a period when Japanese manufacturing output was declining as a share of overall economic activity. By the end of the period MP plants are 38.3 percent of all manufacturing establishments but account for 63.0 percent of output.

The paper also performs the first analysis of the role of product switching inside existing manufacturing establishments. Substantial research has focused on the entry and exit of establishments and firms and their role in industrial dynamics, employment creation and output growth. In that work, new producers of a product are synonymous with entering plants, while in reality most new producers of a product are continuing plants. Far less attention has considered the role of product mix changes within continuing establishments. This research provide the first evidence of the importance of annual product adjustments within manufacturing plants in a major industrialized country. twenty percent of continuing plants adjust their product mix every year with that share rising to a third of MP plants. The within-plant margin of adjustment is as important, or more important, than the extensive margin of new or failing plants.

While this paper describes the mix of products and plants in the Japanese manufacturing sector, there remain important unanswered questions for future research. We know little about how plants adjust their product mix and output over periods of economic expansion or contraction. While we have considered the share of output in new and continuing products at establishments, we will do

[11] The contributions of gross entry and exit extensive margins are attenuated downwards due to the fact that new products and new plant are in the market for less than a full year. Similarly exiting plants and dropped products are also in the market for less than a full year. Measuring the contribution of a full year's sales of new products to output growth over a 12 month period would raise the gross margins (both entry and exit) but has an uncertain effect on the net contributions. See Bernard, Massari, Reyes, and Taglioni (2013) for a discussion of partial year effects.

not know if these new products are more likely to continue in future years or if they are quickly dropped by the plants. The annual nature of the data set and its long time span make it ideal for the study of the evolution of output across products and plants over the business cycle.

References

Bernard, A. B., R. Massari, J.-D. Reyes, and D. Taglioni (2013): "Exporter Dynamics, Firm Size and Growth and Partial Year Effects," Discussion paper, mimeo. 11

Bernard, A. B., S. J. Redding, and P. K. Schott (2010): "Multiple-Product Firms and Product Switching," *American Economic Review*, 100(1), 70–97. 1, 3, 4, 3.4, 4

——— (2011): "Multiproduct Firms and Trade Liberalization," *The Quarterly Journal of Economics*, 126(3), 1271–1318. 1

Goldberg, P., A. Khandelwal, N. Pavcnik, and P. Topalova (2010a): "Multi-product Firms and Product Turnover in the Developing World: Evidence from India," *Review of Economics and Statistics*. 1

Goldberg, P. K., A. K. Khandelwal, N. Pavcnik, and P. Topalova (2010b): "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India," *The Quarterly Journal of Economics*, 125(4), 1727–1767. 1

Iacovone, L., and B. Javorcik (2010): "Multi-product Exporters: Product Churning, Uncertainty and Export Discoveries," *Economic Journal*, 120(544). 1

Pierce, J., and P. Schott (2009): "A Concordance Between Ten-Digit U.S. Harmonized System Codes and SIC/NAICS Product Classes and Industries," Working Paper 155486, NBER. 2

Table 2: Industries and Products by Sector

Sector	Description	Industries	Products
9	Food	41	122
10	Beverages, Tobacco and Feed	13	33
11	Textile	63	235
12	Lumber and Wood products	17	52
13	Furniture and fixtures	9	29
14	Pulp and paper products	15	63
15	Printing	7	18
16	Chemical	38	205
17	Petroleum and coal products	5	29
18	Plastic products	25	61
19	Rubber products	13	53
20	Leather tanning, leather products and fur skins	10	45
21	Ceramic, stone and clay products	44	143
22	Iron and steel	23	86
23	Non-ferrous metals and products	17	64
24	Fabricated metal products	33	135
25	General machinery	19	92
26	Production machinery	25	148
27	Business oriented machinery	22	80
28	Electronic parts, devices and electronic circuits	12	23
29	Electrical machinery	22	99
30	Information and communication electronics equip.	12	42
31	Transportation equipment	16	83
32	Other manufacturing	30	120
	Total	531	2060

Note: The table reports the number of four digit industries and six digit products across two-digit manufacturing sectors.

