Innovation and Product Reallocation in the Great Recession*

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Abstract

We exploit detailed product- and firm-level data to study the sources of innovation and the patterns of productivity growth in the consumer goods sector over the period 2007-2013. Using a dataset that contains information on the product portfolio of each firm, we document several new facts on product reallocation, a concept closely tied to several theories of growth. First, we calculate that every quarter around 8 percent of products are reallocated in the economy, and entry and exit of products is prevalent among different types of firms. Second, we find that most reallocation of products occurs within the boundaries of the firm. Entry and exit of firms have only a small contribution in the overall creation and destruction of products. Third, we document that product reallocation is strongly procyclical and declined by more than 30 percent during the Great Recession. This cyclical pattern is almost entirely explained by a decline in within firm reallocation. Motivated by these facts, we study the causes and consequences of reallocation within incumbent surviving firms. As predicted by Schumpeterian growth theories, the rate of product reallocation strongly depends on the innovation efforts of the firms and has important implications for revenue growth, product quality improvements, and productivity dynamics. Our estimates suggest that the decline in product reallocation through these margins contributed importantly to the slow growth experienced after the Great Recession.

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1 Introduction

For decades, economists have identified product entry and exit as the key mechanism through which product innovation translates into economic growth (Aghion and Howitt, 1992; Grossman and Helpman, 1991; Aghion, Akcigit and Howitt, 2014). But despite the important theoretical implications of product innovation, little is known empirically about the processes of creation and destruction of products, and how these processes differ across different types of firms. In this paper we study product reallocation across and within producers and how it evolved during the Great Recession. What is the role of product reallocation on output growth and quality improvements in the recent decade? How sensitive is innovation by new firms, small incumbents, and large incumbents to changes in aggregate economic conditions? New evidence on these questions will help understand how resources are allocated to their best use within an economy and inform the recent debate on the sources of productivity slowdown in the U.S. (Davis and Haltiwanger, 2014; Decker, Haltiwanger, Jarmin and Miranda, 2014).

We begin by assessing the magnitude of product creation and destruction in the consumer goods sector over the period 2007Q1–2013Q4. We exploit detailed product- and firm-level data at the barcode level to find that new products are systematically displacing existing products in the market. Every quarter more than 10 percent of products are reallocated in the economy with almost equal contribution of product entering and exiting the market. This is particularly relevant for large and well-diversified firms, those that sell products in several product categories. Consistent with several theories of creative destruction, we find that firms expanding, as well as firms contracting, contribute to the overall destruction of products. This source of dynamism in the U.S. economy occurs within the boundaries of the firm, and as a result of entry and exit of new firms. We find that most product reallocation is made by surviving incumbent firm that add or drop products in their portfolio.

After documenting that magnitude and pervasiveness of reallocation of products, we evaluate the evolution during and post the great recession. We find that product reallocation is strongly procyclical; the quarterly reallocation rate declined by more than 30 percent during the Great Recession. To better understand the sources of the cyclicality in the reallocation rate we decompose it in a within and a between firms component. We find that the cyclical pattern is overwhelmingly a consequence of within firm reallocation. In particular, most of the decline in reallocation within firms resulted from the decline in the creation of products during the recession.

In the second part of the paper we provide evidence that the decline in dynamism in the product market affected economic growth and the recovery after the Great Recession. Schumpeterian growth models have traditionally linked the speed of product reallocation to the innovation efforts of the firms and to subsequent gains in productivity. To uncover the causes and consequences of the reallocation slowdown, we begin by establishing that the speed of product reallocation is strongly related to the innovation efforts of the firms as captured by their expenditures on research and development. This is consistent with theories featuring creative destruction where new and better varieties replace obsolete ones.

The paper then establishes the relationship between product reallocation, as measured in our dataset, and several innovation outputs such as revenue growth, product quality improvements, and productivity growth. To do so, we follow Akcigit and Kerr (2010) and distinguish between two different types of innovation from the perspective of the firms: incremental innovations and extensions. Incremental innovations, represent new products within the existent product lines of the firms, where they can exploit their capabilities and resources and benefit from economies of scale or scope. Extensions, represent products beyond the main lines of business of the firms. They are less common than incremental innovations because they represent larger innovations, which are likely to be more costly to develop in the first place. We document that incremental innovations have an immediate large impact on revenue. Extensions, on the other hand, are in general more innovative new products launched with higher average quality and have higher impact on the total factor productivity of the firm. In a similar way, we divide product exits in two types: products that are more likely to be terminated due to creative destruction (replaced by new products within the same product category) and those that were phased out due to the scaling down firms' operations (products without replacement). Consistent with Schumpeterian theories[1], exits due to creative destruction are correlated with gains in total factor productivity. Overall, we find that firms that have higher reallocation rates grow faster, launch products with higher average quality, and experience larger gains in productivity. Our evidence suggests that the decline of reallocation experienced during the recession can explain around 15% of the drop in aggregate productivity in this period and had substantial implications for economic growth in the years that followed.

For most of our analysis, we rely primarily on the Nielsen Retail Measurement Services (RMS) scanner dataset. It consists of more than 100 billion observations of weekly prices, quantities, and store information of approximately 1.4 million products identified at the barcode level. We combine information of prices with the weight and volume of the product to compute unit values in order to approximate the quality of each product. In addition, we identify the firm owning each UPC by obtaining information from GS1, the single official source of barcodes in the United States. The GS1 data contains the list of all U.S. barcodes along with information on the firms that own them. Our combined dataset allows us to have revenue, price, quantity, and quality for each product of a firm's portfolio and allow us to study how the within and between margin of product entry and exit evolve over time. Finally, we complement our dataset with Compustat to obtain measures of total factor productivity and research and development expenses. To the best of our knowledge, our paper is the first one to link the product level information available in the Nielsen RMS with firm level observables available in other datasets.

Our paper contributes to several active research areas. Despite the vast theoretical implications

[1] See Aghion, Akcigit and Howitt (2014) for more details.

of product reallocation, the empirical analysis on the aggregate behavior of product reallocation lags far behind its theoretical counterpart due to data limitations. The extant literature on reallocation has focused on the input markets using establishment and labor market data (Davis and Haltiwanger, 1992; Foster, Haltiwanger and Krizan, 2001, 2006). By contrast, we focus on reallocation in output markets. Importantly, our dataset allows us to study the relative contribution of incumbents to the aggregate reallocation rate without inferring it from their job flows information.

Few papers have studied the degree of product reallocation directly. Bernard, Redding and Schott (2010) study the extent of product switching within firms using production classification codes (five-digit SIC codes). Given the level of aggregation of their data, in their work several firms could produce the same product. We substantially improve on this by measuring products at a much finer level using scanner data. This allows us to explore the dynamics of each firms' unique portfolio of products as opposed to study the dynamics of their product lines. Our work is also closely related to Broda and Weinstein (2010) who study the patterns of product entry and exit using a similar dataset to ours but collected from consumers rather than stores. Collecting data at the store level offers the advantage of observing, for the categories available, the entire universe of products for which a transaction is recorded in a given week rather than the products consumed by a sample of households. Therefore, our dataset allows us to cover less frequently consumed goods and provides less noisy measures of entry and exit of products. Our paper builds on their work by examining between and within firm reallocation separately and examining the contribution of each of these components during the Great Recession. Moreover, we examine the reallocation patterns of firms subdividing them in several different dimensions: according to their size, their level of diversification (i.e. firms selling in a single product category versus firms selling in multiple product categories) and whether they are expanding or contracting at a given point in time.

Furthermore, by studying the connection between reallocation and different measures of innovation, our work links studies on reallocation, which focus mainly on moving resources from less to more efficient uses to enhance productivity growth, to the parallel literature on innovation (Klette and Kortum, 2004; Lentz and Mortensen, 2008; Akcigit and Kerr, 2010; Acemoglu, Akcigit, Bloom and Kerr, 2013; Garcia-Macia, Hsieh and Klenow, 2016). Although we examine only the retail sector of the economy, to the best of our knowledge, our paper is the first to establish empirically the relationship between product entry and exit and the innovation activities of the firms. In particular, our matched dataset allows us to test and validate empirically several predictions of Schumpeterian growth models; prediction that have been hard to examine in the past due to data availability issues.

Lastly, our work is related to literature in firm dynamics that studies the propagation of aggregate shocks after large contractions in output (Caballero and Hammour, 1994; Moreira, 2016). We document that both the reallocation rate and the entry rate of products suffered a persistent decline after the Great Recession. The decline of product creation had consequences in terms of revenue for the firms in the short-run. But, more importantly, this missing generation of products, in the spirit of Gourio and Siemer (2014), combined with the evidence we provide on the relationship between reallocation and productivity growth, have substantial implications for the slow recovery experienced by the U.S economy in the years following the Great Recession.

The rest of the paper is organized as follows. Section 2 presents the data and describes our procedure to link our product level dataset with firm level information available in Compustat. In section 3, we define reallocation and provide several decompositions to explore the relative contributions of the between and within margins. In this section we also provide an interpretation of the magnitudes of the reallocation rate we observe and describe its evolution during the Great Recession. In section 5 we examine the possible determinants of rellocation. We examine its relationship with R&D and define incremental innovations and extensions along with exits due to creative destruction and terminations due to firms scaling down their operations. Section 6 tests and validates the predictions of models involving creative destruction and documents the relationship between reallocation and revenue growth, quality improvements, and productivity dynamics. Section 7 concludes. We include several robustness tests and additional empirical findings in the Appendix.

2 Data Description

2.1 Baseline Product-Level Dataset

We rely primarily on the Nielsen Retail Measurement Services (RMS) scanner dataset, which is provided by the Kilts-Nielsen Data Center at the University of Chicago Booth School of Business. The RMS consists of more than 100 billion unique observations at the week × store × UPC level.[2] Each individual store reports weekly prices and quantities sold for every UPC code that had any sales volume during the week.

The data is generated by point-of-sale systems and contains approximately 40,000 distinct stores from 90 retail chains across 371 MSAs and 2,500 counties between January 2006 and December 2014. The data set includes around 12 billion transactions per year worth, on average, $220 billion. Over our sample period the total sales across all retail establishments are worth approximately $2 trillion and represent 53% of all sales in grocery stores, 55% in drug stores, 32% in mass merchandisers, 2% in convenience stores, and 1% in liquor stores.

The baseline data consist of approximately 1.64 million distinct products identified by a unique UPC. The data is organized into 1,070 detailed *product modules*, aggregated into 114 *product groups*, which are then grouped into 10 major *departments*.[3] For example, a 7-ounce bag of Pringles

[2]A Universal Product Code (UPC) is a code consisting of 12 numerical digits that is uniquely assigned to each specific item.

[3]The ten major departments are: Health and Beauty aids (e.g. cosmetics, pain remedies), Dry Grocery (e.g. baby food, canned vegetables), Frozen Foods, Dairy (e.g. cheese, yogurt), Deli, Packaged Meat, Fresh Produce,

Select Potato Crisps, Bold Crunch Jalapeno Ranch has UPC 037000213758 is produced by Procter & Gamble and it is mapped to product module "Potato Chips" in product group "Snacks", which belongs to the "Dry Grocery" department.[4] Each UPC contains information on the brand, size, packaging, and a rich set of product features including the weight and the volume of the product which we use to compute unit values.

Our data set combines all sales at the national and quarterly level; although we also conduct some exercises at the annual frequency given that some firm level observables are only available at that frequency. For each product j in quarter t, we define revenue r_{jt} as total revenue across all stores and weeks of the quarter. Likewise, quantity q_{jt} is defined as total quantities sold across all stores and weeks of the quarter. Price p_{jt} is defined by the ratio of revenue to quantity, which is equivalent to quantity weighted average price.

For each product we use the panel structure to measure the entry and exit periods.[5] We follow Broda and Weinstein (2010) and Argente and Yeh (2016) to use the UPC as the main product identifier. This is because it is rare that a meaningful quality change occurs without resulting in a UPC change. Two concerns may arise from this assumption. Chevalier, Kashyap and Rossi (2003) notes that some UPCs might get discontinued only to have the same product appear with a new UPC. This is not a concern in our data set because Nielsen detects these UPCs and assigns them their prior UPC. The second concern is that companies could recycle UPCs and use them for different products. Nielsen also identifies these UPCs and assigns them a different UPC version, which we use to identify products.

We define entry as the first quarter of sales of a product and exit as the first quarter after we last observe a product being sold.[6] To study the entry- and exit rates patterns we use information for all products in the period 2007Q1–2013Q4, that include cohorts born from 2007Q1 to 2013Q4

Non-Food Grocery (e.g. detergent, pet care), Alcohol and General Merchandise (e.g. batteries/flashlights, computer/electronic).

[4]In the product group "Snacks" several product modules include: dips, potato chips, tortilla chips, meat, pretzels, popcorn, crackers, trail mix, and health bars.

[5]A critical part of our analysis is the identification of entries and exits. In comparison to other scanner datasets collected at the store level, the RMS has a much wider coverage of products and stores. Table I shows that in comparison to the IRI Symphony dataset, a similar dataset widely used in the academic literature, the RMS covers more 14 times the number of products in a given year. In terms of revenue the RMS represents roughly 2 percent of total household consumption whereas the IRI Symphony is 30 times smaller. In comparison to scanner datasets collected at the household level, the RMS has also a wider coverage of products because it reflects the universe of transactions for the categories it covers as opposed to the purchases of a sample of households. The Nielsen Homescan, for example, which contains information on the purchases of 40,000-60,000 U.S households covers less than 60% of the products the RMS covers in a given year.

[6]A product is first observed in the RMS dataset when a store sells it for the first time. Firms often do not introduce goods in different stores at the same time, and thus, when we first observe a new UPC it may take some time until it is disseminated across stores. Likewise, firms may stop producing a good in a certain time and we can still see some transactions after that, as stores may still have some inventories. In the Appendix, we consider alternative definitions, where entry is defined as the second quarter of sales of a good, and exit as the second quarter to the last that we observe a product being sold. Relative to the definition of entry (exit) as the first (last) quarter where sales are registered, this last measure is more likely to represent a full quarter of sales, instead of just a few weeks.

and cohorts born before that period, from whom we cannot determine the cohort and age.[7] In addition, given that our estimates of product entry and exit may be affected by the entry and exit of stores in the sample, we consider only a balanced sample of stores during our sample period.

Our final sample is described in Table III. Every year, on average more than 600,000 distinct UPCs are present in our sample sold in a total of 33,056 stores. Most products have revenue of less than 500 dollars per year but almost 5% of the products make more than 50 million dollars. A product module contains approximately 582 products, a product group 5,459 products, and a department 62,236 products on average. The table shows that these numbers remain very stable before, during and after the Great Recession.

In order to minimize concerns of potential measurement error in the calculation of product entry and exit, our baseline sample excludes private label products, considers products with at least one transaction per quarter after entering, and excludes products in the Alcohol and General Merchandise departments. We exclude private label goods because, in order to protect the identity of the retailer, Nielsen alters the UPCs associated with private label goods. As a result, multiple private label items are mapped to a single UPC making it difficult to interpret the entry and exit patterns of these items since it is not possible to determine the producer of these goods. We consider products without missing quarters in order to rule out the possibility that our results are driven by seasonal products, promotional items, or products with very small revenue. And, finally, we exclude the two departments for which the coverage in our data is smaller and less likely to be representative.

Nonetheless, all the results that follow are robust to using the full sample of products available in the RMS. We present these results in Appendix D. Lastly, Appendix D also includes results where, instead of using the barcode as the main product identifier, we identify products using a broader definition using the product attributes provided by Nielsen as in Kaplan and Menzio (2014). Under this alternative definition, a good is the same if it shares the same observable features, the same size, and the same brand, but may have different UPCs. We use this definition to minimize the concern that new products, when identified by their barcodes, represent only marginal innovations from the perspective of the firms. Under this definition, each new entry represents at least a new product line for the firm. Appendix D shows that the results we describe below on the aggregate reallocation rate and on the impact of product reallocation on several innovation outputs remain very similar under this specification.

[7] Note that we excluded the first four and last four quarters of the sample. Because we define entry as the first quarter of sales of a product and exit as the first quarter after we last observe a product being sold, we may identify an abnormally high entry in the first quarters and abnormally high exit in the last quarters. Our procedure ensures that we only classify as entrant a product that was not observed for at least for a full year before, and as exiter a product that we no longer observe for at least a full year past exit.

