A Portrait of U.S. Factoryless Goods Producers[1]

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Abstract

This paper evaluates the Census Bureau's most recent data collection efforts to classify business entities in the U.S. economy that engage in an extreme form of production fragmentation called "factoryless" goods production. "Factoryless" goods-producing entities outsource physical transformation activities while retaining ownership of the intellectual property and control of sales to customers. Responses to a special inquiry on the incidence of purchases of contract manufacturing services in combination with data on production inputs and outputs, intellectual property, and international trade is used to identify and document characteristics of "factoryless" goods producing firms in the U.S. economy.

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1. Introduction

Goods production is increasingly vertically disintegrated (Johnson and Noguera, 2012). An extreme form of fragmentation of the goods production process entails outsourcing the processing and manufacturing activities while retaining ownership of the intellectual property and controlling sales to customers, giving rise to the so-called "factoryless" goods producers (FGPs). The Office of Management and Budget (OMB) mandated U.S. statistical agencies to classify FGPs within the existing data collection system to better reflect changing production arrangements.[2]

The Census Bureau's efforts to isolate goods producers that do not perform physical transformation of goods led to data collection, through a special inquiry, on the purchase of contract manufacturing services (CMS). Purchase of CMS indicates if an establishment outsources part or all of its production transformation activities to another establishment either under common ownership or at arm's length within or outside the United States. However, post-collection interviews with responding establishments revealed inconsistencies in how respondents understood the CMS purchase question as intended (Murphy, 2015). OMB concluded that the special inquiry failed "to yield responses that provide accurate and reliable identification and classification of FGPs" at the establishment level and resulted in the latest recommendation to further evaluate "the feasibility of developing methods for the consistent identification and classification of Factoryless Goods Producers that are accurate and reliable" (80 FR 46479-46484).[3]

This paper explores the feasibility of identifying FGP *firms*. Recognizing that establishment responses to purchase of CMS alone may yield unreliable classification of FGPs, this paper augments establishment responses (in the 2012 Economic Census) with firm responses to purchase of CMS (in

[2] Refer to the first federal register notice issued on May 12, 2010, 75 FR 26856-26869, for more details.
[3] See http://www.census.gov/eos/www/naics/federal_register_notices/fedregister.html for a comprehensive list of federal register notices pertaining to the North American Industrial Classification System.

the 2012 Company Organization Survey) and information on firms' manufacturing activities (measured as employment in the manufacturing sector).[4] Although OMB's Economic Classification Policy Committee (ECPC) recommends measuring FGPs at the establishment level, a number of characteristics essential to identifying FGPs have historically not been collected at the establishment level. Research and design activities at the establishment level is collected on a yes/no basis and only for the wholesale sector, but real measures are available at the firm level in all sectors. Merchandise imports (more likely associated with FGP firms when production is not only outsourced but also offshored) are available at the firm level only. Moreover, company headquarters, which possess comprehensive knowledge of the firm's operations, may be better suited to respond to the special inquiry intended to measure FGP activity.

The classification of FGP firms in the existing data collection system faces two main challenges. First, goods-producing firms that outsource all production transformation activities are currently classified outside the manufacturing sector with other services-producing firms. Second, goods-producing firms that outsource only a part of the production transformation process are currently classified in the manufacturing sector with all other goods-producing firms. An instructive comparison of FGPs to other goods-producers requires distinguishing the extent of "factoryless" production arrangements among manufacturing firms. The special inquiry on purchase of CMS was sent to both manufacturing and non-manufacturing establishments in an effort to identify all possible goods-producers in the economy separately from services-producing firms.

This paper begins by identifying three types of goods-producers distinct from firms that provide services: FGP firms that outsource all production activities and do not have any domestic

[4] Murphy (2015) reports results from the 2012 Economic Census. Responding firms to the special inquiry in the 2012 Company Organization Survey were not interviewed as extensively as responding establishments to the special inquiry in the 2012 Economic Census.

manufacturing activity; Hybrid Manufacturers that outsource some production activities but also own domestic manufacturing plants; Traditional Manufacturers that do not outsource any production and perform all production-related activities at own domestic plants; and distinct from goods-producers are Service Providers that do not undertake any manufacturing activity – neither outsources nor owns any domestic manufacturing plants.[5]

The paper then performs two sets of comparisons - FGP firms to Service Providers and Hybrid Manufacturers to Traditional Manufacturers - of characteristics guided by the conceptual definition of "factoryless" production. The ECPC's definition of FGPs states that the FGP "outsources all transformation steps that traditionally have been considered manufacturing, but undertakes all of the entrepreneurial steps and arranges for all required capital, labor, and material inputs required to make a good" (OMB, 2010). The conceptual definition of "factoryless" production can then be summarized along three main attributes: ownership of intellectual property, ownership and control of finished products, and outsourcing transformation activities (Doherty, 2015). The characteristics studied, therefore, include ownership of intellectual property (measured as research and development expenditures, number of patents, number of trademarks), ownership and sales of finished goods (measured as revenue), incidence of borderless production arrangements (measured as imports), incidence of "headquarter" activity encompassing strategic or organizational planning and decision-making activities (measured as employment in NAICS 54 and 55). These variables capture features hypothesized to be more prevalent at firms that outsource production. This approach, thus, combines two distinct strategies for identifying FGP's - self-identification by companies and their

[5] I thank John Murphy for suggesting the terminology for the distinct firm types. Traditional Manufactures include both integrated manufacturers and firms that provide CMS. Hybrid and Traditional Manufacturers represent firms with primary activity in the manufacturing sector (NAICS 31-33). Service Providers represent firms with primary activities outside the manufacturing sector.

establishments on statistical surveys and implementation of a profiling method based on conceptual definitions.