Table 3: Types of Plants, 1992-2006

	1992	2006
SP-collocate HQ	197,411	112,532
MP-collocate HQ	102,767	67,538
SP-separate HQ	27,809	19,193
MP-separate HQ	16,269	12,103
SP-multiple estab.	42,799	27,980
MP-multiple estab.	25,671	19,197
Total SP	268,019	159,705
Total MP	144,707	98,838

Note:

Table 4: Prevalence and Importance Multi-Product Plants

All Plants			
Type of plant	Percent of plants	Percent of output	Products
Single product	61.8	37.0	1.0
Multi-product	38.2	63.0	2.7
Multi-industry	27.2	54.7	2.9
Multi-sector	13.6	32.8	3.1

Single plant, collocated HQ			
Type of plant	Percent of plants	Percent of output	Products
Single product	62.5	47.6	1.0
Multi-product	37.5	52.4	2.7
Multi-industry	26.1	42.8	2.8
Multi-sector	12.6	22.6	3.0

Single plant, separate HQ			
Type of plant	Percent of plants	Percent of output	Products
Single product	61.3	47.6	1.0
Multi-product	38.7	52.4	2.7
Multi-industry	27.5	41.3	2.9
Multi-sector	14.0	26.3	3.1

Multiple establishment			
Type of plant	Percent of plants	Percent of output	Products
Single product	59.3	32.4	1.0
Multi-product	40.7	67.6	2.9
Multi-industry	31.2	60.1	3.1
Multi-sector	17.1	36.8	3.3

Note: The data are for 2006. All plants includes every manufacturing establishment. Single plant (collocated HQ) includes plants at firms with a single manufacturing establishment with the headquarters located on site. Single plant (separate HQ) includes plants at firms with a single manufacturing establishment with the headquarters located elsewhere. Multiple plant includes plants at firms with multiple manufacturing establishments. The first two columns give the share of plants and output, the third column reports the average number of products for plants in that category.

Table 5: Characteristics of Multi-Product Plants, 2006

	Multiple product	Multiple industry	Multiple sector
Employment	0.055	0.117	0.120
Output	0.195	0.089	0.157
TFP	0.042	-0.002	-0.016
Exporter	0.078	0.120	-0.033
Value added per employee	0.151	0.094	0.174

Note: Each row represents a regression with multi-product, multi-industry and multi-sector dummies including industry fixed effects. The coefficients represent the difference between that type of plant and the type in the column to the left where the base type is simple-product (and thus single industry and single sector). All dependent variables are in logs and all regressions are OLS except for the Exporter specification which reports the marginal effects of a probit on an export dummy for the plant. All coefficients are significant at the 5 percent level.

Table 6: Annual Product Adding and Dropping, average 1993-2006

Plant activity	All	SP	MP
None	80	88	67
Drop only	5	0	12
Add only	4	4	4
Both	11	8	16

Note: The numbers indicate the annual average share of surviving plants of different types involved in product adding and dropping between 1993-2006.

Table 7: Annual Product Adding and Dropping by Firm Group and Product-Count type, Average 1993-2006

	Single Plant collocated HQ			Single Plant Separate HQ			Multiple Establishment		
Plant activity	All	SP	MP	All	SP	MP	All	SP	MP
None	80	88	66	79	87	66	82	90	71
Drop only	5	-	13	5	-	12	5	-	11
Add only	4	4	5	5	5	5	4	4	5
Both	11	8	17	11	8	16	9	7	13

Note: The numbers indicate the average share of surviving plants of different types involved in annual product adding and dropping from 1993-2006.

Table 8: Multi-product Plants and Product Switching by Sector, 1993-2006

Sector	Description	Plant MP	Plant Switching	Product Add rate
9	Food	36	13	10
10	Beverages, Tobacco and Feed	58	12	15
11	Textile	22	15	12
12	Lumber and Wood products	62	22	13
13	Furniture and fixtures	37	21	15
14	Pulp and paper products	37	17	11
15	Printing	28	16	20
16	Chemical	50	16	7
17	Petroleum and coal products	17	7	6
18	Plastic products	31	25	18
19	Rubber products	34	20	11
20	Leather tanning, leather products and fur skins	23	17	14
21	Ceramic, stone and clay products	26	10	10
22	Iron and steel	34	16	9
23	Non-ferrous metals and products	41	19	11
24	Fabricated metal products	31	21	13
25	General machinery	35	27	13
26	Production machinery	45	26	15
27	Business oriented machinery	33	26	14
28	Electronic parts, devices and electronic circuits	33	22	11
29	Electrical machinery	49	24	14
30	Information and communication electronics equip.	56	28	16
31	Transportation equipment	63	23	16
32	Other manufacturing	43	18	11