2.2 Matching Firm and Products

We link companies and products using information obtained from GS1 US, the single official source of barcodes. In order to obtain a barcode, companies must first obtain a GS1 Company Prefix. The prefix is a 5-10 digits number that identifies companies and their products in over 100 countries where GS1 is present. The number of digits in a Company Prefix indicates different capacities for companies to create barcodes. For example, a 10 digits Company Prefix allows firms to create 10 unique barcodes and a 6 digits prefix allows them to create up to 100,000 unique items.[8] Although the majority of companies own a single prefix, it is not rare to find that some own several. Small firms, for example, often obtain a larger prefix first, which is usually cheaper, before expanding and requesting a shorter prefix.[9] Larger firms, on the other hand, usually own several Company Prefixes due to past mergers and acquisitions activities. For example, Procter & Gamble owns the prefixes that used to belong to firms it acquired such as Old Spice, Folgers, and Gillete. Our GS1 data accounts for all mergers and acquisitions that occurred before October 2013. For consistency, in what follows we perform the analysis at the parent company level.

Given that the GS1 US data contains the universe Company Prefixes generated in the US, we combine these prefixes with those present in each UPC code in the RMS.[10] Our combined data set allows us to compute revenue, price, quantity, and quality for each product in a firm's portfolio and allow us to study how the within and between margins of product creation and destruction evolve over time.

Table IV describes the characteristics of the firms in our data. We have a yearly average of 22,356 firms with slightly more firms present after the recession. Similar to the size-distribution of products, the size distribution of firms is fat-tailed. Table II shows the top 20 firms in terms of revenue in our data; the top 10 firms alone account for approximately 28% of the total revenue. In addition, most firms are well diversified: 26% of the firms own a single product, 28% are multi-product firms that belong to a single module, 12% are multi-module firms that belong to a single product group, 16% sell in multiple product groups but in a single department, and 17% are multi-department firms.

2.3 Matching Nielsen RMS and Compustat

For the later analysis, we obtain firm level characteristics from Compustat. To combine the Nielsen data with the Compustat database, we matched the names provided by the GS1 to those in Compustat using the string matching algorithm described in Schoenle (2016). After applying

[8]See Figure 1 for examples of different Company Prefixes.

[9]Previous studies including Broda and Weinstein (2010) have assumed that the first six digits of the UPC identify the manufacturer firm. This assumption is valid for 93% of the products in our sample.

[10]Less than 5 percent of the UPCs belong to prefixes not generated in the US. We were not able to find a firm identifier for these products.

the algorithm we matched 435 publicly traded companies over our sample period.[11] Our matched sample represents 26% of the total sales in Compustat and 39% of the total revenue in the RMS. Approximately 17% of the total number of products in the data belong to publicly traded firms. Table V presents summary statistics of both the Compustat data and our matched sample for a number of firm characteristics. Our matched sample mainly consists of large major U.S. companies with mean annual sales of $10.8 billion. These firms are on average more productive, have higher credit rating, and have less leverage. Nonetheless, the merged data set represents well publicly traded firms in many dimensions such as: market power (price to margin ratio), volatility of demand and costs, share of labor expenses, research and development expenses, and financial variables such as cash flows and dividends. We describe in detail the construction of this variables in Appendix C.

3 Reallocation of Products

In this section we document several new stylized facts on the level and evolution of product creation, destruction, and reallocation in the U.S. consumer goods sector. First, we find that the product creation and destruction rates are remarkably large. Over a typical twelve-month interval, about one in five new products are created in these sectors, and a comparable number are no longer available. Second, we show that firm-specific rates of product creation and destruction display substantial heterogeneity. While the majority of product reallocation in this sector is made by surviving incumbents firms with high revenue levels and highly diversified, smaller and less diversified firms are also quite dynamic in making changes to their small portfolio. Third, we document that product reallocation is strongly procyclical and declined by around 30 percent during the Great Recession, and the evolution of entry and exit of firms have only a small contribution in the overall creation and destruction of products. The cyclical pattern is almost entirely explained by a decline in within firm reallocation among surviving incumbent firms.

3.1 Measurement of reallocation

We start this section with a description of the measures that we use to identify the aggregate levels and cyclical patterns of reallocation of products. Most product entries and exits do not necessarily translate into entry and exit of firms because the majority of products is produced by multi product firms (Table IV). In order to study the degree of heterogeneity in this sector, we also compute firm-specific reallocation rates of products. We mainly focus on the overall average of entry and exit of products, and on the averages among broad heterogenous types of firms. In later sections, we show how firm-specific rates relate to firms specific outcomes.

[11] A few public firms in our sample are conglomerates combining more than one independent corporations. For the later analysis, we combine their information into a single firm to perform our reduced form analysis at the public corporation level.

Aggregate reallocation: To capture the importance of entry and exit of products, we use information on the number of new products, exit of products, and total products by each firm i over time t, and define aggregate entry and exit rates as follows:

$$n_t = \frac{\sum_i N_{it}}{\sum_i T_{it}} \tag{1}$$

$$x_t = \frac{\sum_i X_{it}}{\sum_i T_{it-1}} \tag{2}$$

where N_{it}, X_{it}, and T_{it} are number of entrant products, exit products, and total products, respectively. The entry rate is defined as the number of new products in period t as a share of the total number of products in period t. The exit rate is defined as the number of products that exited in period t (i.e. last time we observe a transaction was in $t-1$) as a share of the total number of products in period $t-1$.[12,13]

Two simple and important relationships link these concepts: the net growth rate of the stock of available products equals the entry rate minus the exit rate; the overall change in the portfolio of products available to consumers can be capture by the summation of the entry and exit rates. We refer to this last concept as product reallocation rate, in particular:

$$r_t = n_t + x_t \tag{3}$$

This measure allows us to measure the extent of changes in status of products in our data, either from the entry or the exit margin.

Average within firm reallocation: Using information on the number of new products, exit products, and total products by each firm i over time t, we can define the average reallocation of products by firms as the (unweighted) mean entry rate and exit rate across all firms as follows:

$$\bar{n}_t = \frac{1}{\gamma_t} \sum_{i=1} n_{it} \tag{4}$$

$$\bar{x}_t = \frac{1}{\gamma_{t-1}} \sum_{i=1} x_{it} \tag{5}$$

where $n_{it} = \frac{N_{it}}{T_{it}}$, $x_{it} = \frac{X_{it}}{T_{it-1}}$, and γ_t is the number of firms active in t. The average reallocation rate of firms is then defined as:

$$\bar{r}_t = \bar{n}_t + \bar{x}_t \tag{6}$$

[12]The main advantage of assigning a product exit to the quarter following the last observed transaction of a product is that we can define relative changes in the stock of products as the difference between entry and exit rate.

[13]Note that also call these measures product creation and destruction, respectively.

Aggregated and average within firm reallocation: The aggregate level of reallocation and the average level within can be easily related following an Olley and Pakes decomposition. The aggregate reallocation rate is composed by the average reallocation and a component that measures the covariance between market share and reallocation rates:

$$r_t = \bar{r}_t + \sum_{i \in \Gamma_t} (r_{it} - \bar{r}_t)(t_{it} - \bar{t}_t) \tag{7}$$

where $t_{it} = \frac{T_{it}}{\sum_i T_{it}}$ measures the product share of firm i in t, $t_{it} \geq 0$ and sums to 1, and Γ_t is the set of active firms in t. The second component of the decomposition captures whether firms with more products are more likely to be among firms with high or low reallocation rates.

3.2 Magnitude and heterogeneity of product reallocation

The rates of aggregate product creation and destruction are remarkably large. Table VII shows that, on average, eight percent of products are reallocated every quarter in the period 2007–2013. This means that about one in three products are either destroyed or created over a typical twelve-month interval. This simple fact highlights the remarkable fluidity in the consumer goods sector.

The level of reallocation depends on the product definition that we defined in Section 2. In our baseline sample, products are defined at the barcode level for a set of the consumer goods industries that excludes generics and general merchandise. In the alternative sample, where both generics and general merchandise are included, we observe an average quarterly reallocation rate of 7.7 percent, which is very close to the 8.0 percent that we observe in the baseline sample. The alternative sample, for the same universe of goods, but for the more coarse definition of product (as defined at the level of different module and brand), we still find a average quarterly reallocation rate of 5.1 percent.[14] This means that while there some addictions and destructions of products may involve small changes in the characteristics of their characteristics, a big share of reallocation happens with the introduction and elimination of new brands.[15]

Our measures of product reallocation can be compared with measures of reallocation at the production unit level and input level. Using data from Business Dynamics Statistics, we compute analogous measures of firm reallocation using information on entry and exit of establishments. We find that, during the same period, entry and exit of establishments are about 20 percent of total establishments, over a one-year period. Reallocation of establishments weighted by employment was about 9 per cent per year.

[14] See Table X in Appendix. Although not explicitly mentioned, another source of difference between our baseline sample and the larger sample, is that we exclude products that do no appear every quarter after being introduced. This exclusion mainly excludes seasonal products. Less than two percent of the products are products that reappear after being destroyed. In value terms, these products compose less than 0.2 percent of the sample. If we drop products that reenter after a period of being out of our sample from our calculation, the creation and destruction measures are effectively unchanged.

[15] In Section 5 we discuss this issue in more detail.

In our dataset, we observe entry and exit of firms of about 16 percent over a one-year period (Table IV), which is similar to the whole economy reallocation of firms. Foster, Grim and Haltiwanger (2016) document the evolution of job reallocation, computed as defined by Davis, Haltiwanger and Schuh (1996), pointing to an average level of about 13 percent on a quarter level over the period 2006-2012, on a universe of around 150 million jobs.[16]

Over the 2007–2013 period, the quarterly entry rate of products was 4.5 percent, and the quarterly exit rate of products was 3.5 percent. This means, that over a typical twelve-month interval, about one in five new products are created in these sectors, and about one in six are no longer available (Table VII). Overall, this implies that while the growth rate of products in the consumer goods sector increased almost one percent per quarter over this period, both the entry and exit margins are important in explaining the changes in the portfolio of products available to consumers.

To better understand the sources of reallocation, we explore the degree of heterogeneity of the firm-specific reallocation of products. Table X shows the average quarterly reallocation, entry, and exit rates for the period 2007–2013.[17] On average, firms in the consumer good industry add or drop about 10.7 percent of the products in their portfolio. The fact that this rate is larger than the aggregate reallocation rate implies a negative covariance between reallocation rates and product shares, i.e. firms producing a lower number of products have, on average, higher reallocation rates. This negative covariance is driven entirely by entry and exit of firms. Most products are produced by multi-product firms, and thus the entry and exit of firms only account for a small share of product reallocation (Table IX shows that only 1 out of 20 products are added and destroyed by entrants or exit firms). Figure 4 plots the evolution of the average reallocation rate for the set of all firms, the subset of incumbent firms, and compares these series with the aggregate product reallocation rate.[18] The fact that the average reallocation among incumbent surviving firms is larger than the aggregate reallocation rate, implies that among incumbent firms, firms that have more products on average, have higher rates of product reallocation.

Over the 2007–2013 period, the average firm-specific quarterly entry rate of products was 5.8 percent, and the average quarterly exit rate of products was 5.2 percent. We classify firms by their net creation of products (expanding, contracting and unchanged), and access to the market (entrant, exit, incumbent).[19] Overall, most addition of products is made expanding firms and most product destruction is made by contracting establishments. Table X shows that expanding firms add around 1 product out of every 3 (1 out of every 4 if we exclude entrant firms). As expected, firms that are reducing the total number of products on net, are adding products at a smaller rate

[16]Product reallocation is on average 8.0 percent on a universe of around 400 million products.

[17]Computed as defined in equations 4, 5, and 6, respectively.

[18]Note that firm-specific entry and exit rates vary from 0 to 100 percent, and thus reallocation rates can vary from 0 to up to 200 percent. For firms entering and exiting this sector, these rates are by definition 100 percent respectively, while for single-product surviving firms, these rates are zero percent. Table X in Appendix shows the descriptive statistics for the firm-specific reallocation rates.

[19]Appendix B provides details on the disaggregation.

(only about 1.1 percent, on average). Expanding firms destroy products at a rate of about 2.0 per cent, while firms that are destroying products on net, phase out about 32.0 percent of their products (22.4 percent when we exclude exiting firms).

There is substantial heterogeneity in the size of firms that produce consumer goods products. We classify firms by their quartile of revenue and we measure the contribution of each group to the aggregate reallocation. The average reallocation rates among incumbents firms by revenue quartile are slightly larger among high revenue firms, which hold several products on average, and thus an overwhelmingly large share of products added or destroyed every quarter are originated in firms in the top quartile of the distribution of revenue.

Another important source of heterogeneity in this industry is the degree of diversification of products between firms (Table IV). Single-product firms have higher rates of product reallocation because they are also more likely to be new entrants or exiting firms. When we exclude single-product firms, diversified firms (in particular, multi-department firms) have slightly larger average rates of reallocation, and thus diversified firms have a higher contribution in the aggregate reallocation of products (Table X).

3.3 Evolution of product reallocation in the Great Recession

After examining the sources of heterogeneity in the product reallocation rates, we analyze the evolution of our product reallocation measures over the business cycle. The main takeaway from this analysis is that the reallocation of products in the period under analysis is very procyclical. The share of products that were added or eliminated was approximately 9.4 percent on average during 2007, dropping to about 6.8 percent on average during 2010, and recovering to 8.2 per cent three years later (Table VII and Figure 2).

A significant fraction of this cyclical component is explained by the variation in the number of new products that were created during the Great Recession. The quarterly entry rate declines from around 5.2 percent to about 3.8 percent in the period 2007–2010, followed by a full recovery by 2013. The aggregate exit rate trends downwards during this period and the deviations from trend are also procylical. The aggregate quarterly exit rate varies from 4.2 percent to 3.0 percent from 2007 to 2010, followed by a very tepid recovery until the end on 2013.

This evolution contrasts with the evidence documented in Broda and Weinstein (2010). Their period under analysis includes the 2001 recession and they find that the aggregate creation of products is procyclical, while aggregate product destruction is countercyclical, although the magnitude of the latter is quantitatively less important. This pattern implied that product reallocation was only slightly pro-cyclical. We find the same strong pro-cyclicality in the entry of new products but we do not find any evidence of counter-cyclicalty in the exit rate. Our findings of a strong decline in the product reallocation during the Great Recession and subsequent slow recovery is similar to the evolution of job creation and destruction documented in Foster, Haltiwanger and Krizan

(2001). In the Great Recession, job creation fell by as much or more than the increase in job destruction. In this respect, the Great Recession was not a time of increased reallocation. These patterns also contrast with the responsiveness of job creation and destruction in prior recessions. In prior recessions, periods of economic contraction exhibit a sharp increase in job destruction and mild decrease in job creation.[20]

The aggregate cyclical patterns of the product reallocation rates are pervasive across different types of firms. We find that during our period of analysis, the strong decline in the reallocation rates during the Great Recession is present across all type of firms. Nonetheless, we also find some evidence of systematic heterogeneity as some firms are more procyclical than others. The decline in average reallocation in 2008 and 2009 was larger among firms that reduced their stock of products; such decline results from decreases in both entry rates and exit rates (Table VIII). When we sort all firms based on quartiles of revenue, we find that all quartiles experience a decline in product reallocation during the Great Recession that is mostly explained by the evolution of the rate at which firms add products. The decline in reallocation was particularly large among low revenue firms and resulted from both the decline in entry rates and in exit rates. We also find, however, that after the Great Recession the product reallocation rates of the lower quartile of revenue shows a greater rebound. The cyclical evolution of the product reallocation rates for both diversified and undiversified firms is similar over the period, and does not exhibit substantial differences.

4 Decomposition of Reallocation

Next, we apply decomposition methods to shed further light on the evolution of our product reallocation measures and explain what economic forces drive the evolution of this rate. The extant literature examining the aggregate productivity in the economy has developed decomposition methods to investigate the sources of productivity change. Aggregate productivity is typically computed as a weighted average of productivity at the producer level (firm or establishment). Because the productivity levels of producers are heterogenous, aggregate productivity changes over time can reflect both shifts in the distribution of producer-level productivity or changes in the composition of firms. In turn, changes in the composition of firms in the economy can result not only from changes in market shares among surviving firms, but also from the entry of new producers and the exit of old ones. These three sources of changes in the composition are often named the effect of reallocation of producers in the economy.