The comparison of employment mix across sectors, ownership of intellectual property, and foreign imports between FGPs and Service Providers yields correlations consistent with the conceptual definition of "factoryless" production. I find that FGP firms tend to have higher shares of workers engaged in the provision of "headquarter" services, greater ownership of intellectual property, and higher propensities to import from abroad than Service Providers. FGPs tend to be smaller and younger than Service Providers. I also find that Hybrid Manufacturers tend to have higher shares of non-production workers, lower shares of production workers, greater ownership of intellectual property, and higher propensities to import from abroad than Traditional Manufacturers. Hybrid Manufacturers tend to be larger than and similarly aged as Traditional Manufacturers.

The analyses in this paper offer three main insights to guide identification of FGP firms within existing data collection systems. First, disagreements in responses to purchase of CMS between respondents in the Economic Census and the Company Organization Survey provide an instructive set of cases to select for cognitive interviews to help inform the feasibility of identifying FGPs at the establishment or firm level. Second, combining responses to the special inquiry with firm-level information on ownership of intellectual property, imports, and employment mix across sectors yields a picture consistent with the conceptual definition of "factoryless" production arrangements. Comparison of FGPs with Service Providers highlights differences in characteristics between two distinct entities currently classified outside the manufacturing sector. Comparison of Hybrid Manufacturers with Traditional Manufacturers highlights differences in characteristics between goods-producers that outsource some production and those that perform all production and are currently classified together in the manufacturing sector. The results suggest a profiling method based not only on responses to special inquiries but one that also harnesses existing sources of data, hence, reducing

respondent burden. Third, the meaningful correlations uncovered in this paper between variables identified based on conceptual definitions and outsourcing status indicate a possible path towards developing a model-based approach to identify FGP firms.

This paper relates closely to a set of studies examining responses to the special inquiry on purchase of CMS to characterize the extent and nature of FGP activity in the U.S. economy. Kamal, Moulton, and Ribarsky (2015) evaluate data collection efforts on enterprises' purchase of CMS by the Census Bureau on the 2011 Company Organization Survey and the Bureau of Economic Analysis on the 2009 Benchmark Survey of U.S. Direct Investment Abroad. The authors find that CMS purchasing firms tend to be larger and older. Bernard and Fort (2013), using the 2002 and 2007 Census of Wholesale Trade, find that firms with manufacturing activity that also have a FGP establishment in the wholesale sector are significantly larger compared to firms with a FGP establishment in the wholesale sector and wholesale activity only. Bernard and Fort (2015), using the 2007 Census of Wholesale Trade, document that FGP firms tend to be larger but younger than traditional wholesalers. Tracing employment back in time, they also document that FGPs include former manufacturing firms, new firms born as FGPs, and other firms that became FGPs. Bayard, Byrne, and Smith (2015) identify FGP firms engaged in semiconductor production in the 2007 Economic Census using external company directories and document that FGP firms are larger than non-FGP firms. Previous studies characterizing "factoryless" production arrangements have relied on a single source of data, or on data for a narrowly focused sector, and applied varying definitions of "factoryless" status, making it difficult to compare and draw inferences for the whole economy. This paper implements a consistent definition of "factoryless" status across all sectors and draws from multiple data sources to provide a comprehensive picture of FGP firms as distinct from other goods- and services-producing firms in the U.S. economy.

Developing reliable methods to classify FGP firms accurately in U.S. data not only fulfills the Census Bureau's mandate to implement OMB's recommendation but also provides the foundation to conduct careful analyses of the economic consequences of extreme production fragmentation. "Factoryless" goods production divorces research and design from physical production. This has potentially significant implications for occupational structures, innovation, and international trade. Papers studying the impact of offshoring, an arrangement where goods production is located abroad, offer partial glimpses on the economic consequences along these dimensions.[6] Offshoring is associated with higher relative wages and demand for skilled labor in the home country, consistent with the concentration of design and R&D activities in the home country, while lower skilled production activities shift abroad (Bernard, Fort, Smeets, and Warzynski, 2017; Hummels, Jørgensen, Munch, and Xiang, 2014; Mion and Zhu, 2013). Offshoring is also associated with increases in product development and R&D expenditures (Bernard et al, 2017). Vertical specialization, an outcome under extreme production fragmentation, changes the composition of international trade as it entails increases in imported intermediate inputs to produce goods for export (Hummels, Ishii, and Yi, 2001).

The rest of the paper proceeds as follows. Section 2 describes the data sources used to identify outsourcing of the physical transformation process and firm-level inputs, output, ownership of intellectual property and imports. Section 3 identifies FGP firms currently classified outside the manufacturing sector and systematically documents the extent and characteristics of these firms in relation to Service Providers. Section 4 identifies Hybrid Manufacturers, manufacturing firms who outsource a part of the production process, and systematically documents the extent and characteristics of these firms in relation to Traditional Manufacturers. The final section concludes with discussion for future work.

[6] Fort (2017), using the 2007 Census of Manufactures, documents that domestic outsourcing is more prevalent than offshoring but offshoring firms are almost twice as large.