Note: The table reports averages for two-digit manufacturing sectors for 1993-2006. Column1 reports the average share of multiple-product plants; column 2 has the share of plants doing any product switching (Add only, Drop only or Both); column 3 report the average add rate across products in the sector.

Table 9: Product, Industry and Sector Switching

Annual

	All Plants			MP Plants		
	Product	Industry	Sector	Product	Industry	Sector
None	80	90	95	67	79	88
Drop only	5	1	1	12	4	2
Add only	4	3	1	4	4	2
Both	11	5	3	16	12	7

4-year

	All Plants			MP Plants		
	Product	Industry	Sector	Product	Industry	Sector
None	62	83	91	42	66	81
Drop only	8	2	1	19	5	2
Add only	7	5	2	6	5	3
Both	23	10	6	32	23	14

Note: The upper panel shows average share of plants involved in annual product, industry and sector adding and dropping from 1992-2006, (all plants on the left, multi-product plants on the right). The lower panel show comparable averages for 4-year intervals from 1993-2005 (all plants on the left, multi-product plants on the right).

Table 10: Product-Level Decomposition, 1993-2006

	Backward looking			Forward looking		
	Plants producing the product in t-1 and t	Plants adding the product between t-1 and t	Plants born between t-1 and t	Plants producing the product in t and t+1	Plants dropping the product between t and t+1	Plants that die between t and t+1
			Plant share			
Annual Average	83	12	5	80	12	7
			Output share			
Annual Average	90	6	3	88	7	5
	Plants producing the product in t-4 and t	Plants adding the product between t-4 and t	Plants born between t-4 and t	Plants producing the product in t and t+4	Plants dropping the product between t and t+4	Plants that die between t and t+4
			Plant share			
4 year Intervals	64	23	12	58	21	20
			Output share			
4-year Intervals	76	14	9	72	14	13

Note: The top (bottom) panel reports averages of annual interval (4-year intervals) across the period 1993-2006. Each number represents a share for the product in year t. the left-hand side of each panel looks backward one (or 4) years and show the share of plants producing the product and output of the product in year t that came from continuing producers, continuing plants but new producers of the product and new plant that make the product in year t. The right=hand panel performs the same decomposition looking into the future: the share of today's producers that will continue, survive but drop the product or stop producing.All cells are unweighted averages across all products across all years.

Table 11: Plant Output Decomposition

	All plants				Single plant collocated HQ				Single plant separated HQ				Multiple establishment			
	Backward		Forward		Backward		Forward		Backward		Forward		Backward		Forward	
	Cont.	Add	Cont.	Drop	Cont.	Add	Cont.	Drop	Cont.	Add	Cont.	Drop	Cont.	Add	Cont.	Drop
Annual	93	7	93	7	91	9	91	9	92	8	92	8	94	6	93	7
4 year	83	17	82	18	93	7	93	7	93	7	93	7	95	5	94	6

Note: The left two columns of each panel give the (continuing) plant output share from previously produced product and products added in the last year. The right two columns of each panel give the (continuing) plant output share in products that will still be produced the next year and in products that will be dropped in the next year. All numbers are unweighted averages across all continuing plants.

Table 12: Extensive and Intensive Margins of Aggregate Manufacturing Sales

	Total Sales
Product Entry	2.51
Product Exit	-2.43
Net product	0.07
Growing Products	10.63
Shrinking Products	-7.71
Net Intensive	2.92
Plant Entry	1.70
Plant Exit	-2.27
Net Plant	-0.56
Gross	2.43%

Note: Each cell gives the percentage point contribution to annual gross manufacturing sales growth. Product entry and exit refer to product additions and deletions within continuing plants. The annual percentage growth in gross sales is given in the bottom row for each year (column).