We borrow from the aforementioned literature and we apply these methods to our setting. Our goal is to decompose changes in the aggregate rate of product reallocation between changes in the reallocative behavior of firms and changes in the distribution of firms. The idea is that

[20] As highlighted in Davis, Haltiwanger and Schuh (1996), the greater responsiveness of job destruction relative to job creation in these earlier cyclical downturns meant that recessions are times of increased reallocation.

product reallocation can evolve both because the surviving incumbent firms change their behavior or because firms entry and exit markets. In our case, incumbent firms can increase the rate at which they add or destroy products, while their share of products varies over time, i.e. firms that reallocate more may be gaining or losing overall market share.[21] In this case, all components measure reallocation of resources although some within firms and others between them. We exploit these methods to identify the main sources explaining the decline in reallocation during the Great Recession and in the post-recession period.

4.1 Decomposing changes in reallocation: accounting for entry and exit of firms

Using equation 7, we can decompose changes in reallocation between quarter t and quarter 0, $\Delta r_{t,0} = r_t - r_0$, as follows:

$$\Delta r_{t,0} = \bar{r}_t - \bar{r}_0 + \sum_{i \in \Gamma_t} (r_{it} - \bar{r}_t)(t_{it} - \bar{t}_t) - \sum_{i \in \Gamma_0} (r_{i0} - \bar{r}_0)(t_{i0} - \bar{t}_0)$$

and after simplifying the notation, we express this decomposition in the following components:

$$\Delta r_{t,0} = \Delta \bar{r}_{t,0} + \Delta \sum_{i \in \Gamma_t} (r_{it} - \bar{r}_t)(t_{it} - \bar{t}_t)) \tag{8}$$

The first component represents changes in the average reallocation rate within firm, and the second component is the adjustment by differences in size across firms. It is a natural way to capture changes in the first moment of the distribution of entry rates, and changes in market share reallocation via changes in the covariance. Thus, the evolution of reallocation rates of products can come from changes in the average within firm reallocation rate, and changes in the distribution of products across firms that reallocate more or less intensively.

Melitz and Polanec (2015) proposed an extension of the Olley and Pakes decomposition to accommodate entry and exit of firms, such that we can separately obtain the contribution of continuing, entrant and exit firms. The underlying idea is that we can write the change in entry rates as:

$$\begin{aligned}
\Delta r_{t,0} = {} & \bar{r}_t^{C_{t,0}} - \bar{r}_0^{C_{t,0}} + \sum_{i \in C_{t,0}} (r_{it} - \bar{r}_t)(t_{it} - \bar{t}_t) - \sum_{i \in C_{t,0}} (r_{i0} - \bar{r}_0)(t_{i0} - \bar{t}_0) \\
& + \sum_{i \in EN_{t,0}} t_{it} (\sum_{i \in EN_{t,0}} \frac{t_{it}}{\sum_{i \in EN_{t,0}} t_{it}} r_{it} - \sum_{i \in C_{t,0}} \frac{t_{it}}{\sum_{i \in C_{t,0}} t_{it}} r_{it}) \\
& - \sum_{i \in EX_{t,0}} t_{i0} (\sum_{i \in EX_{t,0}} \frac{t_{i0}}{\sum_{i \in EX_{t,0}} t_{i0}} r_{i0} - \sum_{i \in C_{t,0}} \frac{t_{i0}}{\sum_{i \in C_{t,0}} t_{i0}} r_{i0})
\end{aligned} \tag{9}$$

[21] As defined above, the overall market share is a function of net product creation. Some firms most important source of reallocation comes from adding products, while others comes from eliminating products.

where the contribution of each firm to the aggregate change in the reallocation rate is separated into three categories for continuing $C_{t,0}$, entering $EN_{t,0}$ and exiting $EX_{t,0}$ firms. The first terms of the decomposition apply the Olley and Pakes decomposition to the the subset of surviving firms, decomposed between the change in the average reallocation rate among continuing firms and the change in the covariance between product share and reallocation rate. The latter two terms measure the contribution of entry and exit of firms to the aggregate change in the reallocation rates. The entry component is defined as the weighted average difference between the reallocation rate of entrants and reallocation rate of continuers. The exit component is defined as the weighted average difference between the reallocation rate of exit firms and reallocation rate of continuers.

An alternative approach to identify the importance of the different margins that can potentially generate changes in the aggregate product reallocation is to explore the simple equality $r_t = \sum_{i \in \Gamma_t} r_{it} t_{it}$, and we can write the changes as

$$\Delta r_{t,0} = \sum_{i \in C_{t,0}} (r_{it} t_{it} - r_{i0} t_{i0}) + \sum_{i \in EN_{t,0}} r_{it} t_{it} - \sum_{i \in EX_{t,0}} r_{i0} t_{i0}$$

For continuing firms, we can further disentangle between the sum of the changes in the reallocation rate holding firms' shares of the product market constant (within-firm component) and the percentage sum of shares changes holding all firms' entry constant (between-firm component). The decomposition will be then:

$$\Delta r_{t,0} = \sum_{i \in C_{t,0}} t_{i0} (r_{it} - r_{i0}) + \sum_{i \in C_{t,0}} r_{it} (t_{it} - t_{i0}) + \sum_{i \in EN_{t,0}} r_{it} t_{it} - \sum_{i \in EX_{t,0}} r_{i0} t_{i0} \tag{10}$$

For continuing firms, the first component captures changes in the reallocation rate within them, while the second captures the contribution of changes in product shares between them. Under this decomposition, entry (exit) of firms has a positive (negative) contribution. In order to address this, we can redefine the equation above such that we use the average aggregate reallocation rate as reference $\bar{r}_{0,t} = \frac{r_0 + r_t}{2}$. The decomposition is then given by

$$\Delta r_{t,0} = \sum_{i \in C_{t,0}} t_{it} (r_{it} - \bar{r}_{0,t}) - \sum_{i \in C_{t,0}} t_{0,t} (r_{i0} - \bar{r}_{t0}) + \sum_{i \in EN_{t,0}} t_{it} (r_{it} - \bar{r}_{0,t}) - \sum_{i \in EX_{t,0}} t_{i0} (r_{i0} - \bar{r}_{0,t})$$

And we can split the contribution of continuing firms between within and between components as follows

$$\Delta r_{t,0} = \sum_{i \in C_{t,0}} \bar{t}_{i,0t} (r_{it} - r_{i0}) + \sum_{i \in C_{t,0}} (\bar{r}_{i,0t} - \bar{r}_{0,t})(t_{it} - t_{i0}) + \sum_{i \in EN_{t,0}} t_{it} (r_{it} - \bar{r}_{0,t}) - \sum_{i \in EX_{t,0}} t_{i0} (r_{i0} - \bar{r}_{0,t}) \tag{11}$$

The contribution of the within-firm component among surviving firms is now weighted by the average product share of each firm, while the between-firm contribution is weighted by the average reallocation rate. The main advantage of this last decomposition is that the contribution of entrants can now be negative, and the contribution of exits can be positive.

Foster, Haltiwanger and Krizan (2001) proposes a slightly modified decomposition, where the reference level is period 0, instead of a time varying average. This approach facilitates comparisons across different time periods. The third contribution of the surviving firms is the cross-firm component, that captures the covariance between the change in the share of products and the change in entry rate. The decomposition is then given by

$$\Delta r_{t,0} = \sum_{i \in C_{t,0}} \bar{t}_{i0}(r_{it} - r_{i0}) + \sum_{i \in C_{t,0}} (r_{i0} - r_0)(t_{it} - t_{i0}) + \sum_{i \in C_{t,0}} (r_{it} - r_{i0})(t_{it} - t_{i0})$$
$$+ \sum_{i \in EN_{t,0}} t_{it}(r_{it} - r_0) - \sum_{i \in EX_{t,0}} t_{i0}(r_{i0} - r_0) \quad (12)$$

Similar to the decomposition above, the contribution of entry and exit can be negative or positive, depending on how the reallocation rates among entrants and exiters compares with the reallocation rate in the baseline period 0.

4.2 Results

Table XI reports the results of the decompositions presented above. We apply them to changes in the aggregate entry, exit, and reallocation rates. In particular, we report the decomposition for the Great Recession by adding the cumulative one-quarter changes between 2007Q1 and 2009Q4 and for period following the Great Recession by adding the cumulative one-quarter changes between 2010Q1 and 2012Q4.[22]

First, we present results for the method developed by Olley and Pakes (1996). This method does not accommodate entry and exit of firms but is used as a reference and baseline for the other methods. During the Great Recession, the weighted average reallocation rate declines by around 5.1 percentage points, and is decomposed into a change of -7.0 percentage points in the first moment of firms' reallocation distribution (the unweighted mean), and an increase of 1.8 percentage points in the joint distribution of reallocation and market shares (the covariance between reallocation and product shares). This means that the Great Recession saw a substantial decline in the average reallocation rates, and that firms reallocating more were increasing their product share relative to firms reallocating less. In the post-recession period, the aggregate reallocation increases by 3.7 percentage points, as a result of a recovery of 6.6 percentage points in the average reallocation of firms, and a -3.0 percentage points decline in the covariance between product shares and reallocation. This decline in the covariance between shares and reallocation is explained by

[22] The two periods correspond to a twelve-quarter (three-year) overall change. We selected these particular dates to match the overall evolution that we observe for the aggregate reallocation. The decomposition for each quarter and for alternative sub-periods is available upon request.

the rebound of entry rates within firms followed by an even greater recovery in their exit rates.

Next, we implement the Melitz and Polanec (2015) methodology to further understand the contributions of entry and exit of firms to product reallocation rates. The results suggest that the decline of 5.1 percentage points in the weighted average product reallocation rate during the Great Recession is partially accounted by a 1.4 percentage points increase in reallocation rate from net entry of firms (which in its turn is further decomposed into 2.2 percentage points stemming from the entry of products by entering firms, and -0.8 percentage points explained by the exit of products by exiting firms). In the period following the Great Recession, net entry contributed 0.9 percentage points for the total 3.7 percentage points recovery in the aggregate product reallocation rates.[23] The decline in the importance of the net entry of firms in the post-recovery period indicates that the recovery in reallocation was mainly driven by surviving incumbents firms, which seems to be the group that was more dynamic in adjusting their reallocative behavior.

When we adapt the within and between decompositions of Griliches and Regev (1995) and Foster, Haltiwanger and Krizan (2001) to the product reallocation rate, we obtain similar results for the impact of entry and exit of firms. Moreover, we find relatively small differences in the magnitude of the within versus between components when we examine the impact of surviving incumbent firms. Furthermore, we find that using these decomposition methods, reallocation by surviving firms accounts for -6.4 percentage points of the decline in the weighted average reallocation rate during the Great Recession, whereas the reallocation by surviving firms explains 2.8 percentage points of the increase in reallocation rates in the post-recession period. The Griliches and Regev (1995) decomposition shows that the decline in reallocation in the recession period resulted -7.9 percentage points from declines in the rate of product reallocation within surviving firms and 1.5 percentage points from variation between surviving firms. This decomposition suggests that among surviving firms, the market share of high reallocation firms increased. The Foster, Haltiwanger and Krizan (2001) decomposition assigns a larger negative contribution to the within component (-10.8 percentage points), a negative component to the between firms reallocation (-1.4 percentage points), and a sizable positive cross effect (5.8 percentage points). This decomposition allows a clear counterfactual exercise where changes in reallocation rates are calculated holding constant product shares at their initial levels. Therefore, the above findings suggest that positive effect of between firms variation in explaining the decline in reallocation (obtained in all decompositions with exception of Foster, Haltiwanger and Krizan (2001)) can result from the cross-term, i.e. the relation between the change in shares and the change in reallocation rates.

Overall, the findings from this section show that the aggregate reallocation rate is largely explained by the decisions to create and destroy products by incumbents firms, followed by the contribution of entering and exiting firms. Moreover, the decompositions show that the decline in

[23] It is worth pointing out that the sign of the contribution of entry is always positive and the size of exit is always negative, given that the reallocation rates of entering and exiting firms is by definition equal to 1, while for surviving firms is closer to the level of 0.1.

reallocation result largely from declines in reallocation within surviving firms regardless of whether we consider the recession or post-recession period. Finally, it is also clear from the Table XI, that these results are not sensitive to the choice of decomposition method.

These results motivate us to better understand the consequences of reallocation within incumbent firms. We interpret these empirical facts as evidence that some of the variation of productivity and growth within surviving firms documented in Foster, Haltiwanger and Syverson (2008) is related to how they manage heterogenous multi-product portfolios that are comprised of winners (high revenue and high productivity products) and losers (low revenue and low productivity). In section 6, we provide some suggestive evidence that the actions of firms to manage and reallocated their product portfolio are associated with their subsequent productivity and revenue growth.

5 Product Reallocation and Innovation

What does product reallocation represent? In most models of creative destruction, output reallocation plays an important role to determine productivity dynamics. These models emphasize that adopting new products inherently involves the destruction of the old ones and that the pace at which this takes place depends crucially on the innovation activities of the firm.[24]

In this section we establish that there is a positive relationship between product reallocation and innovation. We implement two strategies to document that the addition and destruction of products includes products that are truly innovative. First, we distinguish between two different types of entry and exit – incremental and extensions– and document their evolution in the recession and post recession period. We show that product extensions have characteristics that constitute innovations within the firm. Second, we exploit the relationship between product creation and destruction in the Nielsen data and R&D expenses available in Compustat. We show that firms that invest more heavily in R&D present higher levels of reallocation. Both pieces of evidence suggest that the measures of product entry and exit developed in the paper can be used as alternative proxies of innovation, with potential implications in testing the theories of how innovation contributes to growth and cyclicality in the economy.

5.1 Exploring heterogeneous types of entry and exit

The results of the previous section do not distinguish products being added or destroyed in what regards to how innovative they are. When we observe an entry of a new bar code, it may result from a good that is very similar to others that the firms already has in its portfolio, or a good that is truly unique and innovative. As discussed in Section 2 defining a product as an unique barcode may rise some measurement concerns. In our dataset, small changes in packing or volume

[24]For example, in Aghion and Howitt (1992) firms get monopoly rents for their innovations until the next innovation arrives. In this case, the incentives for investing in innovation are substantial.

will likely result in a new bar code.[25] This type of new products are not what researchers have in mind when developing models of the effect of innovation in reallocation. We address this issue in two ways. First, we distinguish between two different types of innovation – incremental and extensions– and we document their evolution in the recession and post recession period. Second, we show that the results reported in the previous sections do not qualitatively change when we consider coarser definitions of products.[26]

Under the first approach, our goal is to distinguish entry into new products within the main product line of the firms, and new products beyond the main line of business of the firm. New products that constitute only marginal changes in the stock of existing product, such as changes in volume, and other minor characteristics of the products, are unlikely to involve a lot of resources when developed and impact the outcomes of the firm in a significant way. On the contrary, new products that are not within the core business of the firm, are likely to involve substantial changes in the production technology with sizable consequences in the outcomes of the firm. We implement a distinction between types of product by using the classification system of the Nielsen dataset. In particular, we classify a new product in t as an improvement if the firm already has other products of that type, i.e. if the firm in $t-1$ already produces goods of the same module of the product being created. We classify a new product as an extension if the new product is in a new module to the firm.

We apply the same principle to classify exits by type. Exits are classified as improvements if the firm maintain operations in that module. Exits are classified as extensions if they correspond to a cessation of activity in that module. The distinction can help us understand if some products may be terminated due to creative destruction (re- placed by new products within the same product category) and those that were phased out due to the scaling down firms operations (products without replacement).

Tables XII and XIII present the decomposition of aggregated and average entry and exit rate by type over the period under analysis. For comparison, we also show the share of new and exit products introduced by entrant and exit firms. As expected, most changes in barcode occur within the same product *module*: around 80 percent of new barcodes and exit barcodes. Product extensions correspond to 11 percent of all entries, exit extensions correspond to 14 percent of all exits. Over the period under analysis, we observe that product extensions and shut downs of product lines are more only slightly more cyclical than the entrants and exits of within firm's product lines. We interpret this as evidence that over the business cycle, firms change the rate at which they make marginal changes in their stock of products, as well as the introduction of new product lines.

[25] Broda and Weinstein (2010) also acknowledge that the their measures of product creation and destruction include changes in characteristics that may be secondary, and use information on the bar code characteristics file to show that only a small part result from changes in size and flavor. We follow and alternative approach, more fit to our overall goal.

[26] See Section 2 for details.