2. Data

There does not exist a single data source that contains the ideal set of information to identify FGPs. Therefore, I utilize a host of confidential microdata sourced from the Census Bureau for the most recent year, 2012, of comprehensive data collection efforts. Responses to the special inquiry about purchase of CMS in the Economic Census and the Company Organization Survey are used as a first step towards identifying FGP firms.[7,8] Establishment responses in the Economic Census are aggregated at the firm level to enable comparison to responses in the Company Organization Survey.

The Economic Census, conducted in years ending in 2 and 7, cover the universe of private, non-farm establishments active in the economy. The annual Company Organization Survey is designed chiefly to maintain the Business Register. The Business Register is a current list of business establishments in the U.S. and used as a survey frame to conduct the Economic Census every five years. The Company Organization Survey covers all multi-unit companies with 250 or more employees and a selection of smaller companies. Smaller companies are only selected when administrative records indicate that the company may be undergoing organizational change and is expanding (adding establishments) or shrinking (dropping establishments).

The responses to the special inquiry are further combined with additional firm-level variables. Employment by sector, number of establishments under common ownership, and payroll are aggregated to the firm level using the Longitudinal Business Database (LBD). The LBD contains information on employment, payroll, ownership, sector, and geography of the universe of

[7] In the context of this study, the Economic Census refers to the Census of Manufactures, Census of Wholesale Trade, and Census of Services. Establishments in every six-digit industry within manufacturing (NAICS 31-32), wholesale (NAICS 42), and Professional Scientific, and Technical Services (NAICS 54) and establishments in Corporate, Subsidiary, and Regional Managing Offices (NAICS 551114) were legally required to respond to the special inquiry on the use of CMS.

[8] The Bureau of Economic Analysis also included a question about CMS on the BE-120 (Benchmark Survey of Transactions in Selected Services and Intellectual Property with Foreign Persons) and BE-10 (Benchmark Survey of U.S. Direct Investment Abroad) surveys. These data are not used in this paper.

establishments operating in the U.S. private, non-farm sector with at least one employee (Jarmin and Miranda, 2002). Firm age is equivalent to the age of its oldest establishment. The LBD also provides total revenue for the firm (Haltiwanger, Jarmin, Kulick, and Miranda, 2017).[9]

Firm-level imports is sourced from the Longitudinal Firm Trade Transactions Database (LFTTD) that links the universe of individual customs transaction records to the firms that carry out these transactions (Bernard, Jensen, and Schott, 2009).[10] Information on firm ownership of intellectual property – patents, trademarks, and R&D expenditures - is obtained from Dinlersoz, Goldschlag, Myers, and Zolas (forthcoming). The authors combine survey data on research and design expenditures sourced from the Business R&D and Innovation Survey (BRDIS) with administrative data sourced from the U.S. Patent and Trademark Office on number of granted patents and trademarks. The statistics on R&D expenditures used in this paper only include firms surveyed in the BRDIS.[11] U.S. multinational firms and U.S. affiliates of foreign multinational firms are identified using the mandatory surveys - U.S. Direct Investment Abroad (USDIA) and Foreign Direct Investment in the United States (FDIUS) - conducted by the Bureau of Economic Analysis.[12]

2.1 Special Inquiry on Contract Manufacturing Services

The purchase of CMS identifies whether an establishment or firm outsources the fabrication of products. Appendix tables A1 and A2 display excerpts of the specific question about purchase of CMS from the Economic Census and Company Organization Survey, respectively.[13] The Economic

[9] See http://www.nber.org/data-appendix/c13492/appendix.pdf for details on construction of firm level revenue.
[10] LFFTD contains the universe of import transactions valued over $2,000.
[11] Patent and trademark data are available for all firms in the LBD but R&D data is only available for firms sampled in the BRDIS. The BRDIS sample constitutes of firms that are known to have some R&D activity.
[12] The Center for Economic Studies, in a joint project with the Bureau of Economic Analysis, has linked the 2012 USDIA and FDIUS to the Census Bureau's Business Register. The resulting crosswalks identify multinational firms in the LBD.
[13] The Company Organization Survey and the Census of Manufactures also ask about providing CMS. The focus of this paper is CMS purchasers, not CMS providers.

Census and Company Organization Survey ask whether the establishment and firm, respectively, purchase CMS. The Economic Census also asks for the costs incurred to purchase these services while the Company Organization Survey asks for the CMS cost as a percent of all expenses. The Company Organization Survey further asks whether the company purchased these services inside or outside the U.S. and whether own affiliates abroad provided CMS.

A firm purchases CMS if at least one of its establishment in the Economic Census responded yes or it responded yes in the Company Organization Survey. An establishment in the Economic Census is identified as purchasing CMS if it answers affirmatively to the question of purchasing CMS or if it reports a non-zero value for either costs incurred to purchase CMS or sales generated from products whose purchases were reported as CMS costs. A firm in the Company Organization Survey purchases CMS if it answers affirmatively to the question of purchasing CMS, or it provides a non-zero percent of the cost of sales from expenses for CMS, or it answers affirmatively to using a third party contractor either inside or outside the United States. A firm does not purchase CMS if all its establishments respond no to purchasing CMS in the Economic Census or it responded no in the Company Organization Survey.