Under the alternative definition of product, a good is the same if it shares the same brand within the same product type (as defined by product *module*). Under this definition, we only identify entry and exits that are clearly significant innovations from the perspective of the consumers. Appendix D shows that the results we describe above on the aggregate reallocation rate and on the impact of product reallocation on several innovation outputs remain very similar under this specification.

5.2 Research and Development Expenses

In order to further understand the relation between firms' innovation activities on the reallocation of their products, we use the various measures of product creation and destruction described in the previous section along with information of R&D expenses available in Compustat. This measure is particularly relevant because, as it is defined by Compustat, it encompasses all planned search aimed at the discovery of new knowledge that could lead to new products or the improvement of the existing ones.

We begin by verifying that our Compustat-RMS sample represents well the various measures of product entry and exit described in the previous section. Table VI shows that the entry rate, reallocation rate, and exit rate are extremely close in both data sets. The firms in our matched sample, nonetheless, sell on average more products and generate more revenue per year. To rule out the possibility that firm size or other type of heterogeneity drives our results, in the analysis that follows we control for an extended set of observables at the firm level. Given that our main interest is to explore the determinants of reallocation within incumbent firms, we focus on studying firms present in every period in our sample.[27] Our specification is the following:

$$r_{f,t+1} = \alpha + \beta \text{R\&D}_{f,t} + \Gamma X_{f,t} + \mu_f + \lambda_t + \epsilon_{f,t} \tag{13}$$

where $r_{f,t}$ represents the reallocation rate of firm f in year t. R&D represents the ratio of research and development expenses to total assets for firm f at time t. Our main focus is on β which captures the direct impact of R&D on product reallocation. $X_{f,t}$ is a vector of firm level controls that vary over time. All our specifications include year-effects, λ_t, to control for possible trends and firm fixed effects, μ_f, to control for other types of heterogeneity.

Table XIV reports our results. Column (1) shows that R&D expenditures have a large positive impact on reallocation after controlling for firm size; larger firms tend to engage in more R&D activities. Next, we add a wide range of controls to disentangle the effect of R&D from potentially confounding firm-level factors. In column (2) we include the price cost margin and in column (3) a control for firm idiosyncratic volatility. Our results do not vary under these specifications or if measures of financial constraints are included (column (4)).[28] This is not surprising given that even

[27] Our results are very similar if we study an unbalanced sample of firms and are available upon request.

[28] The magnitude of the point estimate for β and its significance is not sensitive to including other measures of

without any time varying control the inclusion of both firm and time effects account for more than 72% of all possible variation. In all cases the point estimates are large and statistically significant; a hypothetical increase in R&D expenditures relative to sales of 1 percentage point increases the reallocation rate by 1-1.5 percentage points. This is equivalent to an increase of close to 15% in the reallocation rate.[29]

6 Reallocation and Growth of Firm

Our findings so far strongly suggest that the innovation efforts of the firms are associated with higher reallocation rates. The second key prediction of Schumpeterian growth models to test is whether increases in the reallocation rate of products lead to larger growth rates of firms and improvements in the products they produce.

6.1 Reallocation and Revenue Growth

We first confirm the prediction on revenue growth by estimating the following equation in the data:

$$\text{Revenue}_{f,t+1} = \alpha + \beta\, r_{f,t} + \Gamma X_{f,t} + \mu_f + \lambda_t + \epsilon_{f,t} \tag{14}$$

where $\text{Revenue}_{f,t}$ is the sum of the revenue of all products in the firm's portfolio at time t. As before, all our specifications include both firm and time fixed effects and consider only a balanced sample of firms.[30] Furthermore, given that in order to run this specification we only require the information available in the RMS, equation 14 is estimated using quarterly data.

Column (1) in table XVI shows that β, our coefficient of interest, is both economically and statistically significant. This is after controlling for revenue in the previous period. The table also shows that, not surprisingly, most of the revenue growth due to reallocation of products comes from the entry margin. The exit rate on the other hand is negatively related to the revenue growth in the next quarter.

At the entry margin, entry of products in the module where a firm operated before, Column (3) in the table, and entry of products in a new module, Column (4), are associated with revenue growth by similar magnitudes. At the exit margin, closing down a product module completely, Column (7), is more strongly correlated with revenue growth, compared to destructing products in the module they keep operating (related to the idea of Creative Destruction), Column (6). We get

financial constraints such as the firm's S&P long-term issuer rating.

[29] When we study the entry and exit rates separately, we find that most of the correlation comes from the entry margin. However, consistent with the prediction of Schumpeterian growth models, R&D is strongly correlated with both entry and exit when we examine their patterns within the main product module of the firm; exactly where we expect to see older varieties being replaced by newer and better products.

[30] Summary statistics of quarterly firm-level revenue for the balanced sample is reported in Table XV

consistent results with two other specifications, i) with full sample and ii) using brands as product, as shown in Table A.XII and A.XIII.

6.2 Reallocation and Quality Improvements

A similar analysis can be done to explore whether higher reallocation rates lead to increases in the average quality of firms' portfolios. Several growth models, such as those in Klette and Kortum (2004) and Lentz and Mortensen (2008), predict that higher quality versions of a product are the outcome of the innovation activities of the firms. To study these predictions we use three different measures to approximate product quality: relative prices, a percentile-based measure, and perceived quality measure.

Benchmark Quality To measure quarterly firm-level average product quality, we use prices as proxy for quality as Argente and Lee (2016). This measure is similar to those used in the international trade literature where, if a sector or firm in country is able to export a large volume at a high price, then it must be producing high-quality goods (Hummels and Klenow, 2005; Hallak and Schott, 2011; Kugler and Verhoogen, 2012). As a benchmark measure, we proxy product quality by the average relative price of the barcode-level good within each product category. First, we measure the log-difference between the price of good j and the median price for category c in quarter t.

$$R_{jt}^{\text{benchmark}} = \log \frac{P_{jt}}{\bar{P}_{ct}}$$

where $R_{jt}^{\text{benchmark}}$ is the relative price and $\bar{P}_{ct}$ is the median price of category c. Therefore, if the price of a high quality type of milk, say organic milk, is much higher than the median price of milk, then $R_{jt}^{\text{benchmark}}$ is positive and high.

We then calculate firm-level average quality by combining information on product-level quality and product portfolio of each firm. The average product quality of firm f is:

$$Q_{ft}^{\text{benchmark}} = \sum_{jf} \omega_{jft} R_{jt}^{\text{benchmark}}$$

where ω_{jft} is a revenue weight. $Q_{ft}^{\text{benchmark}}$ captures how far the prices of the products produced by firm f are from the median price level in each of their categories at time t.

Percentile-based Quality Measure Since the cross-sectional distribution of prices in a given category is fat-tailed, a cardinal measure of quality may be noisy and thus problematic. For this reason, we also define a percentile-based measure of quality as follows:

$$R_{jt}^{\text{percentile}} = \frac{1}{N_{ct}}(n_{jct} - \frac{1}{2})$$

where N_{jt} is total number of products in category c at quarter t and n_{jt} is an ordinal rank of product j. $Q_{ft}^{\text{percentile}}$ can be defined as before by aggregating the product portfolio of each firm using revenue weights.

Perceived Quality Measure from Demand Estimation (work in progress)

The estimation of our final quality measure begins with the demand specification in Hottman, Redding and Weinstein (2016). We then estimate the elasticity of substitution using an instrumental variable approach and back out the product specific perceived quality from system (Gervais, 2015; Piveteau and Smagghue, 2015; Fieler, Eslava and Xu, 2016). We derive the following equation from the nested constant elasticity of substitution utility system described in Appendix D.

$$\Delta \log(C_{ufmct}) = \lambda_{fmct} - \sigma \Delta \log(P_{ufmct}) + (\sigma - 1)\varphi_u + \epsilon_{ufmct} \tag{15}$$

where P_{ufmct} is an average price of product u of firm f in module m at local market c at time t. To address the standard simultaneity concern that taste shocks in the error term are correlated with observed price changes, we follow Beraja, Hurst and Ospina (2016) and Fally and Faber (2017) and instrument for local consumer price changes across products $\Delta \log P_{ufmct}$ with national-level leave-out mean price changes: $\frac{1}{N-1}\Sigma_{j\neq c}\Delta \log P_{ufmjt}$.

In the current version of the paper, we estimate an elasticity of substitution σ for each product module, using a smaller version of the scanner data, the Nielsen Homescan Panel data (HMS). Table XVII reports the estimated elasticities of substitution. For 80 percent of modules, our IV estimates are statistically significant at the 1 percent level. On average, the module specific elasticity of substitution is 3.62; we find the OLS estimates to be upward biased. Furthermore, we find our perceived quality measures to be positively correlated with our benchmark quality measure.[31]

Using these quality measures, we now test association between our measure of product reallocation and firm-level average product quality improvement. We use the following specification:

$$Q_{f,t+1} = \alpha + \beta\, r_{f,t} + \Gamma X_{f,t} + \mu_f + \lambda_t + \epsilon_{f,t} \tag{16}$$

where f is the firm, and t is the quarter. Our main focus is on β which captures the direct impact of reallocation on firm-level average product quality in the next quarter. $X_{f,t}$ is a vector of firm level controls, μ_f represents firm fixed effects and λ_t represents time effects. By construction, the benchmark quality measure is centered at 0 and the percentile-based quality measure is center at

[31] Mean correlation is 0.54 with standard deviation 0.21. In a subsequent version of the paper, we plan to estimate perceived quality measures using the RMS and check the robustness of our regression results that follow.

50.[32] Table XVIII reports the relationship between our reallocation measures and our benchmark quality measure, $Q^{\text{benchmark}}_{f,t+1}$. We again keep balanced panel of firms to investigate the importance of reallocation among surviving firms. An increase in reallocation is associated with quality improvements in the following quarter. This correlation is mainly driven by the entry margin of products. Large firms tend to produce higher quality products on average. Furthermore, as shown in columns (3)-(4), quality improves more for product extensions beyond the module than for incremental innovations. Our results are consistent in two other specifications, with full sample, or using brands as product, shown in Table A.XIV and A.XV.[33]

6.3 Reallocation and Productivity

The remaining central implication of models with creative destruction to be tested is whether the reallocation of products is a major source of productivity growth. This prediction has been hard to examine directly in the data given the lack of availability of datasets combining both product and firm level information.[34]

We begin by computing total factor productivity in the Compustat data relying primarily on the methodology developed by İmrohoroğlu and Tüzel (2014). We then regress the natural logarithm of TFP on the annual reallocation rate as follows:

$$TFP_{f,t+1} = \alpha + \beta\, r_{f,t} + \Gamma X_{f,t} + \mu_f + \lambda_t + \epsilon_{f,t} \tag{17}$$

where as before f is the firm, and t is the year. Our main focus is once again on β which captures the direct impact of reallocation on firm productivity. Table XIX reports our results. Column (1) shows that both variables are strongly correlated even after controlling for the size of the firm. This is important because in general larger firms have higher productivity and, as we have shown, they also have higher rate of reallocation. Column (2) includes controls for market power by including the price-to-cost margin as control. Column (3) includes the standard deviation of sales to control for the possibility that firms with faster sales growth have higher rates of product entry and exit. Lastly, in column (4) we control for differences in financial constraints across firms by including the Kaplan-Zingales index. Our estimates of β remain very similar across specifications and show that, on average, an increase of 5 percentage points in reallocation increases TFP between 0.9 and 1%.

When we examine the contribution of entries and exits separately, we find that the contribution of reallocation to TFP mainly comes from exits. But, interestingly, when we explore improvements

[32] As shown in Table XV, a balanced sample of firms has an average benchmark quality above 0 and an average percentile-based quality of above 50. This is because short-lived firms in our sample are on average low-quality producers.

[33] The results are also robust to a percentile based quality measure, which is available upon request.

[34] This question has been, nonetheless, explored in other contexts such as the reallocation of establishments (Bartelsman and Doms, 2000; Foster, Haltiwanger and Krizan, 2001; Foster, Grim and Haltiwanger, 2016). In both cases, a large share of productivity growth can be explained by the reallocation of resources.

and extensions separately. We find that product extensions, those products who are more likely to involve a larger innovation but are less common in our data, have a positive and significant contribution to TFP. On the other hand, exits within the main module of the firm, those that are more likely to come from replacing outdated products for better products, contribute positively and significantly to TFP.

6.4 Summary of Results and Implications

The importance of product reallocation has been central in models of creative destruction for decades but, as the theoretical literature has evolved, the lack of data availability made many of its central implications hard to be tested. Our calculations validate many predictions of these models. First, we find that faster innovation-led growth is associated with higher rates of reallocation of products (Aghion, Akcigit and Howitt, 2014). Product reallocation is positively related to R&D and to revenue growth. Second, although both entrants and incumbents innovate (Bartelsman and Doms, 2000), most growth appears to come from incumbents improving existing varieties (Garcia-Macia, Hsieh and Klenow, 2016; Acemoglu and Cao, 2015). Third, small firms and new entrants have a comparative advantage for achieving major innovations or, as we called them within the context of the consumer goods sector, extensions (Akcigit and Kerr, 2010). And, lastly, a more innovative firm has higher levels of productivity (Lentz and Mortensen, 2008).

How much of the decrease in aggregate productivity can be attributed to changes in the product reallocation? Our baseline estimate of column 1 in Table XIX suggests that total factor productivity increases by approximately 0.2 percent for every 1 percentage point increase in reallocation.[35] Given that the reallocation rate decreased by more than 4 percentage points during the recession and that TFP declined almost 5% from 2007 to 2010 in our data, product reallocation can explain 15-20% of the total decline in total factor productivity. This suggests that a significant drop in aggregate productivity was driven by firms slowing down their innovation activities during this period. This, in turn, decreased the dynamism in which they replaced older products for improved products decreasing the pace of quality improvements and ultimately economic growth.

7 Conclusion

This paper describes the extent of product innovation and reallocation in the consumer good sector over the period 2006-2014. We find 30 percent decline in product reallocation during the Great Recession, and investigate the impact of this drop on firm-level outcomes such as revenue, product quality, and total productivity. The analysis provides several findings. First, product reallocation

[35] The interpretation of our results should consider the fact that they were computed using a sample of large publicly traded firms. Moreover, although within firm reallocation is by far the most important component of the overall reallocation rate, our estimates in section 6.3 ignore the contribution of firm entry and exit.

is strongly pro-cyclical and the cyclical pattern is overwhelmingly a consequence of within firm reallocation. Second, the rate of product reallocation is strongly related to the innovation efforts of the firms. Third, firms that have higher reallocation rates grow faster, launch higher quality goods, and experience larger gains in productivity.

Given that higher reallocation activities lead firms to grow both quantitatively and qualitatively, the fact that its pace suffered an important drop had substantial implications for aggregate growth in this period. More importantly, the fact that the reallocation rate took so long to return to its pre-recession level suggests it was an important factor in the slow recovery the economy experienced after the Great Recession. Our findings also suggest that industrial and innovation policies aimed at increasing economic growth should contemplate the relative importance of the product-mix decisions. This is particularly relevant for incumbent firms as they account to the majority of the decline in dynamism in the retail sector that ultimately led to important declines in total factor productivity.

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Tables and Figures

Table I: Comparison between Three Barcode-level Data-sets

The table compares three barcode-level data-sets.

	RMS	HMS	IRI
Time period	2006-2015	2004-2015	2001-2012
Coverage	1,071 modules, 114 groups	1m077 modules, 115 groups	31 categories*
Observational units	Store	Households	Store
# of stores/households	35,510 stores	61,557 households	2,945 stores
# of states	49	49	43
# of counties	2,550	2,699	503
# of products in 2006	724,211	392,455	50,434
Frequency	Weekly, average	Daily, by transaction	Weekly, average
Tag on temporary sales	none	deal flag by household	sales flag by IRI

* Categories in IRI are matched either with modules or groups in Nielsen data. 31 categories in IRI cover roughly 143 modules in Nielsen data.

Table II: Top 20 Firms in Total Revenue

The table reports top 20 firms in total revenue for 2006-2014. The total revenue is in billion USD.

Ranking	Name of Firm	Total Revenue
1	Procter & Gamble Company	87.17
2	General Mills, Inc.	34.09
3	Kraft Foods, Inc.	33.68
4	Nestle USA Inc.	29.48
5	Frito-Lay Company	29.33
6	Coca-Cola USA Operations	27.36
7	Philip Morris USA/Tobacco Products	25.90
8	Pepsi-Cola North America Inc.	24.55
9	Kimberly-Clark/Household Products Div.	18.82
10	Anheuser-Busch InBev	17.02
11	Kellogg Company	16.70
12	Unilever Home and Personal Care USA	16.27
13	The Hershey Company	15.41
14	Nabisco Biscuit Company	14.89
15	ConAgra Foods Inc.	14.89
16	Campbell Soup Company	14.60
17	Produce Marketing Association Inc.	13.97
18	Dr. Pepper/Seven Up, Inc.	12.30
19	Oscar Mayer Foods Corp.	12.18
20	Nestle Purina PetCare Company	11.67

Table III: Summary Statistics of Products

The table shows summary statistics of products.

		2007-2013	2007	2010	2013
Number of products		251032	227249	241811	296527
By status (share of products)					
	Entrants	0.019	0.052	0.032	0.042
	Exits	0.014	0.035	0.035	0.046
By diversification (average)					
	Per module	284	587	575	593
	Per group	2770	5506	5397	5559
	Per department	31856	62769	61526	63376
By Revenue (share of products)					
	$[0,10^4[$	0.600	0.617	0.598	0.629
	$[10^4,10^5[$	0.220	0.228	0.233	0.216
	$[10^5,10^6[$	0.131	0.130	0.139	0.130
	$>=10^6$	0.049	0.025	0.029	0.025

Table IV: Summary Statistics of Firms in the Data

The table shows summary statistics of firms in the data. By revenue, we report share of continuing firms.

			2007-2013	2007	2010	2013
Number of firms (average)			14068	13952	13611	15305
By status (share of firms)						
	Entrants		0.022	0.028	0.017	0.026
	Exits		0.018	0.021	0.015	0.019
	Continuers Expanding		0.129	0.134	0.115	0.147
	Continuers Contracting		0.125	0.136	0.120	0.119
By diversification						
	Single Product					
		Share of firms	0.259	0.275	0.257	0.246
	Multi Product & Single Module					
		Share of firms	0.260	0.255	0.261	0.261
		Mean number of products	5.7	5.6	5.6	5.7
		Median number of products	3	3	3	3
	Multi Module & Single Group					
		Share of firms	0.123	0.118	0.124	0.127
		Mean number of products	13.6	12.8	13.8	14.1
		Median number of products	7	7	7	7
	Multi Group & Single Department					
		Share of firms	0.197	0.193	0.197	0.200
		Mean number of products	25.3	23.2	25.4	27.7
		Median number of products	10	10	11	10
	Multi Department					
		Share of firms	0.162	0.160	0.161	0.167
		Mean number of products	58.5	54.1	58.1	61.9
		Median number of products	16	15	16	17
By Revenue (share of firms)						
	$[0,10^4[$		0.443	0.459	0.433	0.451
	$[10^4,10^5[$		0.266	0.260	0.271	0.263
	$[10^5,10^6[$		0.190	0.187	0.192	0.184
	$>=10^6$		0.102	0.094	0.104	0.102

Table V: Summary Statistics - Publicly Traded Firms vs Matched Sample

The table reports summary statistics for all publicly traded firms and those matched with the Nielsen RMS from 2006-2014. The construction of these variables is detailed in Appendix C. R&D along with the rest of the financial variables are reported relative to net sales. We report the natural logarithm of TFP. Total sales are reported in millions. All statistics are weighted by total sales except the number of firms, employees and sales.

	Compustat	Sample
Num. Firms	6265	435
Employees	9.96	30.21
Sales	3405	10834
R&D	0.03	0.03
TFP	0.04	0.07
Price Cost Margin	0.70	0.67
Share of Labor	0.13	0.13
Std. Sales	0.15	0.13
KZ	1.97	1.49
Cash	0.11	0.11
Cash Flow	0.10	0.11
Dividends	0.02	0.03
Leverage	0.96	0.81
Market Value Equity	0.78	1.12
Q Ratio	0.43	0.77
S&P	2.65	3.23

Table VI: Summary Statistics - Nielsen RMS vs Matched Sample

The table reports summary statistics for all firms in the Nielsen RMS and those matched with the sample of publicly traded firms in Compustat from 2006-2014. Average modules (groups or departments) indicates the average number of modules (groups or departments) in which the firm sells products. Revenue main module (groups or departments) indicates the share of the firm's total revenue that comes from the module (groups or departments) from which the highest share of its revenue comes from. Revenue is reported in millions. The construction of the rest of the variables is detailed in main text. All statistics are weighted by revenue except the number of firms, number of products and revenue.

	RMS	Sample
Num. Firms	37282	505
Num. Products	16.99	213.2
Revenue	1.170	33.62
Reallocation	0.08	0.08
Entry Rate	0.07	0.07
Exit Rate	0.04	0.04
Avg. Departments	2.78	3.45
Avg. Groups	12.62	18.50
Avg. Modules	42.96	57.11
Rev. Main Group	0.71	0.55
Rev. Main Module	0.52	0.37
Rev. Main Dept.	0.88	0.81

Table VII: Aggregate Entry, Exit, and Reallocation Rates

	All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	 (3)/(2)-1
Reallocation	0.080	0.094	0.068	0.082	-28%	21%
Entry	0.045	0.052	0.038	0.050	-28%	32%
Exit	0.035	0.042	0.030	0.032	-29%	7%

Table VIII: Average Within Entry, Exit, and Reallocation Rates

	All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	 (3)-(2)-1
Reallocation	0.107	0.127	0.089	0.115	-30%	28%
Entry	0.058	0.068	0.047	0.068	-31%	45%
Exit	0.052	0.063	0.045	0.050	-29%	12%

Table IX: Aggregate Reallocation by Types of Firms

	All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	(3)-(2)-1
Reallocation						
Expanding Entrant	0.003	0.004	0.002	0.003	-45%	52%
Expanding Incumbent	0.045	0.049	0.037	0.051	-25%	37%
Contracting Exit	0.001	0.002	0.001	0.001	-37%	32%
Contracting Incumbent	0.027	0.035	0.025	0.023	-30%	-8%
Unchanged Incumbent	0.004	0.004	0.003	0.004	-33%	29%
Entry						
Expanding Entrant	0.003	0.004	0.002	0.003	-45%	52%
Expanding Incumbent	0.036	0.038	0.030	0.040	-22%	36%
Contracting Incumbent	0.005	0.008	0.005	0.004	-42%	-7%
Unchanged Incumbent	0.002	0.002	0.001	0.002	-33%	28%
Exit						
Expanding Incumbent	0.010	0.011	0.007	0.010	-34%	42%
Contracting Exit	0.001	0.002	0.001	0.001	-37%	32%
Contracting Incumbent	0.022	0.027	0.020	0.019	-26%	-8%
Unchanged Incumbent	0.002	0.002	0.001	0.002	-33%	31%
Reallocation						
Q1 revenue	0.005	0.008	0.003	0.005	-55%	58%
Q2 revenue	0.006	0.007	0.005	0.007	-31%	48%
Q3 revenue	0.011	0.013	0.009	0.011	-32%	28%
Q4 revenue	0.057	0.065	0.049	0.056	-24%	15%
Q1 revenue only incumbents	0.002	0.002	0.001	0.002	-44%	74%
Q2 revenue only incumbents	0.004	0.005	0.003	0.004	-43%	31%
Q3 revenue only incumbents	0.009	0.012	0.008	0.008	-35%	6%
Q4 revenue only incumbents	0.049	0.058	0.042	0.047	-27%	12%
Entry						
Q1 revenue	0.002	0.003	0.002	0.003	-47%	100%
Q2 revenue	0.003	0.004	0.003	0.005	-33%	77%
Q3 revenue	0.006	0.007	0.005	0.007	-36%	48%
Q4 revenue	0.032	0.036	0.028	0.033	-24%	21%
Q1 revenue only incumbents	0.001	0.001	0.001	0.001	-33%	106%
Q2 revenue only incumbents	0.002	0.003	0.001	0.002	-48%	59%
Q3 revenue only incumbents	0.005	0.007	0.004	0.005	-41%	16%
Q4 revenue only incumbents	0.028	0.032	0.024	0.027	-27%	17%
Exit						
Q1 revenue	0.002	0.004	0.002	0.002	-61%	18%
Q2 revenue	0.003	0.003	0.002	0.003	-28%	16%
Q3 revenue	0.005	0.005	0.004	0.004	-26%	5%
Q4 revenue	0.024	0.028	0.021	0.023	-25%	6%
Q1 revenue only incumbents	0.001	0.001	0.001	0.001	-53%	36%
Q2 revenue only incumbents	0.002	0.002	0.001	0.001	-36%	4%
Q3 revenue only incumbents	0.004	0.005	0.004	0.004	-27%	-4%
Q4 revenue only incumbents	0.021	0.026	0.019	0.020	-27%	6%
Reallocation						
Single-product	0.002	0.003	0.002	0.002	-43%	14%
Single-Module	0.007	0.008	0.005	0.007	-30%	23%
Single-Group	0.008	0.009	0.007	0.007	-19%	1%
Single-Department	0.020	0.023	0.017	0.022	-26%	28%
Multi-department	0.040	0.047	0.034	0.040	-29%	19%
Entry						
Single-product	0.001	0.002	0.001	0.001	-49%	37%
Single-Module	0.003	0.004	0.003	0.004	-33%	41%
Single-Group	0.004	0.005	0.004	0.004	-13%	3%
Single-Department	0.011	0.012	0.009	0.013	-19%	37%
Multi-department	0.022	0.026	0.018	0.024	-30%	32%
Exit						
Single-product	0.001	0.002	0.001	0.001	-38%	-5%
Single-Module	0.003	0.004	0.003	0.003	-26%	5%
Single-Group	0.004	0.004	0.003	0.003	-25%	-2%
Single-Department	0.009	0.011	0.008	0.009	-33%	18%
Multi-department	0.018	0.021	0.016	0.016	-27%	5%

Table X: Average Within Reallocation Rates by Types of Firms

	All	(1)	(2)	(3)	Change	
	2007-2013	2007	2010	2013	(2)/(1)-1	(3)-(2)-1
Reallocation						
Expanding Entrant	1.000	1.000	1.000	1.000	0%	0%
Expanding Incumbent	0.251	0.258	0.238	0.258	-8%	8%
Contracting Exit	1.000	1.000	1.000	1.000	0%	0%
Contracting Incumbent	0.237	0.271	0.224	0.217	-17%	-3%
Unchanged Incumbent	0.007	0.009	0.004	0.009	-57%	116%
Entry						
Expanding Entrant	1.000	1.000	1.000	1.000	0%	0%
Expanding Incumbent	0.232	0.238	0.223	0.240	-6%	8%
Contracting Incumbent	0.014	0.018	0.011	0.015	-42%	37%
Unchanged Incumbent	0.004	0.005	0.002	0.004	-57%	116%
Exit						
Expanding Incumbent	0.020	0.021	0.016	0.019	-26%	18%
Contracting Exit	1.000	1.000	1.000	1.000	0%	0%
Contracting Incumbent	0.224	0.254	0.214	0.203	-16%	-5%
Unchanged Incumbent	0.004	0.005	0.002	0.004	-57%	116%
Reallocation						
Q1 revenue	0.172	0.212	0.140	0.183	-34%	31%
Q2 revenue	0.095	0.099	0.083	0.108	-17%	31%
Q3 revenue	0.087	0.094	0.075	0.093	-20%	23%
Q4 revenue	0.076	0.085	0.066	0.077	-23%	18%
Q1 revenue only incumbents	0.050	0.059	0.040	0.057	-32%	43%
Q2 revenue only incumbents	0.049	0.060	0.040	0.050	-33%	26%
Q3 revenue only incumbents	0.058	0.068	0.049	0.058	-27%	18%
Q4 revenue only incumbents	0.067	0.078	0.058	0.066	-26%	14%
Entry						
Q1 revenue	0.087	0.098	0.069	0.111	-29%	60%
Q2 revenue	0.052	0.059	0.043	0.065	-27%	52%
Q3 revenue	0.049	0.057	0.040	0.055	-30%	37%
Q4 revenue	0.045	0.052	0.038	0.044	-27%	15%
Q1 revenue only incumbents	0.025	0.025	0.019	0.037	-25%	97%
Q2 revenue only incumbents	0.025	0.033	0.019	0.028	-41%	43%
Q3 revenue only incumbents	0.030	0.038	0.024	0.030	-37%	25%
Q4 revenue only incumbents	0.038	0.046	0.032	0.036	-30%	12%
Exit						
Q1 revenue	0.096	0.130	0.078	0.085	-40%	8%
Q2 revenue	0.045	0.043	0.042	0.046	-2%	11%
Q3 revenue	0.039	0.038	0.036	0.039	-4%	8%
Q4 revenue	0.031	0.033	0.027	0.033	-16%	21%
Q1 revenue only incumbents	0.025	0.034	0.022	0.021	-37%	-4%
Q2 revenue only incumbents	0.024	0.027	0.021	0.023	-24%	11%
Q3 revenue only incumbents	0.028	0.030	0.025	0.028	-14%	11%
Q4 revenue only incumbents	0.029	0.032	0.025	0.030	-21%	16%
Reallocation						
Single-product	0.109	0.136	0.091	0.111	-33%	21%
Single-Module	0.068	0.077	0.056	0.076	-27%	35%
Single-Group	0.082	0.097	0.068	0.083	-30%	22%
Single-Department	0.072	0.084	0.059	0.074	-29%	26%
Multi-department	0.079	0.093	0.065	0.081	-30%	25%
Entry						
Single-product	0.030	0.038	0.022	0.036	-43%	67%
Single-Module	0.026	0.029	0.020	0.033	-31%	62%
Single-Group	0.034	0.038	0.028	0.038	-25%	33%
Single-Department	0.031	0.035	0.025	0.035	-29%	39%
Multi-department	0.036	0.042	0.029	0.041	-31%	43%
Exit						
Single-product	0.082	0.102	0.071	0.077	-30%	9%
Single-Module	0.042	0.048	0.036	0.044	-24%	21%
Single-Group	0.048	0.060	0.040	0.046	-33%	15%
Single-Department	0.041	0.049	0.034	0.040	-30%	16%
Multi-department	0.042	0.051	0.036	0.040	-28%	10%

Table XI: Decomposition

The table reports decomposition results.

	Within (+)	Between (+)	Cross (+)	Entry (+)	Exit (-)	Change
OP - Non dynamic						
Entry Rate						
06Q3-09Q2	-2.9	1.0	-	-	-	-2.0
09Q3-12Q2	2.6	-1.1	-	-	-	1.5
Exit Rate						
06Q3-09Q2	-2.1	0.5	-	-	-	-1.6
09Q3-12Q2	-0.1	-0.1	-	-	-	-0.1
Reallocation Rate						
06Q3-09Q2	-5.0	1.5	-	-	-	-3.6
09Q3-12Q2	2.5	-1.2	-	-	-	1.3
OP - Dynamic						
Entry Rate						
06Q3-09Q2	-27.4	22.2	-	3.2	-	-2.0
09Q3-12Q2	-21.2	19.7	-	3.0	-	1.5
Exit Rate						
06Q3-09Q2	21.5	-21.1	-	-	2.0	-1.6
09Q3-12Q2	18.5	-17.2	-	-	1.4	-0.1
Reallocation Rate						
06Q3-09Q2	-5.9	1.2	-	3.2	2.0	-3.6
09Q3-12Q2	-2.7	2.4	-	3.0	1.4	1.3
GR						
Entry Rate						
06Q3-09Q2	-8.6	3.5		3.2	-	-2.0
09Q3-12Q2	-5.6	4.0		3.0	-	1.5
Exit Rate						
06Q3-09Q2	3.7	-3.3		-	2.0	-1.6
09Q3-12Q2	3.7	-2.4		-	1.4	-0.1
Reallocation Rate						
06Q3-09Q2	-4.9	0.2	-	3.2	2.0	-3.6
09Q3-12Q2	-1.9	1.6	-	3.0	1.4	1.3
FHK						
Entry Rate						
06Q3-09Q2	-11.4	0.8	5.4	3.1	-	-2.0
09Q3-12Q2	-8.2	1.4	5.3	3.0	-	1.5
Exit Rate						
06Q3-09Q2	1.9	-5.2	3.6	-	2.0	-1.6
09Q3-12Q2	2.4	-3.7	2.5	-	1.4	-0.1
Reallocation Rate						
06Q3-09Q2	-9.4	-4.4	9.1	3.1	2.0	-3.6
09Q3-12Q2	-5.8	-2.3	7.8	3.0	1.4	1.3

Table XII: Summary Statistics for Aggregate Entry and Exit Rates by Types

The table reports summary statistics for within firms by types.