The choice to utilize responses in the Economic Census aggregated at the firm level in addition to firm level responses to the Company Organization Survey ensures the broadest coverage of likely FGP firms. The unweighted response rates for purchasing CMS is 61.4 percent for the Census of Wholesale Trade, 57.7 percent for the Census of Manufacture, and 47.9 percent for the Census of Services (Murphy, 2015). Over 95 percent of firms provided a response (yes or no) to purchasing CMS in the Company Organization Survey.[14] There is a high degree of disagreement in responses across the two data sources. Table A3 shows the distribution of firms by their response status

[14] The Economic Census and Company Organization Survey data from the special inquiry are not adjusted for non-response.

(yes/no/missing) to purchasing CMS in the Economic Census and the Company Organization Survey. The total number of firms represent the analysis sample of FGP and other goods and services-producing firms considered in this study. About 40 percent of firms that provided a non-missing response in both datasets disagreed in their responses. Most of the disagreements are due to firms that respond no to purchasing CMS in the Company Organization Survey but one of their establishments responded yes to purchasing CMS in the Economic Census.

I apply a broad and restricted definition of CMS purchase status to balance between the goal to comprehensively identify outsourcing firms in the economy and account for the high incidence of disagreement in firm responses to purchase of CMS across the two data sources. Under the broad definition, an outsourcing firm responds yes to purchasing CMS in either data source.[15] Under the restricted definition, an outsourcing firm responds yes to purchasing CMS in both data sources. Firms that do not outsource are similarly categorized except the firm responds no to purchasing CMS. Thus, firms under the restricted definition are necessarily a subset of firms under the broad definition. Analyses in the paper only includes firms that can be classified as purchasing or not purchasing CMS. Respondents that did not provide a response and respondents that did not receive the special inquiry are excluded. An assumption maintained in the discussion of descriptive results in this paper is that non-respondents are not systematically different from respondents.

Under the broad definition, the analyses sample contains 16,500 FGPs and 112,000 Service Providers; and 11,000 Hybrid Manufacturers and 10,000 Traditional Manufacturers. Under the restricted definition, the analyses sample contains 400 FGP and 1,300 Service Providers; and 750

[15] Under the broad definition, a firm purchases CMS if it meets any of the following four criteria (i) responds yes to purchasing CMS in the Company Organization Survey but one of its establishments responded no in the Economic Census; (ii) responds no to purchasing CMS in the Company Organization Survey but one of its establishments responded yes in the Economic Census; (iii) missing response in Company Organization Survey but one of its establishments responded yes in the Economic Census; or (iv) missing response in Economic Census but responded yes to purchasing CMS in the Company Organization Survey.

Hybrid Manufacturers and 400 Traditional Manufacturers.[16] The identified firms are not nationally representative but they provide the opportunity to assess the potential scope and challenges associated with the task of measuring "factoryless" activities in the existing data collection system.

For ease of exposition, each section discusses results based on the broad definition unless statistics differ markedly between the broad and restricted definitions.

3. "Factoryless" activity outside the Manufacturing Sector

The goal in this section is to identify FGPs among firms that are currently classified outside manufacturing sector. A FGP is defined as a firm that purchases CMS and does not have any manufacturing employment. However, this definition does not explicitly capture performance of design activities, a key FGP characteristic. Nonetheless, in contrast to prior studies, it offers the advantage of enabling consistent classification of FGP firms in both the wholesale and services sectors. For example, Bernard and Fort (2015) define a FGP firm as having at least one establishment in the wholesale sector that performs design/engineering/R&D activity, purchases CMS, and has no manufacturing establishments. This definition cannot be applied to the services sector where comparable measures of design/engineering/R&D activities at the establishment level do not exist. To test whether this definition is capable of capturing FGPs as suggested by the conceptual definition of "factoryless" production arrangements, I compare the sectoral employment distribution, ownership of intellectual property, and foreign imports at identified FGPs with those at identified Service Providers.

[16] The final analyses samples only include firms for which we are able to obtain information on basic characteristics from the LBD. Over 90 percent of identified firms were linked to the LBD. Firm counts are rounded to comply with Census Bureau rules on disclosure avoidance.

3.1 Employment Shares

The conceptual definition of FGPs – entities that outsource all transformation activities and retain control of research and design and final sales to customers – suggests three implications for the employment mix at a FGP firm. First, the FGP firm should have little to no manufacturing employment. Second, FGP firms should be more active than Service Providers in the wholesale sector that encompasses delivery, warehousing, order fulfillment, and logistics. Third, services employment at a FGP firm should be relatively concentrated in "headquarter" services, which includes R&D personnel. The focus on FGP firms currently classified outside the manufacturing sector already excludes manufacturing activity and, thus, by construction is concentrated in the wholesale and services sectors. We should then expect to observe FGP firms with relatively higher shares of employment in wholesale and services than Service Providers.

Table 1 presents the average shares of employment in wholesale, services, and all other sectors at FGP and service-providing firms.[17] Employment in the services sector is further decomposed into employment in professional, scientific, and technical services (NAICS 54) and management of companies and enterprises (NAICS 55). Employment in NAICS 54 includes workers providing scientific research and development services. Based on the definition of FGP activities, we would expect FGP firms to specialize in providing "headquarter" services.

FGP firms, on average, have most of their employment in wholesale and the remaining almost evenly divided between services and other sectors of the economy. FGP firms with employment in the services sector have the majority of their workers engaged in provision of "headquarter" services. Service Providers, in contrast, have most of their employment housed in other sectors of the economy and only a third of their services workers are engaged in the provision of "headquarter" services. Using

[17] "Other" sectors include retail, agriculture, transportation, warehousing, and utilities, construction, and public administration but exclude manufacturing.

the restricted definition, Service Providers display higher shares of employment in wholesale and "headquarter" services, although these shares do not reach the levels of FGP firms.