		All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	(3)-(2)-1
Entry							
	Improvement	0.038	0.042	0.032	0.041	-25%	29%
	Extension	0.005	0.006	0.004	0.005	-36%	42%
	Firm	0.003	0.004	0.003	0.003	-45%	52%
	ALL	0.0045	0.052	0.038	0.050	-28%	32%
Exit							
	Improvement	0.029	0.035	0.025	0.026	-27%	5%
	Extension	0.005	0.006	0.004	0.004	-35%	17%
	Firm	0.001	0.002	0.001	0.001	-37%	32%
	ALL	0.035	0.042	0.030	0.032	-29%	7%

Table XIII: Summary Statistics for Within Entry and Exit Rates by Types

The table reports summary statistics for within firms by types.

		All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	(3)-(2)-1
Entry							
	Improvement	0.026	0.028	0.021	0.030	-24%	44%
	Extension	0.010	0.011	0.008	0.011	-28%	45%
	Firm	0.022	0.029	0.018	0.026	-39%	47%
	ALL	0.058	0.068	0.047	0.068	-31%	45%
Exit							
	Improvement	0.019	0.021	0.017	0.018	-22%	11%
	Extension	0.015	0.021	0.013	0.012	-37%	-6%
	Firm	0.018	0.021	0.015	0.019	-30%	30%
	ALL	0.052	0.063	0.045	0.050	-29%	12%

Table XIV: Reallocation Activities and R&D Expenses

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable reallocation at t, defined as the product entry rate plus the product exit rate, at the subsidiary level as defined in the main text. The main independent variable is the ratio of R&D expenses to total sales at $t-1$. The construction of the rest of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Dep. var.: $r_{f,t+1}$				
R&D	0.989**	0.986**	1.469***	1.469***
	(0.399)	(0.399)	(0.477)	(0.479)
Size	-0.014	-0.012	-0.002	-0.002
	(0.018)	(0.018)	(0.019)	(0.019)
Price Cost Margin		0.032	0.241*	0.241*
		(0.069)	(0.123)	(0.124)
Std. Sale			-0.047	-0.047
			(0.057)	(0.057)
Kaplan-Zingales				-0.000
				(0.000)
Observations	563	563	555	553
R-squared	0.701	0.701	0.702	0.701
Year Effects	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes

Table XV: Summary Statistics of Firm-level Revenue and Product Quality

The table shows summary statistics of firm-level revenue (in logs) and product quality (benchmark and percentile). To be consistent with the regressions, we keep balanced sample of firms for the sample period.

		num. of obs.	mean	std. dev.	10th percentile	median	90th percentile
$\text{Revenue}_{f,t}$	main specification	278,016	10.84	2.98	7.04	10.84	14.69
	with full sample	388,608	10.73	3.06	6.79	10.73	14.68
$Q_{f,t}^{\text{benchmark}}$	main specification	277,897	0.05	0.66	-0.64	0.03	0.80
	with full sample	388,279	0.10	0.67	-0.59	0.08	0.87
$Q_{f,t}^{\text{percentile}}$	main specification	278,016	52.55	23.02	20.90	52.95	83.50
	with full sample	338,279	54.63	22.72	23.55	55.08	85.12

Table XVI: Reallocation Activities and Revenue Growth

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the revenue growth in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: Revenue$_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.2730***						
	(0.009)						
$n_{f,t}$		0.5197***					
		(0.013)					
$n_{f,t}$ (in module)			0.5255***				
			(0.015)				
$n_{f,t}$ (beyond module)				0.5501***			
				(0.026)			
$x_{f,t}$					-0.5539***		
					(0.016)		
$x_{f,t}$ (in module)						-0.0520**	
						(0.021)	
$x_{f,t}$ (beyond module)							-1.2070***
							(0.024)
Revenue$_{f,t}$	0.8085***	0.8051***	0.8047***	0.8065***	0.7705***	0.7712***	0.7732***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	269,115	269,280	269,280	269,280	269,163	269,163	269,163
R-squared	0.970	0.970	0.970	0.970	0.967	0.967	0.967
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table XVII: Estimated Elasticity of Substitution by Modules

The table shows summary statistics of estimated elasticity of substitution by modules. Among 1,149 product modules, the OLS estimates for 773 modules are significantly estimated with p-values less than .01. The IV estimates for 832 modules are significantly estimated. We also exclude 76 and 20 modules with negative coefficient for OLS and IV, respectively.

	num. of obs.	mean	std. dev.	10th percentile	median	90th percentile
σ_m^{OLS}	697	7.65	5.65	2.93	6.00	14.14
σ_m^{IV}	812	3.62	2.15	1.71	3.02	6.14

Table XVIII: Reallocation Activities and Benchmark Quality Improvement

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the benchmark quality improvement in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: $Q^{\text{benchmark}}_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.0162***						
	(0.003)						
$n_{f,t}$		0.0274***					
		(0.004)					
$n_{f,t}$ (in module)			0.0250***				
			(0.005)				
$n_{f,t}$ (beyond module)				0.0345***			
				(0.009)			
$x_{f,t}$					0.0040		
					(0.005)		
$x_{f,t}$ (in module)						-0.0183***	
						(0.007)	
$x_{f,t}$ (beyond module)							0.0327***
							(0.008)
Revenue$_{f,t}$	0.0064***	0.0061***	0.0061***	0.0062***	0.0063***	0.0062***	0.0062***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	269,007	269,171	269,171	269,171	269,055	269,055	269,055
R-squared	0.923	0.923	0.923	0.923	0.923	0.923	0.923
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table XIX: Reallocation Activities and Firm-Level Productivity

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the natural logarithm of total factor productivity at the firm-level at $t+1$. Reallocation at t is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. The construction of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\text{TFP}_{f,t+1}$										
$r_{f,t}$	0.204**	0.203**	0.195**	0.195**						
	(0.083)	(0.083)	(0.083)	(0.083)						
$n_{f,t}$					-0.075					
					(0.109)					
$n_{f,t}$ (in module)						-0.162				
						(0.111)				
$n_{f,t}$ (beyond module)							2.448***			
							(0.588)			
$x_{f,t}$								0.707***		
								(0.152)		
$x_{f,t}$ (in module)									0.761***	
									(0.156)	
$x_{f,t}$ (beyond module)										-0.358
										(0.730)
Size	0.257***	0.250***	0.254***	0.252***	0.245***	0.244***	0.245***	0.261***	0.260***	0.245***
	(0.034)	(0.036)	(0.036)	(0.036)	(0.033)	(0.033)	(0.032)	(0.035)	(0.035)	(0.033)
Price Cost Margin		-0.147	-0.211	-0.223	-0.720***	-0.716***	-0.741***	-0.124	-0.122	-0.728***
		(0.228)	(0.231)	(0.232)	(0.214)	(0.213)	(0.211)	(0.230)	(0.230)	(0.214)
Std. Sale			-0.216*	-0.216*	-0.293**	-0.299**	-0.280**	-0.236*	-0.239**	-0.289**
			(0.122)	(0.122)	(0.118)	(0.118)	(0.116)	(0.120)	(0.120)	(0.117)
Kaplan-Zingales				0.000	0.000	0.000	0.000	0.000	0.000	0.000
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	714	714	714	713	799	799	799	713	713	799
R-squared	0.859	0.859	0.860	0.860	0.849	0.849	0.852	0.864	0.864	0.849
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1: Example of a Company Prefix

Note: This figure shows examples of a 6-digit and a 9-digit firm prefix. The source is the GS1-US website (http://www.gs1-us.info/company-prefix).

Figure 2: Aggregate Entry, Exit, and Reallocation Rates

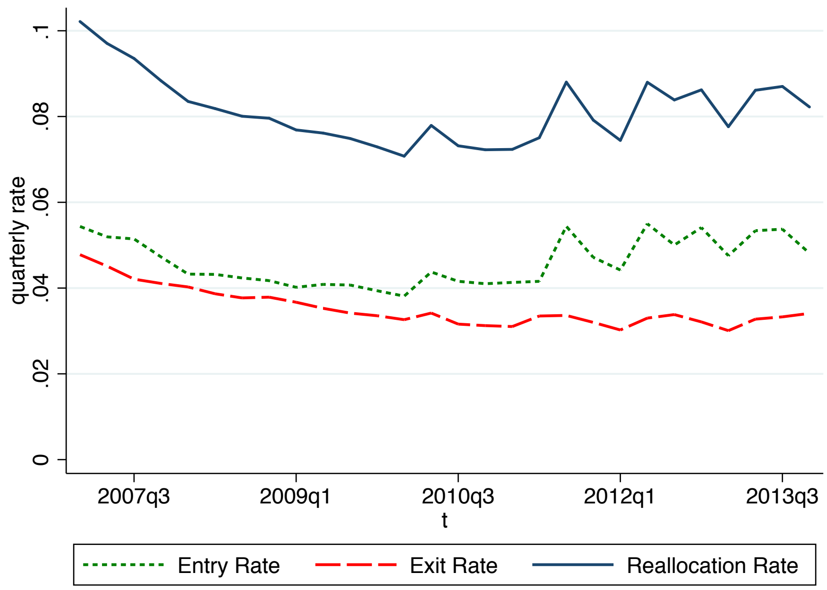


Figure 3: Within-firm Entry, Exit, and Reallocation Rates

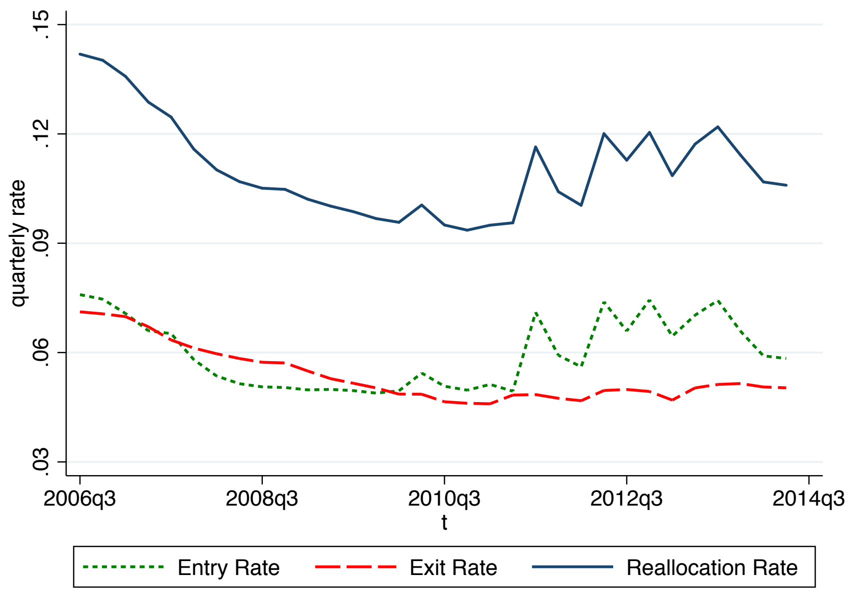
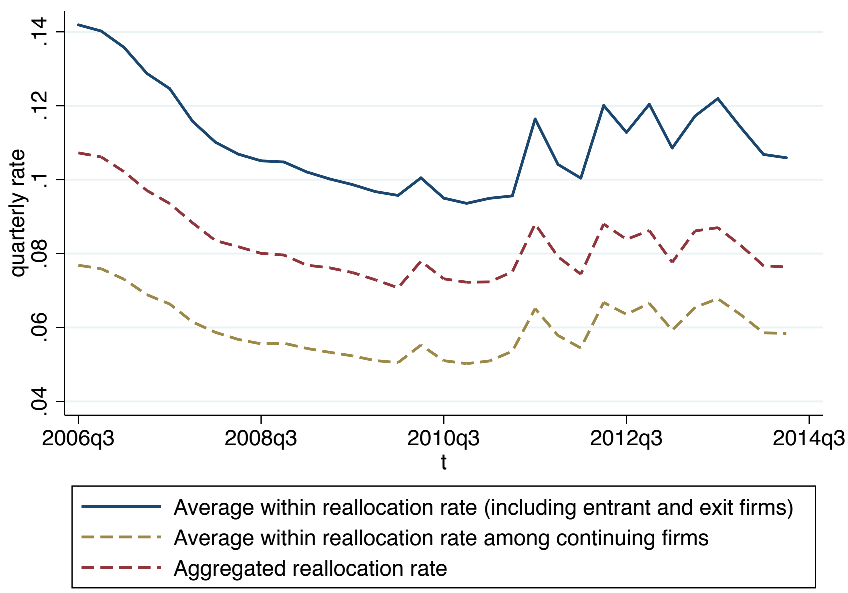


Figure 4: Aggregated and Within Reallocation



A Firm Dataset

Using the product level dataset and the information on the firm, we construct a dataset with the following information for each firm per quarter:

- type of firm Γ_{it} is defined as 1 if it is the first time we see the firm (or all products of the firm are entrants products), -1 if the last period we saw the firms was in t (or all products of the firm are exit products), and 0 otherwise.
- total number of entrant products $N_{it} = \sum_j N_{jit}$
- number of exit products $X_{it} = \sum_j X_{jit}$
- number of continuing products $C_{it} = \sum_j C_{jit}$
- number of all products
  - (i) T_{it} computed as number of observations of products of firm i in t, defined as defined as $N_{it} + C_{it}$
  - (ii) $T2_{it}$ computed as number of observations of products of firm i in $t-1$ plus the changes in the number of products as defined in $\Delta T2_{it}$, i.e. $T2_{it-1} + \Delta T2_{it}$ with $T_{i06Q1} = T2_{i06Q1}$
- change in the number of products
  - (i) ΔT_{it} computed as number of products in t minus number of products in $t-1$
  - (ii) $\Delta T2_{it}$ computed as number of entrants in t minus number of exits in t, i.e. change in products is defined as $N_{it} - X_{it}$
- entry rate $n_{it} = N_{it}/T_{it}$ and $n2_{it} = N_{it}/T2_{it}$
- exit rate $x_{it} = X_{it}/T_{it-1}$ and $n2_{it} = N_{it}/T2_{it-1}$
- reallocation within firm $r_{it} = n_{it} + x_{it}$ and $r_{it} = n2_{it} + x2_{it}$
- total revenue of all products rev_{it}
- total revenue of entrant a products $revN_{it}$
- total revenue of entrant b products $revNa_{it}$
- total revenue of entrant c products $revNb_{it}$
- total revenue of entrant d products $revNc_{it}$
- total revenue of entrant d products $revNd_{it}$

- total revenue of entrant e products $revNd_{it}$
- total revenue of exit products $revX_{it}$
- dummy variable to indicate if is a multi-product firm (i.e. if number of products >1) $multi_{it}$
- number of different modules $modules_{it}$
- dummy variable to indicate if is a multi-module firm (i.e. if number of module >1) $multimodules_{it}$
- number of different groups $groups_{it}$
- dummy variable to indicate if is a multi-group firm (i.e. if number of group >1) $multigroups_{it}$
- number of different departments $departments_{it}$
- dummy variable to indicate if is a multi-department firm (i.e. if number of depart. >1) $multidepartments_{it}$
- main module (defined as the module that generates more revenue) $mainmodule_{it}$
- share of revenue in main module $revmainmodule_{it}$
- main group (defined as the group that generates more revenue) $maingroup_{it}$
- share of revenue in main group $revmaingroup_{it}$
- main department (defined as the department that generates more revenue) $maindepartment_{it}$
- share of revenue in main department $revmaindepartment_{it}$
- simple average quality of all products (using the variable *quality0* to *quality7* in the original dataset) $q0_{it}$ $q1_{it}$ $q2_{it}$ $q3_{it}$ $q4_{it}$ $q5_{it}$ $q6_{it}$ $q7_{it}$
- simple average quality of all exit products $q0_{it}$ $q1_{it}$ $q2_{it}$ $q3_{it}$ $q4_{it}$ $q5_{it}$ $q6_{it}$ $q7_{it}$

B Reallocation measures

B.1 Aggregate entry, exit and reallocation

We define entry, exit and reallocation as follows

Aggregate entry rate

$$n_t = \frac{\sum_i N_{it}}{\sum_i T_{it}} \tag{18}$$

Aggregate exit rate

$$x_t = \frac{\sum_i X_{it}}{\sum_i T_{it-1}} \tag{19}$$

Aggregate reallocation rate

$$r_t = n_t + x_t \tag{20}$$

Aggregate entry rate by firm net growth of product

(Note that $n_t = n_t^{expanding} + n_t^{contracting} + n_t^{stable}$)

$$n_t^{expanding} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} > 0\}}}{\sum_i T_{it}} \tag{21}$$

$$n_t^{contracting} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} < 0\}}}{\sum_i T_{it}} \tag{22}$$

$$n_t^{stable} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} = 0\}}}{\sum_i T_{it}} \tag{23}$$

We can define the revenue-weighted version as follows

$$\tilde{n}_t^{expanding} = \frac{\sum_i Nrev_{it} 1_{\{i \in \Delta T_{it} > 0\}}}{\sum_i Rev_{it}} \tag{24}$$

$$\tilde{n}_t^{contracting} = \frac{\sum_i Nrev_{it} 1_{\{i \in \Delta T_{it} < 0\}}}{\sum_i Rev_{it}} \tag{25}$$

$$\tilde{n}_t^{stable} = \frac{\sum_i Nrev_{it} 1_{\{i \in \Delta T_{it} = 0\}}}{\sum_i Rev_{it}} \tag{26}$$

Aggregate exit rate by firm net growth of product

(Note that $x_t = x_t^{expanding} + x_t^{contracting} + x_t^{stable}$)

$$x_t^{expanding} = \frac{\sum_i X_{it} 1_{\{i \in \Delta T_{it} > 0\}}}{\sum_i T_{it-1}} \tag{27}$$

$$x_t^{contracting} = \frac{\sum_i X_{it} 1_{\{i \in \Delta T_{it} < 0\}}}{\sum_i T_{it-1}} \tag{28}$$

$$x_t^{stable} = \frac{\sum_i X_{it} 1_{\{i \in \Delta T_{it} = 0\}}}{\sum_i T_{it-1}} \tag{29}$$

We can define the revenue-weighted version as follows

$$\tilde{x}_t^{expanding} = \frac{\sum_i Xrev_{it} 1_{\{i \in \Delta T_{it} > 0\}}}{\sum_i Rev_{it}} \tag{30}$$

$$\tilde{x}_t^{contracting} = \frac{\sum_i Xrev_{it} 1_{\{i \in \Delta T_{it} < 0\}}}{\sum_i Rev_{it}} \tag{31}$$

$$\tilde{x}_t^{stable} = \frac{\sum_i Xrev_{it} 1_{\{i \in \Delta T_{it} = 0\}}}{\sum_i Rev_{it}} \tag{32}$$

Using the definitions above we can define the reallocation counterparts: $r_t^{expanding}$, $r_t^{contracting}$, r_t^{stable}, $\tilde{r}_t^{expanding}$, $\tilde{r}_t^{contracting}$, $\tilde{r}_t^{stable}$

Aggregate entry rate by firm net growth of product and type of firm
(Note that $n_t = n_t^c + n_t^d + x_t^e = n_t^{expanding,entrant} + n_t^{expanding,incumbent} + n_t^{contracting,incumbent} + n_t^{stable,incumbent}$)

$$n_t^{expanding,entrant} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} > 0 \bigcap i \in \Delta \Gamma_{it} > 0\}}}{\sum_i T_{it}} \tag{33}$$

$$n_t^{expanding,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} > 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it}} \tag{34}$$

$$n_t^{contracting,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} < 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it}} \tag{35}$$

$$n_t^{stable,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} = 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it}} \tag{36}$$

Aggregate exit rate by firm net growth of product and type of firm
(Note that $x_t = x_t^c + x_t^d + x_t^e = x_t^{expanding,incumbent} + x_t^{contracting,incumbent} + x_t^{contracting,exit} + x_t^{stable,incumbent}$)

$$x_t^{expanding,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} > 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it-1}} \tag{37}$$

$$x_t^{contracting,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} < 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it-1}} \tag{38}$$

$$x_t^{contracting,exit} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} < 0 \bigcap i \in \Delta \Gamma_{it} < 0\}}}{\sum_i T_{it-1}} \tag{39}$$

$$x_t^{stable,incumbent} = \frac{\sum_i N_{it} 1_{\{i \in \Delta T_{it} = 0 \bigcap i \in \Delta \Gamma_{it} = 0\}}}{\sum_i T_{it-1}} \tag{40}$$

As with the previous definitions of entry and exit, we can define the revenue weighted counterparts. Likewise, using the definitions above we can define the reallocation: $r_t^{expanding,incumbent}$, $r_t^{expanding,entrant}$, $r_t^{contracting,incumbent}$, $r_t^{contracting,exit}$, $r_t^{stable,incumbent}$.

Aggregate entry rate by firm revenue level

$$n_t^{Q(rev)=k} = \frac{\sum_i N_{it} 1_{\{i \in Q(rev)=k\}}}{\sum_i T_{it}}, k = 1, 2, 3, 4 \tag{41}$$

Aggregate exit rate by firm revenue level

$$x_t^{Q(rev)=k} = \frac{\sum_i N_{it} 1_{\{i \in Q(rev)_{it}=k\}}}{\sum_i T_{it}}, k = 1, 2, 3, 4 \tag{42}$$

Using the definitions above we can define the reallocation: $r_t^{Q(rev)=k} = n_t^{Q(rev)=k} + x_t^{Q(rev)=k}$.

Aggregate entry rate by firm multi-product status

$$n_t^{status=k} = \frac{\sum_i N_{it} 1_{\{i \in status_{it}=k\}}}{\sum_i T_{it}}, k = 1, 2, 3, 4, 5 \tag{43}$$

where K=1 if single product firm, K=2 if multi-product but single module firm, K=3 if multi-module but single group firm, K=4 if multi-group but single department firm, and K=5 if multi-department firms.

Aggregate exit rate by firm multi-product status

$$x_t^{status=k} = \frac{\sum_i X_{it} 1_{\{i \in status_{it}=k\}}}{\sum_i T_{it}}, k = 1, 2, 3, 4, 5 \tag{44}$$

where K=1 if single product firm, K=2 if multi-product but single module firm, K=3 if multi-module but single group firm, K=4 if multi-group but single department firm, and K=5 if multi-department firms.

Using the definitions above we can define the reallocation: $r_t^{status=k} = n_t^{status=k} + x_t^{status=k}$.

C Construction of Variables: Compustat

We use the Compustat fundamental annual data from 2006 to 2014. Our sample consists of all firms that have positive data on sales that do not belong to the finance or real estate sectors (SIC classification between 6010 and 6800). To compute total factor productivity (TFP) we follow the methodology of İmrohoroğlu and Tüzel (2014). TFP is estimated using the semi-parametric method by Olley and Pakes (1996). We supplement the Compustat data with output and investment deflators from the Bureau of Economic Analysis and wage data from the Social Security Administration.

We compute R&D as the ratio of research and development expenses (Compustat item XRD) to net sales (Compustat item SALE). We winsorize the variable at the 1% level and use the one-year lagged value of in our regressions. *Size* is the natural logarithm of total sales. Given that total staff expenses (Compustat item XLR) is mostly missing in our data, we define labor share as the ratio of the number of employees (Compustat item EMP) times the national wage (obtained from the Social Security Administration) over net sales. *Std Sale* is defined as the volatility of annual growth of sales on a quarterly basis winsorized at the 1% level.

We follow Gorodnichenko and Weber (2016) to construct the rest of our control variables. Specifically, Price to cost margin (PCM) is the ratio of net sales minus costs of goods sold (Compustat item COGS) to net sales. Rating (Rat) is the S&P domestic long term issuer credit rating (Compustat item SPLTICRM) where the highest rating category, AAA, is assigned a value of 4.33, decreasing by 1/8 with every rating notch. We use the one-year lagged value of the mean ratings within the year. In order to control for financial constraints, we include the Kaplan-Zingales index (KZ, Kaplan and Zingales (1997)) defined as follows:

$$KZ_{i,t} = 1.002\frac{CF_{i,t}}{AT_{i,t1}} - 39.368\frac{Div_{i,t}}{AT_{i,t-1}} - 1.315\frac{C_{i,t}}{AT_{i,t1}} + 3.139Lev_{i,t} + 0.283Q_{i,t} \tag{45}$$

where cash flow (CF) is the sum of income before extraordinary items (Compustat item IB) and depreciation and amortization, dividends (Div) are measured as common and preferred dividends (Compustat items DVC and DVP), C is cash and short term investments (Compustat item CHE), leverage (Lev) is the ratio of long term debt and debt in current liabilities (Compustat items DLTT and DLC) to stockholders equity (Compustat item SEQ), and Q is the market value of equity from CRSP as of fiscal year end minus the bookvalue of equity and deferred taxes (Compustat items CEQ and TXDB) to total assets. The first three variables are normalized by lagged total assets. We winsorize all variables at the 1% level before calculating the index and use one-year lagged values of the index in our regressions.

D Quality Estimation

Equation 15 in the main text can be derived from the demand specification in Hottman, Redding and Weinstein (2016). Below we provide the details of their framework and the derivation of the equation. The framework uses a nested constant elasticity of substitution (CES) utility system that allows the elasticity of substitution between varieties within a firm to differ from the elasticity of substitution between varieties supplied by different firms. This approach not only nests the standard CES-monopolistic competition model as a special case but also generalizes it to allow for firms to supply multiple products as in our dataset. Our implementation differs from Hottman, Redding and Weinstein (2016) in that we aggregate real consumption to the product module level instead of the product group level. We chose a finer level of disaggregation to be able to compare the quality of products with their closest equivalent.

Utility $\mathbb{U}_t$ is a Cobb-Douglas aggregate of real consumption, C^M_{mt}, of a continuum of product modules:

$$\ln \mathbb{U}_t = \int_{m\in\Omega^M} \varphi^M_{mt} \ln C^M_{mt} dm, \qquad \int_{m\in\Omega^M} \varphi^M_{mt} dm = 1,$$

where m denotes a product module; φ^M_{mt} is the share of expenditure on product module m at time t; and Ω^M is the set of product modules. We assume two CES nests for firms and UPCs to be able to incorporate multi-product firms. Thus, the consumption indices for product modules and firms can be written as:

$$C^M_{mt} = \left[\sum_{f\in\Omega^F_{mt}} (\varphi^F_{fmt} C^F_{fmt})^{\frac{\sigma^F_m - 1}{\sigma^F_m}} \right]^{\frac{\sigma^F_m}{\sigma^F_m - 1}}, \qquad C^F_{fmt} = \left[\sum_{u\in\Omega^U_{fmt}} (\varphi^U_{ut} C^U_{ut})^{\frac{\sigma^U_m - 1}{\sigma^U_m}} \right]^{\frac{\sigma^U_m}{\sigma^U_m - 1}}.$$

The real consumption in a product module m is a function of the consumption of each firm f's output, C^F_{fmt}, weighted by the consumer appeal of that firm φ^F_{fmt}. σ^F_m indicates the substitutability of the output of each firm in the set Ω^F_{mt}. Similarly, C^F_{fmt} is function of the consumption of each UPC, C^U_{ut}, weighted by the consumer appeal of that UPC, φ^U_{ut}, adjusted by the substitutability between the various UPCs supplied by the firm, σ^U_m, where the set of these UPCs is Ω^U_{fmt}. Since the utility function is homogeneous of degree one in φ^F_{fmt}, we choose the following normalization in order to be able define φ^F_{fmt} and φ^U_{ut} independently:

$$\bar{\varphi}^F_{mt} = \left(\prod_{f\in\Omega^F_{mt}} \varphi^F_{fmt} \right)^{\frac{1}{N^F_{mt}}} = 1, \qquad \bar{\varphi}^U_{fmt} = \left(\prod_{u\in\Omega^U_{fmt}} \varphi^U_{ut} \right)^{\frac{1}{N^U_{fmt}}} = 1,$$

where N^F_{mt} is the number of firms in module m at time t and N^U_{fmt} is the number of UPCs supplied by firm f within module m at time t. The product module price index and the firm price index are:

$$P^G_{mt} = \left[\sum_{f \in \Omega^F_{mt}} \left(\frac{P^F_{fmt}}{\varphi^F_{fmt}} \right)^{1-\sigma^F} \right]^{\frac{1}{1-\sigma^F}}, \qquad P^F_{fmt} = \left[\sum_{u \in \Omega^U_{fmt}} \left(\frac{P^U_{ut}}{\varphi^U_{ut}} \right)^{1-\sigma^U} \right]^{\frac{1}{1-\sigma^U}}.$$

Under this specification, the demand for the output of UPC u supplied by firm f within product module m is therefore:

$$C^U_{ut} = (\varphi^F_{fmt})^{\sigma^F-1} (P^F_{fmt})^{\sigma^U-\sigma^F} E^G_{mt} (P^M_{mt})^{\sigma^F-1} (P^U_{ut})^{-\sigma^U} (\varphi^U_{ut})^{\sigma^U-1}$$

We model φ^U_{ut} as the product of a fixed component φ^U_u, which captures persistent differences across products in terms of perceived quality, and η^U_{ut} which measures idiosyncratic variation in the preferences for each UPC u. Taking logs and substituting with $\tilde{\lambda}_{fmt}$ the firm-specific components (in logs), we can write:

$$ln(C^U_{ut}) = \tilde{\lambda}_{fmt} - \sigma^U ln(P^U_{ut}) + (\sigma^U - 1)\tilde{\varphi}^U_u + (\sigma^U - 1)\tilde{\eta}^U_{ut} \tag{46}$$

Equation 46 suggests that product quality $\tilde{\varphi}^U_u$ can be estimated from the data in a regression of quantity demanded on price and firm-module-time fixed effects. Nonetheless, it is well known that estimating equation 46 using OLS will deliver biased estimates for σ^U, the module-specific elasticity of substitution, and for $\tilde{\varphi}^U_u$, the UPC specific quality. In order to solve the standard simultaneity concern, we use the estimation procedure described in Fally and Faber (2017), which relies on instrumenting for local consumer price changes using regional variation. Given that each UPC u belongs to a single firm f, product module m, and is sold in city c, we can rewrite equation 46 as:

$$ln(C_{ufmct}) = \tilde{\lambda}_{fmct} - \sigma ln(P_{ufmct}) + (\sigma - 1)\tilde{\varphi}_u + \epsilon_{ufmct} \tag{47}$$

which is the analog of equation 15 in the main text.

Appendix Tables and Figures (FOR ONLINE PUBLICATION)

Table A.I: Summary Statistics of Products (with Full Sample)

The table shows summary statistics of products.

		06Q3	2007	2010	2013
Number of products		608368	605139	610356	602407
By status (share of products)					
	Entrants	0.039	0.052	0.032	0.042
	Exits	0.038	0.035	0.035	0.046
By diversification (average)					
	Per module	565	587	575	593
	Per group	5300	5506	5397	5559
	Per department	60422	62769	61526	63376
By Revenue (share of products)					
	$[0,10^4[$	0.676	0.698	0.695	0.693
	$[10^4,10^5[$	0.187	0.192	0.191	0.191
	$[10^5,10^6[$	0.096	0.095	0.098	0.100
	$>=10^6$	0.041	0.015	0.016	0.016

Table A.II: Summary Statistics of Products (using Brands as Product)

The table shows summary statistics of products.

		06Q3	2007	2010	2013
Number of products		62909	57938	61314	72205
By status (share of products)					
	Entrants	0.003	0.003	0.002	0.004
	Exits	0.002	0.002	0.002	0.003
By diversification (average)					
	Per module	69	65	68	80
	Per group	672	630	666	785
	Per department	7725	7242	7664	9026
By Revenue (share of products)					
	$[0,10^4[$	0.054	0.049	0.052	0.064
	$[10^4,10^5[$	0.024	0.023	0.025	0.026
	$[10^5,10^6[$	0.016	0.015	0.016	0.017
	$>=10^6$	0.010	0.007	0.008	0.008

Table A.III: Summary Statistics of Firms in the Data (with Full Sample)

The table shows summary statistics of firms in the data. By revenue, we report share of continuing firms.