3.2 Innovative Activity

A key feature of FGPs is control of the research and design processes, so we expect to observe higher shares of employment in R&D activities as found in Table 1. We also expect FGP firms to own intellectual property defined here as R&D expenditures, ownership of granted patents, and trademarks. Table 2 presents average values of the ownership of intellectual property. FGP firms have substantially higher average values of R&D expenditures and counts of granted patents and trademarks than Service Providers.

The differences in average innovative outcomes between FGPs and Service Providers are magnified when we use the restricted definition. For instance, FGP firms display almost seventy times more R&D expenditures than Service Providers under the restricted definition. This difference is only about four times under the broad definition. The patterns in ownership of intellectual property in this table display that FGPs have a higher likelihood of controlling the research and design process than Service Providers.

3.3 Importing Activity

FGP firms may use factories located in foreign countries to manufacture the goods they control. This implies that FGP firms are likely to import the foreign-produced goods back to the U.S. for domestic sale or further processing. Table 3 shows that, indeed, FGP firms are more likely to be importers relative to Service Providers. The vast majority of FGP firms engage in importing while less than half of Service Providers import. Average import values are also larger at FGP firms.

Table 3 also provides the average share of firm imports sourced from low-wage countries. Lower-income countries are more likely to be low-wage countries (Bernard, Jensen, and Schott, 2006). If lower labor costs motivate FGP firms to use foreign factories, we would expect to see higher shares of imports from low-wage countries at FGP firms. Imports from low-income countries are a very small share of total firm imports (less than 1 percent) at both FGP and service-providing firms. However, the average share of imports from low-wage countries is about twice as high at FGP firms. Finally, imports as a share of firm revenue is more than three times higher at FGP firms. Together, these results suggest that FGP firms are more likely to utilize borderless-production arrangements than Service Providers.

A striking 80 percent of global trade takes place in production networks administered by multinational firms (UNCTAD, 2013). We may expect that FGPs are more likely to also be multinational firms than Service Providers. For example, Kamal et al (2015) document that over half of the firms that purchase CMS outside the U.S. do so from their affiliates. Using the USDIA and FDIUS linked to the Business Register and using the broad definition only, FGP firms that are currently classified outside the manufacturing sector account for 3 percent of all multinational firms operating in the U.S.; 5 percent of all U.S. multinational parent firms; and 3 percent of all U.S. affiliates of foreign parent firms. These shares are considerably higher for Service Providers. Service Providers account for 14 percent of all multinational firms operating in the U.S.; 25 percent of all U.S. multinational parent firms; and 10 percent of all U.S. affiliates of foreign parent firms. These statistics, although not meant to be nationally representative, suggest a more nuanced relationship between multinational status and "factoryless" activity of firms outside the manufacturing sector.

3.4 Firm Characteristics

The descriptive analyses in the previous sections establish meaningful correlations between the definition of FGP firms and observable outcomes implied by "factoryless" activity. FGPs are associated with higher concentration of employment in "headquarter" services, greater ownership of intellectual property, and higher import shares than Service Providers. This section presents characteristics - revenue, employment, revenue per worker, payroll, payroll per worker, number of establishments, and age - of an average FGP classified outside the manufacturing sector and an average Service Provider.

Table 4 shows that FGP firms earn lower average revenue than Service Providers. FGP firms also employ almost three times fewer workers, have smaller payroll, and own fewer establishments than Service Providers. These findings are in contrast to Bernard and Fort (2015) who find that FGP firms tend to be larger than traditional wholesalers using the Census of Wholesale only. However, there is no obvious prediction for firm size and "factoryless" status. Outside the manufacturing sector, FGP firms may employ fewer workers at fewer numbers of establishments than Service Providers, if non-production activities focused on managing production transformation tasks require fewer workers and physical facilities. FGP firms may display lower sales if they are more likely than Service Providers to locate production and sales abroad.

Prior research has found a close and generally positive relationship between firm size and productivity (Haltiwanger, Lane, and Spletzer, 1999). This may lead us to expect that smaller FGP firms are less productive than the larger Service Providers. However, Table 4 shows that FGP firms display higher average revenue and payroll per worker (the difference is more pronounced using the broad definition of FGP firms). Finally, FGP firms tend to be younger, a finding consistent with that in Bernard and Fort (2015), by an average of five to six years.

4. "Factoryless" activity in the Manufacturing Sector

The goal in this section is to separately identify goods-producers that outsource a part of the production process (Hybrid Manufacturers) and goods-producers that do not outsource any production (Traditional Manufacturers), both currently classified in the manufacturing sector. Although the ECPC's conceptual definition of FGPs precludes any production transformation activities, existing evidence shows the growing prevalence of outsourcing by firms with manufacturing activity (Bayard et al, 2015). The authors find that, only 30 percent of firms with some manufacturing activity in the U.S. engaged in "factoryless" manufacturing in 2002 but by 2012 this share had increased to half. Thus, an additional challenge faced by the statistical system is to distinguish between the extent of "factoryless" activities at a firm. A Hybrid Manufacturer is defined as purchasing CMS and having employment in the manufacturing sector. A Traditional Manufacturer is defined as not purchasing CMS and having employment in the manufacturing sector. The goal, as in Section 3, is to compare Hybrid Manufacturers and Traditional Manufacturers along dimensions suggested by the conceptual definition of "factoryless" production and test whether the implied correlations exist for Hybrid Manufacturers that outsource only a part of the production process. The broad and restricted definitions used are as described in Section 2.1.

4.1 Employment Shares

The focus on Hybrid Manufacturers currently classified within the manufacturing sector implies that these firms will have a larger share of their employment in the manufacturing sector. Table 5 confirms that the average share of manufacturing employment at both types of goods-producing firms is over 80 percent. The table presents the share of production and non-production workers in lieu of comparing the share of employment in "headquarter" services at Hybrid and Traditional manufacturing firms. We expect Hybrid Manufacturers to have fewer production workers than

Traditional Manufacturers since part of production at Hybrid manufacturing firms is outsourced. Concurrently, we expect Hybrid Manufacturers' to have more non-production workers than Traditional Manufacturers. Table 5 shows that, in comparison to Traditional Manufacturers, the average share of production workers is lower at Hybrid manufacturing firms while the average share of non-production workers is higher.

4.2 Innovative Activity

Table 6 presents average R&D expenditures and ownership of intellectual property for Hybrid and Traditional manufacturing firms. Hybrid Manufacturers have higher average R&D expenditures than Traditional Manufacturers. Hybrid Manufacturers' also have higher numbers of patents and trademarks than Traditional Manufacturers. These patterns suggest that even Hybrid Manufacturers that outsource only a part of the production transformation process display patterns in ownership of intellectual property that are consistent with the conceptual definition of "factoryless" production.

4.3 Importing Activity

Average trade characteristics displayed in Table 7 yield three sets of correlations that are consistent with the idea that Hybrid Manufacturers may use foreign factories to manufacture goods more intensively than Traditional Manufacturers. First, both types of manufacturers are almost equally likely to import (under the broad definition) but imports make up 23 percent of total revenue at Hybrid compared to 19 percent at Traditional manufacturing firms. Under the restricted definition, 92 percent of Hybrid Manufacturers and 72 percent of Traditional Manufacturers firms import and the share of imports in total revenue is 30 and 12 percent, respectively. Together, these statistics suggest that Hybrid Manufacturers are more likely to import than Traditional Manufacturers. Second, average import values are almost three times larger at Hybrid manufacturing firms. Finally, Hybrid

Manufacturers' have higher shares of imports from low-wage countries than Traditional Manufacturers.

Since multinational firms mediate a large share of world trade, we may expect there to be a correlation between propensity to engage in "factoryless" production and multinational status of a firm. Using the USDIA and FDIUS linked to the Business Register and the broad definition only, Hybrid Manufacturers account for 8 percent of all multinational firms operating in the U.S.; 22 percent of all U.S. multinational parent firms; and 3 percent of all U.S. affiliates of foreign parent firms. These shares are lower for Traditional Manufacturers. Traditional Manufacturers account for 7 percent of all multinational firms operating in the U.S.; 14 percent of all U.S. multinational parent firms; and 5 percent of all U.S. affiliates of foreign parent firms. These preliminary share statistics suggest that Hybrid Manufacturers are more likely to be multinational firms than Traditional Manufacturers.

4.4 Firm Characteristics

The descriptive analyses in the previous sections demonstrate that "factoryless" activity in the manufacturing sector is associated with lower shares of production workers, higher shares of non-production workers, greater ownership of intellectual property, and higher import shares. Thus, meaningful correlations between "factoryless" status and observable outcomes implied by ECPC's conceptual definition also hold for firms that outsource only a part of production. This section presents characteristics - revenue, employment, revenue per worker, payroll, payroll per worker, number of establishments, and age - of an average Hybrid Manufacturer and an average Traditional Manufacturer.

Table 8 shows that Hybrid Manufacturers are larger than Traditional Manufacturers in terms of average revenue, employment and payroll. However, Hybrid Manufacturers own fewer numbers of establishments consistent with the idea that firms require fewer physical plants when part of the

production is outsourced. Hybrid Manufacturers have higher average payroll per worker (under both definitions) and higher average revenue per worker (under the restricted definition only). Both types of manufacturers display similar ages, averaging over twenty-four years.

6. Conclusion

The rise of complex production arrangements in recent decades demands the need for statistical agencies to better reflect these activities in economic statistics. This paper evaluates 2012 data collection efforts by the U.S. Census Bureau to identify "factoryless" goods producers that outsource physical transformation activities while retaining control of designing and marketing a product. All establishments in the manufacturing and wholesale sectors and a select set of establishments in the services sector were legally required to respond to a special inquiry that captures a key element of this extreme form of production fragmentation – decision to outsource the physical transformation activities to other domestic firms or offshored to foreign firms and/or own affiliates. In this study, FGP firms that have no manufacturing employment are separately analyzed from firms providing services and other goods-producers that may or may not outsource some part of the production process.

The paper starts by documenting a high degree of disagreement in establishment and firm responses to self-identifying as an outsourcer, thereby highlighting challenges in relying on survey responses alone for classification of FGPs. Characteristics implied by the definition of "factoryless" production arrangements are then explored to reveal meaningful correlations between "factoryless" status and variables identified based on conceptual definitions: employment mix, innovation, and importing activities. These correlations are presented separately for firms currently classified outside the manufacturing sector from firms currently classified in the manufacturing sector. The unconditional correlations merit further study building towards developing a model-based algorithm

to identify FGPs. A model-based approach would capture salient features of "factoryless" production using existing data sources and reducing sole reliance on survey responses.

There are three practical dimensions along which the identification exercise may be augmented. First, outsourcing status of a firm identified using only the Economic Census requires that one establishment of the firm reports purchasing CMS. I utilize responses to the economic value of activities related to the purchase of CMS to create a binary CMS purchase status indicator. However, this categorization does not explicitly consider the intensity of outsourcing activities. The intensity of activities could indicate how prevalent outsourcing is for FGP firms and suggest thresholds to assign likelihoods of being a FGP firm. This may be more relevant for Hybrid Manufacturers that outsource only a part of production. Second, more than one establishment of a multi-unit firm may have received the special inquiry on purchase of CMS. The firm is assigned a positive CMS purchase status if at least one establishment responds in the affirmative. However, when multiple establishments respond, analyzing the share that say yes versus no may allow an alternative method of classification, for instance, assigning the firm a positive CMS purchases status if majority of its establishments outsource production. Third, the Bureau of Economic Analysis added questions about purchase of CMS in two of their mandatory surveys. One of these surveys, the 2009 USDIA, was separately analyzed in Kamal et al (2015), but was not linked to Census data. Linking the BEA surveys to Census data used in this study would permit further validation of responses by the same firm and a focus on FGP firms that are also multinationals. These extensions will broaden our understanding of and ability to measure "factoryless" goods production arrangements in the U.S. economy.

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Table 1. Firm employment shares of goods-producers outside the manufacturing sector, 2012

	Wholesale	Services		Other
		All	% Share in Headquarter Services	
Broad Definition				
FGP	0.92	0.04	63%	0.03
Service Provider	0.16	0.40	35%	0.45
Restricted Definition				
FGP	0.75	0.16	80%	0.09
Service Provider	0.46	0.26	65%	0.28

Notes: This table displays firms' average share of sectoral employment. FGP: firms that purchase CMS and do not have manufacturing employment; Service Provider: firms that do not purchase CMS and do not have manufacturing employment. See text for "broad" and "restricted" definitions. "Headquarter Services" refers to employment in NAICS 54 (Professional, Scientific, and Technical Services) and NAICS 55 (Management of Companies and Enterprises). "Other" refers to employment in retail, agriculture, transportation, warehousing and utilities, construction, and public administration.

Table 2. Innovative activity by goods-producers outside the manufacturing sector, 2012

	R&D Spending	Number of Patents	Number of Trademarks
Broad Definition			
FGP	3,039	0.32	0.30
Service Provider	862	0.09	0.12
Restricted Definition			
FGP	13,630	1.43	2.20
Service Provider	198	0.19	0.13

Notes: This table displays firms' average R&D expenditures, ownership of the number of granted patents and trademarks. FGP: firms that purchase CMS and do not have manufacturing employment; Service Provider: firms that do not purchase CMS and do not have manufacturing employment. See text for "broad" and "restricted" definitions. R&D spending based only on firms surveyed in the Business R&D and Innovation Survey. R&D spending in 1,000 USD.

Table 3. Importing activity by goods-producers outside the manufacturing sector, 2012

		Imports		
	Importer Share	All	Low-Income Country % Share	Imports/Revenue
Broad Definition				
FGP	0.59	10,150	0.47%	0.46
Service Provider	0.19	9,078	0.29%	0.14
Restricted Definition				
FGP	0.84	33,430	0.78%	0.26
Service Provider	0.42	23,600	0.32%	0.08

Notes: This table displays firms' average importing characteristics. FGP: firms that purchase CMS and do not have manufacturing employment; Service Provider: firms that do not purchase CMS and do not have manufacturing employment. See text for "broad" and "restricted" definitions. Importer share is the fraction of firms that report positive imports. Imports/Revenue is the ratio of imports to total firm revenue. Low-income countries defined using United Nations' country classification. Imports in 1,000 USD.

Table 4. Firm characteristics of goods-producers outside the manufacturing sector, 2012

	Revenue	Employment	Revenue per Worker	Payroll	Payroll per Worker	Number of Establishments	Age
Broad Definition							
FGP	31,290	102	564	6,026	65	3	14
Service Provider	48,760	284	240	14,000	51	9	22
Restricted Definition							
FGP	147,000	404	568	28,920	78	9	20
Service Provider	292,700	1,320	404	55,780	49	44	25

Notes: This table displays average firm characteristics. FGP: firms that purchase CMS and do not have manufacturing employment; Service Provider: firms that do not purchase CMS and do not have manufacturing employment. See text for "broad" and "restricted" definitions. Revenue and payroll in 1,000 USD.

Table 5. Firm employment shares of goods-producers in the manufacturing sector, 2012

	Wholesale	Services	Manufacturing		
			All	Share Production Workers	Share Non-Production Workers
Broad Definition					
Hybrid Manufacturer	0.03	0.03	0.94	66%	34%
Traditional Manufacturer	0.06	0.06	0.88	71%	29%
Restricted Definition					
Hybrid Manufacturer	0.09	0.11	0.80	63%	37%
Traditional Manufacturer	0.11	0.07	0.82	69%	31%

Notes: This table displays firms' average share of sectoral employment. Hybrid Manufacturer: firms that purchase CMS and have manufacturing employment; Traditional Manufacturer: firms that do not purchase CMS and have manufacturing employment. See text for "broad" and "restricted" definitions.

Table 6. Innovative activity by goods-producers in the manufacturing sector, 2012

	R&D Spending	Number of Patents	Number of Trademarks
Broad Definition			
Hybrid Manufacturer	23,270	0.45	2.69
Traditional Manufacturer	2,969	0.33	0.53
Restricted Definition			
Hybrid Manufacturer	48,890	1.34	11.4
Traditional Manufacturer	2,410	0.45	0.36

Notes: This table displays firms' average R&D expenditures, ownership of the number of granted patents and trademarks. Hybrid Manufacturer: firms that purchase CMS and have manufacturing employment; Traditional Manufacturer: firms that do not purchase CMS and have manufacturing employment. See text for "broad" and "restricted" definitions. R&D spending based only on firms surveyed in the Business R&D and Innovation Survey. R&D spending in 1,000 USD.

Table 7. Importing activity by goods-producers in the manufacturing sector, 2012

		Imports		
	Importer Share	All	Low-Income Country % Share	Imports/Revenue
Broad Definition				
Hybrid Manufacturer	0.63	104,900	0.14	0.23
Traditional Manufacturer	0.64	47,440	0.11	0.19
Restricted Definition				
Hybrid Manufacturer	0.92	188,000	0.32	0.30
Traditional Manufacturer	0.72	73,050	0.30	0.12

Notes: This table displays firms' average importing characteristics. Hybrid Manufacturer: firms that purchase CMS and have manufacturing employment; Traditional Manufacturer: firms that do not purchase CMS and have manufacturing employment. See text for "broad" and "restricted" definitions. Importer share is the fraction of firms that report positive imports. Imports/Revenue is the ratio of imports to total firm revenue. Low-income countries defined using United Nations' country classification. Imports in 1,000 USD.

Table 8. Firm characteristics of goods-producers in the manufacturing sector, 2012

	Revenue	Employment	Revenue per Worker	Payroll	Payroll per Worker	Number of Establishments	Age
Broad Definition							
Hybrid Manufacturer	363,400	831	257	60,190	56	11	24
Traditional Manufacturer	194,000	515	299	26,060	50	12	27
Restricted Definition							
Hybrid Manufacturer	978,200	1,744	427	153,600	67	16	29
Traditional Manufacturer	567,900	1,052	366	53,020	51	28	29

Notes: This table displays average firm characteristics. Hybrid Manufacturer: firms that purchase CMS and have manufacturing employment; Traditional Manufacturer: firms that do not purchase CMS and have manufacturing employment. See text for "broad" and "restricted" definitions. Revenue and payroll in 1,000 USD.

Appendix

Table A1. CMS special inquiry, Economic Census, 2012

26 SPECIAL INQUIRIES

A. PURCHASE OF CONTRACT MANUFACTURING

1. Did this establishment **purchase** contract manufacturing services from other companies or foreign plants of your company in 2012?

Include:
- Products for which the manufacturing (i.e., transforming or otherwise processing materials or components based on specifications provided by your company) was outsourced to other companies.
- Products for which the manufacturing was performed by your company's foreign plants.

Exclude:
- Services for packaging and assembling.
- Purchases of merchandise for resale (sale of products bought and sold without further processing or transformation).

1011 ☐ Yes - *Go to line 2*

1012 ☐ No - *Go to B*

	2012		
	$ Bil.	Mil.	Thou.
2. Report the costs incurred by this establishment for contract manufacturing purchased in 2012 . . . 1013			
3. Report the value of sales, shipments, receipts, or revenue generated in 2012 from products whose purchases were reported as contract manufacturing costs in line 2 . . . 1015			

Table A2. CMS special inquiry, Company Organization Survey, 2012

3. Purchase contract manufacturing services from other companies or foreign subsidiaries of your company incorporating your company's patents, trade secrets, or proprietary technology?

9718 ☐ Yes

9719 ☐ No - *Go to* **4** *on the* ***next page***

a. Use 3rd party contract manufacturing services inside the United States (i.e., located in the 50 states and the District of Columbia)?

9720 ☐ Yes

9721 ☐ No

b. Use 3rd party contract manufacturing services outside the United States (i.e., located outside the 50 states and the District of Columbia)?

9722 ☐ Yes

9723 ☐ No

c. Use your company's foreign subsidiaries' or affiliates' contract manufacturing services at locations outside the United States (i.e., located outside the 50 states and the District of Columbia)?

9724 ☐ Yes

9725 ☐ No

d. Estimate the percent of the cost of sales from expenses for contract manufacturing services.

9726 ☐ Less than 25%

9727 ☐ 25% - 49%

9728 ☐ 50% - 74%

9729 ☐ 75% - 99%

9730 ☐ 100%

Table A3. Firm responses to CMS purchase in Economic Census and Company Organization Survey, 2012

	Company Organization Survey			
	Yes	No	Missing	Not in Company Organization Survey
Economic Census				
Yes	1,200	1,900	150	23,000
No	80	1,700	100	9,600
Missing	950	27,000	-	-
Not in Economic Census	800	83,000	-	-

Notes: This table displays the number of firms (both with and without manufacturing employment) that have been identified as purchasing CMS, not purchasing CMS, or missing a response in the Economic Census and Company Organization Survey. Firm counts are rounded to comply with Census Bureau rules on disclosure avoidance and may not sum to totals.