			2007-2013	2007	2010	2013
Number of firms (average)			22267	21918	21825	23743
By status (share of firms)						
	Entrants		0.020	0.030	0.016	0.022
	Exits		0.016	0.014	0.014	0.020
	Continuers Expanding		0.134	0.179	0.116	0.132
	Continuers Contracting		0.165	0.138	0.165	0.182
By diversification						
	Single Product					
		Share of firms	0.260	0.257	0.262	0.259
	Multi Product & Single Module					
		Share of firms	0.285	0.286	0.283	0.284
		Mean number of products	10.1	9.6	10.6	9.5
		Median number of products	4	4	4	4
	Multi Module & Single Group					
		Share of firms	0.126	0.120	0.126	0.133
		Mean number of products	20.9	20.8	21.6	19.2
		Median number of products	9	9	9	8
	Multi Group & Single Department					
		Share of firms	0.159	0.162	0.159	0.155
		Mean number of products	34.8	34.3	35.0	34.3
		Median number of products	12	12	13	12
	Multi Department					
		Share of firms	0.170	0.174	0.170	0.168
		Mean number of products	93.9	95.0	96.1	86.4
		Median number of products	22	22	22	21
By Revenue (share of firms)						
	$[0,10^4[$		0.517	0.515	0.516	0.523
	$[10^4,10^5[$		0.234	0.235	0.235	0.231
	$[10^5,10^6[$		0.161	0.163	0.160	0.158
	$>=10^6$		0.089	0.087	0.089	0.087

Table A.IV: Summary Statistics of Firms in the Data (using Brands as Product)

The table shows summary statistics of firms in the data. By revenue, we report share of continuing firms.

			2007-2013	2007	2010	2013
Number of firms (average)			13431	13094	13016	14810
By status (share of firms)						
	Entrants		0.021	0.025	0.017	0.026
	Exits		0.016	0.020	0.013	0.016
	Continuers Expanding		0.057	0.061	0.051	0.068
	Continuers Contracting		0.045	0.051	0.041	0.044
By diversification						
	Single Product					
		Share of firms	0.462	0.476	0.458	0.450
	Multi Product & Single Module					
		Share of firms	0.062	0.060	0.063	0.062
		Mean number of products	2.6	2.6	2.6	2.7
		Median number of products	2	2	2	2
	Multi Module & Single Group					
		Share of firms	0.120	0.114	0.122	0.124
		Mean number of products	3.8	3.6	3.8	3.8
		Median number of products	3	3	3	3
	Multi Group & Single Department					
		Share of firms	0.197	0.195	0.198	0.199
		Mean number of products	6.8	6.5	6.9	7.0
		Median number of products	4	4	4	4
	Multi Department					
		Share of firms	0.159	0.155	0.159	0.165
		Mean number of products	14.3	13.8	14.3	14.5
		Median number of products	6	6	6	6
By Revenue (share of firms)						
	$[0,10^4[$		0.422	0.431	0.411	0.440
	$[10^4,10^5[$		0.272	0.266	0.276	0.267
	$[10^5,10^6[$		0.197	0.198	0.202	0.188
	$>=10^6$		0.109	0.105	0.112	0.106

Table A.V: Aggregate Entry, Exit, and Reallocation Rates (with Full Sample)

	All	(1)	(2)	(3)	Change	
	2007-2013	2007	2010	2013	(2)/(1)-1	(3)/(2)-1
Reallocation	0.077	0.087	0.067	0.088	-24%	32%
Entry	0.039	0.052	0.032	0.042	-38%	31%
Exit	0.038	0.036	0.035	0.046	-2%	32%

Table A.VI: Aggregate Entry, Exit, and Reallocation Rates (using Brands as Product)

	All	(1)	(2)	(3)	Change	
	2007-2013	2007	2010	2013	(2)/(1)-1	(3)/(2)-1
Reallocation	0.051	0.059	0.043	0.057	-28%	35%
Entry	0.030	0.034	0.025	0.036	-27%	46%
Exit	0.021	0.025	0.018	0.021	-28%	19%

Table A.VII: Average Within Entry, Exit, and Reallocation Rates (with Full Sample)

	All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	 (3)-(2)-1
Reallocation	0.100	0.116	0.085	0.114	-27%	35%
Entry	0.052	0.071	0.041	0.059	-43%	44%
Exit	0.050	0.048	0.045	0.058	-5%	29%

Table A.VIII: Average Within Entry, Exit, and Reallocation Rates (using Brands as Product)

	All 2007-2013	(1) 2007	(2) 2010	(3) 2013	Change (2)/(1)-1	 (3)-(2)-1
Reallocation	0.068	0.080	0.056	0.076	-30%	37%
Entry	0.039	0.044	0.031	0.048	-29%	54%
Exit	0.031	0.038	0.025	0.030	-33%	18%

Table A.IX: Decomposition (with Full Sample)

The table reports decomposition results.

		Within (+)	Between (+)	Cross (+)	Entry (+)	Exit (-)	Change
OP - Non dynamic							
Entry Rate							
	06Q3-09Q2	-4.5	1.1	-	-	-	-3.5
	09Q3-12Q2	2.1	-1.0	-	-	-	1.1
Exit Rate							
	06Q3-09Q2	-0.3	0.4	-	-	-	0.1
	09Q3-12Q2	0.7	0.0	-	-	-	0.7
Reallocation Rate							
	06Q3-09Q2	-4.8	1.4	-	-	-	-3.4
	09Q3-12Q2	2.8	-0.9	-	-	-	1.8
OP - Dynamic							
Entry Rate							
	06Q3-09Q2	-27.7	22.4	-	1.9	-	-3.5
	09Q3-12Q2	-18.1	17.5	-	1.8	-	1.1
Exit Rate							
	06Q3-09Q2	16.4	-15.5	-	-	0.8	0.1
	09Q3-12Q2	18.1	-16.5	-	-	0.9	0.7
Reallocation Rate							
	06Q3-09Q2	-11.4	6.9	-	1.9	0.8	-3.4
	09Q3-12Q2	0.0	1.0	-	1.8	0.9	1.8
GR							
Entry Rate							
	06Q3-09Q2	-8.2	2.9		1.8	-	-3.5
	09Q3-12Q2	-3.4	2.8		1.7	-	1.1
Exit Rate							
	06Q3-09Q2	2.6	-1.8		-	0.8	0.1
	09Q3-12Q2	3.4	-1.8		-	0.9	0.7
Reallocation Rate							
	06Q3-09Q2	-5.5	1.1	-	1.8	0.8	-3.4
	09Q3-12Q2	0.0	1.0	-	1.7	0.9	1.8
FHK							
Entry Rate							
	06Q3-09Q2	-9.8	1.3	3.3	1.8	-	-3.5
	09Q3-12Q2	-5.0	1.3	3.1	1.7	-	1.1
Exit Rate							
	06Q3-09Q2	1.7	-2.7	1.9	-	0.8	0.1
	09Q3-12Q2	2.6	-2.6	1.7	-	0.9	0.7
Reallocation Rate							
	06Q3-09Q2	-8.1	-1.5	5.2	1.8	0.8	-3.4
	09Q3-12Q2	-2.4	-1.4	4.8	1.7	0.9	1.8

Table A.X: Reallocation Activities and R&D Expenses (with Full Sample)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable reallocation at $t+1$, defined as the product entry rate plus the product exit rate, at the subsidiary level as defined in the main text. The main independent variable is the ratio of R&D expenses to total sales at t. The construction of the rest of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: $r_{f,t+1}$	(1)	(2)	(3)	(4)
R&D	1.022***	1.026***	1.401***	1.401***
	(0.291)	(0.291)	(0.342)	(0.343)
Size	-0.015	-0.017	-0.014	-0.014
	(0.013)	(0.013)	(0.014)	(0.014)
Price Cost Margin		-0.034	0.032	0.033
		(0.051)	(0.087)	(0.088)
Std. Sale			-0.057	-0.057
			(0.041)	(0.041)
Kaplan-Zingales				-0.000
				(0.000)
Observations	821	821	813	811
R-squared	0.725	0.725	0.725	0.725
Year Effects	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes

Table A.XI: Reallocation Activities and R&D Expenses (using Brands as Product)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable reallocation at $t+1$, defined as the product entry rate plus the product exit rate, at the subsidiary level as defined in the main text. The main independent variable is the ratio of R&D expenses to total sales at t. The construction of the rest of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Dep. var.: $r_{f,t+1}$				
R&D	1.026**	1.024**	1.529***	1.487***
	(0.427)	(0.428)	(0.514)	(0.512)
Size	-0.011	-0.010	-0.005	-0.010
	(0.019)	(0.019)	(0.021)	(0.021)
Price Cost Margin		0.019	0.148	0.113
		(0.074)	(0.132)	(0.132)
Std. Sale			-0.018	-0.016
			(0.062)	(0.061)
Kaplan-Zingales				0.001***
				(0.000)
Observations	563	563	555	553
R-squared	0.572	0.572	0.578	0.584
Year Effects	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes

Table A.XII: Reallocation Activities and Revenue Growth (with Full Sample)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the revenue growth in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: Revenue$_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.0774***						
	(0.012)						
$n_{f,t}$		0.7734***					
		(0.016)					
$n_{f,t}$ (in module)			0.8595***				
			(0.019)				
$n_{f,t}$ (beyond module)				0.6970***			
				(0.037)			
$x_{f,t}$					-1.2398***		
					(0.020)		
$x_{f,t}$ (in module)						-0.2674***	
						(0.026)	
$x_{f,t}$ (beyond module)							-2.8147***
							(0.033)
Revenue$_{f,t}$	0.6896***	0.6869***	0.6862***	0.6892***	0.6766***	0.6773***	0.6847***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	376,243	376,433	376,433	376,433	376,274	376,274	376,274
R-squared	0.944	0.944	0.944	0.944	0.943	0.943	0.944
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.XIII: Reallocation Activities and Revenue Growth (using Brands as Product)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the revenue growth in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: Revenue$_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.1762***						
	(0.011)						
$n_{f,t}$		0.3854***					
		(0.015)					
$n_{f,t}$ (in module)			0.4113***				
			(0.024)				
$n_{f,t}$ (beyond module)				0.3486***			
				(0.020)			
$x_{f,t}$					-0.4687***		
					(0.018)		
$x_{f,t}$ (in module)						-0.0347	
						(0.035)	
$x_{f,t}$ (beyond module)							-0.6455***
							(0.022)
Revenue$_{f,t}$	0.8040***	0.8027***	0.8026***	0.8027***	0.7839***	0.7837***	0.7842***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	273,694	273,830	273,830	273,830	273,718	273,718	273,718
R-squared	0.969	0.969	0.969	0.969	0.968	0.967	0.968
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.XIV: Reallocation Activities and Benchmark Quality Improvement (with Full Sample)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the benchmark quality improvement in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: $Q^{\text{benchmark}}_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.0312***						
	(0.003)						
$n_{f,t}$		0.0580***					
		(0.004)					
$n_{f,t}$ (in module)			0.0510***				
			(0.005)				
$n_{f,t}$ (beyond module)				0.0823***			
				(0.010)			
$x_{f,t}$					-0.0017		
					(0.005)		
$x_{f,t}$ (in module)						0.0022	
						(0.007)	
$x_{f,t}$ (beyond module)							-0.0080
							(0.009)
Revenue$_{f,t}$	0.0104***	0.0101***	0.0101***	0.0103***	0.0102***	0.0102***	0.0102***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	375,922	376,111	376,111	376,111	375,953	375,953	375,953
R-squared	0.913	0.913	0.913	0.913	0.913	0.913	0.913
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.XV: Reallocation Activities and Benchmark Quality Improvement (using Brands as Product)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the benchmark quality improvement in the next quarter. Reallocation rate at t of firm f, $r_{f,t}$, is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. Revenue is winsorized at the 1% level. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Dep. var.: $Q^{\text{benchmark}}_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$r_{f,t}$	0.0213***						
	(0.004)						
$n_{f,t}$		0.0440***					
		(0.005)					
$n_{f,t}$ (in module)			0.0341***				
			(0.009)				
$n_{f,t}$ (beyond module)				0.0546***			
				(0.007)			
$x_{f,t}$					-0.0088		
					(0.006)		
$x_{f,t}$ (in module)						-0.0111	
						(0.012)	
$x_{f,t}$ (beyond module)							-0.0079
							(0.008)
Revenue$_{f,t}$	0.0036***	0.0035***	0.0035***	0.0035***	0.0035***	0.0035***	0.0035***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	273,609	273,745	273,745	273,745	273,633	273,633	273,633
R-squared	0.916	0.916	0.916	0.916	0.916	0.916	0.916
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.XVI: Reallocation Activities and Firm-Level Productivity (with Full Sample)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the natural logarithm of total factor productivity at the firm-level at $t+1$. Reallocation at t is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. The construction of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TFP$_{f,t+1}$										
$r_{f,t}$	0.258***	0.256***	0.243***	0.242***						
	(0.087)	(0.087)	(0.087)	(0.087)						
$n_{f,t}$					-0.028					
					(0.109)					
$n_{f,t}$ (in module)						-0.128				
						(0.111)				
$n_{f,t}$ (beyond module)							2.982***			
							(0.602)			
$x_{f,t}$								0.647***		
								(0.147)		
$x_{f,t}$ (in module)									0.675***	
									(0.149)	
$x_{f,t}$ (beyond module)										0.058
										(0.726)
Size	0.231***	0.226***	0.230***	0.228***	0.236***	0.235***	0.238***	0.230***	0.229***	0.237***
	(0.029)	(0.030)	(0.030)	(0.030)	(0.027)	(0.027)	(0.027)	(0.030)	(0.030)	(0.027)
Price Cost Margin		-0.118	-0.169	-0.182	-0.668***	-0.659***	-0.670***	-0.066	-0.061	-0.670***
		(0.205)	(0.205)	(0.206)	(0.190)	(0.190)	(0.188)	(0.207)	(0.207)	(0.190)
Std. Sale			-0.240**	-0.239**	-0.323***	-0.332***	-0.319***	-0.266**	-0.262**	-0.321***
			(0.105)	(0.105)	(0.101)	(0.101)	(0.099)	(0.104)	(0.104)	(0.100)
Kaplan-Zingales				0.000	0.000	0.000	0.000	0.000	0.000	0.000
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	1,024	1,024	1,024	1,023	1,147	1,147	1,147	1,023	1,023	1,147
R-squared	0.843	0.843	0.844	0.845	0.834	0.834	0.838	0.847	0.847	0.834
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.XVII: Reallocation Activities and Firm-Level Productivity (using Brands as Product)

The table reports the coefficients of OLS regressions with revenue weights. The dependent variable is the natural logarithm of total factor productivity at the firm-level at $t+1$. Reallocation at t is defined as the product entry rate plus the product exit rate at the firm level as defined in the main text. The construction of the control variables is described in Appendix C. Other controls include firm fixed-effects and year fixed-effects. Revenue is winsorized at the 1% level. The sample used include the set of publicly traded firms that are found in the Nielsen RMS. Standard errors are presented in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\text{TFP}_{f,t+1}$										
$r_{f,t}$	0.425***	0.427***	0.425***	0.425***						
	(0.081)	(0.081)	(0.080)	(0.081)						
$n_{f,t}$					0.440***					
					(0.116)					
$n_{f,t}$ (in module)						0.300**				
						(0.134)				
$n_{f,t}$ (beyond module)							0.963***			
							(0.246)			
$x_{f,t}$								0.373***		
								(0.121)		
$x_{f,t}$ (in module)									0.463***	
									(0.147)	
$x_{f,t}$ (beyond module)										0.182
										(0.211)
Size	0.255***	0.245***	0.249***	0.249***	0.245***	0.245***	0.252***	0.254***	0.249***	0.251***
	(0.033)	(0.035)	(0.035)	(0.035)	(0.032)	(0.033)	(0.032)	(0.036)	(0.035)	(0.033)
Price Cost Margin		-0.207	-0.270	-0.269	-0.825***	-0.806***	-0.721***	-0.205	-0.174	-0.750***
		(0.223)	(0.225)	(0.226)	(0.211)	(0.214)	(0.210)	(0.230)	(0.231)	(0.213)
Std. Sale			-0.222*	-0.222*	-0.257**	-0.280**	-0.248**	-0.252**	-0.257**	-0.288**
			(0.119)	(0.120)	(0.117)	(0.117)	(0.117)	(0.121)	(0.121)	(0.118)
Kaplan-Zingales				-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	714	714	714	713	799	799	799	713	713	799
R-squared	0.864	0.864	0.865	0.865	0.851	0.849	0.851	0.861	0.861	0.848
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes